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Increasing Portfolio Overlap of Japanese Regional Banks with Global Investment Funds and Its Financial Stability Implications*

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[Abstract]

While investment funds have grown rapidly in the global financial market, Japanese financial institutions have been increasing investments in foreign securities. This paper estimates the portfolio overlap – which we define as the correlation of changes in the market value of securities portfolios – between global investment funds and Japanese financial institutions in the last two decades and studies the time series properties and the financial stability implications. There are three main findings. First, the number of financial institutions with a high portfolio overlap with investment funds has increased since before the Global Financial Crisis (GFC). The increase is particularly prominent for the portfolio overlap between bond funds and regional banks. Second, financial institutions with lower capital ratios, loan-to-deposit ratios, lending margins tend to have a higher degree of portfolio overlap with investment funds. Third, financial institutions with a higher degree of portfolio overlap with investment funds tend to see a larger decline in the market value of the securities portfolio in response to global market shocks such as redemption waves to investment funds, rises in U.S. interest rates, or disruptions in the U.S. bond market. Our results indicate that as secular changes in structural factors such as a decline in the potential growth rate of the home country weigh on the long-term profitability, Japanese financial institutions in particular regional banks have increased investment in foreign securities, making themselves susceptible to global market shocks that arise from the activities of global investment funds even without direct exposure to these funds. Moreover, an increase in the number of financial institutions with a higher portfolio overlap suggests that the impact of such a global market shock may extend over wide areas of the domestic financial system.

JEL Classification: G10; G11; G21; G23

Key words: Global Investment Funds, Regional Banks, Securities Portfolio, DCC-GARCH

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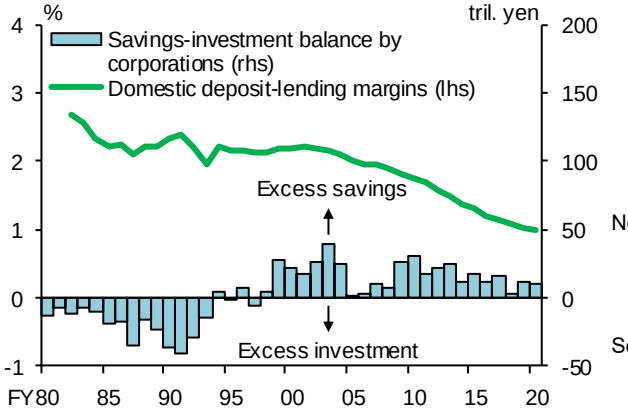
1 Introduction

Japanese financial institutions have been facing a continuous downward pressure on profitability – mainly through shrinking domestic lending margins – over the years due to secular changes in structural factors such as a fall in potential growth, a trend decline in loan demand, and a prolonged low-interest rate environment. Indeed, the time path of investment-saving (I-S) balance of private non-financial corporations in Japan shows that these corporations became excess savers in the period from the late 1990s to early 2000s and have been so until now (Chart 1). As the BOJ's Financial System Report (FSR) has indicated on several issues, this secular change in the pattern of I-S balance is considered to have reduced demand for corporate loans, putting downward pressure on profitability of financial institutions. In fact, the same chart also shows that deposit-lending margins of Japanese financial institutions have shrunk in around fiscal 2000, when corporates turned to "excess savers," and have remained at the level beyond. Against this backdrop, these financial institutions have been actively risk-taking in order to secure profits; Regional banks, including *Shinkin* banks, have actively extended credits to domestic middle-risk firms and real estate businesses and invested in overseas securities, while large banks have taken risks in overseas loans and overseas credit product investment.

Chart 1: Deposit-lending margins among domestically licensed banks and excess savings by corporations

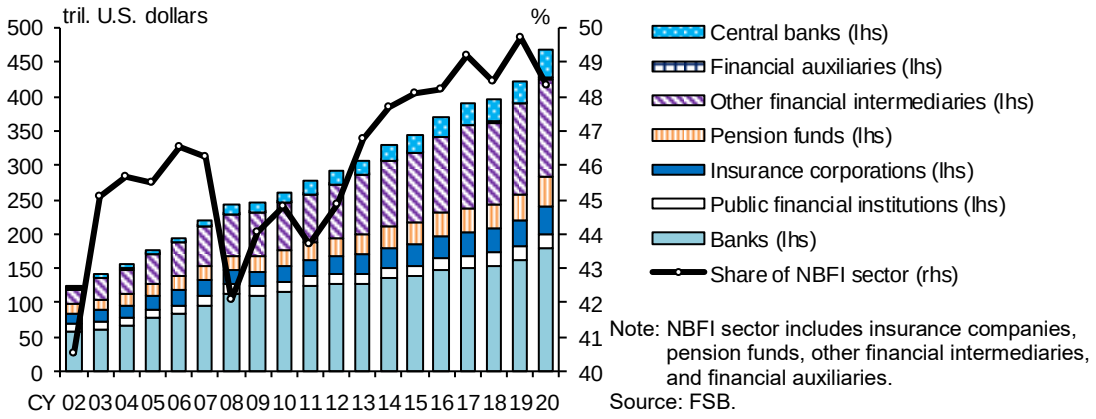


Note: 1. "Savings-investment balance by corporations" covers private nonfinancial corporations. "Domestic deposit-lending margins" covers regional banks.
2. Latest data as at fiscal 2020.
Source: BOJ.

Looking at global financial markets, the presence of Non-Bank Financial Intermediary (NBFI) entities, such as investment funds, has been on an increasing trend since the GFC. Chart 2 shows the developments of financial assets held by various types of financial sectors together with the share of financial assets held by the NBFI sector. In the last two

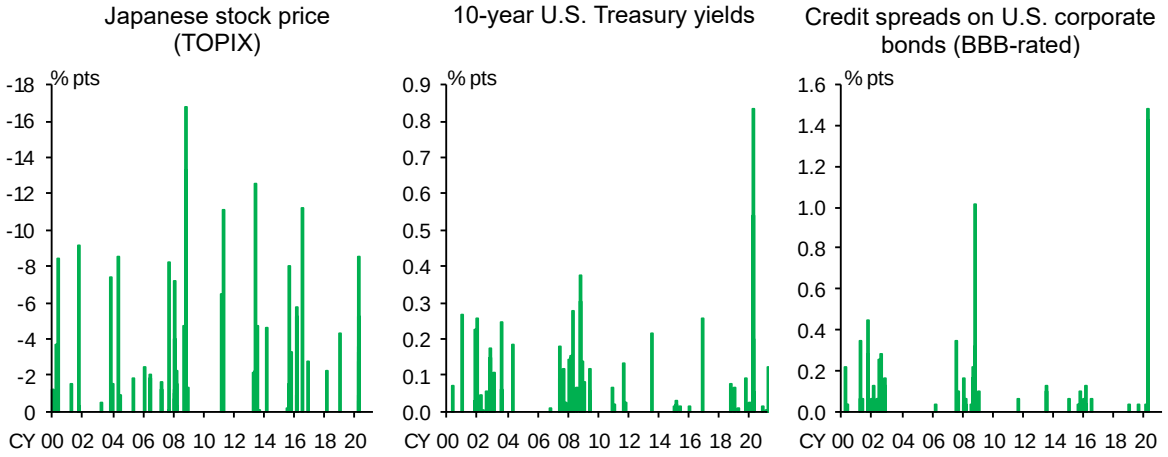
decades, holdings of NBFIs have increased to about 2.3 trillion dollars, which is about half of total financial assets around the globe in 2020. At the outbreak of the pandemic, when the global financial market became volatile toward the end of March 2020, these entities in particular investment funds faced pressure from rapid outflows of funds and increased margin requirements, resulting in a drying up of liquidity in various financial instruments and destabilization of international financial markets. Under these circumstances, many Japanese financial institutions saw price declines in their securities holdings and breaches in various risk management limits, such as loss limits. Chart 3 shows daily changes in the stock price (TOPIX), long-term U.S. interest rate, and U.S. credit spreads of U.S. BBB bonds – the main risk factors of securities investments of Japanese financial institutions – plotted against their historical Value-at-Risk (VaR). It is shown that in the March market turmoil of 2020, daily changes in all three measures largely exceeded the historical VaR, and for the U.S. interest rate and bond spreads the changes exceeded even the peak during the GFC.

Chart 2: Total global financial assets



Note: NBFI sector includes insurance companies, pension funds, other financial intermediaries, and financial auxiliaries.
Source: FSB.

Chart 3: Deviation from the historical VaR



Note: The graph shows the deviation of each index from the historical VaR with a 99 percent confidence level, 10-day holding period, and past 3-year observation period. Latest data as at March 31, 2021.
Source: Bloomberg.

This paper analyzes financial stability implications of the increasing interlinkages between securities portfolios of Japanese financial institutions – in particular regional banks – and those of global NBFIs, that is considered to be brought about by two possibly isolated secular changes: the growing importance of NBFIs in the global financial market and long-term changes in the business environment surrounding Japanese financial institutions that have been exerting downward pressure on their profitability. To this end, we first calculate the portfolio overlap – defined as the correlation between changes in the market value of securities portfolios – between Japanese financial institutions and global investment funds. The data of securities portfolio of global investment funds are semi-aggregated data that are constructed from funds' data grouped by investment region and type of product. Second, we analyze developments in portfolio overlap over time and the driver and study how shocks in the global financial market propagate to Japanese financial institutions differently depending on the degree of asset portfolio.

The findings of the paper are as follows. First, the number of Japanese financial institutions with a high portfolio overlap with investment funds has increased since prior to the GFC. This tendency is particularly apparent for a pair of bond funds and regional banks. Second, financial institutions with low capital ratios, loan-to-deposit ratios, and lending margins tend to have a higher overlap with these investment funds. Third, financial institutions with a high portfolio overlap with investment funds tend to see a larger decline

in the market value of their securities portfolio in response to global market shocks – large redemptions at investment funds, rises in U.S. interest rates, and adjustments in the U.S. bond market.

These findings indicate that while secular changes in the domestic economy such as a decline in the potential growth rate have weighed on profitability of domestic financial institutions leading to a larger investment in foreign securities by these institutions, in particular regional banks, investment funds have increased its importance in the global financial market, which in turn has increased the portfolio overlap between the otherwise two separate entities, domestic financial institutions and global investment funds. Consequently, even though the domestic financial institutions do not have a much direct exposure to the global investment funds, securities portfolios of these financial institutions have become more susceptible to economic activities undertaken by the investment funds. Moreover, an increasing number of financial institutions with a higher overlap suggests that the impact of the behavior of investment funds may extend over increasingly wider areas of the financial system in Japan.

The remainder of the paper proceeds as follows. Section 2 provides the related literature and describes how our analysis compares to existing studies. Section 3 gives an explanation of the data used in our analysis and the methodology used for estimating the portfolio overlap. Section 4 investigates developments in the portfolio overlap since the period before the GFC, the drivers of changes in the overlap and the implications of changes in the portfolio overlap on financial stability. Section 5 concludes.

2 Related Literature

Our work mainly relates to three strands in the literature: analysis on fire-sale models, the portfolio overlap, and on search for yield. We discuss theses relations in this order.

First, our analysis is related to studies of "fire-sale" models, as it studies the transmission mechanism, through price impacts, of global market shocks including those triggered by fire-sales of some entities to financial institutions in Japan. A fire-sale in general is a

phenomenon where assets are sold at heavily discounted prices, possibly propagating to the whole financial system when occurring at a large scale.[5] Models that feature fire-sales have been increasingly used not only by academics but also by policy makers, such as central banks and international organizations, as part of a toolkit to assess financial vulnerabilities since the GFC. For example, Greenwood, Landier and Thesmar (2015), with a model of financial system that consists of banks, consider implications of an exogenous negative price shock to an entity's asset holdings, which leads to the "first-round" asset sales, and a further decline in assets induced by an array of "second-round" asset sales by other entities, ultimately affecting banks' capital.[6] Extending their work, Duarte and Eisenbach (2021) construct the time-series of an index of aggregate fire-sale vulnerability for U.S. banks and find that the vulnerability has declined since the GFC, which accords with the view that the banking sector has become more resilient as a consequence of the regulatory reforms undertaken. In recent years, there are also works that focus on fire-sale behaviors triggered by the investment funds (Cetorelli, Duarte and Eisenbach (2016), Fricke and Fricke (2021)) or on the transmission across various types of financial system entities, including banks, insurance companies, and investment funds (Caccioli, Ferrara and Ramadiah (2020), Mirza et al. (2020)). For example, Cetorelli, Duarte and Eisenbach (2016) construct a measure of the potential second-round spillover effects under a hypothetical adverse scenario for mutual funds in the U.S. and argue that potential spillovers have increased since the GFC due to their increasing asset size and holding of illiquid assets.[7] Along these lines, as investment funds have played an increasingly larger role in financial transactions since the GFC, structural vulnerabilities associated with these funds have been explored in a good number of works, including FSB (2017), ESRB (2106, 2017), and Grill et al. (2021). These studies point out that while funds

[5] As for the empirical evidence about the existence of fire sales, see, for example, Pulvino (1998) for real assets, Coval and Stafford (2007), for equities, and Ellul, Jotikasthira and Lundblad (2011) and Haddad, Moreira and Muir (2020) for bonds.

[6] A similar mechanism is shown in Cifuentes, Ferrucci and Shin (2005). They show, using a model that consists of banks that are subject to regulatory constraints and mark their assets to market, that price drops stemming from asset sales of illiquid assets of distressed banks could heighten risks to financial stability.

[7] See also Haddad, Moreira and Muir (2021). They use transaction level data to analyze the effects of corporate and U.S. government bond sales by investment funds in the March market turmoil of 2020. They point out that investors sold massive amounts of investment grade bonds at discounted prices relative to the CDS and that the arbitrage market mechanism did not function. Another driving force for acceleration of investors' dash for cash behavior is increases in margin calls for additional collateral (FSB (2020)).

have to meet daily redemption obligations, sometimes holding illiquid assets, a large redemption wave could destabilize the financial system through forced fire-sales.

Second, related to the first strand of studies, our work is close to works that study the degree and implications of interlinkages of asset holdings across different financial institutions that arises from various channels including crossholding of assets or common and similar asset holding. When financial institutions hold common assets, for example, a price shock to an asset held by a specific institution propagates easily to a value of balance sheet of other entities, possibly being reinforced by the fire-sale mechanism. Barucca, Mahmood and Silvestri (2021) use regulatory holding-level asset data for banks and insurers in the U.K. together with private data for open-ended investment funds in Europe and construct measures of portfolio overlap across institutions for assessing fire-sale vulnerabilities. From a slightly different perspective, Wagner (2010) uses a theoretical model to show that even when risks are diversified at the individual financial institution level, such a diversification could lead to crossholdings of assets and synchronizations of risks faced by these institutions. He also points to the possibility that, under these circumstances, a failure of an institution could trigger additional failures that would cascade through the whole financial system. There are also several empirical studies that measure the actual degree of portfolio overlap among different types of entities.[8] Among them, our work is close to studies that investigate overlap across investment funds such as Fricke (2019), Fricke and Fricke (2020), Delpini et al. (2015), and Blocher (2016). For example, Fricke (2019) uses security-level holdings data on equity funds investing in U.S. stocks between 2003 to 2014 to measure common asset holdings with cosine similarity[9] and finds that portfolio overlap between individual funds has risen in recent years. He further shows that funds with low levels of portfolio overlap with other funds do not necessarily outperform other funds. While our works are built upon these works, our paper

[8] Admittedly, portfolio overlap is not the only reason that generates "connectedness" across different institutions. For example, market values of balance sheets of two institutions can be correlated if there are direct trade relationships between them. See, for example, Diebold and Yilmaz (2014) and Demirer et al. (2018), where overall connectedness across institutions are measured using time-series techniques.

[9] Cosine similarity (S_{mn}) is technically the angle between the vectors of portfolio weights between institution m and n, which is defined as $S_{mn} \equiv \sum_k w_{mk} w_{nk} / (\sqrt{\sum_k w_{mk}^2} \sqrt{\sum_k w_{nk}^2})$, where w_{mk} is the share of asset k held by institution m.

differs from the first and second strands of studies in that it focuses on the secular change in the interlinkages between traditional financial institutions, i.e., banks, and growing investment funds over around 20 years and draws the quantitative implications to the financial stability. To the best of our knowledge, this is the first paper that estimates the time path of portfolio overlap between individual financial institutions in Japan and global investment funds and shows that the degree of overlap indeed matters to the transmission of global market shocks to these institutions.[10]

Third, our paper relates to the empirical literature on the search for yield (SFY) behavior of financial institutions in a low interest environment. After the GFC, most of the advanced economies experienced prolonged periods of low interest rates until the inflation rates globally started to increase in 2021 due mainly to supply-chain disruptions. There has been a good number of empirical studies, such as Borio, Gambacorta and Hofmann (2017) and Claessens, Coleman and Donnelly (2017), that document that low interest rates may reduce banks' profits. Some studies further document low interest rates have changed financial institutions' risk taking behavior. Dell'Ariccia, Laeven and Suarez (2017), using the data on internal ratings of U.S. banks, show that banks' ex-ante risk taking, measured as the risk rating of new loans, is negatively associated with increases in short-term interest rates. Jimenez et al. (2014), using Spanish data, show that lower interest rates lead banks to lend more to borrowers with a worse credit history and to grant more loans with a higher per-period probability of default. Ammer, Tabova and Wroblewski (2018) show that low interest environments in home countries have induced banks to invest on U.S. bonds. Along the same lines, the Bank of Japan's Financial System Report (2016, 2017) point out that amid a low interest environment Japanese banks have been investing in foreign risky assets, mainly investment trusts and foreign bonds and that such a tendency is pronounced for banks with low lending margins and capital. The results of our analysis is somewhat consistent with these conventional view that lower domestic interest rates induces financial

[10] The current analysis is also related to Hogen, Koide and Shinozaki (2022) that empirically estimates the portfolio overlaps, together with other metrics of interlinkages, in terms of the correlations in market value of securities portfolios between Japanese financial sectors with various types of financial sectors overseas as a whole, using the flow of funds data. The current paper differs from the paper as it uses an institution-level data for estimating the portfolio overlap and provides a quantitative evaluation regarding how much asset portfolio matters to the transmission of global shocks.

institutions to increase risk taking on foreign assets. Our work is, however, novel in pointing out that such a SFY behavior of these financial institutions has coincided with a growing importance of NBFIs in the global financial market and has tightened the linkages with NBFIs.

3 Estimation of the Portfolio Overlap

3.1 Data

The main focus of our analysis is on changes in the market value of securities portfolios held by Japanese financial institutions and global investment funds. Data on changes in the market value of portfolios of investment funds are taken from EPFR Global. For the purpose of the analysis, instead of aggregating the securities portfolio of all of the investment funds, the funds are grouped into about 50 categories depending on their investment region and type of product (Table 1). Investment regions are the U.S., Europe, Asia-Pacific (advanced economy), Emerging Asia, EMEA emerging economies (Africa, the Middle-East, European emerging economies), and South America. Types of products include equities, government bonds, corporate bonds, mortgage-backed securities, inflation-protected bonds, depending on the region, as product types available are different across regions. Investment funds are defined as including mutual funds and ETFs, and therefore not including MMFs, and the total amount of assets in as of 2021 is 48 trillion dollars.[11,12]

[11] MMFs generally invest in short-term bonds with maturities within a year, so the portfolio overlap with financial institutions can be considered to be small. Furthermore, most MMFs have constant NAV. We therefore exclude MMFs from our analysis. Note also, however, that we include investment funds investing in short-term bonds (see Table 1) to calculate the portfolio overlap. According to the "Global Monitoring Report on Non-Bank Financial Intermediation 2021" (Financial Stability Board, 2021), MMFs account for about 10% of the whole global investment fund universe.

[12] Comparing the coverage of our investment fund universe and the sum of mutual funds and ETFs with other sources, the Investment Company Institute (ICI) covers 46 regions with total NAV of about 62 trillion dollars (as of end-2021), and the FSB (2021) covers 29 regions with about 58 trillion dollars (as of end-2020).

Table 1: List of investment funds

Investment region	Product	Investment region	Product
U.S.	Equity	Europe	Bond: Medium term corporate
U.S.	Bond: MBS	Europe	Bond: Medium term government
U.S.	Bond: Inflation protected	Europe	Bond: Medium term
U.S.	Bond: Total return	Europe	Bond: Long term corporate
U.S.	Bond: High yield	Europe	Bond: Long term government
U.S.	Bond: Bank loan	Europe	Bond: Long term
U.S.	Bond: Short term corporate	Asia Pacific	Equity
U.S.	Bond: Short term government	Asia Pacific	Bond: MBS
U.S.	Bond: Short term	Asia Pacific	Bond: Inflation protected
U.S.	Bond: Municipal bond	Asia Pacific	Bond: Total return
U.S.	Bond: Medium term corporate	Asia Pacific	Bond: Short term corporate
U.S.	Bond: Medium term government	Asia Pacific	Bond: Short term government
U.S.	Bond: Medium term	Asia Pacific	Bond: Short term
U.S.	Bond: Long term corporate	Asia Pacific	Bond: Medium term corporate
U.S.	Bond: Long term government	Asia Pacific	Bond: Medium term government
U.S.	Bond: Long term	Asia Pacific	Bond: Medium term
Europe	Equity	Asia Pacific	Bond: Long term government
Europe	Bond: MBS	Asia Pacific	Bond: Long term
Europe	Bond: Inflation protected	Emerging Asia	Equity
Europe	Bond: Total return	Emerging Asia	Bond
Europe	Bond: High yield	EMEA	Equity
Europe	Bond: Bank loan	EMEA	Bond
Europe	Bond: Short term corporate	North America	Equity
Europe	Bond: Short term government	North America	Bond
Europe	Bond: Short term		

Source: EPFR Global; Haver Analytics.

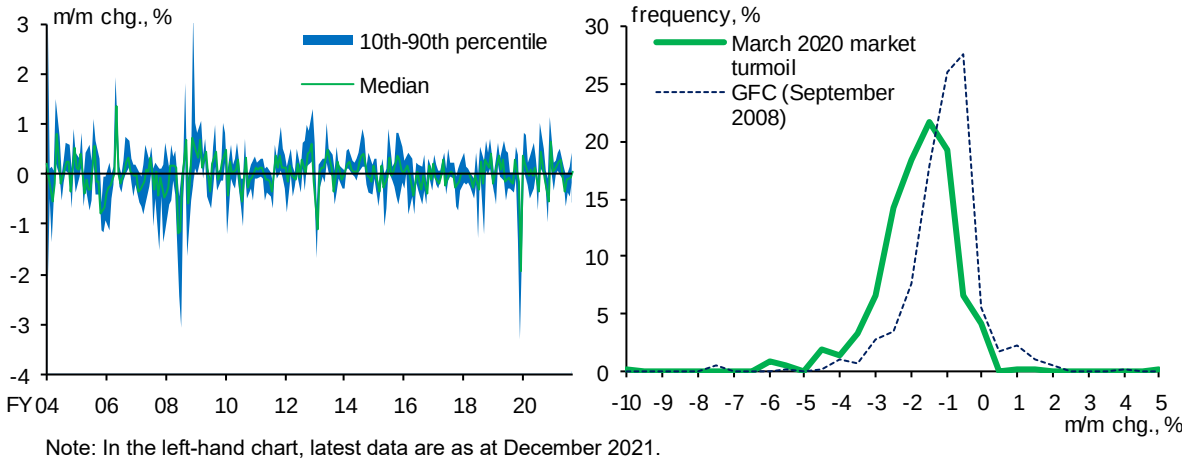
Data for calculating changes in the market value of securities portfolios held by Japanese financial institutions are taken from the regularly reported data to the BOJ submitted by these institutions. Note that the scope of financial institutions in our analysis is about 360 entities including large financial institutions, regional banks, and *Shinkin* banks and do not include other financial institutions such as pension funds and insurance firms.[13] More specifically, the change in the market value of bank i's securities portfolio $r_{Bank_i,t}$ – which we simply call asset returns hereafter – is calculated by

[13] The scope of financial institutions in our analysis includes large financial institutions, regional banks and *Shinkin* banks. Large financial institutions includes major banks, Japan Post Bank, and a central organization of financial cooperatives. The amount of total financial assets accounts for 40 % of the whole Japanese financial system at the end of fiscal year 2021. We do not include other financial institutions such as pensions and insurance companies.

$$r_{Bank_i,t} = \frac{UGL_{Bank_i,t} - UGL_{Bank_i,t-1}}{Total\ \ Amount\ \ of\ \ Securities_{Bank_i,t-1}}$$

where *UGL* stands for the total amount of unrealized gains/losses on all types of securities holdings held by a bank *i,* namely the sum of those of bonds, equities, investment trusts, and other securities. The reason for using the differences in the *UGL* in the numerator is to remove the changes in market value of securities portfolio that arise from transactions of securities that occur within the time period. The frequency is monthly, and the data runs from April 2004 to December 2021. The left panel of Chart 4 shows developments of asset returns $r_{Bank_i,t}$ over the sample period. It is seen that there were large declines in stress events such as the GFC and the March market turmoil of 2020. The right panel of the chart compares the cross-sectional distribution of $r_{Bank_i,t}$ in these two events. It is seen that a larger proportion of financial institutions faced more negative changes in market value during the March market turmoil.

Chart 4: Asset returns of securities portfolios of financial institutions



Note: In the left-hand chart, latest data are as at December 2021.
Source: BOJ.

3.2 Estimation Method

We define the portfolio overlap between Japanese financial institutions with investment funds as pairwise asset return correlation and calculate this using the Dynamic Conditional Correlation (DCC)-GARCH model proposed by Engle (2002). The DCC-GARCH model is widely used in the time-series analysis in particular that on financial markets (such as Brownlees and Engle (2017)). Our model described below is essentially built upon these previous studies.

We assume that asset returns of Japanese financial institution *i*'s securities portfolio $r_{i,t}$

and those of investment fund *j* to follow a bivariate normal distribution that is described as

$$\begin{bmatrix} r_{i,t} \\ r_{j,t} \end{bmatrix} \Big| F_{t-1} \quad \sim \; N\left(\begin{bmatrix} \mu_i \\ \mu_j \end{bmatrix}, \quad \begin{bmatrix} \sigma_{i,t}^2 & \rho_{ij,t}\sigma_{i,t}\sigma_{j,t} \\ \rho_{ij,t}\sigma_{i,t}\sigma_{j,t} & \sigma_{j,t}^2 \end{bmatrix} \right). \tag{1}$$

Here $r_{i,t}$ denotes the asset return of the securities portfolio of entity *i* at period *t* and $F_{t-1}$is the information set as of period *t-1*, μ_i is the mean of $r_{i,t}$, $\sigma_{i,t}$ is the conditional standard deviation (volatility) of $r_{i,t}$, and $\rho_{ij,t}$ is the conditional correlation of $r_{i,t}$ and $r_{j,t}$. We assume that the volatility process follows a GARCH(1,1) model (Bollerslev (1986)) with parameters ω, α, β as follows:

$$\begin{aligned} \sigma_{i,t}^2 &= \omega_i + \alpha_i \left(r_{i,t-1} - \mu_i \right)^2 + \beta_i \sigma_{i,t-1}^2, \\ \sigma_{j,t}^2 &= \omega_j + \alpha_j \left(r_{j,t-1} - \mu_j \right)^2 + \beta_j \sigma_{j,t-1}^2. \end{aligned} \tag{2}$$

In order to satisfy the non-negativity of the variance and stationarity, we assume that for all $k = i, j$, $\omega_k > 0, \alpha_k \geq 0, \beta_k \geq 0, \alpha_k + \beta_k < 1$. In this set-up, the conditional correlation matrix R_t is specified as follows:

$$\begin{aligned} R_t &= \begin{bmatrix} 1 & \rho_{ij,t} \\ \rho_{ij,t} & 1 \end{bmatrix} = diag\left(Q_{ij,t}\right)^{-\frac{1}{2}} Q_{i,t}\, diag\left(Q_{ij,t}\right)^{-\frac{1}{2}}, \\ Q_{ij,t} &= \left(1 - a_{ij} - b_{ij}\right)\bar{Q}_{ij} + a_{ij} \begin{bmatrix} \varepsilon_{i,t-1} \\ \varepsilon_{j,t-1} \end{bmatrix} \begin{bmatrix} \varepsilon_{i,t-1} \\ \varepsilon_{j,t-1} \end{bmatrix}' + b_{ij} Q_{i,t-1}. \end{aligned} \tag{3}$$

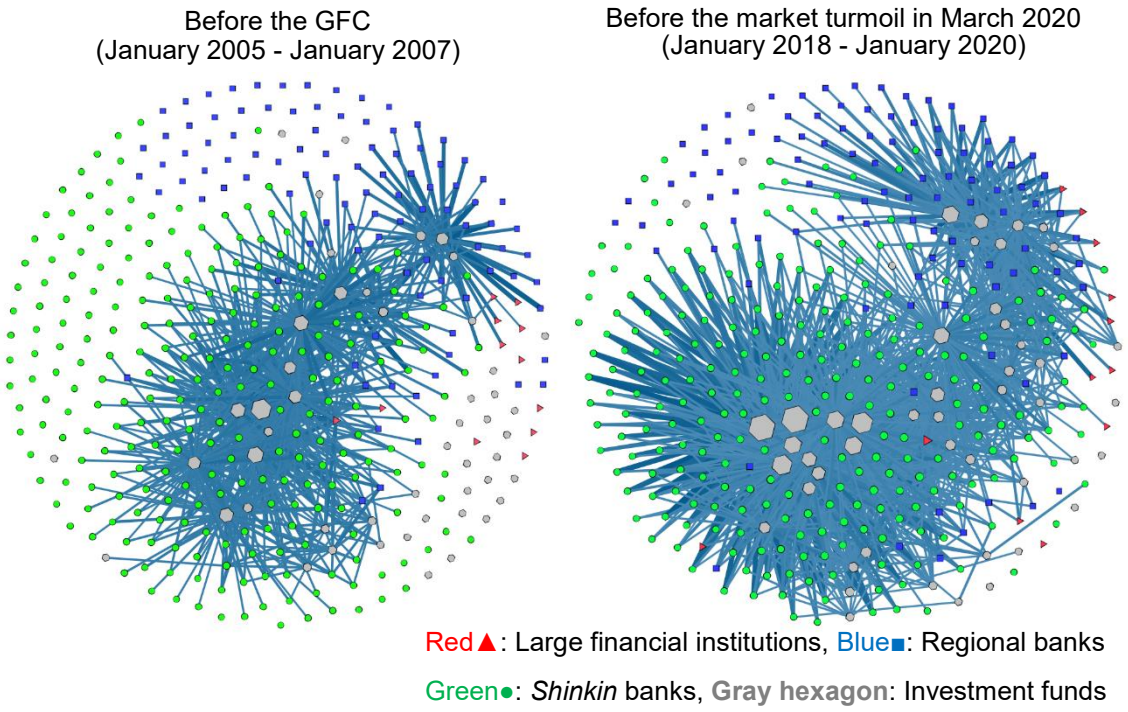
Here, $\varepsilon_{i,t} = (r_{i,t} - \mu_i)/\sigma_{i,t}$ is the standardized asset return, $Q_{ij,t}$ and $\bar{Q}_{ij}$ denote the conditional and unconditional variance-covariance matrix of the standardized asset return, respectively, and $diag\left(Q_{ij,t}\right)$ is a diagonal matrix with the diagonal elements of $Q_{ij,t}$. In order for $Q_{ij,t}$ to be positive definite, we assume $a_{ij} \geq 0, b_{ij} \geq 0, a_{ij} + b_{ij} < 1$, where parameters a_{ij} and b_{ij} are scalars that represent the sensitivity to past shocks and the autocorrelation coefficient, respectively. The estimated portfolio overlap – which corresponds to correlation $\rho_{ij,t}$ – is time varying. Using this model, for all combinations of each of Japanese financial institutions (360 banks) and each of 50 groups of investment fund (grouped by investment region and type of product; 50 groups), we calculate a total of 18 thousand (360 times 50) pairwise correlations $\rho_{ij,t}$.

3.3 Developments of the portfolio overlap over time

Before analyzing the time series properties of portfolio overlap, we provide an overview on how securities portfolio of Japanese financial institutions and global investment funds are overlapped. Chart 5 summarizes how the portfolio overlap has developed in the last two decades. The left figure represents the portfolio overlap during the period before the GFC and the right figure represents that during the period before March market turmoil in 2020. For each of the two figures, a line is drawn when the estimated average of the overlap between a financial institution's securities portfolio and assets under management (AUM) of an investment fund is 0.5 or higher (which corresponds to about the 90th percentile of the whole sample pooled across time and cross-section).[14] Gray hexagons represent investment funds grouped by investment region and product, while red triangles, blue squares, and green circles represent large financial institutions, regional banks, and *Shinkin* banks (small FIs), respectively. Each of these shapes is drawn more largely if the entity sees more of the combinations with correlations 0.5 or higher. Comparing these two periods, the number of lines increased from about 1,200 to 2,100, which indicates that the overlap of securities portfolios of Japanese financial institutions and investment funds has generally increased.

[14] Chart 5 is drawn using a standard software program (called "Gephi") which is widely used for network analysis. The chart is drawn with a mechanics model (Fruchterman-Reingold algorithm) where the steady state position of nodes (dot) is calculated iteratively assuming that each node's repulsive force and gravity are in balance.

Chart 5: Portfolio overlap between Japanese financial institutions and investment funds



Note: Gray hexagons indicate approximately 50 types of investment funds by investment region and product. A line is drawn when the overlap between a financial institution's securities portfolio and AUM of an investment fund is high (i.e., a correlation of asset returns of 0.5 or higher). Shapes are larger the more they are connected.
Source: EPFR Global; Haver Analytics; BOJ.

In order to see the characteristics of developments of the portfolio overlap, from a different angle, for all financial institutions i we calculate the ratio of portfolio overlap $\rho_{ij,t}$ greater than 0.5 with investment fund j relative to the number of all possible combinations as follows:

$$\frac{\sum_{j \in C} I(\rho_{ij,t} > 0.5)}{N_{C,t}} \quad where \;\; C = \{bond \;\; fund, equity \;\; fund\}. \tag{4}$$

Here, C is investment fund type (bond fund or equity fund), I( ) is an indicator function, which takes the value of 1 if the statement in brackets is true and 0 otherwise, and $N_{C,t}$ is the number of investment funds belonging in that category at period t. This measure summarizes the degree to which a financial institution is related to funds that fall in a specific investment fund group, by counting the number of investment fund counterparts with a high portfolio overlap.

Chart 6 shows developments of this measure calculated by equation (4), grouped by type

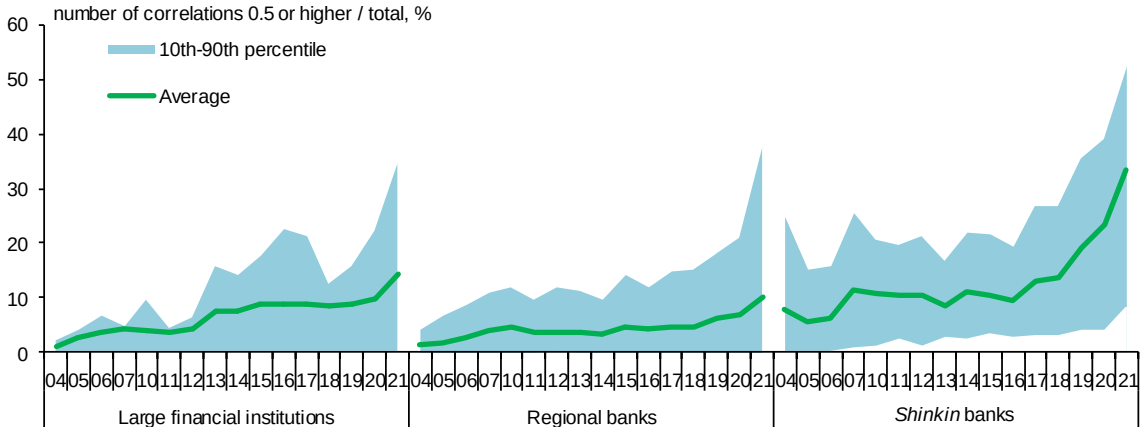
of financial institutions.[15] Each panel shows the time path of the distribution of the financial institutions that belong to the type depending on financial institution's degree of portfolio overlap. The shaded area represents 10^{th}-90^{th} percentile of the financial institutions and the green line represents the average of financial institutions at each period. There are two observations. First, the number of financial institutions with a high portfolio overlap with bond funds has monotonically increased for all three types of financial institutions. The increase is pronounced the most for *Shinkin* banks in particular, where the average number of financial institutions with a high overlap increased from 7.8% in 2004 to 33.3% in 2021. The observed secular increase in the measure of portfolio overlap accords well with secular changes in risk-taking stance of Japanese financial institutions in the last two decades. As pointed out in the BOJ's FSR (2021), amid the prolonged low interest rate environment, financial institutions have been shifting their securities portfolios to overseas assets, which offer relatively high yields, and *Shinkin* banks have been increasingly investing in multi-asset investment trusts for which overseas interest rates are the main risk factor. For example, from 2004 to 2021, the ratio of investment trusts in the securities portfolio, namely market value of investment trusts holdings divided by that of the total securities portfolio, have remained stable at 2% for large financial institutions, while increased from 1% to 15% for regional banks and from 1% to 12% for *Shinkin* banks. Similarly, from 2004 to 2021, the ratio of foreign bonds in the securities portfolio have increased from 17% to 25% for large financial institutions, from 12% to 15% for regional banks and from 8% to 14% for *Shinkin* banks. Second, focusing on the portfolio overlap with equity funds, the increase of the measure is pronounced for large financial institutions and regional banks, which respectively rose from 6.8% to 20.0% and 10.0% to 24.3% from 2004 to 2021. One potential explanation is stock holdings by Japanese financial institutions and those of investment funds. As indicated by the BOJ's FSR (2021), although major

[15] As broad range of financial assets tends to see a large and simultaneous price fall during the crisis period, the portfolio overlap of securities portfolio estimated based on equation (1) also tends to increase relative to normal times. We do not show the values of the measures during the period of the GFC and March market turmoil in 2020, i.e., two years after the subprime mortgage problem manifested itself and the Lehman shock occurred, and one year after the March market turmoil in 2020, from the chart. This is because as described below, the focus of the current study is to assess the implications of having a higher portfolio overlap during the normal times to changes in the market value of securities portfolio during the crisis period.

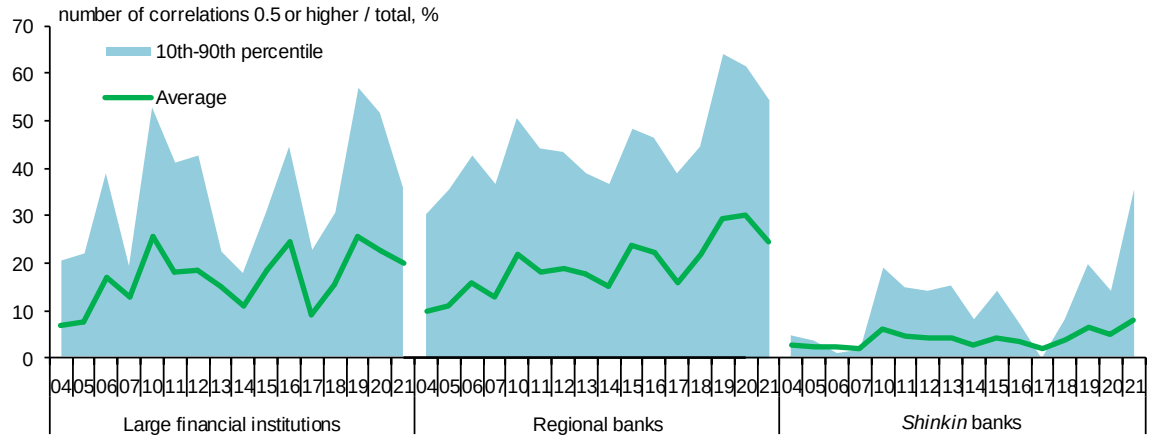
banks, which constitute the most of financial institutions, and regional banks have been reducing their strategic stock holdings, they still hold a considerable amount of stocks. As of 2022, the secular increase in investment in Japanese stocks by foreign funds may also be contributing to the increase in portfolio overlap.[16]

Chart 6: Portfolio overlap with investment funds

(a) Bond Funds



(b) Equity Funds



Note: Vertical axis represents the percentage of high portfolio overlap (i.e., correlation of price changes is 0.5 or higher) between a financial institution's securities portfolio and AUM (assets under management) of an investment fund among approximately 50 types of investment funds by investment region and product. The numbers on the horizontal axis represent years. To examine portfolio overlap in normal times, two years after the manifestation of subprime mortgage problem and the Lehman shock, and one year after the March market turmoil in 2020 are excluded from the compilation.
Source: EPFR Global; Haver Analytics; BOJ.

[16] Share of stock holdings in the whole securities portfolio is 9 % for both large financial institutions and regional banks, as of December 2021.

4 Drivers of the increase in the portfolio overlap and implications for financial stability

4.1 Drivers of the increasing portfolio overlap

In this sub-section, we investigate drivers of the increasing portfolio overlap of Japanese financial institutions with investment funds. More specifically, we regress the portfolio overlap on financial institutions' financial indicators using the following cross-section:

$$\bar{O}_{i,2020.1} = \alpha_0 + \sum_n \alpha_n X_{i,n,2019.3} + u_{i,2020.1}, \quad (5)$$

where $\bar{O}_{i,2020.1}$ is financial institution i's portfolio overlap at the beginning of 2020 averaged across all investment funds (i.e. $\bar{O}_{i,2020.1} = \sum \rho_{ij,2020.1} / (Number\ of\ investment\ fund\ types)$), $X_{i,n,2019.3}$ is financial indicators of financial institution i, and $u_{i,2020.1}$ is the error term. In order to avoid endogeneity with the explanatory variable, the timing of financial indicator $X_{i,n,2019.3}$ is lagged by one year − as of March 2019 − and includes six bank-specific financial variables, such as capital ratio, loan-to-deposit ratio, and profitability (Table 2).[17]

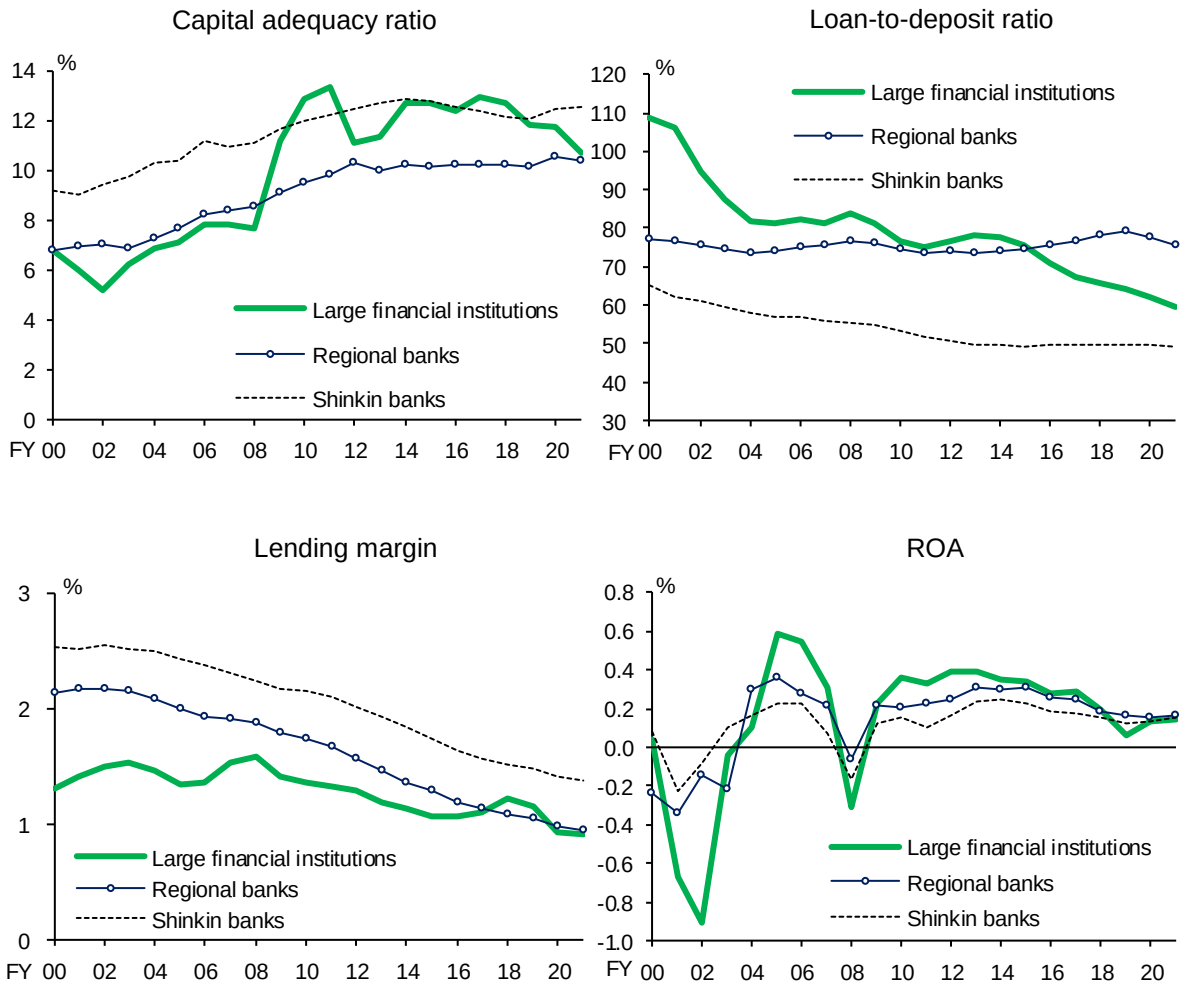
Table 2: Financial indicators (explanatory variables)

Variable	Definition
Capital adequacy ratio (%)	CET1 ratio for internationally active banks Capital adequacy ratio for domestic banks
Loan-to-deposit ratio (%)	Loans ÷ Deposits × 100
Lending margin (%)	(Interest rate on loans - Interest rate on deposits) × 100
Total assets (logarithm)	Logarithm of total assets
ROA (%)	Net income ÷ Total assets × 100
Net fees and commissions ratio (%)	Net fees and commissions ÷ Gross operating profits ×100

[17] Bank of Japan (2016, 2017) points out that as a result of the secular decline in a profitability in lending margins and deposit and lending-related businesses, financial institutions in Japan have increased their holdings of assets that they had not much invested so far, such as mutual funds. The following results in this paper are consistent with these findings.

Chart 7 shows developments of these variables where it shows that capital adequacy ratio shows upward trend until around fiscal 2012, after which it remained stable. Meanwhile, most of loan-to-deposit ratio and lending margin have followed a downward trend, reflecting reduced loan demand and, mainly for large financial institutions, increase in corporate deposits of large firms with strong earnings. Note that loan to deposit ratio for regional banks has increased moderately after fiscal 2015 because of steadily increase in lending to real estate and middle-risk firms (Bank of Japan (2019)).

Chart 7: Development of main financial indicators (explanatory variables)



Note: Latest data as at fiscal 2021. "Large financial institutions" includes major banks, and excludes Japan Post Bank, and a central organization of financial cooperatives.
Source: BOJ.

The estimation results are summarized in Table 3. It shows that parameters of capital ratios and variables related to loan deposit businesses are statistically significantly negative, which indicates that financial institutions with low capital and profitability tend to have a higher overlap with investment funds. In order to see the quantitative impact of each

variable on the portfolio overlap, by multiplying each sensitivity by the inter-quantile differences (the difference between the 10th percentile and the 90th percentile value)[18], the impact of the capital ratio (domestic banks and *Shinkin* banks) is 0.04, while that of the loan-to-deposit ratio is 0.12 and those of lending margins come to 0.02, suggesting that the loan-to-deposit ratio makes the largest contribution.

Table 3: Relationship between the portfolio overlap with investment funds and financial indicators

Explanatory variables / Dependent variables	Portfolio overlap
Intercept	0.617 ***
	[0.061]
Capital adequacy ratio (%)	
Internationally active banks	-0.004 **
	[0.002]
Domestic banks & *Shinkin* banks	-0.003 ***
	[0.001]
Loan-to-deposit ratio (%)	-0.003 ***
	[0.000]
Lending margin (%pt)	-0.023 **
	[0.011]
Total assets (logarithm)	-0.005
	[0.004]
ROA (%)	0.006
	[0.015]
Net fees and commissions ratio (%)	-0.001
	[0.001]
Adj. R^2	0.32
Sample size	351
Estimation period of dependent variables	January 2020

Note: ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively. [ ] represents standard error. Data cover regional banks and *Shinkin* banks. The capital adequacy ratio for internationally active banks represents the common equity Tier 1 (CET1) ratio. Explanatory variables are as of March 2019.
Source: EPFR Global; Haver Analytics; BOJ.

[18] The inter-quantile differences (10th percentile and 90th percentile differences) are -11.6%pt for the capital ratio, -41.3%pt for the loan-to-deposit ratio, and -1.1%pt for the lending margins.

Given the above findings, although regional banks and *Shinkin* banks overall have been increasing their investment trust holdings, the portfolio overlap with investment funds is particularly high for financial institutions with lower profitability of loans and lower indicators with regard to financial soundness. Admittedly, the background to these drivers may include secular changes in the aggregate economic environment surrounding financial institutions such as a decline in Japan's potential growth rate, and financial institutions facing a particularly weak loan demand or low profitability tend to search for relatively high yields. It is considered that these financial institutions have increased their holdings of products such as multi-asset investment trusts for which overseas interest rates are the main risk factor, tightening the linkages with investment funds greater.

In addition, even without secular changes in the behavior of Japanese financial institutions in terms of investment in foreign securities, the portfolio overlap may also increase by factors outside these financial institutions such as the expansion of investments in global securities and arbitrages. To see this, we estimate the following equation, while controlling for financial indicators of financial institutions.

$$\bar{O}_{i,t} = \alpha_0 + \sum_{s=2002}^{2021} \psi_s I(t=s) + \sum_n \alpha_n X_{i,n,t-1} + u_{i,t}, \qquad (6)$$

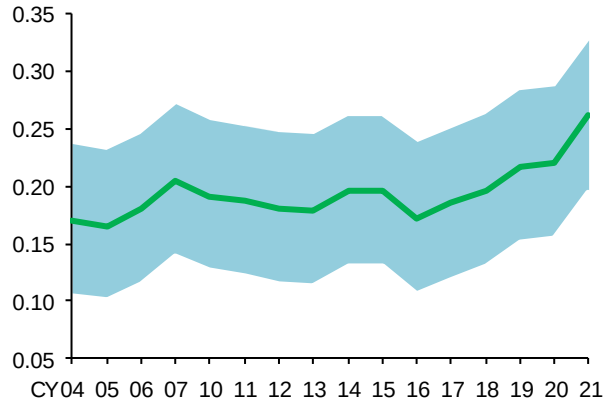
where $\bar{O}_{i,t}$ is the average degree of portfolio overlap of financial institution i with investment funds as of year t, $I(t=s)$ is the year dummy variable, $X_{i,n,t-1}$ is financial indicators of financial institution i used in equation (5), and $u_{i,t}$ is the error term. Note that, to evaluate portfolio overlap in normal times, $\bar{O}_{i,t}$ is compiled excluding periods during the GFC and the March market turmoil in 2020 as well as Chart 6. In the above equation, ψ_s captures the effect of factors that have pushed up the portfolio overlap other than those that arise from the behavior of Japanese financial institutions.

Chart 8 shows the estimated values of ψ_s over time. The time path of the value exhibits after a rise and fall around the GFC an upward trend since around 2013.[19] The chart

[19] The parameters for capital adequacy ratio, loan-to-deposit ratio and lending margin used as control variables have the same sign as in Table 3 and statistically significant in the estimation results of equation (6). The result implies that in the time-series direction, declines in the capital adequacy ratio, loan-to-

suggests that factors other than the behavior of Japanese financial institutions, such as the expanding role of investment funds' global investments, may have contributed to increase the portfolio overlap in recent years.

Chart 8: Estimated parameters for year dummy variables



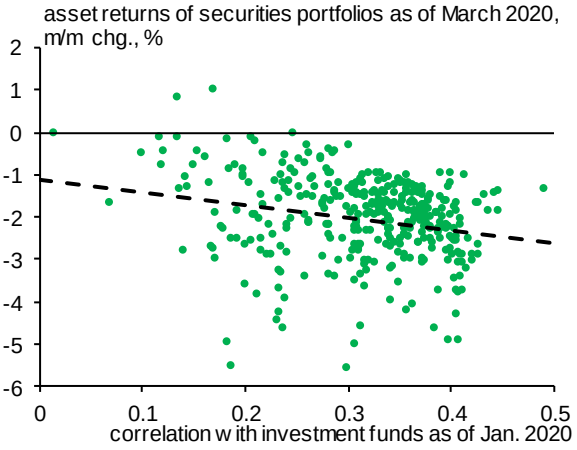
Note: The solid lines are estimates, and blue shaded areas are 90% confidence intervals.

4.2 Portfolio overlap with investment funds and the propagation of market shocks

This sub-section investigates the implications of the increasing portfolio overlap with investment funds seen above on Japan's financial stability. Chart 9 shows the relationship between asset returns of financial institutions' securities portfolios in March 2020, at the time of the March 2020 market turmoil, and the degree of portfolio overlap with investment funds in January 2020, at the dawn of the turmoil. Each plot denotes the average portfolio overlap with investment funds for a financial institution. The slope is negative at a statistically significant level, which indicates that the higher a financial institution's degree of portfolio overlap just before the turmoil, the larger the decline tended to be in the market value of its securities portfolio. This casual observation suggests that financial institutions with increasing overlap may have become more vulnerable to global financial market fluctuations.

deposit ratio, and loan margin were associated with subsequent increase in the portfolio overlap with investment funds.

Chart 9: Portfolio overlap with investment funds
and asset returns in the March 2020 market turmoil



Note: Correlation with investment funds is calculated as the average across all bilateral correlations. The intercept and slope of the regression line are both statistically significant at the 1% level.
Source: EPFR Global; Haver Analytics; BOJ.

Next, in order to see more formally the relationship between the portfolio overlap before the market turmoil and changes in market value of securities portfolio amid the turmoil, using the following panel regression, we examine how the sensitivity of asset returns of a financial institution's securities portfolio ($r_{i,t}$) to changes in global market conditions is affected by the degree of overlap of its securities portfolio with investment funds:

$$\begin{aligned} r_{i,t} = {} & \beta_1 \Delta r_t^{U.S.} + \beta_2 \Delta Redem_t + \beta_3 \Delta FCI_t \\ & + (\gamma_1 \Delta r_t^{U.S.} + \gamma_2 \Delta Redem_t + \gamma_3 \Delta FCI_t) \times D(\bar{O}_{i,t-1}) \\ & + \delta_0 D(\bar{O}_{i,t-1}) + \sum_{n=1}^{N} \delta_n Z_{n,t} + \mu_i + \varepsilon_{i,t}. \end{aligned} \tag{7}$$

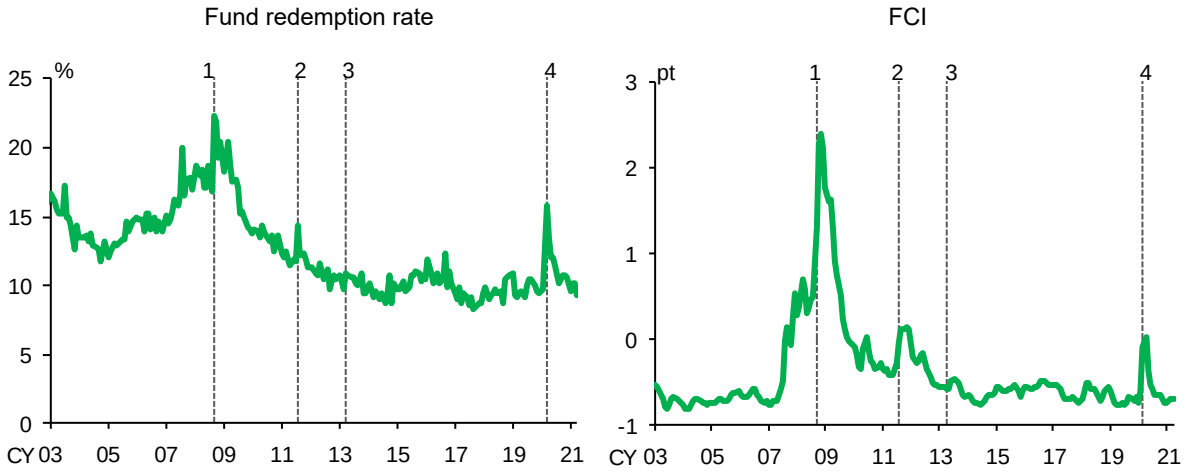
In equation (7), $\Delta r_t^{U.S.}$ is the monthly change in the U.S. long-term interest rate (10-year), $\Delta Redem_t$ is the monthly change in the redemption rate of investment funds, ΔFCI_t is the monthly difference in the Financial Conditions Index (FCI). $D(\bar{O}_{i,t-1})$ is a dummy variable if the average degree of portfolio overlap of financial institution i with investment funds as of the previous period, $\bar{O}_{i,t-1} = \sum \rho_{ij,t-1} / (Number\ of\ investment\ fund\ types)$, exceeds one standard deviation of the whole pooled sample. μ_i indicates fixed effects and $\varepsilon_{i,t}$ are the residuals. $Z_{n,t}$ is a vector of other control variables that has effects on the fluctuations of the securities portfolio, which

includes monthly changes in Japan's 3-month rate and changes in stock prices in the U.S. and Japan (TOPIX and S&P500).

In equation (7), as proxies for changes in the global financial market condition, we consider three variables: the U.S. long-term interest rate, the fund redemption rate, and the FCI. The fund redemption rate is chosen as a variable to capture the materialization of risks associated with investment funds, and the FCI captures the impact of a broad deterioration in financial conditions, such as rising credit spreads in the US financial markets. The former is calculated as the amount of redemptions at investment trusts, ETFs (stocks, bonds, etc.), and MMF (prime and government) in the current period divided by assets outstanding at the end of the previous period, using the data taken from the ICI. Note that the Investment Company Institute (ICI) covers 46 regions with total NAV of about 62 trillion dollars (as of end-2021). This is fairly close to the coverage with other sources, such as the FSB (2021) which covers 29 regions with about 58 trillion dollars (as of end-2020). The latter is the FCI (Chicago Fed National Financial Conditions Risk Subindex) calculated by the Federal Reserve Bank of Chicago, which is constructed from variables such as the volatility index (VIX) and credit spreads on corporate bonds (Brave and Kelly (2017)).

Looking at developments in the fund redemption rate and the FCI in Chart 10, both indicators tend to rise significantly during stress events in the global financial market, such as the GFC and the March market turmoil of 2020, which indicates that stress in terms of redemption pressure at investment funds and funding strains in financial markets tend to be larger when these indicators rise. In equation (7), parameters γ_1, γ_2, γ_3 capture the additional sensitivities in the market value of securities portfolios to the U.S. long-term interest rate, the fund redemption rate, and the FCI, depending on the portfolio overlap with investment funds. Furthermore, by calculating the ratio γ_k/β_k, for example, we are able to measure how the global market shocks are amplified at financial institutions with a high overlap relative to financial institutions with a low overlap.

Chart 10: Fund redemption rate and FCI



Note: 1. The fund redemption rate is calculated as the amount of investment trusts, ETFs (stocks, bonds, etc.), and MMF (prime and government) redemptions in the current period divided by assets outstanding at the end of the previous period. Data are seasonally adjusted.
2. The event lines represent 1: the GFC (September 2008), 2: the European debt crisis (August 2011), 3: the Taper Tantrum (April 2013), and 4: the market turmoil in March 2020.
3. Latest data as at April 2021.
Source: Federal Reserve Bank of Chicago; Haver Analytics; ICI.

Column (1) in Table 4 shows the estimation results of equation (7). This indicates that the sensitivity of the market values of securities portfolios are negative for rises in the U.S. long-term interest rate, the fund redemption rate, and the FCI. That is, stress of the global financial market is straightforwardly translated into a decline in market values of securities portfolios of domestic financial institutions. Furthermore, the cross-terms of these shocks with a portfolio overlap show that the sensitivity becomes significantly higher for financial institutions with a higher degree of overlap with investment funds. While this is the case for all of the three global market factors examined, the marginal effect on the sensitivity is particularly large with regard to the fund redemption rate. Quantitatively, when each of the explanatory variables fluctuates, as in past market stress events[20], financial institutions with a high overlap face additional losses in their securities portfolios of -0.17% to a rise in the U.S. long-term interest rate, -0.45% to a rise in the fund redemption rate, and -0.38% to a rise in the FCI. Compared to the additional propagation faced by high overlap financial institutions relative to low overlap financial institutions, the ratio is 0.4 for the U.S. long-

[20] For the exercise we used the U.S. long-term interest rate rise of 1.1%pt (maximum rise during the Taper Tantrum), the fund redemption rate of +6%pt (rise in the March market turmoil of 2020), and the FCI rise of 1.9pt (maximum rise in during the GFC).

term interest rate, 3.9 for the fund redemption rate, and 0.3 for the FCI, which indicates that the sensitivity increases substantially with the degree of portfolio overlap when shocks to fund redemption rates occur.

Columns (b) and (c) in Table 4 show the estimation results that use the alternative setting of equation (7), where cross-terms of global shock variables with the foreign bond holdings ratio (amount of foreign bonds divided by that of total securities holdings) or with the investment trust holdings ratio (amount of investment trusts divided by that of total securities holdings) are added as explanatory variables in the estimation equation. By adding these cross-terms, we aim to isolate the effect that stems from the financial institutions' decisions regarding the holdings of foreign bonds and/or investment trusts in their securities portfolios from factors outside these institutions including changes in market value fluctuations that arise from investment funds' activities. The estimation results show that, even after controlling for developments in foreign bond holdings and investment trust holdings in the securities portfolios, cross-terms of global market shocks with the portfolio overlap remain negative at a statistically significant level. This suggests a possibility that the portfolio overlap with investment funds by itself, including what is not necessarily the direct outcome of financial institutions' securities portfolio decisions, leads to increases in vulnerabilities – a greater propagation from global market shocks to the market value of their own securities portfolio. These findings suggest that in order to assess the vulnerabilities to global market shocks of the securities portfolios of Japanese financial institutions, it is essential to monitor developments not only of their own balance sheets, but also the relationships with global investment funds through indicators such as the portfolio overlap proposed in this paper. Furthermore, given the fact financial institutions with low capital ratios tend to have a higher portfolio overlap with investment funds, these institutions could be more vulnerable to shocks in the global financial market, which could lead to instability of the financial system.

Table 4: Portfolio overlap with investment funds and transmission of market shocks

Explanatory variables / Dependent variables	Asset returns of securities portfolio (%) $_t$		
	(a)	(b)	(c)
ΔU.S. long-term interest rate (%pt) $_t$	-0.341 ***	-0.340 ***	-0.343 ***
	[0.017]	[0.033]	[0.039]
× Overlap with inv. funds (high) $_{t-1}$	-0.148 ***	-0.172 ***	-0.464 ***
	[0.041]	[0.042]	[0.079]
× Foreign bond holding ratio $_{t-1}$		0.230	-0.280
		[0.299]	[0.389]
× Investment trust holdings ratio $_{t-1}$			-0.746 *
			[0.404]
ΔFund redemption rate (%pt) $_t$	-0.019 ***	-0.003	-0.020 **
	[0.004]	[0.007]	[0.009]
× Overlap with inv. funds (high) $_{t-1}$	-0.076 ***	-0.070 ***	-0.094 ***
	[0.009]	[0.009]	[0.011]
× Foreign bond holding ratio $_{t-1}$		-0.141 **	-0.105
		[0.055]	[0.084]
× Investment trust holdings ratio $_{t-1}$			-0.146 **
			[0.064]
ΔFCI (pt) $_t$	-0.605 ***	-0.513 ***	-0.276 ***
	[0.04]	[0.078]	[0.085]
× Overlap with inv. funds (high) $_{t-1}$	-0.196 **	-0.219 ***	-1.241 ***
	[0.079]	[0.078]	[0.198]
× Foreign bond holding ratio $_{t-1}$		-0.573	-2.978 ***
		[0.524]	[0.617]
× Investment trust holdings ratio $_{t-1}$			-6.982 ***
			[0.991]
Fixed effect	Yes	Yes	Yes
Control variables	Yes	Yes	Yes
Adj. R^2	0.15	0.17	0.19
Number of financial institutions	361	357	357
Sample size	66,178	60,003	42,612
Estimation period	January 2005 – April 2021		

Note: ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively. [ ] represents standard error clustered by financial institutions. Financial institutions with a high degree of overlap with investment funds are those with a correlation that is at least one standard deviation higher than the full sample average. Models (b) and (c) have a smaller sample size than (a) due to the shorter data start period for the foreign bond holding ratio and investment trust holdings ratio.
Source: Bloomberg; EPFR Global; Federal Reserve Bank of Chicago; Haver Analytics; ICI; BOJ.

5 Concluding remarks

This analysis studies the financial stability implications to Japan of two seemingly unrelated events occurring at the same time; A growing presence of investment funds in global financial markets in particular after the GFC, and increasing foreign securities holding by Japanese financial institutions against the background of long-run changes in the domestic economy including the slowdown of the potential output growth. Even when portfolio investments of Japanese financial institutions do not represent large direct exposure to global investment funds, as pointed out in the literature, if the returns of assets held by these two types of entities are correlated, global market shocks triggered by global investment funds may be translated to a threat to financial stability.

In this paper, we first calculate the portfolio overlap, which is defined as the correlation between changes in the market value of securities portfolios, between 360 Japanese financial institutions and 50 types of global investment funds, over 20 years. Second, we analyze the time series developments of the portfolio overlap and explore the implications for Japan's financial stability.

The findings of the paper are as follows. First, the number of Japanese financial institutions with a high portfolio overlap with investment funds has been increasing since prior to the GFC. This tendency is especially pronounced for the combination of bond funds and regional banks.

Second, investigations of the domestic drivers of portfolio overlap show that financial institutions with low capital ratios, loan-to-deposit ratios, and lending margins tend have a higher overlap with these investment funds. These findings indicate that the drivers of the increasing overlap can be attributed to structural factors such as a decline in Japan's potential growth rate, which weighs on bank profitability; as a result, financial institutions with weak loan demand and profitability tend to search for relatively high yields and have increased their holdings of foreign securities.

Third, financial institutions with a high portfolio overlap with investment funds tend to have larger price sensitivities in their securities portfolios in response to global market

shocks – large redemptions at investment funds, rises in the U.S. interest rate, and widespread deterioration in financial conditions measured by the FCI. This propagation effect becomes the largest for fund redemption shocks among the three shocks, which could indicate that when investment funds are faced with a large wave of redemption, such as in the March market turmoil of 2020, they are forced to sell assets for liquidity purposes to some extent, and the effects from these asset sales could spill over to financial institutions that have similar portfolios in terms of fluctuations in the market value of security holdings. Moreover, given that the number of financial institutions with a large overlap is increasing, this suggests that the impact of the behavior of investment funds may extend over wide areas of the financial system.

From a macroprudential perspective, the FSB, various standard-setting bodies, and financial authorities of various countries have recognized that additional measures may need to be taken and have started discussions to address the vulnerabilities related to liquidity mismatches of investment funds and other entities, reflecting their experiences.[21] One of the focal points of these discussions has been to better understand the systemic risks inherent in the financial system, particularly the interconnectedness and interlinkage among various entities and the cross-border transmission effects, given the growing importance of investment funds in financial intermediation activities. Further analyses like the one presented here may be important for promoting future international discussions in this field.

[21] For example, in the U.S., a public comment was released on amendments to the MMF (Investment Company Act of 1940) regulation in December 2021, describing the potential usage of mandatory swing pricing (a scheme for passing on the liquidation costs to existing investors and redemption costs), and on additional liquidity requirements.

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