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FINANCIAL SECTOR ASSESSMENT PROGRAM

September 2017

TECHNICAL NOTE—LONG-TERM CHALLENGES FOR FINANCIAL INTERMEDIATION

This Technical Note on Long-Term Challenges for Financial Intermediation on Japan was prepared by a staff team of the International Monetary Fund. It is based on the information available at the time it was completed on September 2017.

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LONG-TERM CHALLENGES FOR FINANCIAL INTERMEDIATION

Prepared By
Monetary and Capital Markets Department

This Technical Note was prepared by IMF staff in the context of the Financial Sector Assessment Program in Japan. It contains technical analysis and detailed information underpinning the FSAP's findings and recommendations. Further information on the FSAP can be found at http://www.imf.org/external/np/fsap/fssa.aspx

CONTENTS

FIGURES

TABLES

ANNEXES

Glossary

ABL	Asset-based lending
BoJ	Bank of Japan
CPI	Consumer Price Index
CSR	Corporate social responsibility
DB	defined benefit
JFSA	Japan Financial Service Authority
IT	Information Technology
KZ	Kaplan and Zingales (KZ) index
NSFIE	National Survey of Family Income and Expenditure
OECD	Organization for Economic Cooperation and Development
SMEs	Small- and medium-sized enterprises
VC	Venture capital
U.S.	United States

EXECUTIVE SUMMARY

Sustained demographic change can have potentially significant effects on the economy and the financial system. Aging can affect financial intermediation through its effects on potential growth, on the term structure of interest rates and risk premiums in general, and on the demand for retirement-related products and services. At the same time, in an aging society, the financial sector has a particularly important role to play in helping to foster growth and productivity. This note analyzes and quantifies the effect of aging in Japan—both at the national and regional levels—on the nature of financial intermediation and concludes that the relative role of banks is likely to diminish.

Empirically, aging seems to be associated with a smaller relative role of banks in financial intermediation. Economies with an aging population tend to feature smaller term spreads. Smaller term spreads, in turn, are associated with less bank finance. Specifically, the increase in the elderly dependency ratio observed in Japan between 1990 and 2015, accordingly to the estimates, can account for up to 40 percent of the decline in the term spread observed during the same period. The offer of services by the financial industry will need to continue to adapt to the demands of an aging population. In addition, given relatively flat term structures that drive compressed net interest margins, banks should be encouraged to increase fee-based income, namely by charging for basic banking services.

Population growth and aging have a sizable impact on loan and deposit dynamics and on banks' choice of business models. Econometric analysis of regional bank data shows that shrinking populations tend to lead to smaller balance sheets and declining loan-deposit ratios. The evidence suggests that population aging has been an important driver of an ongoing a shift in regional banks' business models, away from primarily lending-oriented banking towards a greater focus on securities investments and fees as new sources of income. The search for new growth and return opportunities by regional banks and other financial intermediaries requires appropriate risk management. Authorities should continue to encourage the development of adequate risk management in institutions that do not have significant experience in these new types of investment.

Mounting demographic headwinds constitute a major challenge for regional financial institutions. According to prefectural population projections and econometric estimates, the impact from demographic headwinds is likely to intensify significantly over the next two decades. The combined negative impact from aging and especially of population growth on the loan-deposit ratio is estimated to decline by an average of over 1 percentage point per year over the next two decades. Moreover, the observed trend of regional banks shifting away from lending-based banking is likely to accelerate in the near future, highlighting the need for supervisors and regulators to engage with banks to ensure a smooth transition both for individual banks, and for the banking system as a whole. After carefully weighing costs and benefits, authorities should promote sustainable business models and could facilitate the exit of unviable firms, as well as provide an enabling environment for consolidation among regional banks.

Financial constraints to small- and medium-sized enterprises (SMEs) and startups exacerbate the adverse effects of an aging society on productivity and economic growth. A significant portion of Japanese SMEs still face financial constraints, in addition to labor shortages and the lack of managerial skills. The percentage of SMEs that face financial constraints in Japan is higher than in Germany and in France. Lending to SMEs remains largely based on fixed-assets collateral and personal guarantees. Bank loans to SMEs in Japan require fixed-assets collateral more frequently than in other advanced economies. This means that credit may not be channeled to the most productive firms but those with more collateral. In addition, SME loans backed by personal guarantees are four times more likely in Japan than in the average for advanced economies. This constitutes an important constraint on limited liability and hinders risk taking by nonfinancial firms.

Financial sector policies should aim to address the constraints to financial access by further promoting risk-based lending and asset-based lending. Banks should continue to be encouraged to build capacity for risk assessment to do more risk-based lending. Public credit guarantees can help address information problems but need improvement so that they do not discourage banks from improving credit screening and monitoring. Further enhancing the ease in the transfer of account receivables, and upgrading lenders' ability to value movable collateral is essential. Larger venture capital funds are also necessary to improve access to finance by startups.

Table 1. Japan: FSAP Key Recommendations

Financial Intermediation	Timeframe;
Further engage with banks on implications of macroeconomic and demographic trends and take actions on a timely basis when viability concerns are identified for individual institutions (Japan Financial Service Authority (JFSA).	I
Encourage regional and *Shinkin* banks to review measures such as cost reduction, consolidation, income diversification, and fee structures to address medium term profitability concerns (JFSA, Government).	MT
Promote asset-based lending further by continuing to encourage banks to build capacity for risk assessment (JFSA).	NT
Credit guarantees should have lower coverage (SME Agency).	MT

[1] I–Immediate" is within one year; "NT–near-term" is 1–3 years; "MT–medium-term" is 3–5 years.

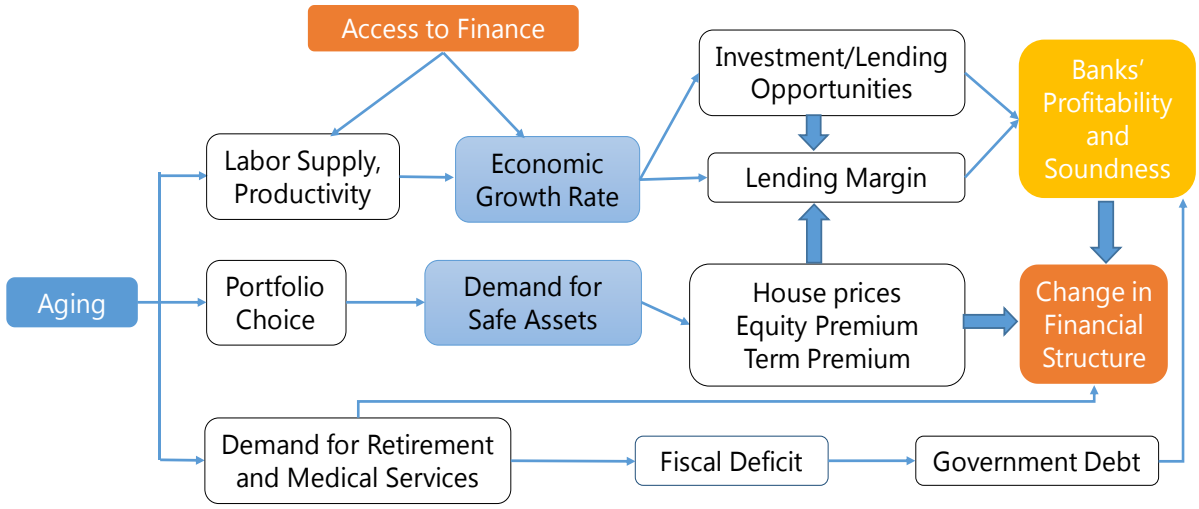
INTRODUCTION[1]

1. This note identifies and discusses the long-term challenges facing Japan's financial system in a context of an aging society. The Japanese economy has been going through a prolonged period of low economic growth and low interest rates. Short-term interest rates hit the zero lower bound in the early 2000s and the combination of low growth, low inflation, and quantitative easing by the Bank of Japan (BoJ) has resulted in declining term premiums. Although it is not certain that interest rates and economic growth will remain low, Japan is also faced with continued population aging, which is unlikely to be reversed in the foreseeable future.

2. Aging can affect the financial system through its effects on potential growth, on the term structure of interest rates and risk premiums in general, and on the demand for retirement-related products and services (Figure 1). The Japanese population began to shrink in 2010 and approximately 20 percent was aged 70 or above in 2015. In particular:

Figure 1. The Effect of Population Aging on the Financial Sector—A Roadmap

Aging can affect the stability and structure of the financial systems through its effects on economic growth, on risk premiums



Source: IMF staff.

- **Aging may reduce labor supply and productivity growth, thus keeping economic growth and real interest rates at low levels.**[2] Overall, low population growth and aging will also mean fewer profitable investment opportunities and lower profits. For instance, aging affects

[1] This Technical Note was prepared by Luis Brandão Marques, Dyna Heng, and Niklas Westelius (all IMF).

[2] For instance, aging is estimated to have reduced the real interest rate in Japan by 1.25 percentage points since 1985 (Ikeda and Saito 2014). This is the same as Gagnon, Johannsen, and Lopez-Salido (2016) estimate to have happened in the United States since 1980.

productivity growth by reducing the pool of entrepreneurs, slowing down the adoption of innovations, (Liang, Wang, and Lazear 2014). In addition, it reduces labor supply, which in turn reduces the expected returns to capital accumulation and the demand for investment goods. Furthermore, aging implies demand shifts away from products such as durables and into services such as health care where productivity gains are lower and more uncertain. Finally, the changes in the sectoral composition of aggregate supply will probably imply important adjustment costs, which may further depress total factor productivity, at least until a new steady state is reached.

- **An increase in older population cohorts could pressure asset prices downwards as the older generations unload their savings or shift their asset choices towards safer assets, but the effects are far from certain**. This effect could be particularly pronounced in real estate and credit markets, especially in the long end of the yield curve. However, the demand for safe assets in Japan is unlikely to increase substantially because of aging, and may actually be driven by other factors such as longevity risk or lowered expectations about future retirement income. Although traditional retail banks could benefit if long-term rates rose because of aging—and this is not the only possible outcome—it is unlikely that the net effect on financial intermediaries of downward asset prices is positive.[3]

- **Aging may also affect the structure and soundness of the financial system through its effect on public finances.** An increase in the fraction of population above the age of retirement will, everything else equal, strain public finances and may affect the soundness of financial intermediaries that invest heavily in government securities.

3. The level of interest rates and the slope of the yield curve affect financial institutions profitability, funding structures, and risk taking. A cut in short-term interest rates likely boosts bank profits in the short run through its positive effect on economic activity, borrowers' balance sheets and overall asset values, as well as by lowering funding costs. However, the effects of low interest rates and flat yield curves—caused by low economic growth—on bank profitability over the medium term are probably negative. Banks that are more engaged in financial intermediation are likely to be hurt by relatively flat yield curves (see IMF 2017). The challenge posed by very low and even negative rates is expected to be especially large for traditional banks which rely more heavily on core deposits, have more expensive branch infrastructures, and are bound to lose business to internet-based banks and finance companies.

4. From a financial stability point of view, there are two potentially worrisome consequences for banks of a prolonged period of low interest rates. First, very low rates (that is, below the 0.8-1 percent range which administering deposits are estimated to cost) can create an incentive for banks to rely more on wholesale funding, making them more vulnerable to disturbances in money markets. Second, low interest rates may encourage excessive risk taking by banks either be decreasing their incentive to monitor credit risk or by encouraging "reach for yield"

[3] For example, lower asset prices have a negative effect on collateral values and will mean more expensive funding for many intermediaries.

behaviors. This (and other) risk-taking channels also apply to insurance companies and other financial institutions.

5. Regardless of the level and slope of the term structure of interest rates, low economic growth will probably cause financial intermediaries to further increase their exposures to foreign markets. More broadly and for all financial intermediaries, a prolonged period of low economic growth will restrict investment opportunities at home (or in their traditional markets) and encourage them to invest more in nontraditional markets and overseas. Although this trend may have positive effects by making the investment portfolios of these institutions more diversified, it can also be detrimental to financial stability, namely when these institutions are less knowledgeable of the risks associated with these new investments.

6. Strong demographic headwinds have contributed to a challenging operating environment for regional banks. The Japanese population is shrinking and aging rapidly. However, trends vary significantly across regions with rural prefectures hit harder than prefectures close to major metropolitan areas (i.e., Tokyo, Osaka, and Nagoya). With regional financial institutions' highly dependent on prefectural deposit-taking and lending activities, these demographic trends have created a challenging operating environment. In particular, declining loan-to-deposit ratios combined with falling term premiums have squeezed net interest margins and put downward pressure on bank profitability. Accordingly, some regional institutions have adjusted their business models by increasing securities investments (foreign and domestic), lending to local government, and real estate investments.

7. Despite recent increases in credit flows to SMEs, a significant portion of Japanese SMEs still faces more difficulties in obtaining financing than their peers in other advanced economies. The availability of financing for SMEs has often been mentioned as a key challenge for the efforts to revitalize regional economies. In addition, banks' overreliance on lending backed by real estate, personal guarantees, or credit guarantees may mean that credit is not being channeled to the most productive firms but those with more collateral. This note attempts to quantify the financial constraints faced by Japanese SMEs and it concludes that they are more severe than in France or Germany. Given this finding, it suggests policies that can improve the availability of financing for Japanese SMEs.

AGING AND FINANCIAL INTERMEDIATION

This section establishes stylized facts about the relationship between the nature of financial intermediation (bank-based versus market-based) and demographic change. Aging seems to decrease the relative importance of market-based finance relative to bank-based finance but only through its effect on the term spread.

A. Cross-Country Evidence

8. Aging can affect the relative importance of market-based finance relative to bank-based finance in many ways. On the one hand, an aging society could demand more financial services

from nonbank financial intermediaries such as pension funds and life insurance companies, thus reducing the role of banks. On the other hand, aging households could demand more safe assets and increase the preference for bank deposits.

9. However, data suggest that aging does not seem to directly affect the composition of the financial sector. An empirical analysis of the determinants of the nature of financial intermediation for a large sample of advanced, emerging, and developing economies show that aging has on its own no measurable effect on the nature of financial intermediation—either bank-based or market-based. When the direct and indirect effect of aging is disentangled, only the indirect effect is significant (see last two columns of Table 2).[4] The results using a smaller but more homogenous sample of advanced and emerging economies confirm this assertion.

Table 2. Japan: Aging and Market vs. Bank Finance

	Fixed Effects			Instrumental Variables	
	FI (All)	FI (AE&EM)	FI (AE&EM)	TS (AE&EM)	FI (AE&EM)
GDP per capita					
Credit to Deposits					
Deposit Insurance					
Aging					
Term Spread					
Inflation					
Growth					
Credit Rating					
Number of Countries	113	38	38	34	34

Sources: FactSet; Haver Analytics; Thomson-Reuters Datastream; United Nations; World Bank; and IMF staff estimates.
Note: FI=Financial Intermediation; TS=Term Spread; Financial intermediation is the ratio of stock market capitalization to bank credit for each country and year; Gree = Positive effect; Red = Negative effect; Yellow = Effect is not statistically significant. See annex for detailed results.

10. However, the effect of aging on the structure of the financial system can also be indirect. Aging can act on the nature of financial intermediation through its effect on the term structure of interest rates. The explanation is as follows. Banks main advantages lie on: (1) their ability to screen and monitor credit (particularly in opaque settings); and (2) their ability to do

[4] The nature of financial intermediation is measured by the ratio of stock market capitalization to bank credit. The statement that aging does not directly affect the relative importance of market vs. bank finance is based on statistical significance. Therefore, the data do not rule out the possibility that there is no relation between financial intermediation and aging. The absence of significance can also be caused by measurement error in the data or misspecification issues. Yet, the absence of relationship between the two variables remains when a smaller but more homogeneous sample of advanced and emerging market economies is used. However, the average country in each sample has between 17 and 22 years of data available (with a maximum of 40 years), which is relatively short for properly gauge the effects of slow-moving variables such as aging and the evidence should be interpreted as suggestive.

maturity transformation, at least in part because of the existence of deposit insurance. Thus, the term spread—the difference between the long- and the short-term sovereign interest rate—can be used as an imperfect measure of the gains accruing to maturity transformation and banks.[5] In this case, one hypothesis is that aging affects the term structure by changing the demand for safe and liquid assets relative to the demand for risky or illiquid assets which, depending on the shift in portfolios, could cause the term premium to rise or fall. Alternatively, aging can cause deflationary pressures and constrain monetary policy to be at the zero-lower bound.[6] In this case, the term structure could flatten because real interest rates commove negatively with consumption growth and lower the term premium (IMF 2017).

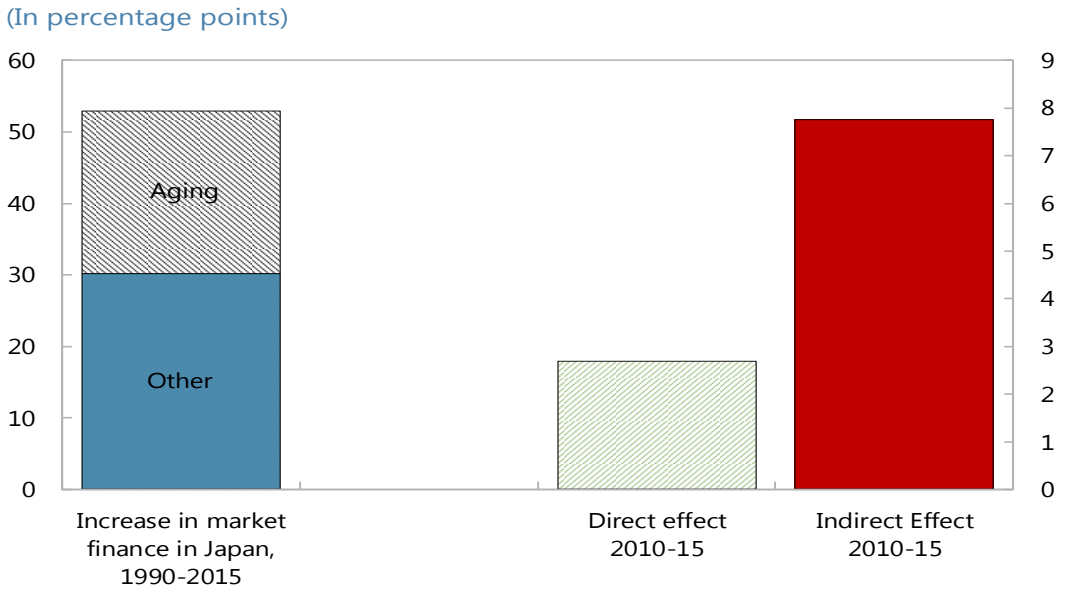
11. Empirically, the effect of aging on the structure of the financial system seems to be mostly indirect. Even after taking account for the fact that the term spread and the prevalence of market or bank finance may be jointly determined, the data suggest that a smaller term spread is associated with less bank finance. In addition, aging is consistent with smaller term premiums and, thus, a decrease in the importance of banks. Specifically, the increase in the elderly dependency ratio observed in Japan between 1990 and 2015, accordingly to the estimates, can account for roughly 40 percent of the decline in the term spread observed during the same period (Figure 2). A one standard-deviation increase (or about 7 percentage points) in the elderly dependency ratio would cause market-based finance to increase by about 10 percent relative to bank-based finance. See Annex I for details on data, method, and results.

[5] The term spread can be decomposed into the expected future changes in short term rates and the term premium proper. The benefits to maturity transformation related to the latter, not the former. However, it is challenging to appropriately measure the term premium for a large sample of countries given that expectations about future short term rates are not directly available for most economies. Even long-term forecast of GDP growth or inflation are only available for a restricted number of advanced economies and the time series are not very long. In addition, using affine models require considerably more information on the term structure of the interest rates tan is available for many countries.

[6] Aging can be deflationary in two ways. First, it can cause the exchange rate to appreciate as an aging population liquidates foreign investments while cashing out its retirement savings (Anderson, Botman, and Hunt 2014). Second, deflation could arise because an aging population shifts aggregate demand away from high productivity-growth sectors like durable goods into low productivity-growth sectors like healthcare and causes the natural interest rate to be temporarily lower than its steady-state value and below the prevailing real interest rate (Katagiri 2012). However, both channels are temporary and should have long-lasting implications on the structure of the financial system.

Figure 2. Increase in Market-Based Finance and Aging

About 40 percent of the increase in the size of market finance in Japan since 1990 can be explained by aging.



Source: IMF staff estimates.

Note: The first column in the chart shows the increase in market-based finance—stock market capitalization as a percent of bank credit to private sector—during 1990-2015 and the part of the increase that can be attributed to aging. The last two columns show the estimated increase in the same ratio during 2010–15 that can be attributed directly or indirectly to aging. The stripped pattern of the second column means the effect is not statistically significant.

B. Life-Cycle Investment in Japan

12. In Japan, investment choices by households change over demographic cohorts and, within each cohort, have changed over time but, when compared to other countries, households still invest less in risky assets. Data from the NSFIE (National Survey of Family Income and Expenditure) suggest that savings habits differ across age groups (Figure 3). In 2014, younger generations have a stronger preference for liquid and safer assets than older age groups. Older generations hold significantly more nonbank instruments, including equity, than younger generations. However, Japanese households, regardless of age, hold fewer risky assets as a share of total wealth than households in the United States (U.S.) and slightly less than in Europe. This happens because they are less likely to participate in capital markets and, even those that do, hold fewer equities than their foreign counterparties.[7]

13. Between 1999 and 2014, holdings of more liquid assets have increased but the evidence of the preference towards safer assets is mixed. For all cohorts, but especially for the younger assets, demand deposits account now a larger share of total financial assets. However, this increase

[7] Stock market participation rates are 15 percent in Japan, 50 percent in the U.S., 36 percent in Australia, 23 percent in Germany, and 22 percent in France.

happened at the expense of time deposits and money market funds, while equity holdings by the older cohort have increased. These developments are probably related to the evolution of interest rates and incomes: Low real rates, low term spreads, and low inflation risk contribute to an increase in the preference for cash and demand deposits.[8]

14. Changes in asset holdings by age cohort are very persistent and signal that policies aimed at altering investment habits can have long-lasting effects. For instance, higher ownership of life-insurance products in the 40–49 age group in 1999 continues in 2014 for the 50–59 age group. Therefore, policies to promote participation in equity markets or investments in products that offer some insurance against longevity risk can have a persistent effect. However, changes in financial investment habits induced by low and stable inflation or low trust in capital markets can be difficult to overcome.

15. The effects of aging on the demand for risky assets, portfolio choice, and asset prices are uncertain and specific to each country. For instance, Ang and Maddaloni (2005) document that, for most countries (except the U.S.), equity prices rise as the population ages. This stylized fact can be explained by retirees' income (in defined benefit (DB)—pension schemes) being uncorrelated with aggregate risk, causing the demand for assets with higher systematic risk (like equity) to be higher for this demographic segment. However, if agents have doubts about the sustainability of the DB pension system, this effect may be muted. In order to provide insight into some of these effects, a model is needed.

16. The model of portfolio choice suggests that aging has only a slight effect on portfolio choices. A model in the spirit of Cocco, Gomes, and Maenhout (2005) is calibrated to reflect labor income risk and survival probabilities in Japan and then is solved and simulated. Details are presented in Annex II. Comparing the portfolio choices of each age cohort for different age distributions shows that the preference for safe assets is little affected by an increase in longevity and the associated increase in the population share of older people (Figure 4).[9]

17. The simulation suggests that the average portfolio has slightly more risky assets as the population ages, which is consistent with a smaller role for banks. The optimal portfolio and consumption choices derived before used in conjunction with simulated income and returns profiles show that the average share of the risky asset increases slight with an aged population. This happens because the increase in longevity causes households to save more and increases their investment in the risky asset. As investors increase their portfolios' allocation of risky assets, the price of said assets should increase and the risk premium decrease. That is, the simulation is

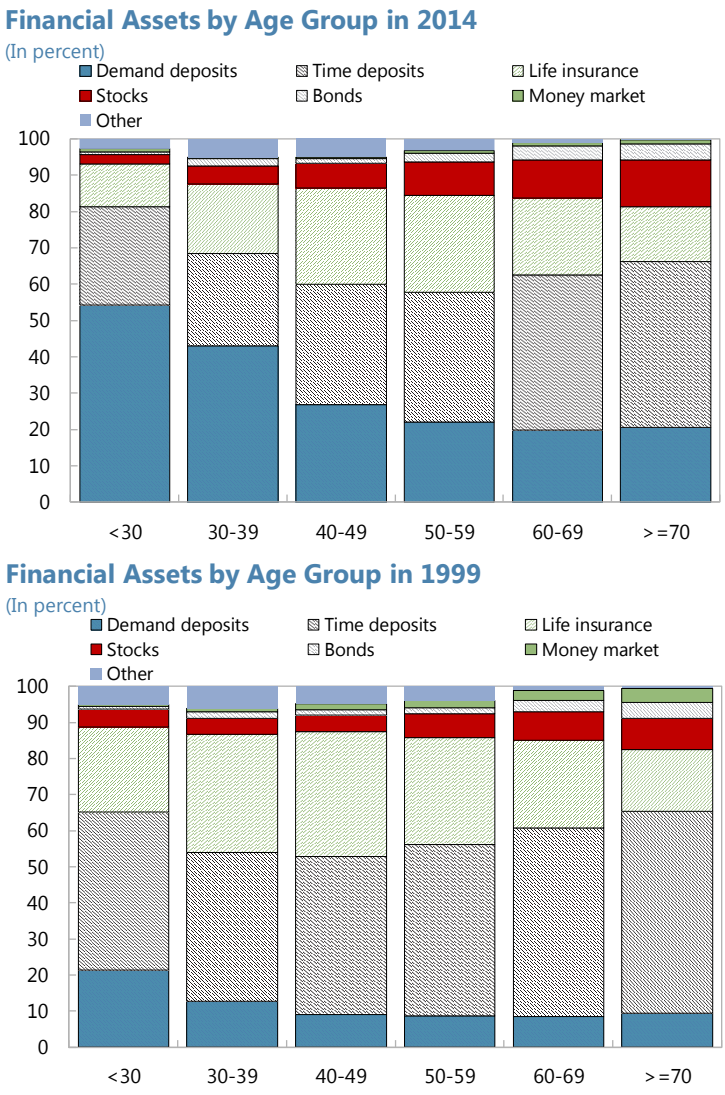
[8] Low real interest rates mean that the returns to assets other than cash and demand deposits will be low. Low inflation risk—that is, when the covariance between inflation and expected future consumption growth is low or even negative—means households will have a lower demand for assets that provide a good hedge against inflation risk such as stocks. See Aoki, Michaelides, and Nikolov (2016) for an application to the Japanese economy.

[9] The model is only capturing the behavior of investors who participate in capital markets (the markets for the risky assets). However, the choices of these marginal investors should be the ones that influence asset prices. Hence, analyzing their behavior provides insight as to what could happen to risk premiums due to aging.

consistent with a decrease in the benefits to bank intermediation, assuming the risk premium approximates the term premium. However, the increase is slight and should have a small effect on the risk premium.[10] Therefore, the results of the simulation should be interpreted as corroborating the hypothesis that portfolio choice on its own would not have a large effect

Figure 3. Financial Assets by Age Group in Japan

Savings habits in Japan differ across age groups and there is evidence of important cohort effects.



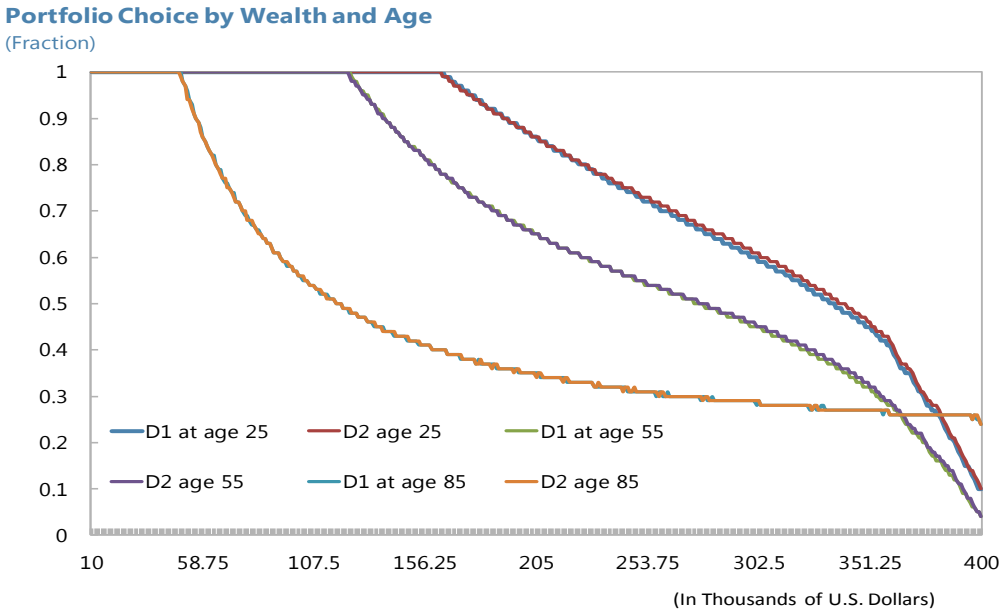
Sources: National Survey of Family Income and Expenditure (NSFIE).

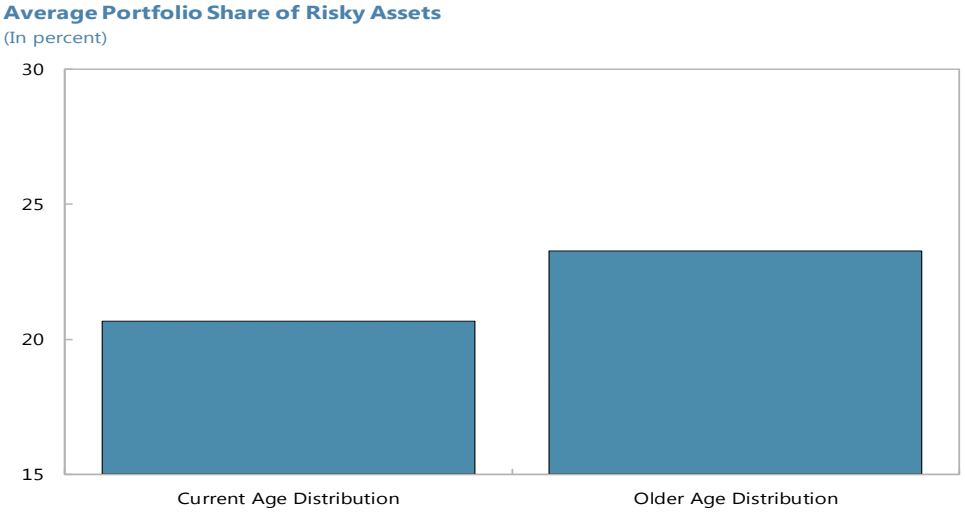
[10] The simulation takes the risk premium as given and does not solve for it in equilibrium.

18. An increase in uncertainty concerning retirement income causes households to save more. Since the risk of experiencing a very large drop in their retirement cannot be insured, in the model, households respond by accumulating more precautionary savings. For the most part, households in the model increase slightly their investment in safe assets following an increase in the perception of a cut in retirement income.

Figure 4. Portfolio Allocation of Risky Assets

An increase in longevity increases slightly the share of risky assets





Source: IMF staff.
Note: D1 = current age distribution; D2 = distribution where households get to live longer with a higher probability. In the top chart, the y-axis shows the share of the risky asset in the portfolio of an individual of age 25, 55, or 85 years old under the two distributions and the x-axis is cash-at-hand.

C. Implications for the Nature of Financial Intermediation

19. It is likely that aging will lead to a more important role for nonbank financial intermediaries in Japan. On the one hand, aging increases the preference for safe assets as people retire. In addition, if retired agents perceive that retirement income is no longer safe and that it can suffer substantial cuts, their preference for liquid assets will also increase. On the other hand, increases in longevity and in longevity risk and the perception by younger generations that their retirement income is not guaranteed may encourage them to save more. However, results from a simulated model suggest the effects are not large.

20. Banks will need to continue to adjust their business models in response to a relatively flat yield curve. An empirical analysis based on cross-country data suggests aging will continue to put downward pressure on the term spread and, under certain conditions, on the benefits that accrue to maturity transformation. Hence, it is likely than banks will dedicate more resources to fee-based wealth.

21. As the population ages, demand for health insurance and certain life-insurance products may increase. For instance, with higher longevity risk and lower guarantees of retirement income, the emergence of a true annuities market could provide substantial gains. Studies have shown that welfare gains are stronger for older individuals, those with lower retirement income, and for those with less certain income. Gains are also stronger when equity-linked annuities are considered (Horneff, Maurer, and Stamos 2008). Going forward, it is important to carefully simulate the welfare gains accruing to the development of different types of annuities and markets for longevity risk in Japan. Finally, it is important to compare them with the gains from cheaper but perhaps less attractive alternatives such as deferred annuities or products with dimension of risk sharing.

REGIONAL BANKING IN AN AGING JAPAN

This section takes a closer look at how and to what extent prefectural aging and population growth have affected regional banks' deposit and lending activities and influenced their choice of business model. Based on these results and prefectural demographic projections, the section also discusses how these demographic challenges are likely to shape the future of regional banking.

A. Structure and Performance of Regional Banking

22. Regional banks play and important role in prefectural financial intermediation. There are currently 105 regional banks operating in Japan's 47 prefectures and accounting for 14 percent of total assets of Japan's financial system.[11] Regional banks traditionally extend loans to small SMEs and households within their respective prefecture.[12] Larger prefectures such as Tokyo and Osaka

[11] Regional banks are divided into first and second tier banks. The first tier comprises of 64 larger banks, while the second tier comprises of 41 smaller regional banks.

[12] Some larger regional banks are also internationally active.

contain about five to six regional banks, while some smaller prefectures such as Fukui only contains two regional bank. Other regional financial institutions include cooperative banks *(Shinkin* banks), but their clientele typically comprise small member enterprises that are of less interest to regional banks, hence limiting direct competition.

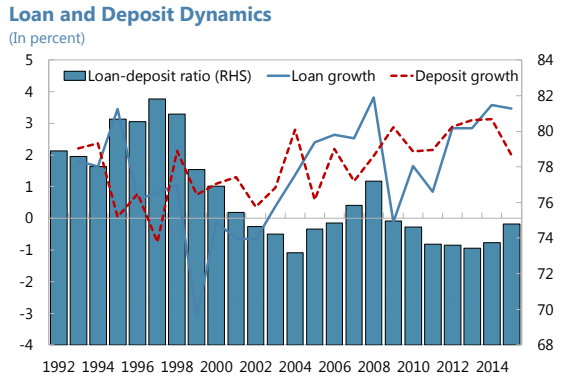
23. The consolidated balance sheet structure of regional banks has remained relatively stable over time. Deposits constitute the main source of funds. The share of deposits in total funding liabilities was 97 percent in the early 2000s but has since fallen to about 90 percent (Figure 5). On the asset side, loans as a share of total earning assets have been relatively stable over the past two decades, fluctuating around 70 percent. Other main assets, includes securities (about 25 percent) and cash.

24. Net interest rate margins for regional banks have been falling since the early 2000s. The lower long-term interest rate combined with falling loan-deposit ratios has put downward pressure on net interest margins and squeezed profitability of regional banks. [13] In response, some banks have tried to adjust their business models or merged with other banks to diversify income sources and cut operating costs.[14] Consequently, some regional banks have shifted away from a loan-oriented banking to a more securities oriented business model.

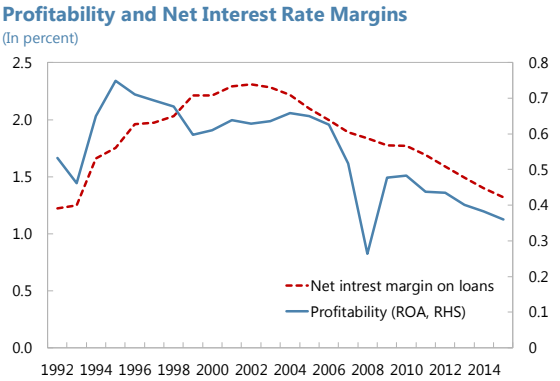
[13] It is worth noting that loan-to-deposit ratios of regional banks have not fallen as much as for *Shinkin* and major banks.

[14] See IMF (2017) for additional insight into the effect of low interest rates and low term premiums on bank profitability.

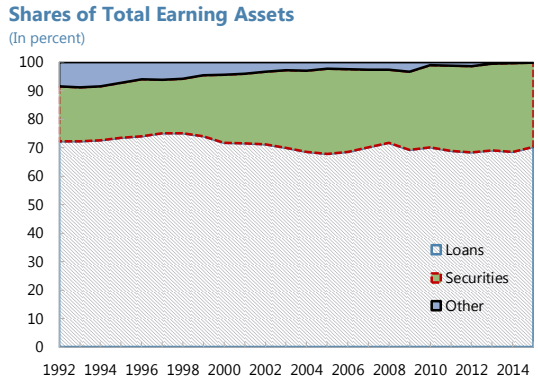
Figure 5. Structure and Performance of Regional Banks, 1992–2015



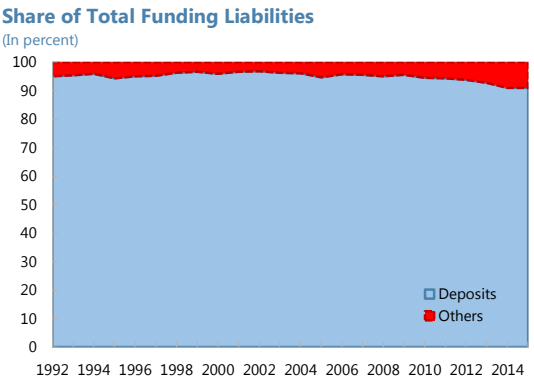
Sources: Fitch Connect; and IMF staff calculations.



Sources: Fitch Connect; and IMF staff calculations.



Sources: Fitch Connect; and IMF staff calculations.



Sources: Fitch Connect; and IMF staff calculations.

B. Demographic Trends and Links to Loan and Deposit Dynamics

25. Demographic headwinds in Japan have gradually worsened and are projected to intensify over the next two decades. These demographic trends are likely to intensify in the future (Figure 6).

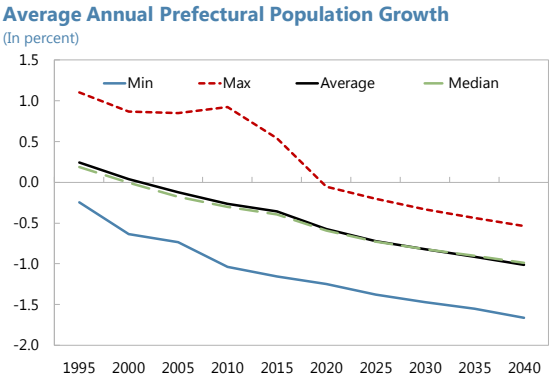
- **Population growth**. The average prefectural population growth rate fell into negative territory in the early 2000s. By 2015, only a handful of prefectures—mostly those in metropolitan areas—still experienced positive population growth.[15] After 2020, however, all prefectures are expected to experience negative population growth, but the loss of population will continue to be less pronounced in metropolitan areas.
- **Aging:** The average prefectural share of the adult population aged 70 and above has steadily been rising over the past two decades.[16] During 1995 and 2005, this came mostly at the expense of the age group 34–54, while the aging that took place between 2005 and 2015 was primarily mirrored by a fall in the share of those aged 20–34. Looking to the future, however,

[15] The more benign demographic dynamics of large cities is partly due to inter-prefectural migration as younger people move in to urban areas.

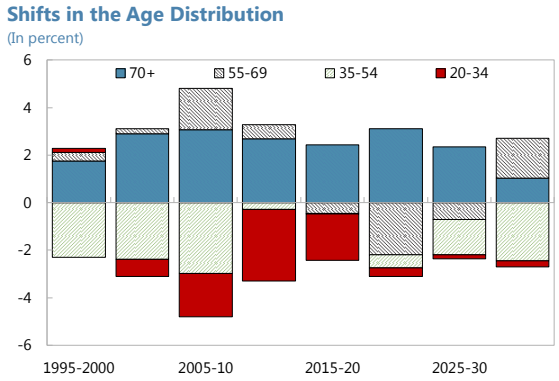
[16] The share of the adult population age above 70 rose sharply from 13 percent in 1995 to 24 percent in 2015, and is projected to further increase to 32 percent by 2035.

the pace of aging will slow down somewhat and largely be associated with a fall in the shares of age groups 55–69 (between 2020-30) and 34–54 (between 2025–35).

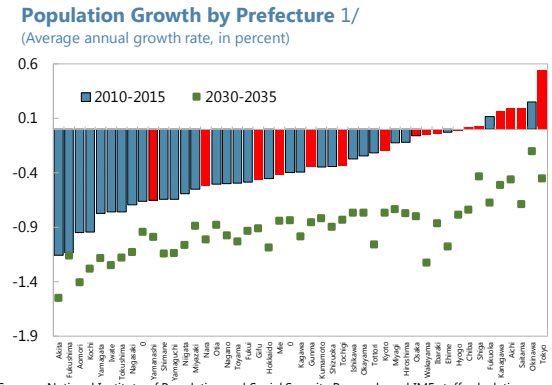
Figure 6. Actual and Projected Demographic Trends, 1995–2040



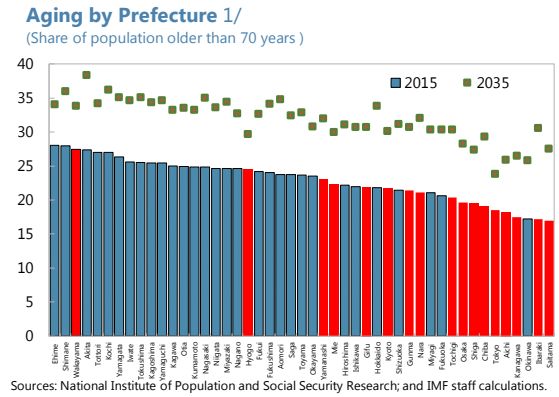
Sources: National Institute of Population and Social Security Research; and IMF staff calculations.



Sources: National Institute of Population and Social Security Research; and IMF staff calculations.



Sources: National Institute of Population and Social Security Research; and IMF staff calculations.
1/ Red bars represent prefectures in the three major metropolitan areas.



Sources: National Institute of Population and Social Security Research; and IMF staff calculations.
1/ Red bars represent prefectures in the three major metropolitan areas.

26. Population growth and aging affect regional banking through various channels.[17]

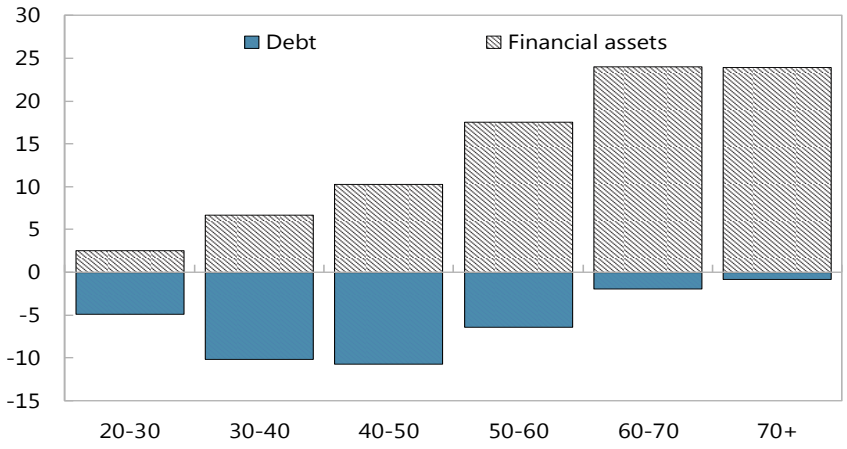
- **Population growth:** A larger population implies a larger economy and greater customer base. This, in turn, should translate into both higher loan demand as well as availability of loanable funds. But since labor is only one factor of production, changes in the size of the population may also affect the *relative* supply of factors and thus their returns. Specifically, a lower population growth should lead to a higher capital-labor ratio and a decrease the return to capital. Falling returns to investment is then likely to depress loan demand (Gagnon and others 2016). Moreover, to the extent that higher population growth spurs technology change, creates positive agglomeration and network effects, and stimulates learning by doing, it can also lead to productivity growth and increased demand for loanable funds. In sum, the size of bank's balance sheets should rise with population growth. It is, however, unclear what the relative impact would be on loan vis-a-vis deposit growth and hence the loan-to deposit ratio.

[17] While a large literature has addressed the impact of demographic trends on savings behavior (e.g., Modigliani and Brumberg 1954) and portfolio choices (Poterba, 2001), less attention has been given to the impact of shrinking and aging populations on banks' balance sheets and business models.

- **Aging.** As the size of households' balance sheets tends to rise and fall along the life-cycle, aging can have important effects on lending and deposit dynamics. Young households gradually accumulate debt to smooth consumption and invest in education and housing, while older households tend to pay off loans while opting for more liquid assets such as deposits.[18] Indeed, survey data shows that the debt of Japanese households tend to rise and fall with the age (Figure 7). On the other hand, the same evidence suggests that households' financial asset holdings continue to rise only to marginally fall at later ages. Similarly, there seems to be limited evidence of a preference for more liquid assets at more advanced ages. This would suggest that aging could have a significant negative impact on the loan-deposit ratio. Aging may also affect loan demand through its impact on productivity. For instance, some studies show evidence of an inverted U-shaped relationship between productivity and age. That is, while productivity initially rises with age due to the accumulation of work experience, it then falls because older workers are more affected by health issues, lower processing speed, and less entrepreneurship.

Figure 7. Households' Financial Assets and Debt by Age Group, 2016

(In millions of Japanese yen)



Sources: Family Savings Survey; and IMF staff calculations.

27. Demographic change could also induce changes to banks' business models. If aging and shrinking populations mainly affect the size of banks' balance sheets and have limited impact on loan-deposit ratios, banks may try to consolidate to improve efficiency and reduce fixed costs. Alternatively, to prevent balance sheets from shrinking, they may increase wholesale funding to finance extra-regional lending opportunities or securities investments (IMF 2017). However, if demographic trends have a disproportionate negative impact on regional lending relative to deposits-taking activities, banks may not necessary have to seek wholesale funds but instead use surplus funds to extend extra-regional loans or invest in securities.

[18] This may lead banks to a shift away from maturity transformation (see Imam, 2013).

C. Empirical Links Between Demographics and Banking

Regression specification

28. A panel regression is employed to estimate the impact of aging and population growth across prefectures on loan and deposit growth. The annual data covers more than 100 regional banks over the period 1990–2015. Two separate regression models are specified for loan and deposit growth as dependent variables (see Annex III). Independent variables can be classified in three blocks:

- **Demographics variables.** The main independent variables of interest are prefectural population growth and changes in the age distribution. The latter is captured by changes in prefectural share of the adult population aged 20–34 (the young), 35–54 (middle aged), 55–69 (older but still in the labor force), and above 70 (pensioners). Since the sum of the population shares add up to one, the age group 35-54 was chosen as the reference group and excluded from the regression analysis. Hence the estimated coefficients should be interpreted relative to this age group.
- **Macroeconomic variables.** To controls for prefectural macroeconomic conditions, the regressions also include prefectural consumer price inflation and real Gross Domestic Product (GDP) growth. Moreover, given the potentially important role of relative labor scarcity, an estimate for the capital-labor ratio is included.[19]
- **Bank specific variables.** Given that health and performance of individual banks could impact their lending capacity and ability to attract deposits, the regressions also control for bank profitability, capitalization, efficiency, and loan quality. Any time-invariant banks specific effects are accounted for by including a bank-fixed effects.

Results

29. Macroeconomic conditions and bank specific factors play a relatively more important role for loan growth than demographic factors. Table 1 in the Annex III shows the results from both the loan and deposit growth regressions. Macroeconomic conditions do not seem to matter as much for deposit growth, suggesting that a deterioration in economic condition would lead to a fall in the loan-to-deposit ratio. For most regression specification capitalization is positively and significantly associated with both loan and deposit growth, but the relative impact is greater for loan growth, indicating that higher levels of capital-to-assets also translate into higher loan-deposit ratios. Finally, profitability and loan quality do not impact loan growth but are positively related to deposit growth, suggesting that depositors discriminate between banks based on financial health and performance.

[19] The data for prefectural Consumer Price Index (CPI) and GDP growth only covers the period 1990–2008.

30. Population growth expands banks' balance sheet and has a larger impact on loan growth relative to deposit growth. For some specifications, population growth has a positive and statistically significant impact on both loan and deposit growth, but with a proportionally larger effect on the former. For instance, if the population shrinks by one percent, loan growth would fall by 2.2 percentage points while deposit growth would only shrink by 1.1 percentage points, leading to a one percentage point fall in the loan-to-deposit ratio. Interestingly, population growth becomes statistically insignificant in the loan regression when the capital-labor ratio is added as an independent variable. The latter is highly significant, and with the expected negatively coefficient. This suggests that a shrinking population primarily impact loan growth by raising the relative abundance of capital and thereby lower the return to investment.

31. Consistent with the life-cycle prediction, aging has non-linear effects on loan and deposit growth. The results suggest that loan growth increases as the age distribution shifts from the 20–34 age group to the reference group aged 35–54, while it falls in response to a shift from the 35–54 to older age groups. A similar impact seems to exist for deposit growth. However, aging does seem to have a relatively stronger impact on loan growth compared to deposit growth.[20] For instance, a one percentage point shift from the 35–54 age group to the 70+ age group lowers loan growth by 1.9 percentage points, while it only contracts deposit growth by 0.7 percentage points, leading to a fall in the loan-to-deposit ration by about 1.2 percentage points.[21]

Historical and projected impact of demographics on loan and deposit dynamics

32. Population growth contributed positively to loan and deposit growth in 1990s but has become a drag since the early 2000s pushing down loan-to-deposit ratios. Figure 3 show the implied average impact from population growth and aging on loan and deposit growth and the loan-deposit ratio across regional banks.[22] In the 1990s, population growth had a positive impact on loan and deposit growth, but as the number of banks facing shrinking populations increased, the average impact turned negative. Specifically, between 1990 and 1995, population growth raised annual loan growth by an average of 0.5 percentage points across prefectures, while between 2010 and 2015, shrinking prefectural populations reduced annual loan growth by 0.8 percentage points. A similar pattern can be observed for deposit growth. However, since the impact on loan growth was larger, downward pressure on loan-to-deposit ratio also increased in the 2000s.

33. Conversely, aging had a negative impact on loan-deposit ratios in 1990s but the effect dissipated in the 2000s and even turned positive before the global financial crisis. Because the rise in the share of older age groups in the 1990s came at the expense of a costly fall in the 35–54 age group, aging had a large negative impact on loan growth. On average, aging is estimated to have reduced loan growth by around 0.7−0.8 percentage points per year. With deposit growth being less affected by the fall in the 35−54 age group, aging also led to downward pressure on the

[20] This is consistent with the household survey data on holdings of deposits and debt discussed earlier.

[21] This is based on specification (4) and (9) in Table 1 in Annex III

[22] Again, the estimates are based on regression models (4) and (9), respectively.

loan-deposit ratio of about 0.2–0.4 percentage points per year. Thus, the impact from aging on the loan-deposit ratio was negative in the 1990s. In the 2000s, however, the rise in the older age-groups had a lesser impact on the 35–54 age group. Instead, the share of youngest age group (aged 20–34) started to fall as they moved into the higher age group. This reduced the impact of aging on loan growth, but did not much affect deposit growth, resulting in a positive annual impact on the loan-deposit ratio of about 0.4 percent between 2005 and 2010. Hence, some of the pick-up in loan growth preceding the global financial crisis could have been due to favorable shifts in the age distribution.

34. Looking forward, the impact of demographic headwinds on deposit and loan dynamics will intensify. Using prefectural population projections up until 2035 and our estimates from the panel regression, it is possible to project the impact of demographic headwinds on loan and deposit dynamics going forward (Figure 8).[23] A few observations are worth noting. First, the impact from demographic headwinds is likely to intensify significantly over the next two decades. The combined negative impact from aging and population growth on annual loan and deposit growth is projected at around 2.0−2.5 and 1.0−1.2 percentage points, respectively. Second, because the impact on loan growth is relatively larger than on deposit growth, the average annual decline in the loan-deposit rate will be about 1−1.5 percentage points. Thus, regional banks will find themselves with even higher excess surplus of funds to invest. Indeed, over the next two decades the average cumulative decline in the loan-deposit ratio would be well over 20 percentage points. Third, the impact of population growth is gradually expected to become more important than aging. In fact, during the period 2030−35, aging will have a negligible impact.[24] Finally, the demographic impact will vary significant across regional banks. Regional banks in the three major metropolitan areas will fare better, while a nontrivial share of banks could see their loan-deposit ratios fall by more than 30 percentage points by 2035.

35. Countering the demographic trends in regional banking would require a significant pick-up in inflation and real growth. Based on the regression results in displayed in Table 3, an improved macroeconomic performance could mitigate the projected fall in the loan-deposit ratio.[25] For instance, if the two percent inflation target was to be achieved consistently across prefectures this would help raise the loan-deposit ratio by about 1.4 percentage points per year. Moreover, a potential growth rate of 2 percent would increase loan growth by another 0.3-0.4 percentage points per year. However, over the past two decades inflation has persistently been close to zero for and BoJ's current estimate of potential growth is about 0.7 percent.[26]

[23] The analysis carries a certain degree of uncertainty as the demographic projections by the National Institute of Population and Social Security Research may not materialize. Moreover, the results will vary depending on which regression specification that is used. The results in Figure 8 are derived using specification (4) and (9) in Table 1 of Annex III.

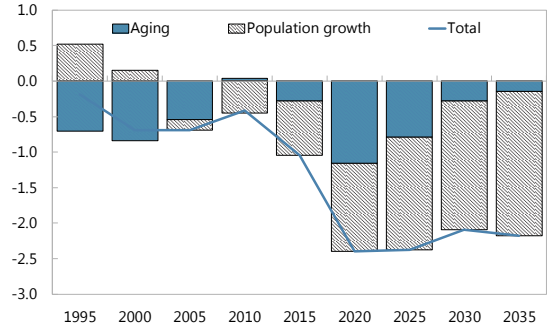
[24] This stems from the fact that the increase in the 70+ age group is small and that the reduction in the most productive age group (35−54) is mostly absorbed by a rise in the 55−69 age group (see Figure 6).

[25] See specification (4) and (9) in Table 1 Annex III.

[26] See https://www.boj.or.jp/en/research/research_data/gap/index.htm.

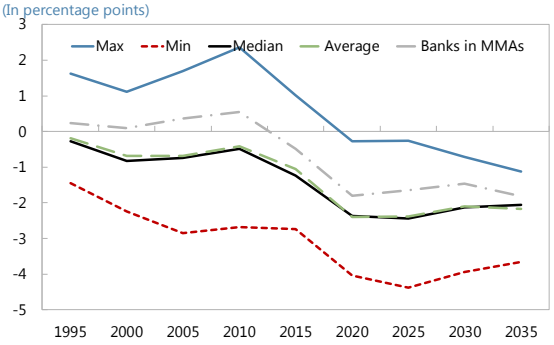
Figure 8. Historical and Projected Impact on Loan and Deposit Dynamics, 1995–2035

Impact on Average Annual Loan Growth
(In percentage points)



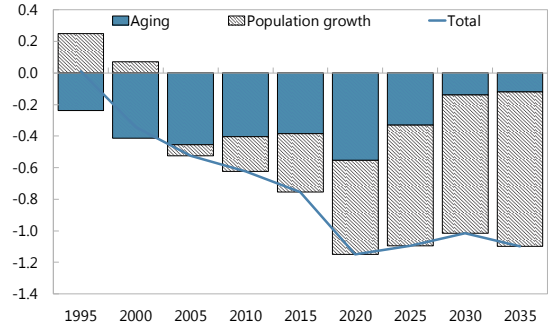
Source: IMF staff calculations.

Demographic Impact on Annual Loan Growth Across Banks
(In percentage points)



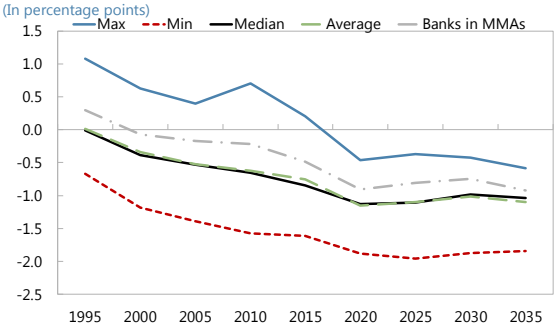
Source: IMF staff calculations.

Impact on Average Annual Deposit Growth
(In percentage points)



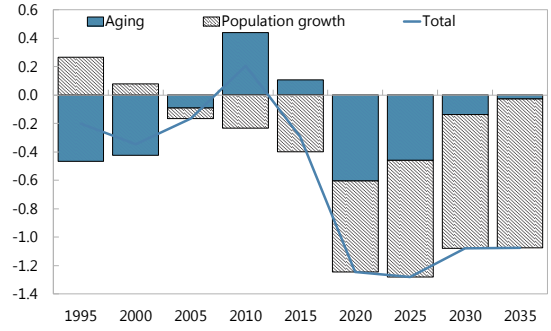
Source: IMF staff calculations.

Demographic Impact on Annual Deposit Growth Across Banks
(In percentage points)



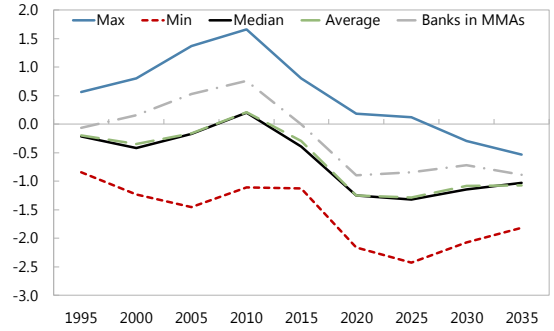
Source: IMF staff calculations.

Demographic Impact on the Annual Loan-Deposit Ratio
(In percentage points)



Source: IMF staff calculations.

Demographic Impact on Loan-Deposit Ratios Across Banks
(Average annual percentage points change)



Source: IMF staff calculations.

D. Demographics and the Evolution of Banks' Business Models

36. Clustering of regional banks by balance sheet characteristics reveals marked heterogeneity. To identify distinct business models and examine their evolution, regional banks were classified along several balance sheet characteristics.[27] Table 3 shows the result from applying statistical clustering analysis using the loan-to-asset-, securities-to-assets-, and deposit-to-liabilities

[27] See Roengpitya et al (2014).

ratios. The share of fees and commission income is also included in the table as a measure of income diversity. The results show three different banking models, reflecting a progression from a more securities oriented business model—that is marginally less dependent on deposits and has a higher income share from fees and commissions—to a more loan oriented business model with less income diversity.

Table 3. Japan: Classification of Regional Banks' Business Models

	Securities Oriented Business Model		Mixed Business Model		Loan Oriented Business Model	
	Mean	Stdev.	Mean	Stdev.	Mean	Stdev.
Loans as a share of total earning assets	0.61	0.04	0.70	0.03	0.79	0.04
Securities as a share of total earning assets	0.36	0.05	0.25	0.03	0.17	0.03
Deposits as a share of funding liabilities	0.94	0.04	0.96	0.03	0.97	0.04
Fees and commissions as a share of income	0.10	0.04	0.07	0.04	0.04	0.05

Source: IMF staff calculations.

37. The share of regional banks utilizing a securities and fees based business model has gradually increased over time. While the loan oriented business model dominated in the 1990s, the share of regional banks with high securities holdings and more fee-based income has risen since the early 2000s (Figure 9). This likely reflects some banks' attempt to improve profitability by expanding the size and maturity of their sovereign bond portfolios and increase fee income (IMF, 2017). Moreover, looking closer at the probability of a bank switching from one business model to another reveals a couple of noteworthy points (Table 4). First, the three business models are fairly absorbent, and the probabilities of switching model in one particular year are fairly symmetric. It is only slightly more likely that a loan-oriented bank will move towards a more securities-oriented model than a securities-oriented banks to switch towards more lending oriented model. Second, the transition matrix is stable and suggest a long-run equilibrium in which the share of securities oriented banks stabilize at about 26 percent compared to the loan-oriented model at about 32 percent. Of course, this is based on unconditional probabilities and disregards any structural shifts, such as demographics, or bank characteristics that could affect banks' likelihood of switching business model.

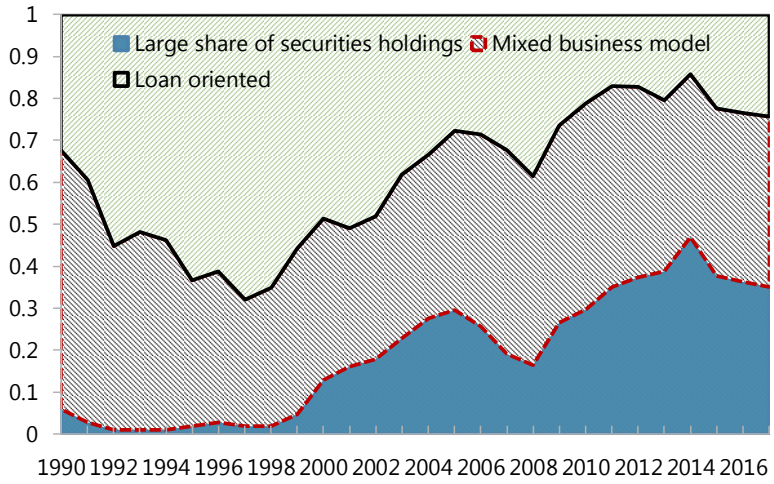
38. Demographic headwinds tend to push regional banks away from lending and toward the holding of securities. Since there is a zero probability of moving from a loan oriented to securities oriented business model without first transition through the mixed business model, one can use an

ordered probit model to examine determinants of banks' choice of business model (see Annex III). In the estimations, shifts in the age distribution are consistently statistically significant, suggesting that an increase in the share of the 55–69 and 70+ age groups raises the likelihood that a bank will switch to a more securities oriented and fee based banking model. Moreover, there is also evidence that higher population growth tends to be associated with more lending-oriented banking.

Figure 9. Business Model Switching

Share of Regional Banks by Business Model, 1990-2015

(In percent)



Sources: Fitch Connect; and IMF staff calculations.

Table 4. Japan: Transition Matrix Across Business Models

Unconditional Probability of Maintaining or Switching Business Model		Year T+1		
		Large Share of Securities Holdings	Mixed Business Model	Loan Oriented Model
Year T	Large Share of Securities Holdings	89	11	0
	Mixed Business Model	7	84	9
	Loan Oriented Model	0	12	88

Source: IMF staff calculations.

E. Implications for the Future of Regional Banking

39. Mounting demographic headwinds constitute a major challenge for regional financial over the next couple of decades. Because of their dependence on local deposit-taking and lending activities, regional banks are sensitive to changes in the local environment.[28] While shifts in the age distribution and population growth have to some degree off-set each other in the past (e.g., lower population growth in the early 2000 coexisted with an either stable or increasing share of the most economically active part of the population), this is likely to change over the next decade, creating a potential demographic cliff.

40. The analysis in this section stresses two important channels through which demographics will impact regional banking. First, unless regional banks find alternative sources and uses of funds, shrinking and aging prefectural populations will lead to smaller balance sheets and declining loan-deposit ratios. This, in turn, would continue to put downward pressure on already low levels of profitability. Second, the trend of regional banks shifting to a more securities-holding, and fee based banking model is likely to accelerate in the near future. The intensification of these two effects highlights the need for regulators and supervisors to take a proactive stance to manage demographic risks**.** This would include (i) engaging with regional financial intuitions to ensure that they are appropriately and prudently adapting to demographic trends (e.g., by improving risk management capabilities and developing realistic business strategies), and (ii) ensure that systemic risks to the banking system due to shifting business models are monitored and managed effectively.

ARE JAPAN'S BANKS DOING ENOUGH FOR SME'S?

A. Are Japanese SME's Financially Constrained?

41. Japanese SMEs are being challenged by labor shortages, aging owners, and the lack of managerial skills.[29] With a shrinking population and limited women participation, labor shortages are posing important constraints on SMEs in regional economies. In 2015, SMEs posted three job offers per job seeker large firms posted only one. Overall labor shortages, as measured by the *employment condition index*, are twice as bad for SMEs than for large firms (Figure 10). In addition, about half of all SME owners are over the age of 60 (Labor Force Survey, MIC 2015), while 27 percent of SMEs mentioned difficulties in finding successors (Mizuho Research Institute 2015). Firms older than 10 years old account for three quarters of SMEs, compared to one half in most of the OECD countries (Criscuolo et al. 2014). SMEs in Japan also tend to have lower productivity than its peers elsewhere in the OECD (see OECD 2015).

[28] Regional banks are also sensitive to compressed term spreads resulting from aging or low interest rates (GFSR, April 2017, Chapter 2).

[29] In Japan, SMEs play important roles in both employment and production. SMEs account for 99.7 percent of all firms, about 70 percent of total employment, and 55 percent of total gross value-added (SME White Paper 2016).

42. Financing conditions for SMEs are key to revitalize regional economies but remain subdued. Financing is one of the key factors for SMEs' innovation and capital investment, which help offset the impact of ageing-driven labor supply shortage on productivity. As observed in other countries, financial constraints can significantly lower productivity (Ferrando and Ruggieri 2015). The inability to access external sources of funding can cause firm to bypass profitable investment opportunities (Almeida and Campello, 2007). Despite recent improvements, a large part of SME credit flows to construction- and real-estate-related businesses (Figure 10, panel 4). Many small firms still find it difficult to obtain loans, their main source of external funds (Figure 10, panel 5).[30] Obtaining financing remains challenging for SMEs in key sectors such as manufacturing, wholesale and retail trade, and services (Figure 10, panel 6).

43. Indicators suggests that a significant proportion of SMEs faces financial constraints despite abundant liquidity in the financial system.[31] A survey shows that about 24 percent of SMEs face difficult financial position (Mizuho Research Institute 2015).[32] About 37 percent of SMEs still rely on public credit guarantees to obtain loans. Other standard measures based on the literature suggest significant financial constraints among SMEs (See Annex IV).

44. Finance for entrepreneurial firms is not widely available, especially for female-owned business. The range of financing instruments available to entrepreneurs, particularly risk capital is limited. The availability of venture capital, for instance, is only 0.02 percent of GDP compared with 0.3 percent in Israel and the U.S. (Figure 11). Funding for startups has increased recently but remains concentrated in information technology (IT).[33] Furthermore, startups at an early stage mostly rely on internal funds, personal savings, and family loans. Raising funds is especially hard for female entrepreneurs as the gender gap in access to entrepreneurial finance is larger in Japan compared to other OECD countries (OECD 2015). Thus, firm creation, essential to boost productivity and innovation, is slow and well below what is found in other advanced economies.

[30] About 30 percent of SME financing comes from bank loans and 22 percent from internal funds (Financial Statements Statistics of Corporation by Industry, Ministry of Finance 2016).

[31] "Financial constraints" refer to the frictions that prevent firms from funding all desired investment that might be due to weak cash flow, inability to borrow, or inability to issue equity. It does not mean financial distress or bankruptcy risk.

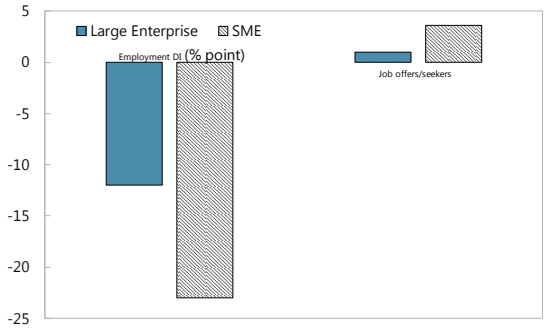
[32] The rate of rejection in loan application can be also useful, but it does not include information on discouraged borrowers—entrepreneurs who need finance, but do not apply for a bank loan for fear of being rejected. The rejection rate is about 16 percent in Japan (Mizuho Research Institute 2015).

[33] In 2016, total capital raised for ventures in Japan reached a record ¥276 billion (US$2.5 billion), well above an average of ¥50 billion per year since 2008 (Japan Times).

Figure 10. Challenges Facing SMEs in Japan

Labor shortages are more critical for SMEs

Employment Conditions

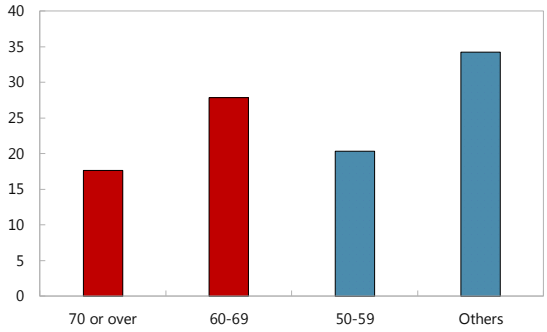


Sources: Bank of Japan, Business Condition Survey; and Recruit Works Institute.

...while half of the owners need to address succession issues

SME Owners' Age

(In percent)

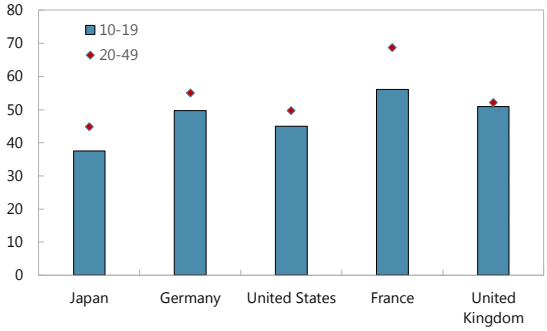


Sources: Labor Force Survey, MIC 2015.

SME productivity in Japan lower than in OCED peers

SME Productivity in Manufacturing

(Value added Per person, Index 250= 100 in 2014 ; Size = number of employees)

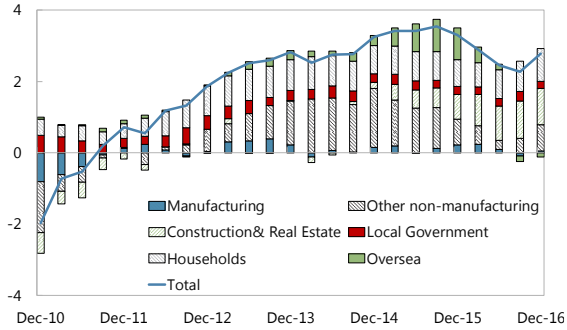


Source: OECD 2015.

while credit has grown.

Contribution to Credit Growth

(In percent)

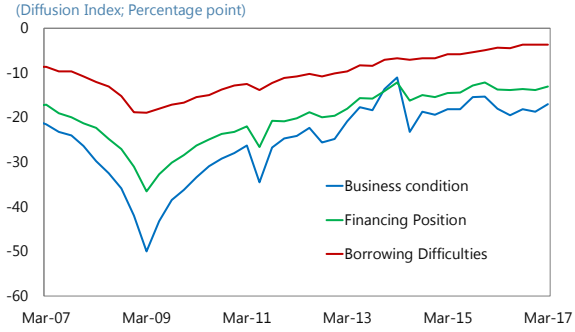


Source: Bank of Japan.

SMEs financing has increased, but remains difficult

SME Business and Financing Conditions

(Diffusion Index; Percentage point)

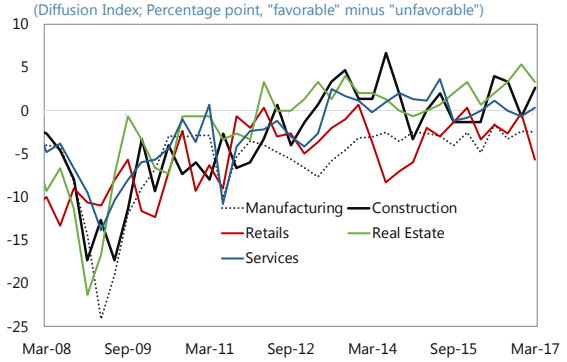


Source: SME Agency and SMRJ, Survey of SME Business Conditions.
Note: The Diffusion Index is calculated as percent of firms that described "favorable minus percent of those that described "unfavorable."

... amid challenging financial position of SMEs in some sectors.

SME Financial Position

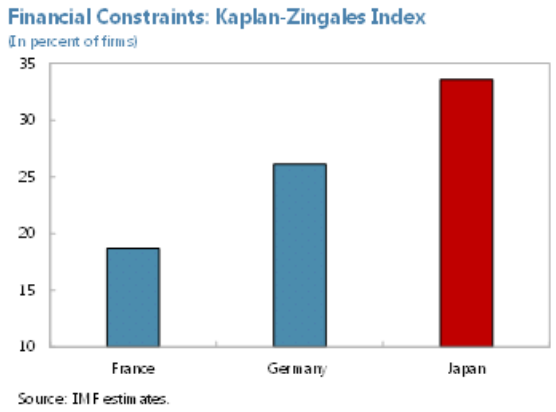
(Diffusion Index; Percentage point, "favorable" minus "unfavorable")



Source: Shoko-Chukin Bank Survey of SMEs; Haver Analytics.

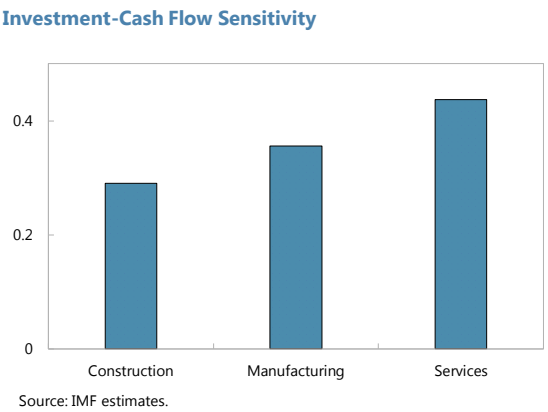
Figure 11. Access to Finance by SMEs

About one third of SMEs faces financial constraints



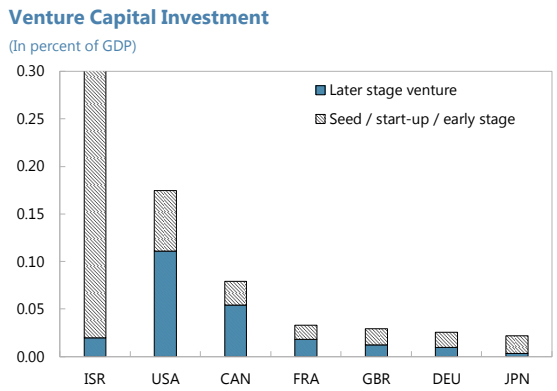
Source: IMF estimates.

While services sector faces more constraints



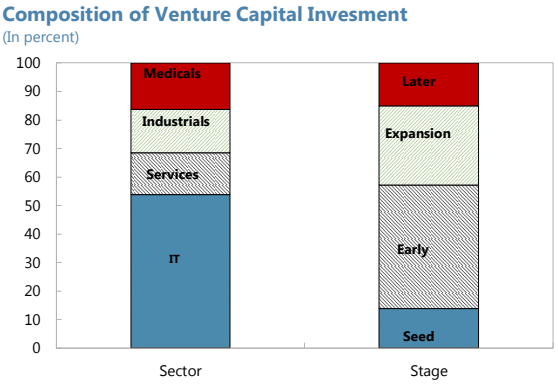
Source: IMF estimates.

Venture capital remains limited

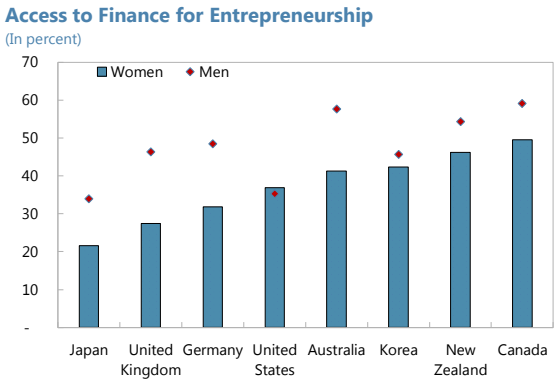


Source: OECD 2015.

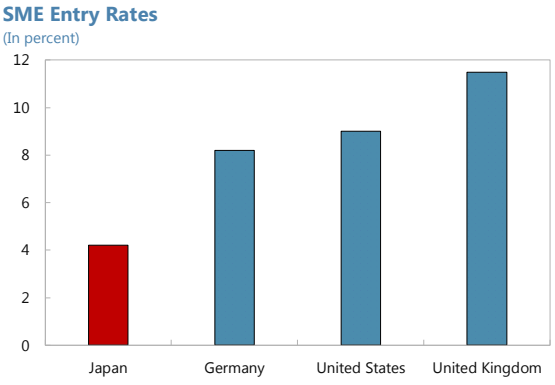
and concentrates on IT sector and early stage.



Source: Venture Enterprise Centre 2016.



Source: OECD 2015.



Source: OECD 2015.

B. Collateral-Based vs. Risk-Based Lending

45. Lending to SMEs in Japan remains largely based on fixed-assets collateral and personal guarantees (Figure 12). About 80 percent of SME loans require personal guarantees or fixed-assets collateral, including personal real estate (Mizuho Research Institute 2015), despite existence of credit

bureaus and databases.[34] Banks require personal guarantees because it is often difficult for banks to assess SMEs' profitability and growth opportunities, or due to low creditworthiness of SMEs. The value of personal guarantees exceeds owners' assets in 78 percent of the cases (The Mitsubishi UFJ Research and Consulting Group 2010). SMEs seldom produce audited financial statements that yield credible financial information and have no obligation to publicly disclose their financial reports (Urasaki 2014; Mizuho Research Institute 2015). Furthermore, in smaller enterprises, the separation between the finances of the owner and those of the business is usually blurred (OECD 2015).

46. Although collateral requirements and personal guarantees cause SME owners to have skin in the game, it also has negative impacts. Collateral-based lending can pose challenges to newer, more innovative, and fast growing SMEs without sufficient collateral. Banks' preference for collateral can limit financial access and weaken banks' incentives to do credit screening and risk-based lending. Furthermore, the widespread use of personal guarantees by banks may reduce risk taking by entrepreneurs as it goes against limited liability.

47. The overreliance on collateral can negatively affect the allocation of credit. Banks may not necessarily lend to the most productive firms, but instead lend to those with sufficient collateral (Caballero 2007). Thus, it can lead to an inefficient allocation of financial resources because the firms with best investment projects do not necessarily hold sufficient collateral (Caballero and Hammour 2005).[35] Finally, dependence on collateral can amplify macrofinancial risks because inefficient credit allocation during the boom are often linked to more significant credit crunches and drops in economic activity during recessions (Dell'Ariccia, Igan, Laeven, and Tong 2016).

48. Asset-based lending (ABL)—an alternative to the traditional pledging of real estate collateral and personal guarantees—has increased recently but still faces various challenges. Efforts have been taken by government institutions such as SME Support Japan and the Japan Finance Corporation in promoting ABL.[36] The number of asset-backed loans has tripled from about 4,000 cases in 2011 to 12,000 cases in 2015 after the introduction of several measures undertaken by the FSA.[37] However, lending based on assets such as movable collateral—machines and inventory—and account receivables is less than 0.5 percent of total bank loans.[38] Challenges include

[34] Japan has several private sector credit registries such as the Credit Risk Database, and the Teikoku Data Bank, that collect credit information and provide credit scoring on firms. The Japan Credit Information Reference Centre, and the Credit Information Centre provide credit information on individuals (Lam and Shin 2012).

[35] The lack of proper screening can be caused by competitive pressures (Ruckers 2004 and Dell'Ariccia and Marquez 2006) or because of agency problems during loan origination (Keys and others 2009).

[36] Asset-based lending is nothing more than lending against a firm's business assets such as inventories, equipment, or accounts receivable.

[37] Such measures include the publication by the FSA of "Reference Example of Contract of Mortgage of Aggregate Movable Property and Account Receivables," in 2012 and "Active use of ABL," in 2013.

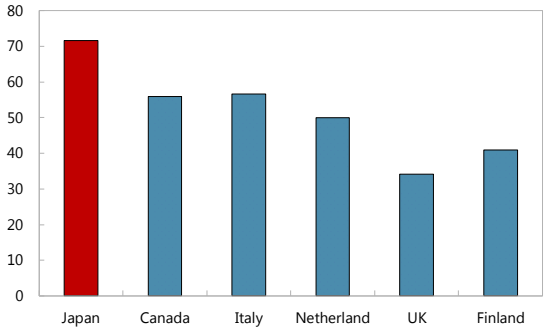
[38] Similarly, leasing volumes to SMEs has been very limited, accounting for less than one percent of total leasing volumes (OECD 2017; Japan Leasing Association 2017).

the lack of a collateral registry in which all functional equivalents can be registered,[39] and the limited capacity of financial institutions in assessing the fair value and the status of the movable assets (see also Box 1).[40] For ABL to SMEs expanding abroad, there are important challenges in assessing the implications for collateral valuations of differences in property rights and legal or juridical uncertainty in host countries, especially in emerging economies.[41]

Figure 12. Collateral and Risk-Based Lending

Banks in Japan usually require collateral in order to lend...

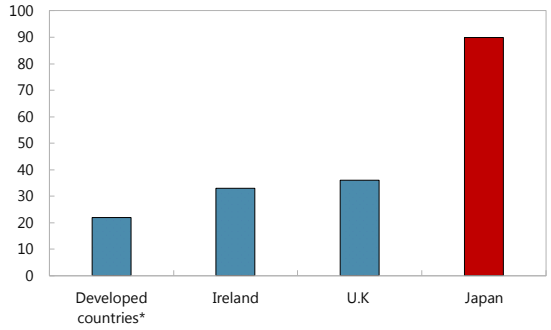
Collateral Requirement, 2014
(In percent)



Sources: OECD 2016; and SME White Paper 2016.

... in addition to personal guarantees from business owners.

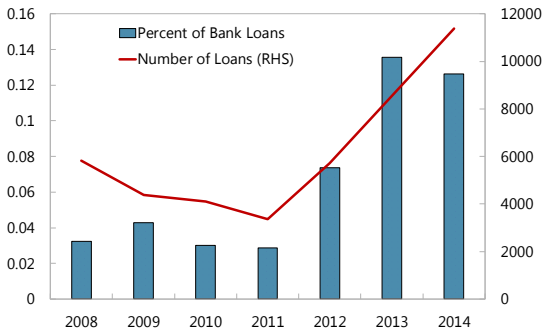
Personal Guarantees
(In percent of number of SMEs Loans)



Sources: *World Bank 2008.

Asset-based lending has increased, but remains low.

Asset-Based Lending



Source: SME White Paper 2016.

Asset evaluation and collateral management remain key challenges

Issues in Asset-Based Lending
(In percent of respondents)

Sources: METI Report; and SME White Paper 2016.

[39] Haidar and Hoshi (2015) suggest that the collateral registry could be improved by covering both incorporated and non-incorporated businesses and by allowing secured creditors to register, search, amend, or cancel security interests online.

[40] There are only a few firms with valuation expertise in Japan such as: Gordon Brothers and Nihondosankantei. Anecdotal evidence suggests that until very recently, inventory valuations for the purposes of asset-backed lending were near 10 percent of book value.

[41] In addition to these challenges, when doing a cost-benefit analysis of ABL, banks should consider the high monitoring costs of asset values, especially under a low-interest rate environment.

Box 1. Enabling Factors for Asset-Based Lending

Asset-based lending (ABL) is one of the key alternative financing instruments that aim to address challenges in fixed-asset collateral-based loans. In ABL, the firm can borrow against the appraised value of some of the firm's business assets. Working capital and loans are secured by assets such as trade accounts receivable, inventory, machinery, and equipment. The development of ABL requires two key enabling factors (OECD 2015):

- **An efficient secured-transactions law**. Key issues include clarity in the country's commercial law on how a collateral lien can be perfected, how collateral priority is determined, and how notification of a lien is made. For instance, the ability of lenders to file a single lien on all existing and future accounts receivable and inventory explains the significant development of asset-based lending in countries such as Australia, Canada, the United Kingdom, and the U.S.

- **Specialized expertise by lenders**. Assessing and monitoring the value of collateral for liquidation purposes is critical for ABL. The ability to do so often relies on industry-specific knowledge which may not be available for brick and mortar credit institutions but may be available to specialized lenders.

Compared to other countries, Japan's legal system is not the most amenable to ABL. Several regulatory and legal constraints in Japan standout as compared to the four countries that have experienced significant development in asset-based lending (Box Table 1.1).

Box Table 1.1. Relevant Enabling Factors for Asset-Based Lending

	Australia	Canada	U.K.	Japan	U.S.
Does an integrated or unified legal framework for secured transactions that extends to the creation, publicity and enforcement of functional equivalents to security interests in movable assets exist in the economy?	Yes	Yes	No	No	Yes
Does the law allow businesses to grant a non possessory security right in substantially all of its assets, without requiring a specific description of collateral?	Yes	Yes	Yes	No	Yes
May a security right extend to future or after-acquired assets, and may it extend automatically to the products, proceeds or replacements of the original assets?	Yes	Yes	Yes	No	Yes
Does a notice-based collateral registry exist in which all functional equivalents can be registered?	Yes	Yes	No	No	Yes
Does a modern collateral registry exist in which registrations, amendments, cancellations and searches can be performed online by any interested third party?	Yes	Yes	No	No	Yes
Are secured creditors paid first (i.e. before tax claims and employee claims) when a business is liquidated?	Yes	No	Yes	No	Yes
Secured Transaction System	Yes	Yes	No	No	Yes

Source: World Bank, Doing Business Database 2017.

49. Venture capital can play an important role but requires improving the environment for angel inventors who not only supply finance, but also provide mentoring and networking. New business in Japan often face limited talented staff due to limited risk-taking, low risk-tolerance, and limited capacity from local venture capitalist in guiding and mentoring at early and growth

stage. Most of the local venture capitalists are affiliated with large firms which set up venture capital as a part of their corporate social responsibility (CSR) or as industry surveillance. Currently, corporate sector accounts for about ¾ of the total venture capital, compared to a quarter in the U.S. Also, there are also limited funding engagement from institutional investors such as pension fund as in the U.S. There is room for pension funds in Japan to invest in funds of funds along with their portfolio rebalancing toward riskier assets.

C. Credit Guarantees and Lending to SMEs

50. Public credit guarantees remain large in scale and broad in scope despite declines in total outstanding amount (Figure 13). The coverage of credit guarantees is 80–100 percent. Total credit guarantees have further declined from the peak of ¥35.9 trillion in 2009 to ¥25.8 trillion, driven by a decline in Safety Net Guarantee No. 5 (100 percent guarantee) and emergency guarantees. Nonetheless, 37 percent of SMEs rely on credit guarantees to obtain loans.

51. The government is revising the guarantee scheme to effectively support SMEs' financing according to their business cycles without creating overdependence. The revised scheme aims to encourage financial institutions to provide loans based on business evaluation. The system predicates on three pillars: (i) to encourage financial institutions to provide a non-guarantee loans in addition to guaranteed loans; (ii) to decrease coverage from 100 to 80 percent for the Safety Net Guarantees Program No. 5 while establish a new Safety Net Guarantee program exclusively for crises; and (iii) to enhance 100 percent credit guarantees for startups (from ¥10 to ¥20 million) and microbusiness (from ¥12.5 to ¥20 million).

52. Credit guarantees in Japan have helped many SMEs obtain loans. As observed in other countries, public credit guarantees can address information problems by allowing risk sharing among financial institutions that lend to SMEs perceived to be financially constrained or to have low creditworthiness (Honohan 2010). In many countries, credit-guarantee schemes are designed to help young firms that do not have sufficient collateral or a long credit history (Banerjee and Duflo 2004): learning about new borrowers may be costly to an individual lender while the benefits often also accrue to other lenders.[42] Credit guarantees help lenders offset some of these costs and encourage lending to underserved firms.

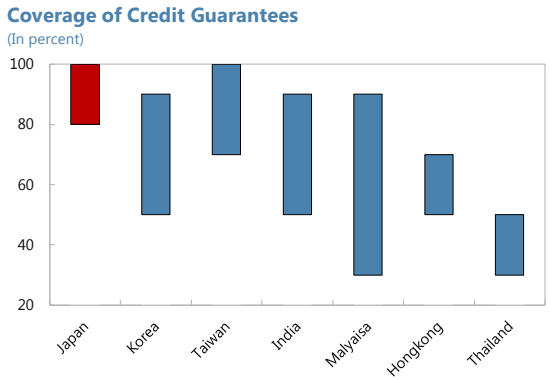
53. Gradually phasing out credit guarantee is important to encourage credit risk assessment capacity among financial institutions and avoid credit misallocation. Cross-country experience suggests that**,** depending on the design of the scheme, credit guarantees can also have negative impacts (World Bank 2015). Excessive credit guarantees can weaken banks' incentives in credit screening and monitoring and risk-based lending. A concern with credit guarantees is that excessive coverage and long duration can lead to moral hazard and affect banks' incentives to build credit

[42] When a lender lends to a new borrower it sends a signal to other potential lenders about the creditworthiness of said borrower.

assessment capacity (Arping, Loranth, and Morrison 2010). Another concern is that after some time credit guarantees may not necessarily lead to additional lending (Wilcox and Yazuda 2008; Ono and Uesugi 2014; World Bank 2014). Moreover, if poorly implemented, credit guarantees can increase credit misallocation and delay the exit of non-viable firms (Lam and Shin 2012).

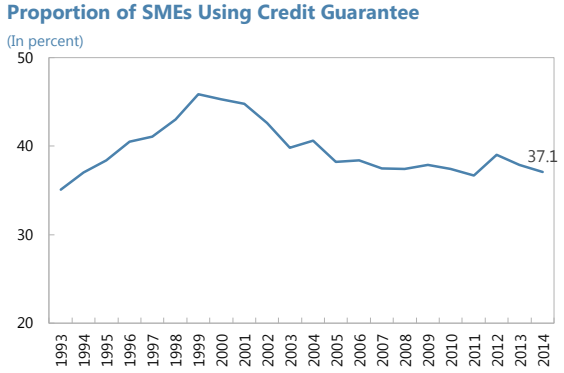
Figure 13. Credit Guarantees and SMEs Lending

Credit guarantee coverage is relatively high



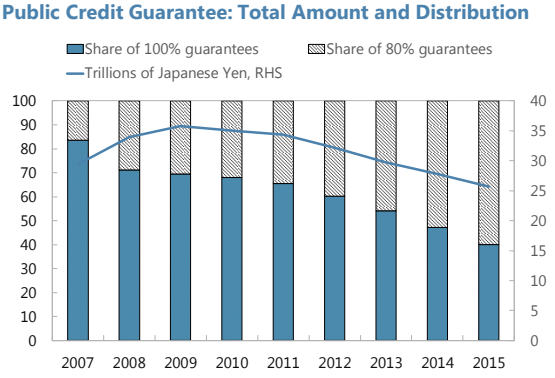
Sources: Shin 2014; and Japan Credit Guarantee Corporations 2015.

Over one third of SMEs obtain loans with guarantees.



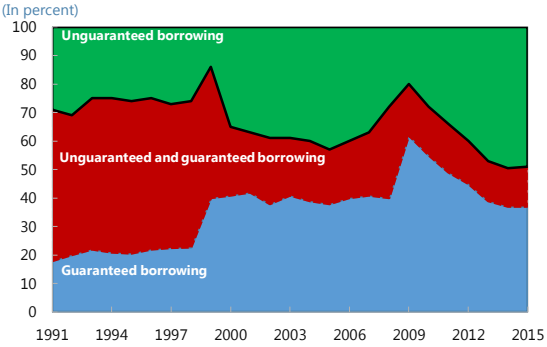
Source: SME White Paper 2016.

The share of 100 percent guarantee has decreased



Source: SME White Paper 2016.

Unguaranteed borrowing has also increased.



Source: SME White Paper 2016.

54. International best practices suggest lower coverage and shorter duration of credit guarantees reduce distortions and encourage risk-based lending. Experiences in other countries suggest that best practices for credit guarantee schemes are (World Bank 2013):

a. The private sector should be responsible for assessing and deciding about credit;

b. Coverage should be capped and payouts should only occur after the lender has attempted recovery; and

c. The use of risk management tools should be encouraged.

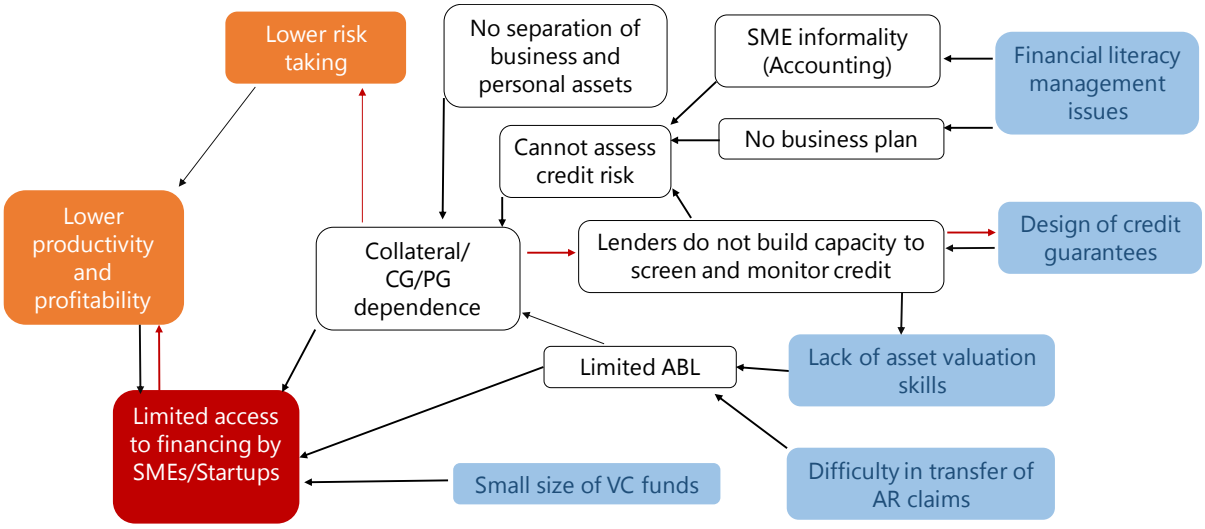
FINANCIAL SECTOR POLICIES FOR AN AGING ECONOMY

A. Lending to SME's and New Businesses

55. The still limited access to credit by SMEs and the difficulties of startups in obtaining financing exacerbate the adverse effects of an aging society on productivity and overall economic growth (Figure 14). Lending to SMEs in Japan remains largely based on fixed-asset collateral and personal guarantees.[43] Japanese banks usually require collateral because it is often difficult to do risk assessment of SME given their high opacity. These practices depress lending to younger and possibly more innovative firms and discourage risk taking by entrepreneurs. Specifically, the firms that have most collateral are the ones that obtain credit, not the ones with the best prospects of future growth, which can ultimately result in a misallocation of credit. In addition, public credit guarantees remain large in scale and broad in scope which discourages banks from investing in credit screening and credit monitoring technologies. Alternative forms of finance for SMEs and startups—asset-backed lending (ABL) and venture capital (VC)—have grown but from very low levels and still face important challenges.

Figure 14. Problems in the SME Lending Chain

SME informality and opacity and lenders' low capacity for risk-based lending hamper finance to SMEs and startups.



Source: IMF staff.
Note: ABL: Blue-color boxes highlight constraints to be addressed to promote access to finance by SMEs and startup. Red-color boxes show direct effects for SMEs. Orange-color boxes show effects on the broader economy. ABL: Asset-Backed Lending; AR: Accounts Receivable; CG: Credit Guarantees; PG: Personal Guarantees; SMEs: Small and Medium Enterprise; VC: Venture Capital.
Source: IMF staff.

[43] About 80 percent of SME loans require personal guarantees or fixed-asset collateral (SME white paper 2016).

56. Financial sector policy should aim to address the constraints to financial access and deepening for SMEs and startups namely by further promoting risk-based lending. Banks should continue to be encouraged to upgrade their credit risk-assessment capacity and reduce their reliance on collateral and personal guarantees. One way to achieve this is to reduce the size and duration of credit guarantees. Reporting standards by SMEs should continue to be improved and sustained investment in the promotion of financial literacy is needed.

57. Alternative forms of finance to SMEs and startups should be encouraged further. On the one hand, further expanding ABL will probably require an upgrade in lenders' ability to value movable collateral and accounts receivable. On the other hand, for VC to become more supportive of growth in startups it is necessary that VC funds become larger to be able to fund later stage ventures.

B. Meeting New Challenges

58. The search for new growth and return opportunities by financial intermediaries requires appropriate risk management. Many Japanese financial institutions are responding to compressed margins in their core domestic business by expanding abroad or into new businesses with higher returns but higher risk. Authorities should continue to encourage the development of adequate risk management in institutions that do not have significant experience in these new types of investment.

59. The offer of services by the financial industry should continue to adapt to the demands of an aging population. For example, advisory services for life-cycle portfolio management or retirement planning can create value for customers and raise revenue for financial institutions. In addition, the development of a market for life annuities could vastly improve households' ability to hedge longevity risk relative to what is now possible with the available term certain annuities.

C. Dealing with a Smaller Financial System

60. Overall, policymakers need to facilitate, or at least not hinder, necessary adjustments in the financial sector brought about by aging, especially when it comes to regional banks. Prudential frameworks would need to provide incentives to ensure long-term stability instead of falling prey to demands for deregulation to ease the short-term pain. Policies could have the two main thrusts.

a. **Banks in general, and regional banks in particular, must adapt to an environment of low growth and low margins.** Regional banks may wish to increase fee-based income namely by charging for basic (but still costly) banking services. However, the introduction of such fees may run counter to domestic banking culture and competitive pressures such that banks are unlikely to introduce such fees on their own.

b. **In the context of the promotion of sustainable business models among regional banks, authorities could facilitate the exit of unviable firms and encourage consolidation after**

carefully weighing costs and benefits. Consolidation among regional banks may be bring valuable economies of scale and scope and smoothen the transition to smaller financial systems at the regional level. An alternative path of reduction of the number of players through attrition may be costlier if weaker players gamble for resurrection. In addition, consolidation through mergers and acquisitions may help preserve the credit history of borrowers in the context of relationship banking and thus be less disruptive to the flow of credit.

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Annex I. Country Panel Regression Analysis

1. The data are composed of two samples at the annual frequency. The first sample includes 133 advanced, emerging, and developing economies and covers the period 1975–2014 albeit with considerable variability by country. The second sample covers up to 38 advanced and emerging economies for the period 1990–2014. The first sample has a wider and longer coverage, which is important given the slow-moving nation of demographic changes. In contrast, the second sample is both narrower and shorter but offers a more homogeneous sample—lowering the risk of omitted variables and structural change—and includes data on the term spread.[1]

2. The analysis is based on simple econometric model of panel data with fixed effects. The empirical specification models the nature of financial intermediation in each country and time as a function of the demographic structure and other controls, as follows

$$FI_{it} = \alpha_i + \beta Aging_{it} + x_{it-1}'\Gamma + \tau_t + u_{it},$$

in which *FI* is the log of the ratio of stock market capitalization (market finance) to bank credit (bank finance), both available from the World Bank's Global Financial Development Database 1960–2014), *Aging* is the ratio of population aged 65 or more to population between 15 and 65 years old (from the UN's Demographic Yearbook 1948–2015), and α and τ are country and year fixed effects. *X* is a set of lagged controls which include the level of economic development (log of real GDP per capita), banks' ability to convert deposits into credit (credit to deposits ratio, also in logs), and a dummy signaling the existence of deposit insurance. Other important determinants—like institutional quality or the nature of the legal system—are assumed to be time invariant and absorbed by the country fixed effects.

3. The advantages of market vs. bank finance depends, among other things, on the benefits to maturity transformation—banks' main purpose. The benefits to maturity transformation, everything else equal, are a function of the term premium.[2] Unfortunately, measures of the term premium are difficult to be obtained for many economies. Typically,

$$FI_{it} = \alpha_i + \beta_1 Aging_{it} + \beta_2 Term_{it} + \mathbf{x}_{it-1}'\Gamma + \tau_t + u_{it}$$
$$Term_{it} = \lambda_i + \delta Aging_{it} + \mathbf{x}_{it-1}'\phi + z_{it}'\eta + + \tau_t + \varepsilon_{it}.$$

[1] In both samples, the number of usable observations by country varies considerably. For instance, in the second sample, almost half the countries have 19 or more years of usable data but in 1/5 of the countries in the sample there are fewer than 10 years available. Excluding the countries with fewer than 10 years of data does not change the conclusions of the analysis.

[2] Since banks not only engage in maturity transformation but also take on credit and other types of risk which they can screen and monitor better than other financial intermediaries and markets, bank activity should also benefit more from certain types of risk premiums being higher.

where *Term* is the term spread and ***z*** is a set of excluded instruments. The instruments are the lagged real GDP growth rate, the lagged inflation rate, and the sovereign long-term credit rating assigned by Fitch Ratings.[3] GDP growth and inflation are lagged to avoid joint determination while the credit rating is contemporaneous assuming that its information content is mostly backward looking. GDP growth and inflation are trying to control for the expected path of future interest rates, while the credit rating variable is included because most countries have significant credit risk that is more pronounced at longer horizons.

Annex Table 1. Financial Structure, Aging, and the Term Spread

	Fixed Effects			Instrumental Variables	
	FI (full sample)	FI (AE&EM)	FI (AE&EM)	Term Spread	FI (AE&EM)
GDP per capita	0.167	0.732 ***	0.444 **	-3.754 ***	0.257
Credit to Deposits	-0.575 ***	-0.734 ***	-0.711 ***	0.047	-0.681 ***
Deposit Insurance	0.200	-0.423 ***	-0.407 ***	0.582	-0.079
Aging	-2.184	0.271	-0.123	-7.901 **	0.552
Term Spread			-0.045 ***		-0.201 ***
Inflation				-0.028	
Growth				-0.110 ***	
Credit Rating				0.039 ***	
Observations	2488	666	666	590	590
Number of Countries	113	38	38	34	34
F-test	17.42 ***	42.51 ***	36.93 ***	9.58 ***	28.23 ***
Overidentification					4.33
Underidentification					24.89 ***
Weak Instruments					9.58 (note)
WI Robust Inference					8.73 ***

Sources: ADIC - Association of Deposit Insurance Corporations; Central Bank of Chile; Demirguc-Kunt, Kane, and Laeven (2014); FactSet; Fitch Ratings; Haver Analytics; IADI - International Association of Deposit Insurers; International Financial Statistics; World Bank Global Financial Development Database; and IMF staff.

Note: FI = Financial intermediation structure (ration of stock market capitalization to bank credit); TS = Term spread (difference between a long-term interest rate (usually a 10-year sovereign yield) and a short-term rate (the 3-month treasury bill rate or equivalent, for most countries). Columns 1 through 3 show estimation results using the fixed effects estimator. Column 4 shows the first-stage fixed effects regression of a simultaneous equation model of FI and TS estimated by 2SLS. Column 5 shows the results of the second-stage regression. All specifications contain country and year fixed effects. In column 5, "Weak Instruments" shows the Kleinbergen-Paap statistic which is higher than the 10 percent maximal IV relative bias.

[3] Although it is possible that a country's credit quality influences the composition of the financial system directly, it is far more plausible that it only does so through its effect on the term premium. In this case, it becomes an excludable instrument and assists with identification. The same is assumed for the other two instruments. First because the empirical literature on financial system structure and economic growth has found no reliable relationship. Second, while some banks may be better at providing protection against inflation risk, it is unclear that the level of inflation matters for the composition of the financial system.

4. The empirical analysis suggests that aging may not have a significant direct influence on the structure of the financial system. In particular, the ratio of older-to-working age people does not seem to have a statistically significant association with the financial system leaning more towards market finance or bank finance (Annex Table 1). When the term spread is added to the specification as an explanatory variable, it is highly significant and suggests that a flatter yield curve works against the banks' role in financial intermediation, while aging on its own still has no influence.

5. When the determinants of the term spread are considered explicitly, aging plays a significant role in changing the composition of the financial system. Since the term spread may itself be endogenous and jointly determined with the composition of the financial system,[4] it is important to use an instrumental variables approach. The first-stage regression results in column 5 of Annex Table 1 suggest aging is associated with a declining term spread. For instance, if the old-age dependency-ratio (the ratio of people over 65 years of age to those between 40 and 65) were to increase by one percentage point, then, on average, the term spread would increase by about 8 basis points, everything else equal. Such increase in the term spread, in turn, is estimated to increase the relative size of market finance by about 1.6 percent.

Annex Table 2. Summary Statistics

	Observations	Mean	Std. Dev.	Min	Max
Financial Intermediation	666	-0.465	0.777	-3.407	1.204
Spread	666	1.736	1.887	-3.870	11.921
log GDP per capital	666	9.716	1.120	6.200	11.125
log Credit-to-Deposits	665	4.710	0.357	3.867	5.906
Deposit Insurance	666	0.887	0.316	0.000	1.000
Aging	666	0.185	0.075	0.054	0.419

Sources: Association of Deposit Insurance Corporations (ADIC); Central Bank of Chile; Demirguc-Kunt, Kane, and Laeven 2014; FactSet; Fitch Ratings; Haver Analytics; International Association of Deposit Insurers (IADI); International Financial Statistics; World Bank Global Financial Development Database; and IMF staff.

[4] For instance, there may be preferred-habitat investors with a preference for long-lived assets that push the term premium—and, everything else equal, the term spread—downwards (Vayanos and Vila 2009).

Annex II. Life-Cycle Model of Portfolio Choice

1. The model is that of Cocco, Gomes, and Maenhout (2005) with a small modification.[1] Their model has a structure where agents/households (of age 19 and above) live for a finite number of periods (T=81, that is, they live at most until 100 years of age) with a given probability p_t of being alive at time *t+1* conditional of being alive at *t* (*t* is the age of the individual). Asset returns are exogenous. We propose a small modification to the model which will alleviate this shortcoming. The rest of the model is as follows.

a. Optimization problem and preferences. Householders maximize lifetime expected utility and their preferences are defined over life-time consumption (*C*) and cash-at-hand (*X*)—the latter will define a bequest motive for asset accumulation. The solution to the household's optimization problem is given by the solution to the following Bellman equation sub:

$$V_{it}\left(X_{it}\right)=\max_{C,\alpha}\left\{U\left(C_{it}\right)+p_t\beta E_t\left[V_{i,t+1}\left(X_{i,t+1}\right)\right]\right\}, \tag{0.1}$$

where

$$U\left(C_{it}\right)=p_{t-1}\frac{C_{it}^{1-\rho}}{1-\rho}+b\left(1-p_{t-1}\right)\frac{\left(X_{it+1}/b\right)^{1-\rho}}{1-\rho},$$

and ρ is relative risk aversion coefficient, β is a discount factor, and *b* is the strength of the bequest motive. Given that this is finite period model, there is the need for a terminal condition for (1.1):

$$V_{T+1}=b\left(X_{T+1}/b\right)^{1-\rho}/\left(1-\rho\right).$$

b. Labor income. Labor income before retirement (t<46, that is, age 65)[2] is defined by the following stochastic processes

$$\begin{aligned} &Y_{it}=P_{it}U_{it},\\ &\log P_{it}=f\left(t,Z_{it}\right)+\log P_{it-1}+\log N_{it},\\ &\log N_{it}\ \square\ iid\left(-0.5\sigma_n^2,\sigma_n^2\right),\\ &\log U_{it}\ \square\ iid\left(-0.5\sigma_u^2,\sigma_u^2\right), \end{aligned} \tag{0.2}$$

where *P* is the permanent component of income which follows a random walk with deterministic drift $f(t,Z_{it})$, dependent on age and household characteristics. *U* is the

[1] The model is solved using a MATLAB code which builds on Cocco, Gomes, and Maenhout's (2005) FORTRAN codes, available at http://faculty.london.edu/fgomes/cgmcode.ZIP.

[2] The retirement age is assumed to be 65 which will be the mandatory retirement age in 2025.

temporary component of income. Labor income after retirement is a constant fraction of P given by

$$Y_{it} = \phi P_{it}.$$

c. Disaster risk. The model considers the possibility that a given household suffers a large loss in working or retirement income. The assumption is that with a probability *q* income drops to 25 percent of its current permanent component.

d. Asset markets. There are two assets: a short-term risk-free bond or bank deposit that yields a constant return R^f and a risky long-term asset—a stock or a perpetuity depending on the stochastic process assumed for returns—which can be liquidated in case of death for a fee μ. The return on the risky asset can be correlated with labor income and is given by

$$R^L_{t+1} = R^f + \mu + \eta_{t+1}, \eta_{t+1} \sim iid\left(0, \sigma^2_\eta\right).$$

e. Wealth accumulation. The next-period cash-at-hand X_{it+1} is given by the following budget constraint,

$$X_{i,t+1} = Y_{i,t+1} + \left(X_{it} - C_{it}\right)\left(\alpha\left(R^L_{t+1} - \left[1 - p_t\right]\lambda\right) + \left(1-\alpha\right)R^f\right), \quad (0.3)$$

where *a* is the portfolio share of long-term asset holdings. As usual in the literature, we assume that short selling is not allowed, that is:

$$B_{it} \geq 0, \quad (0.4)$$

$$L_{it} \geq 0. \quad (0.5)$$

2. The model is calibrated to reflect Japan's mortality rates and age distribution. The values for many parameters follow Cocco, Gomes, and Maenout (2005) with some key exceptions (Annex Table 1). The survival probabilities are taken from Japan's mortality tables. The variances of the temporary and permanent shocks to labor income come from Lise and others (2014) and the replacement rate are calibrated following Abe and Yamada (2009). For simplicity, the calibration ignores the bequest motive and sets *b=0*. The Bellman equation is then solved by backward induction using grid search.

Annex Table 1. Calibration

	Parameter	Value
ρ	Risk aversion	10
$\sigma 2_{\eta}$	variance of shock to asset return	0.156
σ^2_{u}	variance of temporary income shock	0.03
$\sigma 2_{n}$	variance of permanent income shock	0.01
b	weight of bequests motive	0
λ	liquidity cost	0.001
q	probability of disaster	0.005 or 0.1
ϕ	replacement rate	0.593
μ	average excess return to asset	0.04

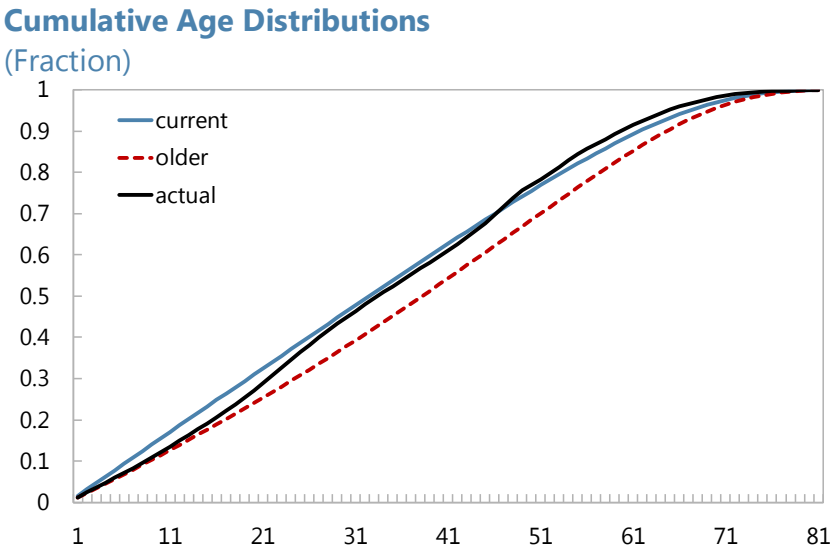
Sources: Cocco, Gomes, and Maenout (2005); Abe and Yamada (2009); IMF staff.

3. The effect of aging is simulated by comparing the solutions of the model with different age distributions. The first simulation uses the stationary age distribution derived from current mortality tables for Japan. The second simulation uses the stationary age distribution derived from slightly higher probabilities of survival (Annex Figure 1). For each age distribution, the model is solved and policy functions for consumption and portfolio choice (as a function of wealth) are derived. The simulation assumes that agents will decide to participate in capital markets (that is, the market for the risky asset) with some probability, depending on their age and wealth.

4. The simulation uses the portfolio choice rules derived by solving the model as well as simulated income profiles and returns to the risky asset. The simulation draws income and returns shocks for 5,500 periods and 2,000 individuals. After discarding the first 500 observations, it builds the income processes and then solves for cash-at-hand, the portfolio allocation, and consumption using the policy rules derived under each age distribution. The simulation assumes an exogenous probability if 5 percent that an individual will participate in the market for the risky asset at age 20 and that probability increases to 25 percent once its wealth is above the median.[3] Finally, it calculates the average portfolio allocation for the risky asset, using the appropriate policy rules and the derived stationary age distributions. Under the current age distribution, the average share of the risky asset is 20.66 percent, with a standard deviation of 0.76 percent. Under the aged age distribution, the share is 23.27, with a standard deviation of 0.63 percent.

[3] These probabilities roughly reproduce what is observed in Japan in terms of participation in equity markets (Fujiki and others 2012).

Annex Figure 1. Age Distributions



Sources: National Institute of Population and Social Security Research; IMF staff calculation.

Annex III. Panel Regression for Regional Banks

1. Data used in the analysis was taken from various sources, broadly covering the time period 1992–2015. Annual bank-level data was taken from FitchConnect, covering 103 Regional banks over the period 1992–2015. Data on prefectural real growth, capital stock, and labor input (measured in hours worked) was taken from the Regional-Level Japan Industrial Productivity (R-JIP) but only covers the period 1992–2008. Finally, data on prefectural inflation and annual prefectural age distributions and overall prefectural populations was taken from the Portal Site of Official Statistics of Japan.

2. The following model was used to estimate the impact of aging and population growth on loan and deposit growth regressions.

$$\Delta logY_{i,r,t} = \gamma \Delta logPOP_{r,t} + \alpha_1 \Delta w20\_34_{r,t} + \alpha_3 \Delta w55\_69_{r,t} + \alpha_4 \Delta w70_{r,t} + \Theta' MF_{r,t} + \Gamma' BF^{d}_{r,t-1} + \delta_i + \theta_t + u_{i,r,t} \quad (2)$$

The dependent variable, $Y_{i,r,t}$, is the amount of outstanding gross loans or deposits for each bank i, in prefecture, r, at time t. Shifts in prefectural age distributions are captured by changes in the age groups, $w20\_34$, $w55\_69$, and $w70$, and are expressed as shares of the adult population in each prefecture (i.e., those aged 20 and above). Since the sum of all age groups add to one, the age group 35–54 is excluded to avoid perfect collinearity. The second demographic variable of interest is prefectural population growth which is denoted by $\Delta logPOP$. The regression also controls for macroeconomic factors, $MF_{r,t}$, (i.e., prefectural real GDP growth, prefectural inflation, and lagged prefectural capital/labor ratios), and banks specific factors, $BF_{r,t}$ (i.e., the capital to asset ratio, return on assets, non-interest expenses as a share of income, and loan impairment costs). The bank specific factors are lagged one period as they are likely to be affected by contemporaneous changes in credit and deposit growth. Finally, the panel regression includes bank fixed effects, δ_i, and some specification includes time fixed effects, θ_t as well. Standard errors are clustered around individual banks.

3. The results are presented in Annex Table 1 suggests that aging and population growth have non-trivial impact on loan and deposit growth. Specification (1)-(5) corresponds to credit growth regressions, while specification (6)–(9) corresponds to deposit growth regressions. Specification (1)–(2) and (6)–(7) include both time and banks fixed effects, while the other specifications only includes bank-fixed effects. The exclusion of time-fixed effects in some specifications was motivated by the fact that some changes in dependent variables such as prefectural macroeconomic conditions and population growth tend to be highly correlated across prefectures, suggesting that most of the information pertain to movements over time. Moreover, speciation's (1), (3), (6), and (8) only includes demographic variables while the other specifications control for both macroeconomic and bank specific factors. In general, the results show a strong inverted U-shaped relationship between aging and deposit/loan growth, while the population

growth only shows up as significant when year effects are excluded. However, the lagged capital-labor ratio is highly significant and negative when included.

Annex Table 1. Loan and Deposit Growth Regressions

	Loan Growth					Deposit Growth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Demographic variables (prefectural level)									
Population growth	0.305	-0.854	1.494**	2.218**	0.106	-0.557	-0.230	-0.375	1.070**
Δ in age group share 20-34	-2.454***	-1.456**	-1.702***	-1.726***	-2.465***	-2.287***	-1.737***	-1.268***	-0.512
Δ in age group share 55-69	-1.668**	-2.202**	-0.446	-0.261	-0.231	-1.325***	-1.670***	-0.791**	0.0129
Δ in age group share 70+	-2.174***	-1.531**	-2.638***	-1.896***	-1.965***	-2.088***	-1.315**	-2.267***	-0.726*
Macroeconomic variables (prefectural level)									
Inflation		-0.0822		0.907***	0.480***		-0.217		0.210*
Real GDP growth		0.0942		0.175***	0.157***		0.0559		0.0121
Capital-labor ratio (lagged)		-0.0922***		...	-0.0743***				
Bank specific variables 2/									
Capitalization	0.953*	1.105**	0.836	0.975*	1.055**	0.0774*	0.0971**	0.0435	0.0854**
Profitability	0.00951	0.0165	0.00372	0.0129	0.0112	0.0232***	0.0272***	0.0153**	0.0203**
Efficiency	0.00185	-0.00663	0.00297	0.00136	-0.0183	-0.00460	-0.00823	0.00874	-0.000674
Loan quality	-0.426	-0.265	-1.071*	-0.676	-0.544	-1.060***	-1.033***	-1.168***	-1.075***
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	No	No	No	Yes	Yes	No	No
Observations	2,442	1,766	2,442	1,766	1,766	2,442	1,766	2,442	1,766
R-squared	0.239	0.310	0.255	0.231	0.255	0.108	0.114	0.067	0.075
Number of banks	103	103	103	103	103	103	103	103	103

Source: IMF staff estimates.

1/ Robust standard errors in parentheses. ***, **, and * signify significance at the 1, 5, and 10 percent levels, respectively.

2/The bank specific variables are all lagged one time period. Capitalization is measured by the simple capital-asset ratio. profitability by return to assets, efficiency by the cost-income ratio, and loan quality by impairment cost.

4. The following model was estimated to assess the influence of demographic factors on banks' choice of business model.

$$BM_{i,r} = \gamma \Delta logPOP_r + \alpha_1 w20\_34_r + \alpha_3 w55\_69_{r,} + \alpha_4 w70_r + \Theta' RCF_r + \Gamma' BF_r + \theta_Y + u_{i,r} \quad (2)$$

The dependent variable, $BM_{i,r,}$ is a discrete variable that takes the lowest value when a bank is classified as using a securities-oriented business model, and the highest value when a bank has adopted the lending-based business model. Equation (2) was estimated using an ordered probit model. This implies that a negative coefficient indicates that a change in a dependent variable increases the likelihood of switching to a more securities-oriented business model, while a positive coefficient indicates an increased the likelihood of switching to a more loan oriented model. The

dependent variables include population growth, $\Delta logPOP_r$, and the age group share (excluding the age group 35-54), real income per capita, RC (to control for prefectural level of economic development, and the bank specific factors, BF. Some specifications also include a year fixed effect, denoted θ_Y.

5. The results displayed in Annex Table 2 show a strong relationship between demographics and banks' choice of business model. Specification (1)-(3) excludes year fixed effects. Speciation (1) and (4) only includes demographic variables, while (2) and (5) also includes bank specific factors, and (3) and (5) includes all dependent variables. The coefficients on older age groups are significant and negative across specifications, indicating that banks that face older populations tend to gravitate towards more securities and fee oriented banking. The result for population growth is only positive and significant for specification (2), which excludes year fixed effects.

Annex Table 2. Determinants of Banks' Choice of Business Model

	(1)	(2)	(3)	(4)	(5)	(6)
Demographic variables						
Population growth	-4.722	16.93**	-7.132	-4.442	5.313	-10.29
Age group share 20-34	2.352	-0.00765	-0.419	2.409	2.661	7.314**
Age group share 55-69	-7.453***	-12.35***	-13.38***	-8.889***	-12.49***	-10.56***
Age group share 70+	-7.506***	-2.899**	-4.404***	-5.800**	-2.052	-10.56***
Bank specific variables 2/						
Capitalization		-27.19***	-29.35***		-27.66***	-29.17***
Profitability		1.148***	1.014***		1.274***	1.061***
Efficiency		0.864***	0.834***		0.721***	0.606**
Loan quality		14.25***	14.19***		9.362*	9.302*
Macroeconomic variables						
Real income per capita			0.407**			0.313*
Year fixed effects	No	No	No	Yes	Yes	Yes
Observations	2,442	2,536	1,968	2,557	2,536	1,968

Source: IMF staff calculations.
1/ Robust standard errors in parentheses. ***, **, and * signify significance at the 1, 5, and 10 percent levels, respectively.
2/Capitalization is measured by the simple capital-asset ratio, profitability by return to assets, efficiency by the cost-income ratio, and loan quality by impairment cost.

Annex IV. Financial Constraints for Japanese SME's

This section estimates the intensity of financial constraints using the Kaplan and Zingales (KZ) index and investment-cash flow sensitivity of SMEs. The KZ index for SMEs is constructed based on firm-level data on cash flow, debt, cash, and capital (Kaplan and Zingales 1997). To complement the analysis, the study also investigates the investment-cash flow sensitivities based on firm-level data. Firms facing financial constraints tend to have higher investment-cash flow sensitivity (Gelos and Werner 2002).

A. The Kaplan and Zingales Index (KZ Index)

1. The Kaplan and Zingales (1997) index measures the degree to which firms are likely financially constrained, and is higher for firms more likely to be constrained. We follow the Fund's corporate vulnerability Utility and Lamont and others (2001) in constructing this index:

KZ Index= - 1.001909*[cashflow to capital] + 0.2826389*[Tobin's Q] + 3.139193*[debt to capital] - 39.3678*[dividends to capital] - 1.314759*[cash to capital]

These coefficients are based on regressions by Kaplan and Zingales (1997) 4. After calculating the KZ index for every firm, Lamont et al. (2001) classify the top 33 percent of all firms ranked on the KZ index as constrained. An important caveat to the Kaplan and Zingales (1997) index is that its coefficients are based on U.S. data. These coefficients may not carry over to other countries, where financial markets are less developed or institutions and regulatory frameworks differ. But still, for this exercise, we can apply and compare across the countries.

2. For our analysis, we estimate the KZ index for SMEs in Japan with the following steps:

i. The KZ index for SMEs is calculated with firm-level data for 2015 from the Orbis database of Bureau Van Dijk using the KZ formula, excluding Tobin's Q and dividends, which are not available for private firms. The higher the KZ, the higher the probability that a firm is financial constrained.

ii. The KZ index for all firms is derived for public listed firms and defines the top 25 percent as likely financially constrained.

iii. The number of SMEs that have a KZ index above the threshold obtained in Step 2 is counted to obtain the percentage of SMEs that are likely to be financially constrained.

3. The share of firms with KZ index above the threshold suggests that about one third of SMEs face significant financial constraints (Annex Table 1). This level is about 7 and 15 percentage points higher than in Germany and France, respectively (Figure 11). This result comes with two caveats. First, the KZ index is calculated setting Tobin's Q and dividends to zero because

there are no data for these variables. Second, due to data limitations, the number of Japanese firms used in the sample is considerably smaller than that of French or German firms.

Annex Table 1. Financial Constraints (Kaplan-Zingales Index)

	Japan	France	Germany
KZ* (top 25% of all firms)	0.23	0.41	1.09
SMEs with KZ> KZ*	1,253	39,816	1,134
Number of SMEs in sample	3,730	212,542	4,346
Share of SMEs with Financial Constraints (%)	33.6	18.7	26.1

Source: IMF staff estimates.
Note: SME is defined as a firm with employees fewer than <100.

B. Estimates of the Investment-Cash Flows Sensitivity

4. To complement the KZ index, the study also examined financial constraints by estimating investment-cash flows sensitivity at firm level. An important strand of the corporate finance literature argues that the sensitivity of investment to internal funds should increase with the wedge between the costs of internal and external fund (see, for instance, Bond and Van Reenen (2007), Almeida and Campello 2007). In an environment of informational asymmetries, external funds can be more costly than internal funds due to the need to compensate lenders for adverse-selection and moral-hazard problems. In contrast, higher cash flows improve the financial position of the firm and increase the internal funds available for investment. Therefore, investment should respond positively to an improvement in cash flows. Nonetheless, several studies cast doubt on the interpretation of investment-cash flow sensitivity as evidence of capital market imperfections (Kaplan and Zingales, 1997, Cummins and others 2006, and Chen and Chen 2012).

5. To mitigate the criticism, this study follows the approach in Almeida and Campello (2007) and Gelos and Werner (2002) by incorporating fixed assets in the analysis. Given banks' reliance on collateral, tangible assets can support borrowing by SMEs. We estimate investment functions in which cash flow is used as a key explanatory variable. We then observe differences in the sensitivity of investments to cash flow by the type of industry in Japan, and, for comparison, in France and Germany.

Data

6. Annual firm data is derived from Orbis database of Bureau van Dijk. SMEs are defined as firms with capital below ¥300 million or that employ under 100 people. The data are between 2005 and 2015. Each firm has information on cash flow, capital, total assets, fixed assets, and depreciation. Investment is defined as $total\ assets_{it}$ —$total\ assets_{it-1}$— $depreciation_{it}$.

Econometric Specification

7. The regression with fixed-effect takes the following forms:

$$\frac{I_{it}}{K_{it-1}} = \propto + \beta_1 \frac{CF_{it}}{K_{it-1}} + \beta_2 \Delta S_{it} + \beta_3 \frac{FA_{it}}{K_{it-1}} + \lambda_t + \nu_i + \varepsilon_{it}$$

where I: investment, CF: Cash flows, K: capital ΔS: sale growth, λ_t: year dummy, v_i: firm fixed effect. Our interest is the sensitivity of investment to internal cash flow, β_1. FA denotes the value of fixed asset owned by the firm. We expect β_1 to be larger for firms with higher financial constraints.

C. Results

8. The results for the estimation of investment functions are shown in Annex Table 2. The coefficient associated with cash flow (β_1) in Japan is higher than those in France and Germany. This suggests that a proportion of SMEs in Japan more likely more financially constrained—than those in France and in Germany. In addition, the value of fixed assets also affects investment decisions.

Annex Table 2. Comparison of Investment-Cash Flow Sensitivities

Variables	Japan	Germany	France
Cash Flows	0.33***	0.23***	0.29***
	(0.085)	(0.010)	(0.003)
Sale Growth	0.49***	0.60***	0.08
	(0.109)	(0.054)	(0.095)
Fixed Asset	0.06***	0.01***	0.39***
	(0.010)	(0.001)	(0.002)
Observations	3,147	44,095	140689
R-squared	0.155	0.059	0.289

Source: IMF Staff estimates.
Note: All regressions include firm and year fixed effects. Robust standard errors in parentheses. ***, **1 and * signify significance at the 1, 5, and 10 percent levels, respectively.