

Supervisory Simultaneous Stress Testing Based on Common Scenarios

Financial System and Bank Examination Department of the Bank of Japan
Strategy Development and Management Bureau, and Supervision Bureau of the Financial Services Agency

December 2020

In light of the experience of the 2008 global financial crisis, the use of stress testing has become widespread among financial authorities in major jurisdictions as a central tool in assessing the resilience of systemically important financial institutions. In Japan, too, given that major banks' risk profiles have become more diversified and complex in recent years as they have expanded their overseas activities and non-commercial banking businesses within their groups, it is becoming ever more important to use stress testing for assessing banks' resilience and ensuring that risk management capabilities are put in place. This paper outlines the supervisory simultaneous stress testing based on common scenarios, an exercise newly started by the Bank of Japan and the Financial Services Agency, describing its background, differences in the institutional arrangements from the United States and Europe, and the role of benchmarking and horizontal reviews.

Introduction

Stress testing is a risk management tool to quantitatively examine how the soundness of individual financial institutions and the stability of the financial system overall would be affected should a situation arise that produced severe stress in the business environment of financial institutions, such as a large deterioration in the economy, a sharp fall in asset prices, or a drying up of liquidity in financial markets.

While stress testing has been used since the 1990s, mainly by financial institutions in major developed countries, as a tool for managing market risk, after the global financial crisis triggered by the collapse of Lehman Brothers in 2008 it started to become more widely appreciated as a tool for holistically examining various risks, including credit risk. Until then, risk management tools mainly consisted of measuring the loss that is expected to arise with a certain probability based on the assumption that the correlation between economic and financial variables observed in the past would remain stable in the future, as exemplified by value at risk (VaR). The calculated losses were then regarded as the amount of potential losses that needed to be kept within a certain range, balanced against the capacity to absorb losses, such as through capital reserves. Until the global financial crisis, such tools were the prevalent method of managing risks thanks to their usability in practice. However, during the global

financial crisis, as the rapid deterioration in financial institutions' financial conditions due to the sharp fall in asset prices increasingly interacted with severe economic recession, the correlation between economic and financial variables changed substantially, exposing the limitations of risk management using VaR. This experience led to the widespread use of stress testing, where risk scenarios assume rare but nevertheless plausible stress events that would have an extremely large impact if they were to occur. Using economic models, stress testing then measures the impact that the materialization of those risk scenarios would have on the soundness of individual financial institutions or on the financial system as a whole.

In the wake of the global financial crisis, financial authorities too increasingly used stress testing amid the dysfunction of the financial system deepening. In particular, they regarded it as a useful tool for gauging how rapid changes in financial and economic conditions could affect the profitability and capital adequacy of financial institutions as a whole. Today, financial authorities, particularly in Europe and the United States, not only check how individual financial institutions apply stress testing as part of their scrutiny of whether individual financial institutions conduct appropriate risk management, but also have set up a supervisory framework of simultaneous stress testing in which they (1) formulate stress scenarios, (2) simultaneously conduct stress testing of large banks

based on the scenarios, and (3) use the results as a central tool in their regulation and supervision from both a micro- and a macroprudential perspective.

This paper provides an overview of the supervisory simultaneous stress testing based on common scenarios commenced by the Bank of Japan (BOJ) and the Financial Services Agency (FSA) last year. It outlines the background to implementation, and summarizes future issues.

Simultaneous stress testing in Europe and the United States

Following the global financial crisis and the subsequent European sovereign debt crisis, the need to employ simultaneous stress testing as a policy tool in order to restore confidence in the stability of the financial system was strongly recognized in the United States and Europe.

In the United States, the Dodd-Frank Act requires the Federal Reserve to conduct simultaneous stress testing of large banks on an annual basis. Based on this legal framework, the Federal Reserve has conducted annual simultaneous stress tests since 2011 to quantitatively and simultaneously examine the capital adequacy of large banks from a supervisory perspective, has disclosed the results for individual banks, and has examined the appropriateness of banks' capital plans including their dividend payments and share buybacks. Further, in March this year, the Federal Reserve finalized the rule for the "stress capital buffer" (SCB), a framework that sets the capital requirements for individual financial institutions based on the simultaneous stress test results, which started to be applied in October.

In the United Kingdom, the Bank of England (BOE) has been conducting annual simultaneous stress tests of large banks since 2014 and has published the results for individual banks. The results of the simultaneous stress tests are used to set capital buffers for individual banks and thereby deal with their highly idiosyncratic risk profiles (such as the concentration of risk in a specific portfolio), to evaluate the appropriateness of banks' dividend payments and share buybacks, and to set countercyclical capital buffer rates to prepare for risks from a macroprudential perspective.

In Europe, the European Banking Authority (EBA) and the European Central Bank (ECB) have been conducting simultaneous stress tests of large banks since 2011 and, like the United Kingdom and the United States, have disclosed the results for individual banks. Moreover, in 2018, a framework to use stress

test results to set Pillar 2 supervisory capital buffer levels and evaluate the appropriateness of dividend payments and share buybacks was established.

As these examples illustrate, it has become common practice in the United States and Europe to disclose the results of the stress tests for individual banks. Moreover, frameworks to use the results of the stress tests to impose additional regulatory and supervisory capital buffers and to determine the appropriateness of dividend payments and share buybacks are also being developed.

Stress testing in Japan

In Japan, too, both the FSA and the BOJ each have been undertaking initiatives to use stress testing as a prudential policy tool. For instance, the BOJ and FSA have examined the results of the financial institutions' own stress tests and have held a series of dialogues with financial institutions to encourage them to improve their stress testing models and incorporate the results in their managerial decisions.¹ In addition, the BOJ conducts macro stress testing using its own model, details of which will be described later in this paper, in order to analyze and evaluate the stability of the financial system as a whole, and the results are published semi-annually in the Financial System Report.

In Japan, however, such frameworks to tie the results of stress tests using scenarios specified by the authorities to the imposition of additional regulatory and supervisory capital requirements had not been adopted as in the United States and Europe. This was for two reasons. First, unlike in the United States and Europe, the financial system in Japan remained relatively stable throughout the global financial crisis and the European sovereign debt crisis. Second, the selection of a particular set of scenarios could unintentionally distort financial institutions' portfolio allocation.

While this rationale has remained unchanged, the business models and risk profiles of major Japanese banks, including the three megabanks, have undergone major changes. That is, as a result of the prolonged low interest rate environment at home, major banks have been taking more diverse and complex risks by expanding their overseas business and non-commercial banking businesses within their groups with the aim of expanding and diversifying their revenue sources. With these trends expected to continue, the BOJ and the FSA, following a series of discussions including at the Council for Cooperation on Financial Stability,² share

the view that enhancing the existing initiatives of the both institutions to conduct simultaneous stress testing based on common scenarios on a regular basis provides an important tool to (1) gain a deeper understanding of the risk profiles embedded in the business models of major banks and develop a comprehensive perspective for evaluating their financial soundness, and (2) based on this, to deepen the dialogue with major banks on their management issues and ensure the appropriate risk management frameworks are in place. Further, (3) for both the authorities and major banks, the results of the simultaneous stress testing can serve as a "common language" for effective communication with overseas authorities.

The following presents an overview and describes the characteristics of the simultaneous stress testing conducted by the BOJ and FSA, along with a timeline of the work being conducted.

Overview and characteristics of the simultaneous stress testing

The first simultaneous stress testing exercise commenced last year, 2019, and consists of the following steps. (1) In October 2019, common scenarios were formulated. (2) In early December 2019, the common scenarios were presented to the five major banks³ to be subject to the simultaneous stress testing during this first round exercise (hereafter "participating banks"), and the participating banks submitted the stress test results by the end of March 2020. Concurrently, the BOJ and FSA also conducted stress tests of each of these participating banks using the same scenarios. (3) From April 2020, the BOJ and FSA jointly compared and examined the submitted stress test results while closely communicating with the participating banks. In doing so, due respect was paid to the participating banks' efforts to deal with the spread of COVID-19. Subsequently (4) feedback was provided to the participating banks through mid-July 2020.

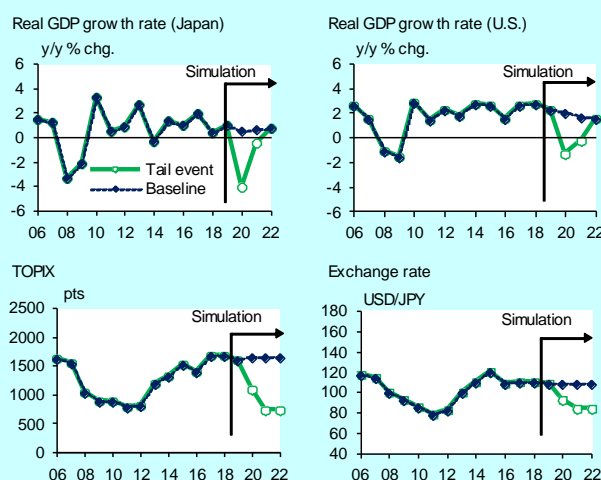
The following provides a more detailed explanation of these four steps.

(1) Formulation of common scenarios

For this simultaneous stress testing, two common scenarios were formulated: a baseline scenario, in which no stress is assumed to occur, and a tail event scenario, in which stress is assumed to occur. The simulation period for assessing the stress event and its effects is set to 3 years, from fiscal 2020 to 2022 (Chart 1).

The baseline scenario was developed as a reference for assessing the results of the tail event scenario and was based on the average forecasts of several research

[Chart 1] Developments in key scenario variables



Source: Bloomberg, Cabinet Office, BEA

institutions and market participants premised on the economic situation as of October/November 2019.

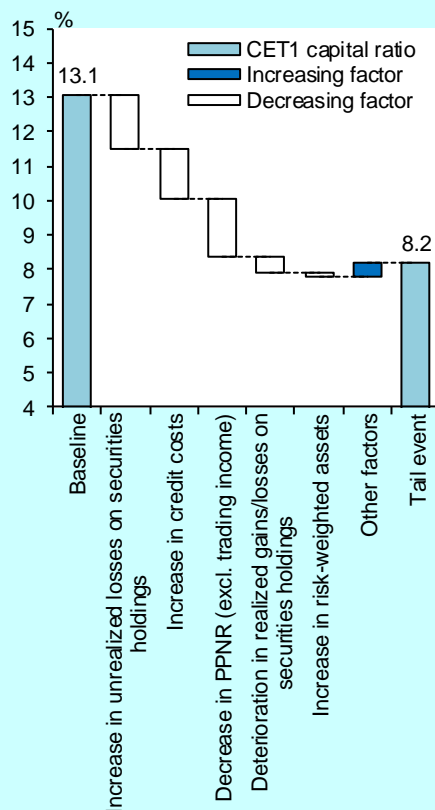
On the other hand, the tail event scenario assumed that economic conditions at home and abroad deteriorated to a level comparable to those during the global financial crisis, and financial markets experienced a decline in stock prices, appreciation of the yen against the U.S. dollar, and decline in domestic and overseas interest rates to an extent similar to those during the global financial crisis. Moreover, the scenario assumed that Japan's output gap deteriorated to a level comparable to that seen during the global financial crisis. Since this scenario was formulated in October/November 2019, it did not incorporate the impact of the spread of COVID-19. Meanwhile, as will be described later, these common scenarios were formulated based on almost the same approach as the macro stress test scenarios that the Bank of Japan regularly employed in the Financial System Report.⁴

(2) Implementation of stress tests

The participating banks as well as the BOJ and FSA (hereafter the "authorities") started implementing the stress tests based on these two scenarios in December 2019. The participating banks estimated income items such as net interest income and credit costs as well as the impact of these items on their capital.⁵ In this process, the participating banks could incorporate more granular assumptions on developments in the variables and their balance sheet into the scenarios while maintaining consistency with the common scenarios.

The model-based analysis by the authorities employs the BOJ's "Financial Macro-econometric Model (FMM)."⁶ The FMM is used in the BOJ's macro stress testing, which provides a comprehensive quantitative analysis of the stress resilience of Japanese financial institutions from a macroprudential perspective. The results of the BOJ's macro stress

[Chart 2] Macro stress test results (CET1 ratio of internationally active banks)



Note: The chart shows the contribution of each factor to the difference between the CET1 capital ratio at the end of the simulation period (end-March 2023) under the baseline and tail event scenarios.
Source: Bank of Japan, *Financial System Report*, April 2020.

testing are published twice a year in the BOJ's Financial System Report (Chart 2).

The FMM is a two-sector macro-econometric model consisting of the financial sector and the real economy sector that uses balance sheet and profit-and-loss data of individual financial institutions, making it possible to obtain not only aggregate values for the financial sector overall but also results for individual financial institutions.

The model focuses on approximately 360 financial institutions (major banks, regional banks, and *shinkin* banks) that hold current accounts at the BOJ and consists of a large-scale system of simultaneous equations using a large amount of data obtained from individual financial institutions. The relationships

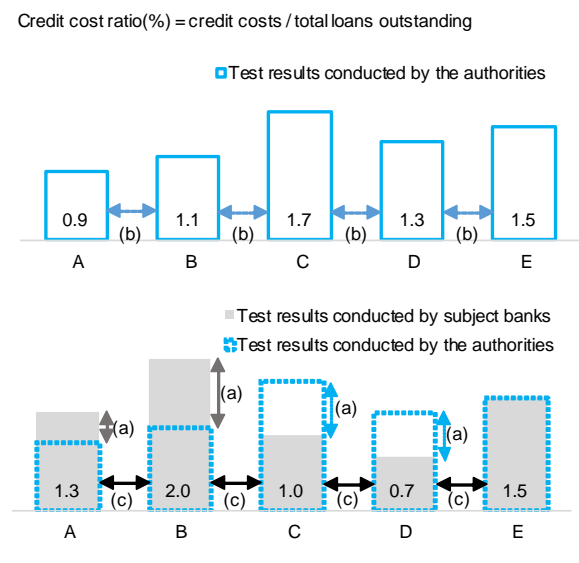
between the variables are based on the average behavior of financial institutions observed in the past, and the model parameters are calibrated mainly using the estimates of panel regressions with an emphasis on their empirical fit.

It should be noted that since the model was originally constructed with the aim of examining the soundness of the financial system overall from a macro perspective, some degree of simplification is made with respect to the portfolios of individual financial institutions from a cost-benefit perspective.

(3) Comparison and examination of simultaneous stress test results

Participating banks submitted their stress test results by the end of March 2020. The results were then compared using two approaches, benchmarking and horizontal reviews, to elicit differences in participating banks' stress test results and analyze the reasons for these differences. Based on these analyses, the authorities

[Chart 3] Benchmarking and horizontal review (Hypothetical illustration using credit cost ratios as an example)



Note: The top row illustrates the work of comparing the results for credit cost ratios in the stress tests conducted by the authorities for Banks A to E with each other, while the bottom row illustrates the work of comparing those results (blue dotted box) with the results of the tests conducted by Banks A to E themselves (gray shaded area) under the same scenario. (a) represents the benchmarking, (b) represents the horizontal review of the results of the tests conducted by the authorities, and (c) represents the horizontal review of the results of the tests conducted by Banks A to E and submitted to the authorities.

then held discussions with the participating banks (Chart 3).

Benchmarking consists of comparing and examining the results of the stress tests conducted by

banks with the results of the stress tests conducted by the authorities for each of those banks.

Potential sources of difference in the stress test results, broadly speaking, include (1) differences in the assumed stress scenarios, (2) differences in the data on portfolios (differences in business models and risk-taking, or differences in data coverage), and (3) differences in risk quantification methods such as modeling.

Conducting stress tests in which the authorities and the participating banks employ common scenarios eliminates differences in the assumed stress scenarios (source (1) above) as a reason for differences in the benchmarking results.⁷ Furthermore, if the data used by participating banks and the authorities in the analysis are identical, this will eliminate differences in portfolio data (source (2) above). And under these circumstances, it is possible to elicit the quantitative impact of differences in quantification methods (source (3) above) between the participating banks and the authorities. (This benchmarking is denoted by (a) in Chart 3).

On the other hand, the horizontal reviews consist of cross-comparing and examining the results of the stress tests conducted by the participating banks, and of cross-comparing and examining the results of the stress tests conducted by the authorities for the participating banks.

In the horizontal reviews, using common scenarios for all participating banks again eliminates differences in assumed stress scenarios (reason (1) above) as a potential source of differences in the results. Under such circumstances, provided that the modeling (reason (3) above) by the authorities is appropriate, the horizontal reviews of the stress test results obtained by the authorities for the participating banks make it possible to identify, for example, banks with relatively risky portfolios (reason (2) above). This horizontal review is denoted by (b) in Chart 3. This work is complemented by conducting a horizontal review of the stress test results calculated and submitted by participating banks themselves, which helps to further refine the analysis of the root causes of any differences. (This horizontal review is denoted by (c) in Chart 3).

However, in practice, there are many factors that prevent such an ideal analysis of the root causes of any differences. For example, there are usually some differences in the data used for the analysis by the participating banks and that used by the authorities, which will appear as differences in the portfolio data (source (2) above) and quantification methods used (source (3) above).

In general, participating banks use their own

granular and private data for the stress testing, describing in detail the characteristics of transaction counterparties and the contents of the transactions. While, in their analysis and modeling, banks can take advantage of detailed information on the characteristics of their own portfolios, it is difficult for them to utilize information on transactions executed by other financial institutions.

On the other hand, the data submitted by financial institutions and held by the authorities are often less granular than the data held by participating banks due, for example, to the need to standardize the format of the data. However, the authorities have the advantage of being able to utilize data collected from a large number of financial institutions, and the BOJ, in fact, has been trying to make the most of this fact in developing and improving the FMM.

Taking these limitations into account, the authorities simultaneously proceeded with the benchmarking and horizontal reviews and deepened the dialogue with the participating banks to discover the root causes of differences in the results. Continuing this work provides both the authorities and the participating banks with an opportunity to gain awareness of the risks involved in their portfolios and of the adequacy of methods for quantifying those risks.

(4) Feedback to participating banks

Through mid-July 2020, the authorities presented the results of these comparisons and examinations using horizontal reviews and benchmarking to each of the participating banks, exchanged views, and finally gave feedback in the form of a letter to the CEO.

As mentioned above, this simultaneous stress testing exercise places emphasis on deepening the understanding of differences in the participating banks' risk profiles and their managements' risk awareness. On that basis, the purpose of the feedback is to present the participating banks with a perspective for evaluating the results of their own stress testing and to engage in deeper dialogue on the management issues facing each of the participating banks.

Also as mentioned above, the supervisory simultaneous stress testing in Europe and the United States was originally designed as a tool to restore confidence in the soundness of financial institutions and the financial system in the event of a crisis. Accordingly, the stress test results for individual participating banks are disclosed and communicated to participating banks under an institutional framework in which additional regulatory and supervisory capital buffers can be set on the basis of the results. While such

a framework may help to ensure transparency and increase confidence in individual participating banks and the financial system, it can also, however, be a factor that hinders candid communication between participating banks and the authorities. In fact, regulatory authorities in Europe and the United States remain cautious about disclosing details of the models they use for benchmarking.

In Japan, the BOJ publishes the results of macro stress testing twice a year to ensure confidence in the stability of the financial system. The BOJ and FSA believe that under the current circumstances, in which the financial system remains stable, there is limited advantage in disclosing the results of the simultaneous stress testing in addition to the results of the macro stress testing. The authorities believe that it is more important to use simultaneous stress testing as a tool for communication with participating banks. From this perspective, when providing feedback on the results to the participating banks, the authorities disclose to the banks, to the greatest extent possible, the details of the comparison and examination results as well as the results produced by the authorities' model and its characteristics. Moreover, details of the model used by the authorities have been published as a Financial System Report Annex Series paper.⁸

Preparations for the next round

The BOJ and FSA have already started working on preparations for the next round of simultaneous stress testing, such as the design of the common scenarios.

In developing the common scenarios, the biggest challenge is what kind of financial and economic situation should be assumed in the baseline and tail event scenarios given the outbreak of the coronavirus pandemic. Moreover, it is necessary to take steps to fill in the gaps between participating banks and the authorities in the data used for the analyses and to further improve the model used by the authorities, with the cooperation of participating banks. When considering these issues, the key principle is to design

the exercise so that it provides meaningful insights into the challenges facing the management of participating banks, without imposing an excessive burden on them.

In entering the process for the next round, the BOJ and FSA expect participating banks to report on how their management perceives the issues presented in the feedback and what actions they plan to take.

Conclusion

This paper outlined the supervisory simultaneous stress testing based on common scenarios conducted jointly by the BOJ and FSA, providing an overview of issues such as the background to the exercise, differences in the institutional arrangements from Europe and the United States, and the role of benchmarking and horizontal reviews.

From the very beginning, simultaneous stress testing was assumed to be a continuous exercise. For the time being, it is important that, while making use of the findings gained during each round, the authorities and the participating banks engage with each other to steadily continue efforts such as (1) formulating common scenarios tailored to the financial and economic situation at the time, (2) accurately assessing the management risks of participating banks by enhancing the benchmarking and horizontal review work, and that the BOJ and FSA (3) deepen their dialogue with the participating banks and encourage them to take necessary actions. In particular, given the high degree of uncertainty about the impact of the coronavirus pandemic, it has become even more important to enhance the stress resilience of individual banks and of the Japanese financial system as a whole through these exercises.

The BOJ and FSA have recently strengthened their cooperation further in various ways. One such example is the Survey of Overseas Credit Investment and Lending,⁹ the results of which were used in this exercise. Going forward, the BOJ and the FSA will continue to closely work together and further improve the effectiveness of simultaneous stress testing.

* This paper is an English translation based on the Japanese original released on October 6, 2020.

¹ In its on-site examinations, the BOJ particularly focuses on (1) the involvement of the board of directors and senior management and the control functions of the relevant divisions in charge of such activity; (2) the comprehensiveness of scenarios and coverage of the subjects of the stress testing; (3) schemes to develop and verify models and data; and (4) frameworks to utilize test results for business operations and the decision on business policies. Moreover, in the FSA's monitoring, stress tests by financial institutions, if designed and tailored to fit their own circumstances and risk-profiles, are thought to be useful in

providing insights on channels of possible risk contagion and help them prepare for possible changes in the business environment.

² Meetings of the Council for Cooperation on Financial Stability have been held about twice a year since June 2014 for the purpose of exchanging views on the situation in the financial system and financial markets in order to strengthen cooperation between the FSA and the BOJ with respect to macroprudential policy.
<https://www.fsa.go.jp/en/news/2020/20200408nichiginrenrakukai.html>

³ The five banks are Mitsubishi UFJ Financial Group,

Sumitomo Mitsui Financial Group, Mizuho Financial Group, Sumitomo Mitsui Trust Holdings, and Norinchukin Bank.

⁴ These scenarios are purely hypothetical ones designed to examine the resilience of financial institutions to stress and represent neither the BOJ's outlook for the future economic and financial environment or asset prices, nor the likelihood of their outcomes. In order to effectively conduct stress tests from a macroprudential perspective, it is important that tail event scenarios meet conditions such as the following: they are (1) sufficiently severe (but also plausible), (2) countercyclical (i.e., the more financial imbalances build up, the more severe the stress), and (3) forward-looking (i.e., they examine stress events that may occur in the future, not stress events that occurred in the past). For details, see, for example, N. Liang (2018), "Well-Designed Stress Test Scenarios Are Important for Financial Stability," Blog post at the Brookings Institution, February 2018. The tail event scenario formulated for this exercise meets these conditions in that (1) it assumes severe stress comparable to that during the global financial crisis, and (2) since the output gap in the event of stress is assumed to deteriorate to the same level as during the global financial crisis, the stress becomes more severe (in terms of the extent of change) the higher the level of the current output gap.

⁵ In the simultaneous stress testing in the United States and Europe, it is common for the authorities to impose some kind of balance sheet constraint such as setting a lower limit on the assumed future loans outstanding. The purpose is, (1) to ensure that the stress testing assumptions are consistent with maintaining the functioning of financial intermediation while avoiding having to assume that participating banks restrain their lending, and (2) to increase the comparability of results across financial institutions. However, these constraints have been criticized as rendering the results unrealistic when considering the behavior of financial institutions under stress. With regard to

a future response to such criticism by authorities in Europe, see A. Enria (2019) "The Future of Stress Testing -- Some Further Thoughts," Speech at the 8th Annual Research Workshop "The Future of Stress Tests in the Banking Sector -- Approaches, Governance and Methodologies," Paris, November 2019.

⁶ For more details on the FMM, see Bank of Japan, "The Financial Macro-Econometric Model (FMM, March-2020 Version): Overview and Recent Developments," Financial System Report Annex Series, August 2020.

⁷ Strictly speaking, some differences can arise because participating banks need to make their own assumptions, to an extent that maintains consistency with the common scenarios, with regard to developments in the variables that the authorities do not provide and developments in their balance sheet.

⁸ See footnote 6.

⁹ See Financial System and Bank Examination Department of the Bank of Japan and Supervision Bureau of the Financial Services Agency, "Developments in Overseas Credit Investment and Lending by Japanese Financial Institutions: An Overview Based on the Joint Survey by the Bank of Japan and the Financial Services Agency," Bank of Japan Review 2020-E-2, June 2020.

Bank of Japan Review is published by the Bank of Japan to explain recent economic and financial topics for a wide range of readers. This report, 2020-E-9, is a translation of the original Japanese version, 2020-J-13, published in October 2020. If you have comments or questions, please contact the Financial System and Bank Examination Department (E-mail: post.fsbe2@boj.or.jp). Bank of Japan Review and Bank of Japan Working Paper can be obtained through the Bank of Japan's Web site (<https://www.boj.or.jp/en>).