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REPUBLIC OF KOREA

FINANCIAL SECTOR ASSESSMENT PROGRAM

September 2020

TECHNICAL NOTE—NON-FINANCIAL BALANCE SHEET VULNERABILITIES AND RISKS TO FINANCIAL STABILITY

This Technical Note on Non-Financial Balance Sheet Vulnerabilities and Risks to Financial Stability for the Republic of Korea FSAP was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed in September 2020.

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September 1, 2020

TECHNICAL NOTE

NON-FINANCIAL BALANCE SHEET VULNERABILITIES AND RISKS TO FINANCIAL STABILITY

The content of this Technical Note is based on information available as of end-June/December 2019, before the global intensification of the COVID-19 outbreak. It focuses on the Republic of Korea's medium-term challenges and policy priorities and does not cover the outbreak or the related policy response, which has since become the overarching near-term priority.

Prepared By
Monetary and Capital Markets Department

This Technical Note was prepared in the context of an IMF Financial Sector Assessment Program (FSAP) in Republic of Korea in August 2019 and December 2019 that was led by Udaibir Das. Further information on the FSAP can be found at http://www.imf.org/external/np/fsap/fssa.aspx

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Glossary

AC	Amortized Cost
AFC	Asian Financial Crisis
BMA	Bayesian Model Averaging
CC	Consumer Credit
CCC	Credit Community Cooperative
CCyB	Countercyclical Capital Buffer

EXECUTIVE SUMMARY AND RECOMMENDATIONS[1]

Non-financial private sector debt remains elevated in Korea and requires close monitoring:

- *Non-Financial Corporate Sector*. Non-financial corporate leverage as share of GDP in Korea remains higher than peer countries but has remained stable since 2013 at around 100 percent of GDP. The stock of non-corporate debt has become slightly more resilient due to the deleveraging of non-conglomerate affiliated firms. Average firm performance has remained resilient for conglomerate-affiliated corporates but weakened for all other firms. As a result, despite the low interest rate environment, around one-quarter of total corporate debt (around 28 percent of GDP) is registered 'at-risk'. Banks balance sheets are at risk as over half of non-financial corporate debt-at-risk resides with SMEs; Stress tests show that (i) Korean firms which are more indebted, less profitable, smaller and have lower turnover are more likely to experience difficulties servicing their debt; (ii) corporate balance sheets are vulnerable to a sudden hike in interest rates, which combined with a profit shock, could double the amount of debt-at-risk held by non-SME firms and; (iii) exchange rate shocks appear manageable given low FX debt and natural FX hedges. Under a downside macro-financial stress test scenario, non-SME credit losses would total a touch over 2 percent of GDP. Bank stress tests suggest that the maximum cumulative bank losses from distressed SME loans in a stress scenario would total around 2 percent of GDP. Together, these losses would be broadly manageable for the financial system to absorb.

- *Households Sector*. The level of household leverage as share of GDP in Korea is among the highest in the OECD and continues to grow. While household loan delinquency rates remain low and there has been little subprime lending, risks to household debt stem from around 50 percent bank loans being linked to floating rates and/or structured as a bullet payment, and a weakening in household balance sheets in recent years. Factors include (*i*) a fall in household balance sheet resilience due to higher leverage and debt service ratios; (*ii*) concentration of household assets in real estate, which is relatively illiquid in the short-term; (*iii*) demographic developments that mean the share of household debt held by retiree households, characterized by relatively unstable income flows, is growing. Despite the low interest rate environment, there exists a tail of households with debt-at-risk, equating to around 14 percent of GDP; this is equivalent to around one-third of Korea's total stock of non-financial debt-at-risk. Around one-quarter of household debt-at-risk is held by retiree households. Stress tests show; (i) income shocks would increase household debt-at-risk by around 40 percent; (ii) retiree households would be hit most from an interest rate shock, given their propensity for floating rate loans, higher leverage and less stable income flows and; (iii) the risk of balance sheet insolvencies from adverse house price shocks rise with age, while younger households are more at risk from adverse income shocks. While the stock of household debt-at-risk and proportion of household debt held with households that have insolvent balance sheets (debt obligations greater than

[1] The author of this note is Sohrab Rafiq (IMF), member of the FSAP 2019 team led by Udaibir Das. The analysis has benefitted from discussions with the staff of the BOK, FSC, FSS, the Korea FSAP team, and reviewers at the IMF.

assets) will rise in an adverse scenario, credit losses for the banking system will remain manageable at around 2.5 percent of GDP.

NON-FINANCIAL CORPORATE BALANCE SHEETS

A. Introduction

1. This paper analyzes the structure of non-financial corporate financing in the Korean economy, their balance sheet vulnerabilities, and their possible channels of transmission through interconnections with the financial system. The objective of this paper is to document the evolution of Korean non-financial corporate debt since the Global Financial Crisis, analyze its riskiness, the quality of allocation of this debt, and uncover potential heterogeneity in balance sheet vulnerabilities across firms that may have implications for debt sustainability and ultimately financial stability. The paper undertakes various firm level panel regressions analysis on a large sample of large, medium and small-cap Korean firms to assess: (i) determinants of debt-at-risk, including the role of macro-financial conditions; (ii) whether there are any Korea-specific factors that affect the capital structure of firms and; (iii) develop empirical models for the purpose of macro-financial stress test scenarios and to characterize risks to financial stability.

2. The main findings of this paper are as follows:

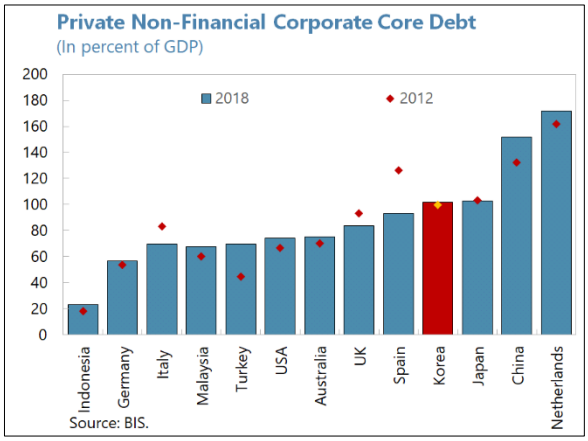
- Since 2013 the debt of Korean non-financial corporations has been relatively stable at around 100 percent of GDP. Non-SMEs hold around 60 percent of total core corporate debt, which is comprised mainly of fixed income instruments. SME debt is around 38 percent of GDP and is almost entirely composed of bank loans. Since 2013 smaller firms have deleveraged, while conglomerate-affiliated firms have maintained their leverage ratios. Corporate FX debt has been falling and remains low;
- Conglomerate-affiliated firm leverage has been driven by bond issuances and is mitigated by an increase in cash holding. The fall in interest rates has helped contain the debt service ratios across non-financial sector corporates;
- Profitability for non-conglomerate firms has weakened significantly in recent years. There has been a significant divergence in corporate performance between large and smaller corporates. The share of firms with short-term liquidity risks, debt-at-risk and negative return on assets has risen;
- Around 28 percent of non-financial corporate debt is at risk. Importantly for the stability of the banking system over 50 percent of this resides with SMEs. Non-SME debt-at-risk has fallen due to restructuring in the ship building industry;
- Empirical analysis suggests that the low-for-long interest rate environment has been a conducive environment for Korean firms with weaker balance sheets from defaulting. However, the analysis also suggests corporate debt may not be allocated efficiently across corporates. Macro-financial conditions impact firm average profitability as well as the likelihood that a firm may belong to the left tail of the distribution of debt-servicing capacity (debt-at-risk, defined as

debt of firms with an interest coverage ratio below 1), after controlling for various firm characteristics;

- Static stress tests show that the Korean corporate sector may be vulnerable to a sudden hike in interest rates. The low interest rate environment has been conducive to poorly performing corporates. Combined with a profit shock, corporate debt-at-risk would increase significantly. Exchange rate shocks appear more manageable given low FX corporate debt and natural FX hedging;
- A stress scenario based on Korea's typical historical crisis episodes suggest that default risks for non-SMEs would rise but would remain lower than default risks registered during the Asian and Global Financial Crises. Moreover, at around 2 percent of GDP, expected and unexpected credit losses will be manageable for the financial system;
- Despite the small credit losses for non-SME firms in a stress scenario, due to strong corisk between large corporate solvency risks and SME performance, there are risks to bank balance sheets.

B. Stylized Facts on Non-Corporate Balance Sheets

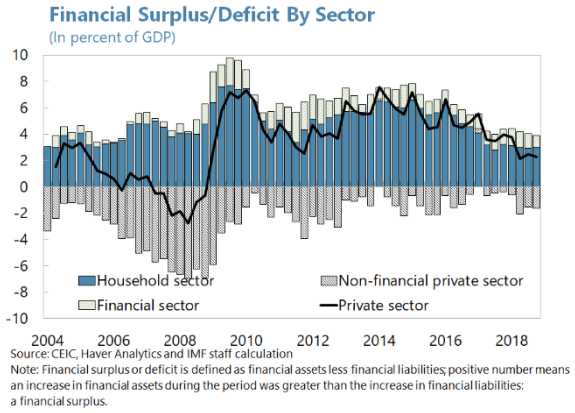
3. Corporate leverage in Korea is slightly elevated compared to peer countries. Since 2013 the consolidated debt of non-financial corporations has remained relatively stable at around 100 percent of GDP. Around 60 percent of this is held with non-small-medium size enterprises (non-SMEs). The majority (80 percent) of non-SME debt is concentrated in less than 50, mainly conglomerate-affiliated, firms. The non-financial corporate leverage cycle grew rapidly in the years leading up to the Global Financial Crisis. Since then leverage flows have been subdued. This contrasts with the experience of other Asian countries where non-financial corporate debt has risen. Leverage is relatively spread between economic sectors in Korea, but more elevated in SMEs (Figure 1).



4. Non-SME exposure to the banking system is small and has fallen since the GFC. Banks' exposure to non-SME firms is low at around 6 percent of GDP. In contrast, the banking systems exposure to the SME sector is around 32 percent of GDP and is mostly secured against commercial and residential real estate; there is little non-financial corporate bank risk-based lending in Korea. Around 80 percent of the stock of corporate debt is linked to floating rates.

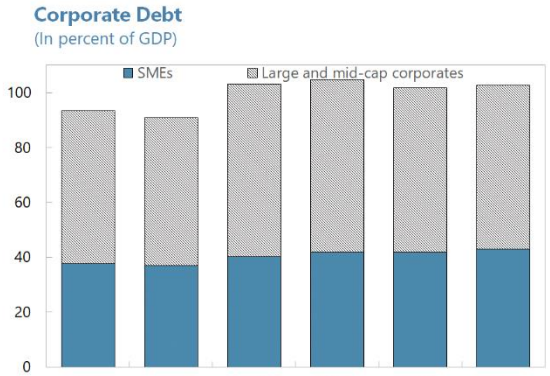
Figure 1. Korea: Non-Financial Corporate Leverage and Debt Structure

Korean non-financial corporates have been financed by surplus savings in other economic sectors.



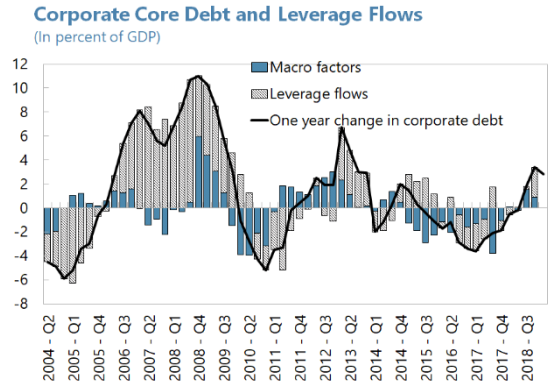
Source: CEIC, Haver Analytics and IMF staff calculation
Note: Financial surplus or deficit is defined as financial assets less financial liabilities; positive number means an increase in financial assets during the period was greater than the increase in financial liabilities: a financial surplus.

Non-financial corporate debt is split approximately 60-40 between large and SME firms.



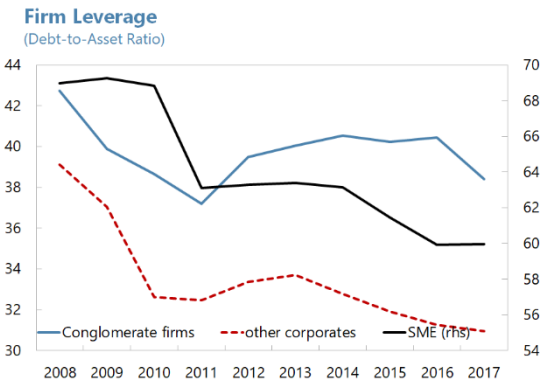
Source: Orbis, Bank of Korea and IMF staff calculations.

Since the GFC the corporate leverage cycle in Korea has remained subdued.



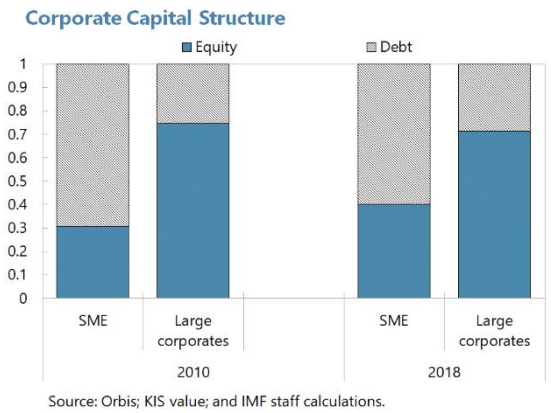
Source: BIS, Haver and IMF staff calculations.

Leverage has declined for smaller corporates and stabilized for larger ones, but firm leverage is highest for SME.



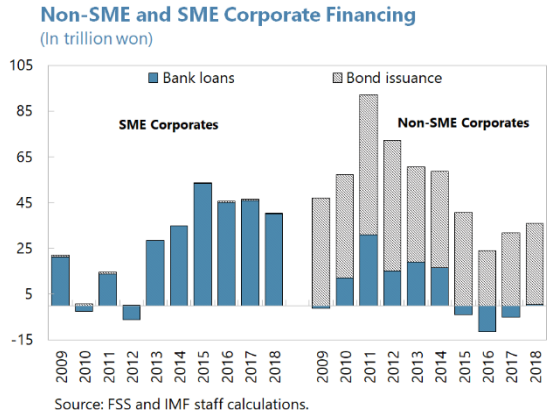
Source: Orbis; KIS Value; and IMF staff calculations.

The capital structure of larger firms is much less reliant on debt compared to SMEs.



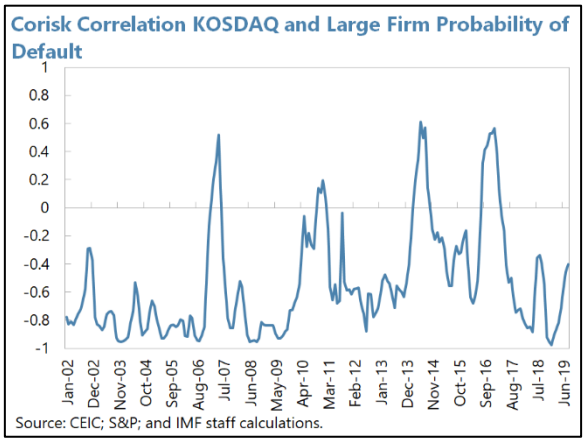
Source: Orbis; KIS value; and IMF staff calculations.

SME firms are much more reliant on bank financing than larger corporates.



Source: FSS and IMF staff calculations.

5. The debt structure for non-SMEs is market based while SME debt is owed to banks. The rise in bond financing, much of which is investment grade, for non-SMEs partly reflects a growing cost of capital differential between capital market and equity and bank financing. The higher cost of equity partly reflects Korean firms being valued at a discount relative to their performance. The discounted performance in turn reflects the low dividend payouts of Korean corporates and concerns over governance.



6. The capital structure of SMEs is characterized by more debt compared with larger corporates. The average debt-to-asset ratio for SME firms is around 60 percent compared to 30 percent for non-SMEs.

7. Non-SME firms' performance is closely tied to the export sector and are a systemic source of risk for banks due to their interconnectedness with SMEs. The data shows a strong corisk correlation between non-SME performance and the KOSDAQ index: an aggregate proxy performance indicator for Korean SME firms. As non-SME corporate performance is closely tied to the export sector bank balance sheets are significantly exposed to external shocks despite small core and non-core foreign liability exposures. The data reports a close correlation between bank and non-SME firm default risks, as measured by their probability of defaults (PDs).

8. Since the GFC the share of corporate FX borrowing has been declining and is low. The share of FX corporate bank lending has declined since the Global Financial Crisis and is now around 4 percent of total non-financial corporate lending. Based on limited available data the share of market-based FX corporate debt has also declined since the Global Financial Crisis and is currently around 11 percent of total market based corporate debt. Much of this debt is hedged, either naturally or through swaps.

9. Since the GFC corporate leverage, as defined by the debt-to-asset ratio, has fallen for smaller firms but remained stable for conglomerate-affiliated firms. While leverage remains greatest for SME firms, non-conglomerate firms, who were most affected by the Global Financial Crisis, have deleveraged. Together, this implies that a larger share of the stock of corporate debt is being held by stronger balance sheet firms. The deleveraging for non-conglomerate firms reflects a growing non-financial corporate cash balance. There is also been an increasing reliance on internal finance for investment, measured here using the Kaplan-Zingales index.

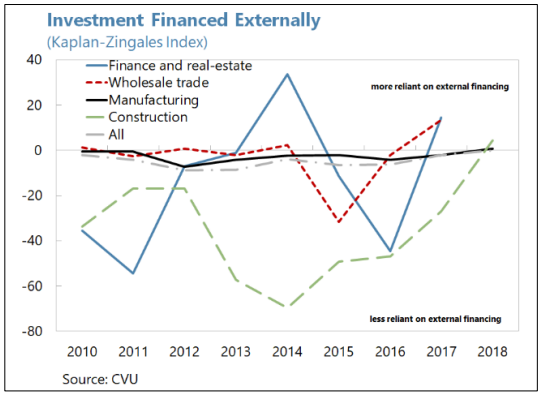
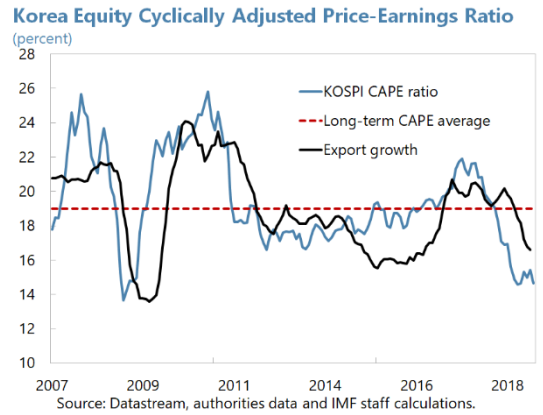


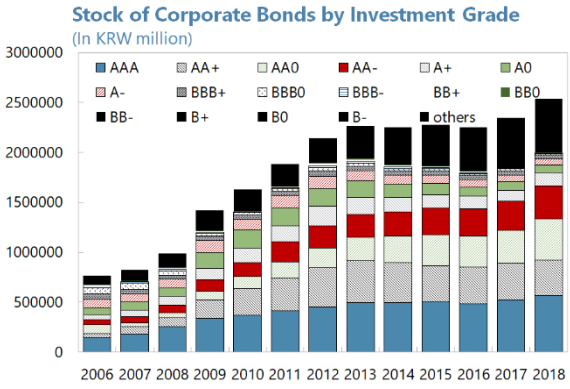
Figure 2. Korea: Non-SME Corporate Debt Risks

Corporate performance is closely tied to the export sector.



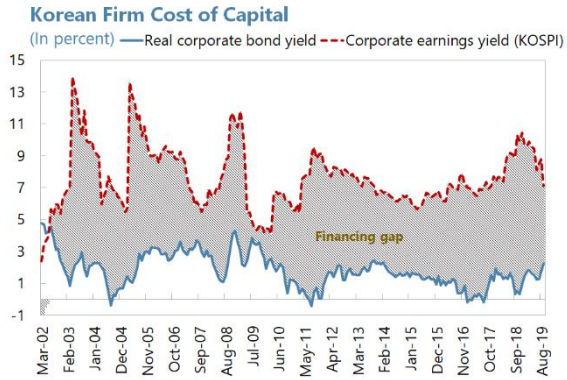
Source: Datastream, authorities data and IMF staff calculations.

Non-SMEs rely on bond financing, much of which is investment grade…



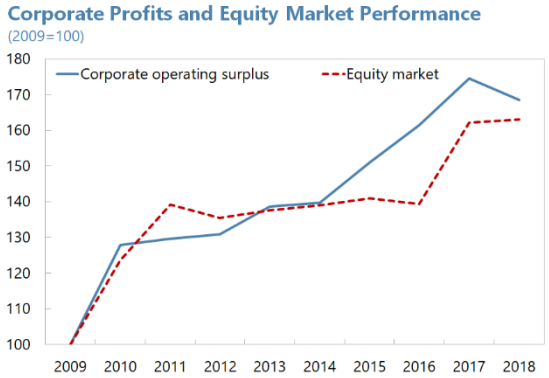
Source: Korea capital markets institute.

…due its lower cost compared to equity.



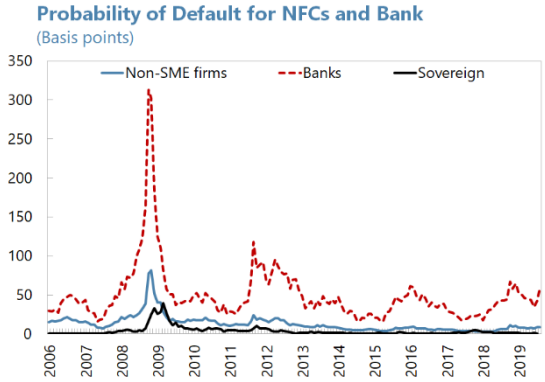
Source: CEIC; Haver; and IMF staff calculations.

Equity costs are higher for Korean firms due to them being valued at a discount relative to performance.



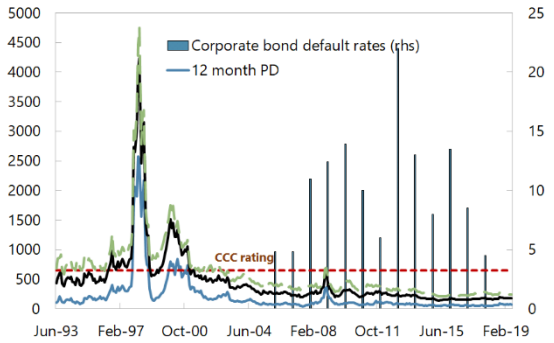
Source: Haver; and IMF staff calculations.

Nonetheless, non-SME corporate and bank default risks are closely correlated.



Source: S&P; and IMF staff calculations.

Currently non-financial corporate default risks remain contained.



Source: S&P; Korea Capital Market Institute; and IMF staff calculations.
Note: CVI measures the relatively more distressed firms in a group based on the 5th percentile of firm PDs.

10. There has been a growing disparity in non-financial corporate performance. Since 2014, on the back of expanding global trade, firm profit margins and ROAs rose for conglomerate affiliated firms (Figure 3). However, these indicators deteriorated for non-conglomerate firms; the number of non-SME non-conglomerate firms reporting a negative return on assets and/or two consecutive years of negative operating income growth has increased while firm profit margins also declined for smaller firms. Firm activity performance indicators—asset turnover or the sales-to-asset ratios—suggest that non-financial corporate debt has not significantly improved firm efficiency.

11. Aggregate corporate liquidity buffers have remained stable, but the proportion of firms with short-term liquidity risks has risen. The current ratio, which measures a firms' ability to pay its short-term liabilities with current assets, has remained stable and above the minimum threshold of 1. The aggregate solvency ratio, which measures a firms' ability to meet its short- and long-term liabilities, for both conglomerate and non-conglomerate firms has also remained stable. However, the share of non-SME firms with a liquidity ratio below 1—i.e. firms that cannot meet their short-term obligations—has risen markedly since 2011.

12. Around one-quarter (28 percent of GDP) of non-financial corporate debt is considered 'at-risk' of which just around half of is held by on the balance sheets of SMEs. Around half of total SME debt is estimated to be at-risk and is held by firms that have a ROA below 1, posing a significant risk to banks balance sheets. As SMEs are the largest source of employment in Korea, continued SME balance sheet weakness also poses significant indirect risks to household balance sheets. Weaker firm performance, as mirrored by a rise in number of firms with a negative ROA and an ICR below 1, has seen the number of non-SME firms with debt-at-risk rise. However, debt risks from non-SME firms should be manageable as the share of total corporate debt held by these weaker firms has fallen since 2013, reflecting debt restructuring in the ship building industry in 2016. As of 2018 around 7 percent of total non-SME corporate debt is held with firms that have an ICR>1, and which are mainly conglomerate-affiliated.

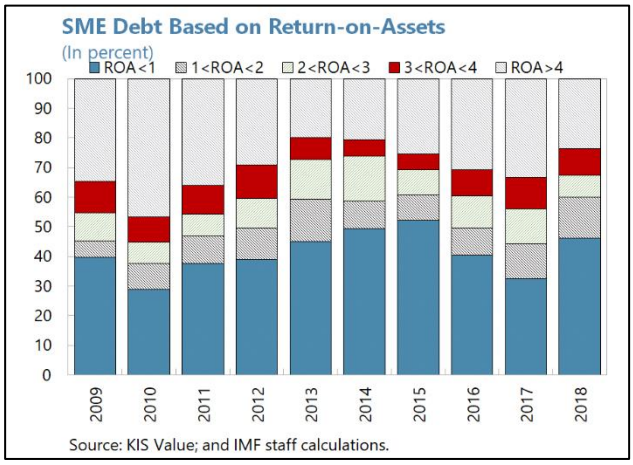
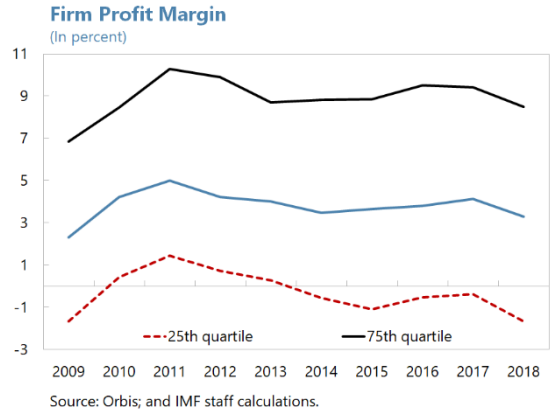


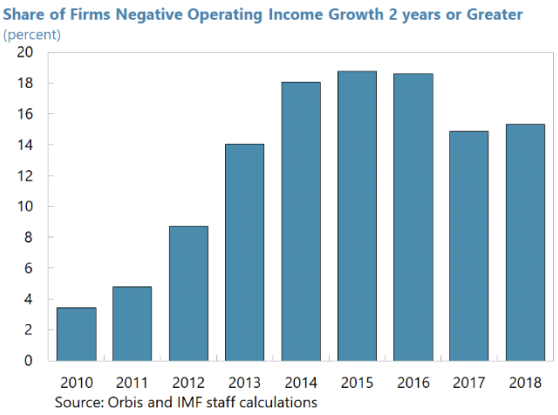
Figure 3. Korea: Non-Financial Corporate Performance and Activity Indicators

For mid- and small-cap non-SME firms profit margins have fallen…



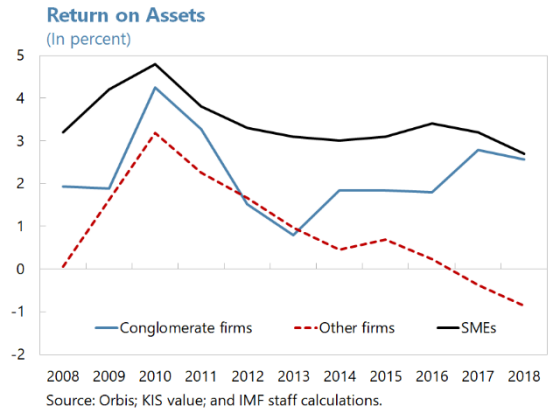
Source: Orbis; and IMF staff calculations.

…which has compressed their income.



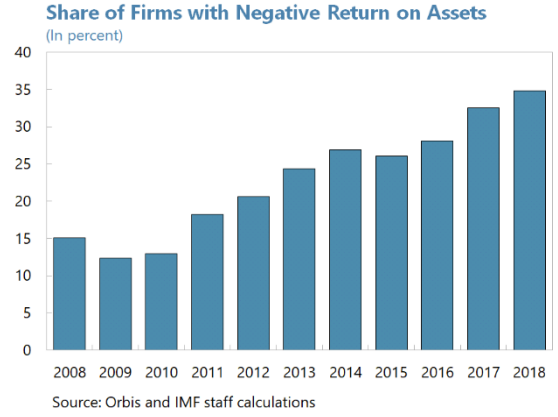
Source: Orbis and IMF staff calculations

Corporate performance has diverged significantly between conglomerate and non-conglomerate affiliated firms…



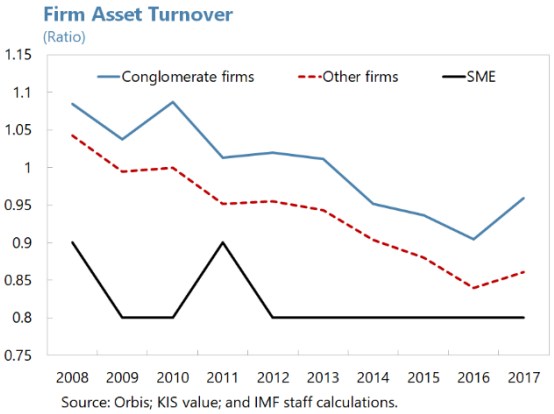
Source: Orbis; KIS value; and IMF staff calculations.

…with the number of firms reporting negative ROA having risen and mainly concentrated in small-to-mid cap firms.



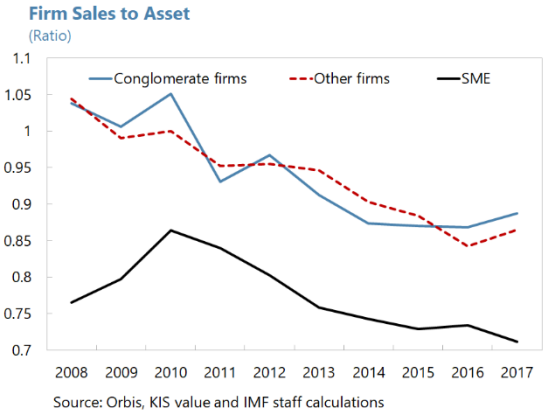
Source: Orbis and IMF staff calculations

The ability of firms to turn a unit of their assets into turnover has fallen…



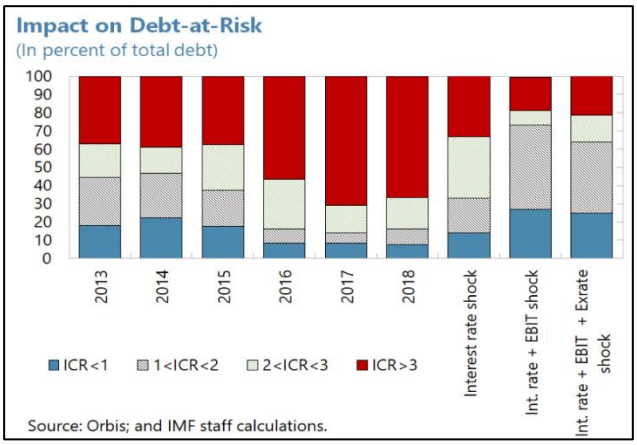
Source: Orbis; KIS value; and IMF staff calculations.

…as their efficiency in using their assets to generate sales has also fallen.



Source: Orbis, KIS value and IMF staff calculations

13. For non-SMEs the low-for-long interest rate environment has been conducive for containing corporate balance sheet vulnerabilities. Static simulations show that in a hypothetical macroeconomic scenario where financial conditions tighten (Box 1), characterized by a sharp rise in the interest rate, the aggregate debt at risk of non-SME firms would rise by 3 percent of total debt. A corporate profitability shock coupled with a rise interest rates would have an even larger impact on the proportion of non-SME debt-at-risk. A sizeable aggregate amount of corporate debt-at-risk would impact the cost of risk in capital markets and the banking system.



Box 1. Shocks to Corporate Balance Sheets

Scenario 1: Interest rate shock. Define the baseline interest rate on debt as interest expense in year *t* relative to last year's debt. We then apply a severe 300 basis point shock to the baseline rate:

$$interest\ expense_{ishock,t} = \frac{i_{rate,t} + 3}{100} * debt_{t-1}$$

Scenario 2: Interest and profit shock. This considers an adverse combined shock, consisting of an interest rate hike and a decline in profits as set out above.

$$ICR_{profitshock,t} = \frac{EBIT_t * (1 - 0.35)}{interest\ expense}$$

The shock in operating income (equivalent to EBIT) directly by assuming a 35 percent decline.

$$EBIT_{ishock,t} = EBIT_t$$

The ICR in the shock scenario is given as

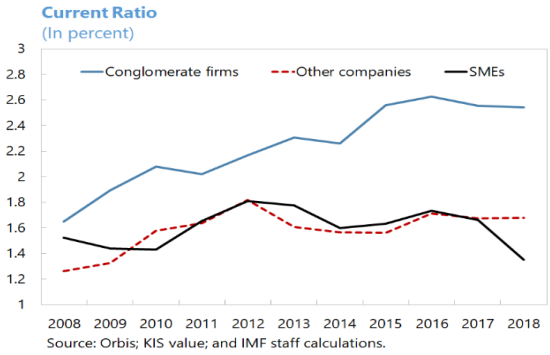
$$ICR_{ishock,t} = \frac{EBIT_{ishock,t}}{interest\ expense_{ishock,t}}$$

Scenario 3: Interest, profit and KRW-US dollar exchange rate shock. In this analysis, a simultaneous shock of 300 basis percent increase in interest expense, 35 percent decline in EBIT and exchange rate depreciation (20 percent against the dollar) is applied across the sample firms.

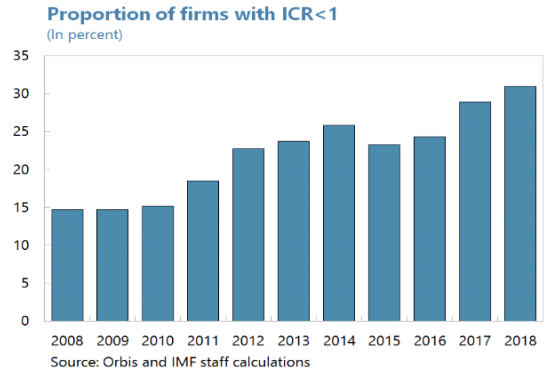
$$Share\ of\ External\ Debt\ x\ Borrowing\ Cost\ x\ Total\ Debt\ x \left[\begin{pmatrix} Share\ of\ USD\ Debt\ x\ Nominal\ Exch.Rate \\ Depreciation\ vs\ USD \end{pmatrix}\right]$$

Figure 4. Korea: Non-Financial Corporate Liquidity Buffers

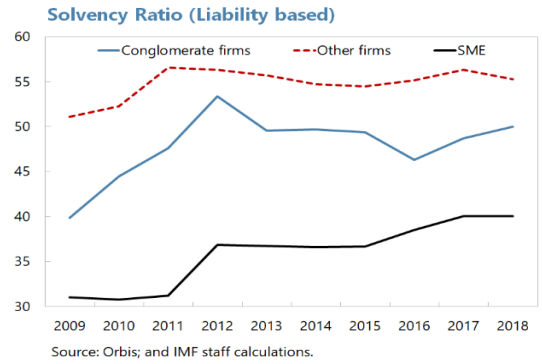
Aggregate short-term liquidity buffer indicators remain above 1 for conglomerates and non-conglomerates.



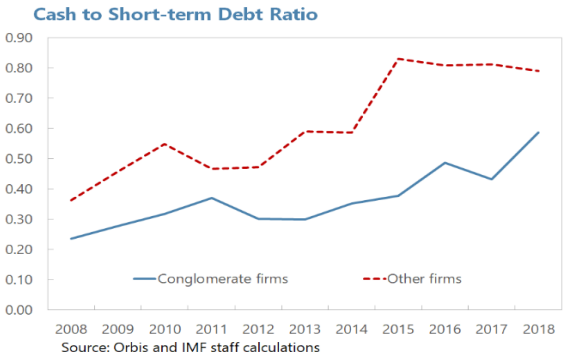
However, the number of non-SME firms at risk of a short-term liquidity risk has risen since 2010.



Firm solvency ratios have remained flat since 2013….



…while the aggregate cash-to-short debt ratio has risen.



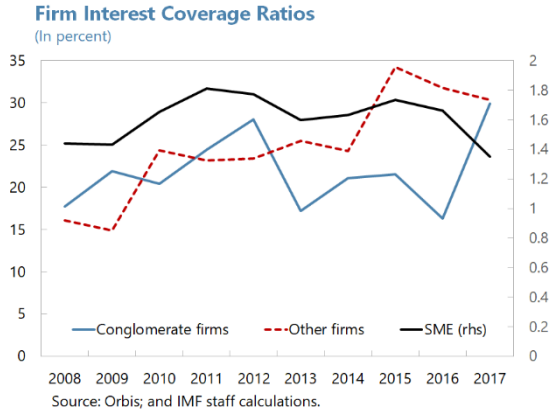
C. Empirical Determinants of Debt-at-Risk Among Non-Financial Corporations

14. This section presents an empirical model of debt-at-risk developed on firm level balance sheets. The model relates the analysis of firm level cash flows to firm level characteristics and macro-financial conditions. The model aims to explain the tail of the distribution of firm level debt servicing capacity, and the evolution of predicted debt at risk in the baseline macro-financial scenario.

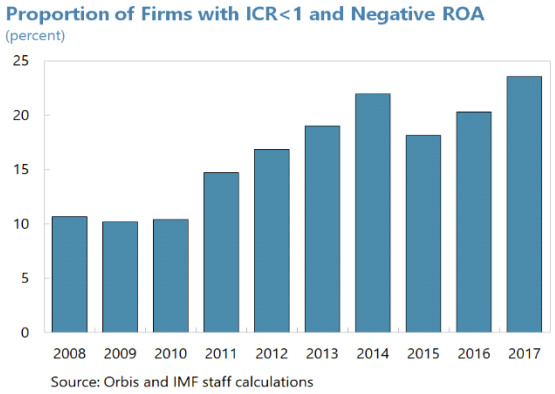
15. Econometric analysis is performed to assess the determinants of Korean firms' cash flow vulnerabilities (Box 3 and Box 4). Firm level Korean corporate data is limited, with no SME balance sheet data. The sample is therefore based on private non-financial companies located in Korea from the Orbis database. The sample covers 2749 firms from 2008 to 2018. The database captures around 60 percent of total core corporate debt stock, which is almost the entire total stock of non-SME corporate debt, most of which is market based. Since the economy is dominated by large conglomerate-affiliated firms, the key systemically important firms and most of firm production in GDP is captured.

Figure 5. Korea: Non-Financial Corporate Debt-at-Risk

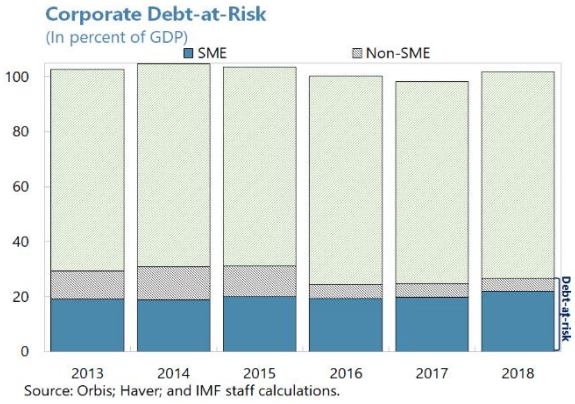
Aggregate ICR for conglomerate-affiliated and other firms has remained relatively stable.



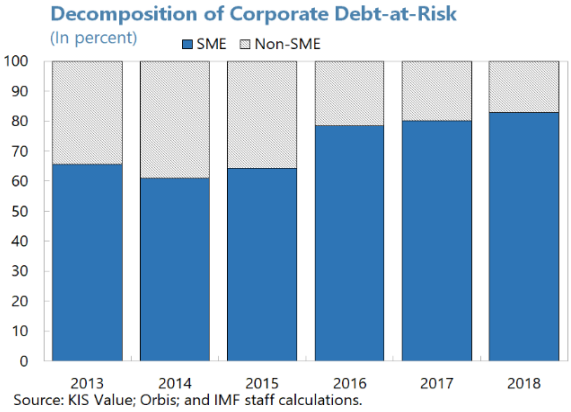
However, the number of firms with debt-at-risk and an ICR<1 has risen.



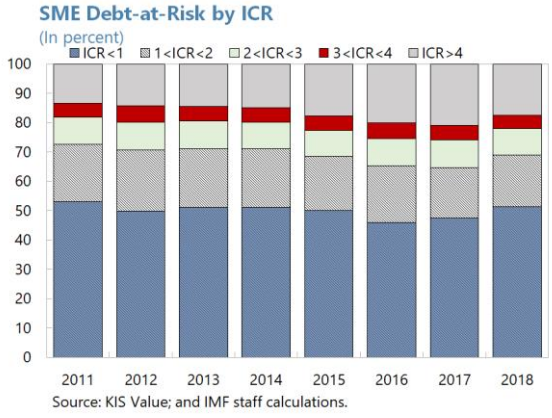
Around one-quarter (28 percent of GDP) of non-financial corporate debt is at-risk…



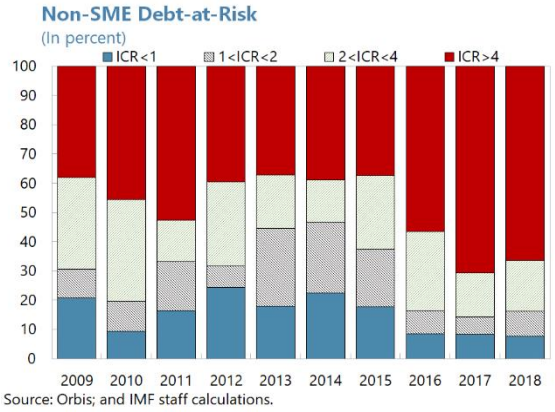
…much of which resides with SME firms.



Over 40 percent of SME debt is considered at-risk…



…while non-SME debt-at-risk has declined owing to debt restructuring in the ship bulding industry.



Box 2. Low for Long Interest Rates, Korean Corporate Leverage and Firm Performance

The traditional view holds that when long-term rates fall the net present value of future cash flows increases, making it more attractive for firms to invest in productivity-enhancing technologies. Low interest rates therefore have an expansionary effect on the economy through stronger firm productivity growth. However, this view is now being reconsidered. An alternate view suggests that

- Low rates encourage greater concentration in market power of large firms. This is because larger firms are better able to take advantage of low rates than their smaller (and lagging) rivals, since the payoff to borrowing to larger firms is greater.

- Dominance of large corporations impacts aggregate corporate performance via lower productivity. Even if these companies' operations are more productive, they can choke off markets to increase their profits. Together, these factors imply that persistent low rates may act as a drag on overall corporate performance and economic growth.

These issues are particularly relevant in Korea where there is significant firm market concentration and low productivity for smaller firms. The data shows that non-chaebol firms have deleveraged (as measured by the firm debt-to-asset ratio) while much larger chaebol-affiliated firms have taken advantage of the lower borrowing costs to maintain or leverage up. The market capitalization of the largest chaebols has grown; Samsung's market capitalization is now around 30 percent of the KOSPI, up from around 20 percent a decade ago. Firm performance (as measured by ROA) between chaebol and non-chaebol affiliated firms has widened, which in part reflects growing market concentration and rising corporate profits. Using micro corporate balance sheet data from 2008 to 2018 on Korea firms the following panel regression is estimated:

$$ROA_{it} = \alpha \cdot ROA_{it-1} + A \cdot firm_{char_{it-1}} + \beta \cdot macro_{financial_{t-1}} + (\beta_7 Firm\ Size * \beta_8 interest\ rate) + \upsilon_{it}$$

The equation relates firm characteristics, including firm size and interest rates, to their performance (ROA). Following Liu, Mian and Sufi (2019) an interaction term is included that interacts changes in interest rates with firm size. A positive value for the interaction term would imply the larger the firm, the greater (more positive) the effect of interest rates on firm ROA. Said differently, the greater the resources available, the stronger the effect of interest rates on firm performance. All coefficients are statistically significant and imply:

$$ROA_{it} = 5.22 + 1.5 \cdot\ operating\ revenue + 0.14 \cdot\ profit\ margin - 3.61 \cdot \frac{net\ debt}{asset} + 0.82 \cdot firm\ size - 0.42 \cdot financial\ conditions + 0.91 \cdot (Firm\ Size * interest\ rate) + \upsilon_{it}$$

- *Firm balance sheet characteristics important*: Profitability is negatively associated with a firm capital structure that carries more debt, and positively with size, turnover and profit margins.
- *Firm size, interest rates and firm performance interact*: The positive coefficient value for the effect of the interaction term implies that the bigger the firm, the greater (more positive) the effect of interest rates on firm performance. This implies that the lower rates are more likely to have benefitted larger firms.

The analysis suggests that persistent low interest have been more beneficial to larger firms. While falling rates have helped contain corporate debt-at-risk, low interest rates could further weaken small corporate performance, eroding their debt servicing capacities. Smaller corporates and, in particularly SMEs, have seen declining performance while a large share of SME debt is estimated at-risk. Larger corporates have maintained their leverage ratios and seen their performance rise. Moreover, due to smaller firms being the largest source of employment in Korea, further small firm balance sheet weakness would also pose significant indirect risks to household balance sheets. Policies should ensure that credit market frictions to viable SME firms remain contained.

Box 3. Corporate Debt Servicing Capacity

The analysis aims to understand the extent to which firms' ability to service their debt are influenced by their characteristics and macro-financial conditions. A panel probit empirical model explains the likelihood that a non-financial firm could experience debt servicing difficulties:

$$P[Risk_{it} = 1] = A \cdot firm\_char_{it-1} + \delta \cdot macro\_financial_{t-1} + \varepsilon_{it} \quad (1)$$

Where $Risk_{it}$ is a binary variable taking a value of 1 if the interest coverage ratio $ICR < \overline{ICR}$ and zero otherwise, where $\overline{ICR}$ is a threshold level (1), $firm\_char_{it-1}$ is a vector of firm level characteristics. These include the debt-to-income ratio of the firm, a measure of the size of the firm (total assets), the turnover ratio (defined as operating revenues as a percent of total assets) and the return on assets and asset composition (the ratio of net fixed assets to total assets). The variable $macro\_financial_t$ synthetizes the state of macro-financial conditions in the economy at date t (see below). ε_{it} is an error term which is assumed to be potentially correlated across firms in any given year, and thus clustered by year. In robustness tests, the error term is modelled to account for industry characteristics: $\varepsilon_{it} = \Delta \cdot \overline{industry\_char_{it-1}} + \gamma_{it}$ where $\overline{industry\_char_{it-1}}$ is a vector of time varying firm characteristics averaged at the industry level and year, and γ_{it} is clustered by year.

Box 4. Corporate Profitability

Also considered is an empirical model of the determinants of profitability. This model will allow an assessment of the extent to which macro-financial conditions have an impact on the profitability of Korean firms. Such effects will generate second round feed-back effects to the debt-at-risk of firms. Specifically, we consider the following empirical model:

$$ROA_{it} = \alpha \cdot ROA_{it-1} + A \cdot firm\_char_{it-1} + \beta \cdot macro\_financial_{t-1} + \upsilon_{it} \quad (2)$$

16. The amount of non-financial corporate debt-at-risk would rise in scenarios of a large unexpected tightening in financial conditions. Firms ability to service their debt is explained by a combination of firm level characteristics and macro-financial conditions (Tables 1 and 2). The estimates show that firms which are more indebted, less profitable, are smaller and have lower turnover are more likely to experience difficulties to service their debt. Profitability, in turn, is negatively associated with a capital structure relying relatively more on debt financing, and positively with size, turnover and the share of fixed assets in total assets. The strong negative correlation between leverage and profitability is possible evidence of misallocation of borrowing across non-financial corporates. Tighter financial conditions negatively impact firms' servicing capacity directly and profitability, while a rise in growth-at-risk affects debt servicing capacity directly as well as profitability. The direct effect of financial conditions is likely to reflect the combination of higher financing costs at large (e.g. including not only the cost of debt finance but also the cost of equity finance) and lower overall profitability.

17. Marginal analysis reports firms with a higher net debt ratio and low ROA or liquidity ratio are more likely to have debt-at-risk. Figure 6 shows the probability of a firm with debt-at-risk when ROA, the current ratio and net debt increase by a predetermined unit. The marginal analysis suggests that firms with a lower ROA have a significantly higher probability of debt-at-risk than firms with a low liquidity ratio, as defined here by the current ratio. Firm ROA in Korea is closely tied to growth performance and financial conditions.

Figure 6. Korea: Marginal Effects of Firm Balance Sheet Indicators on Corporate Debt-at-Risk

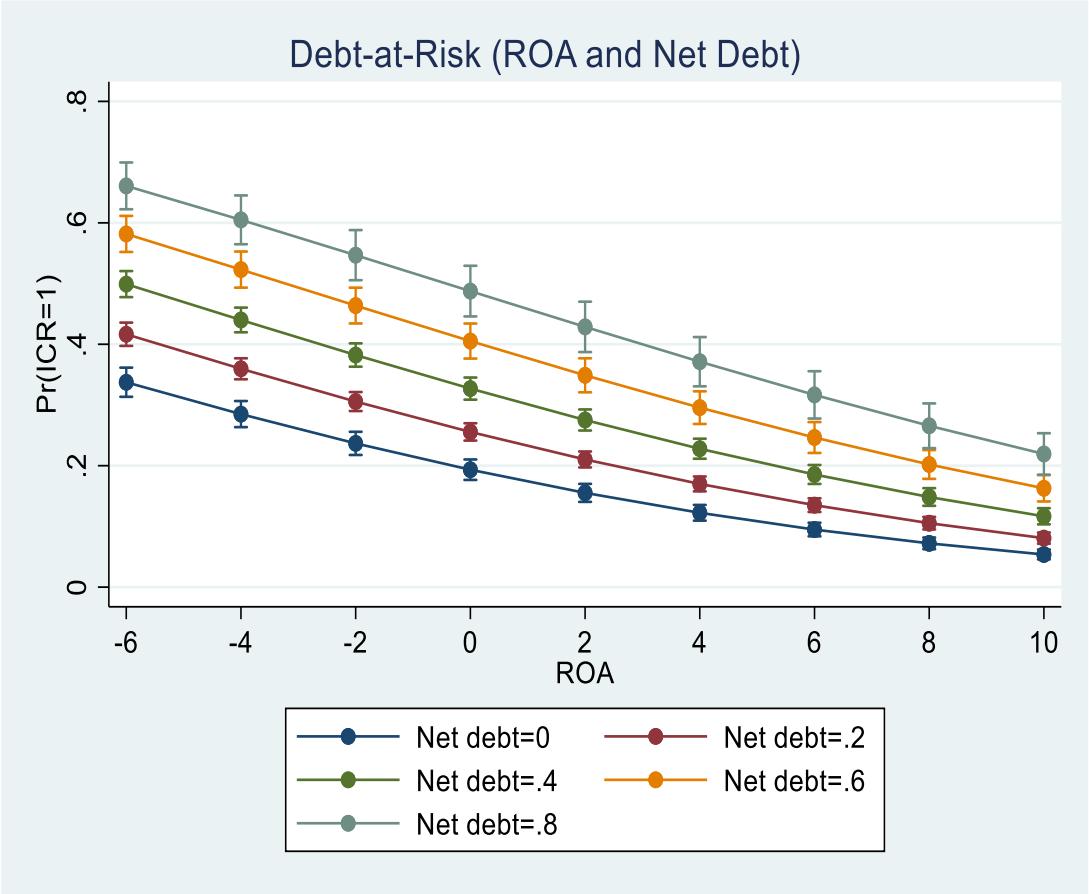


Table 1. Korea: Corporate Debt-at-Risk Probit Regressions (ICR<1)

	(1)	*(2)*	*(3)*	*(4)*
ROA	-0.31***	-0.30***	-0.03***	-0.02**
Debt-to-assets	0.51***	0.50***	0.53***	0.61***
Current ratio				-0.04*
Turnover to assets				-0.39**
Total assets				-0.38***
FCI	**0.02****		**0.02****	**0.02****
Growth-at-risk		**-0.01****	**0.02**	**0.00**
Industry fixed effects	No	No	No	Yes
Constant	-0.85	-0.86	-0.86	-1.62
Pseudo-R2	0.31	0.31	0.32	0.38

Source: IMF staff calculations.
Note: *** (**) (*) denotes 1 (5) (10) percent signifiance level.

Table 2. Korea: Corporate Profitability Regressions

Dependent variable ROA

	(1)	*(2)*	*(3)*	*(4)*
Debt-to-assets	-2.86***	-2.62***	-2.85***	-2.01***
Operating revenue	1.84***	1.90***	1.84***	3.35***
ROA	0.18**	0.18**	0.18**	0.03*
Total assets	1.30**	1.24**	1.30**	2.53***
Profit margin	0.07**	0.07**	0.07**	0.03**
FCI	**0.72*****		**0.59*****	**0.55*****
Growth-at-risk		**-0.21****	**-0.07***	**0.12****
Industry fixed effects	No	No	No	Yes
Constant	-7.81	-7.83	-7.22	-15.7
Pseudo-R2	0.20	0.21	0.22	0.21
Observations	20540	20540	20540	20540

Source: IMF staff calculations.
Note: *** (**) (*) denotes 1 (5) (10) percent signifiance level.

D. Non-SME Firm Corporate Stress Analysis and Risk to Financial Stability

18. To assess how the left tail of the corporate debt distribution responds to shocks, a stress scenario is designed that accounts for shocks to growth and financing conditions. Korean corporates are vulnerable to an evolving external environment. How will corporate solvency risks evolve as the external macroeconomic outlook changes? Firm and financial stability indicators suggest a close nexus and facilitate what-if scenarios.[2]

19. A model is estimated where macroeconomic financial conditions directly affects a firms' ability to honor its obligations, including the timely payment of interest and principal, measured by its probability of default (PD).[3] The analysis is based on a 'bottom-up' dynamic non-SME corporate balance sheet solvency analysis with a three-year horizon. Using micro balance sheet information corporate PDs are projected under different macroeconomic assumptions via both economy-wide and firm-specific risk factors selected as risk transmission channel. These risk factors are assumed to be influenced by the macroeconomic variables and serves as input to the forward intensity model to produce default probabilities of individual firms (Box 5). The projected corporate default risks of individual Korean firms are then used as inputs in a credit portfolio module to calculate the expected credit loss distribution associated with the default risk of individual Korean firms. The sample is based on private non-financial companies located in Korea from the Orbis database. The sample covers 2748 firms from 1992 to 2018. Due to a lack of data SME firms are not included. Nonetheless, the database captures around 60 percent of the total core corporate debt stock, which is almost entirely the total stock of non-SME corporate debt. Since the economy is dominated by conglomerate-affiliated firms, the key systemically important firms and most of firm production in GDP is also captured.

20. The stress scenario is designed and motivated by structural and external considerations. Following the bank stress test scenario, the slowdown is referenced with regards the ongoing trade dispute between the U.S and China, Korea and Japan. Risk is assumed to materialize from the sudden spread of trade protectionism, along with a material drop in China economic activity, which would have material impact on Korea's exports. The scenario assumes a broad-based, worldwide sell-off in equity markets, reflecting general fall in investors' risk appetite, significant capital outflows, coupled with KRW depreciation, potentially resulting in corporate solvency risks of export-oriented NFCs in Korea (Figure 7). It is assumed there will be adverse effects on supply chains and unemployment. Depressed confidence will act as an additional drag on consumption and investment.

[2] While useful as a first approximation of emerging pressure points, static analysis on financial ratios cannot provide a comprehensive view of corporate solvency risk. Accounting-based approaches are static and backward looking, and largely independent of the external or domestic macroeconomic outlook.

[3] Default probability is the likelihood over a specified period, usually one year, that a corporate will not be able to make scheduled repayments. A corporate default event falls under at least one of 3 categories: the default event falls under at least one of three categories, namely, (1) a bankruptcy filing, (2) a delisting due to bankruptcy, or (3) a default corporate action. Default probability, or probability of default (PD), depends not only on the borrower's characteristics but also on the economic environment.

Box 5. Bottom Up Korean Non-Financial Corporate Stress Testing

The analysis aims to understand the extent to which non-SME firms' ability to service their debt are influenced by their characteristics and macro-financial conditions. Corporate stress analysis often does not address the natural dynamic setting of corporate default predictions where common risk factors and firm-specific attributes evolve over time. In this model, macroeconomic and financial conditions directly affect a firm's ability to honor its obligations, including the timely payment of interest and principal, or its probability of default (PD). Default probability is specified as the likelihood over a 12-month period that the corporate will not be able to make scheduled repayments. Conceptually, following Chan-Lau *et al*. (2017) the corporate stress test is undertaken as a four-step procedure:

1. Scenario: A macroeconomic stress scenario is specified (see Figure 8). The stress scenario assumes a decline in Korean GDP growth a tightening in domestic financial conditions, as reflected by a rise in the short and long-term interest rate. Asset prices also decline, as reflected in a real house price adjustment. The scenario also includes external variables, including a temporary fall in China growth (Korea's key export market) and a tightening in global financial conditions.

2. Common and corporate risk factors: Forecast economy-wide and firm specific risk factors under the specified macroeconomic scenario. The economy and firm risk indicators are as follows:

Risk factors

Common risk factors	*Firm risk factors*
Return of domestic stock market index	Liquidity (cash + short-term investments/total assets)
Short-term domestic interest rate	Profitability (Net income/total assets)
	Distance-to-default (volatility adjusted leverage)
	Size (market capitalization relative to median market capitalization)
	Market misvaluation (market cap + total liabilities/ total assets)
	Idiosyncratic volatility

Liquidity is measured as the ratio of cash and short-term investments to total assets; and profitability as the ratio of net income to total assets. The measure of volatility-adjusted leverage is a variation of the distance-to-default (DTD), based on the Merton (1974) structural pricing model as described in Crosbie and Bohn (2000), but correcting for the higher leverage financial firms exhibit relative to non-financial firms (Duan, Sun, and Wang, 2012). The model also accounts for the relative size of the firm since, in general, large firms are less likely to default. The relative size variable is defined as the natural logarithm of the ratio of the market capitalization of the firm to the median market capitalization of the firms in the economy. Market mis-valuation is measured as the market-to-book asset ratio. The idiosyncratic volatility of a firm is set equal to the standard deviation of the residuals obtained after regressing a firm's equity returns on the returns of the domestic market index.

The mixed-frequency regression equation for the economy-wide risk factors assumes that their one-period difference depends only on its own lagged level values and the lagged values of the exogenous scenario variables:

$$\Delta X_{m,t} = \beta^X_{m,0} + \sum_{i=1}^{n} \beta^X_{m,k} Z_{k,t} + \sum_{j=1}^{p} \gamma^X_{m,p} X_{k,t-p} + e^X_{m,t}$$

where $X_{m,t}$ is the m-th economy-wide risk factor, $Z_{k,t}$ is the k-th economic or financial variable included in the macroeconomic scenario. Modeling the individual firm-specific variables is done using a two-stage regression, as in Duan, Miao and Wang (2014). The first stage forecasts the average value of the firm-specific risk factor for all firms in a given industrial group of the economy using a regression of the form:

$$\Delta \bar{Y}_{i,j,t} = \beta^Y_{i,j,0} + \sum_{i=1}^{n} \beta^Y_{i,j,k} Z_{k,t} + \sum_{j=1}^{p} \gamma^Y_{i,j,p} X_{i,j,t-p} + e^Y_{i,j,t}$$

Box 5. Bottom Up Korean Non-Financial Corporate Stress Testing (Concluded)

where $\Delta\bar{Y}_{i,j,t}$ is the *i*-th industry average of the *j*-th firm-specific risk factor at time *t*, $Z_{k,t}$is the *k*-th economic or financial variable included in the macroeconomic scenario. The second stage involves modeling the distance of individual firms to the industry average. The distance is the difference between the values of the individual firm's specific risk factor and the industry average:

$$d\left(Y_{i,j,t}^{k}, \bar{Y}_{i,j,t}\right) = Y_{i,j,t}^{k} - \bar{Y}_{i,j,t}$$

where for firm *k*, in industry sector *i*, the value of its *j*-th firm-specific factor is $Y_{i,j,t}^{k}$, and the average value of the *j*-th firm-specific factor for the industry is $\bar{Y}_{i,j,t}$.

3. Project corporate solvency: These risk factors are then used as inputs in a forward intensity model to yield the one-year ahead projected PD's for individual Korean firms under the scenario. The PD's of individual firms can also be aggregated to assess default risk economy-wide. PDs are projected using a variation of the model in Duan, Sun, and Wang (2012) and Duffie, Saita and Wan (2007). The DSW model considers a firm's exit for reasons other than default such as merges and acquisitions. Since exit for other reasons greatly exceeds the number of defaults, an accurate default prediction model should accommodate the two competing risks of both default and other exit.

4. Expected corporate credit losses: One-year projected PDs are then used as inputs in a credit portfolio module to calculate the expected credit loss distribution associated with the default risk of individual Korean firms. The model links changes in PDs to their impact on expected credit losses by drawing on Vacisek's (1987, 2002) single factor credit risk portfolio model. The model assumes that the asset value of the loan obligor, A_i, follows a standard normal distribution. The obligor defaults when its asset value falls below a certain threshold, d_i, whose value depends on the obligor's PD_i:

$$\text{Default if and only if } A_i \leq d_i \equiv N^{-1}(PD_i)$$

where N^{-1} is the inverse of the standard normal distribution. Loan defaults are correlated since the one-factor model assumes asset values are dependent on a systematic factor, *S*:

$$A_i = \rho S + \sqrt{1-\rho^2}\varepsilon_i$$

where ε_i is an idiosyncratic shock and ρ is the firm's asset value correlation with the systematic factor. Both ε_i and S are uncorrelated, standard normal variables. Consistent with the homogeneity assumption, the correlation coefficient is the same for all loans. This enables the estimation of the loss distribution using simulations. In each simulation realization, a random realization of *S* is drawn and for each loan in the portfolio, draw a random realization of ε_i and calculate the asset value of the firm, and verify whether the loan defaults are based on the firm default evaluation. The losses are added up to obtain one loss realization.

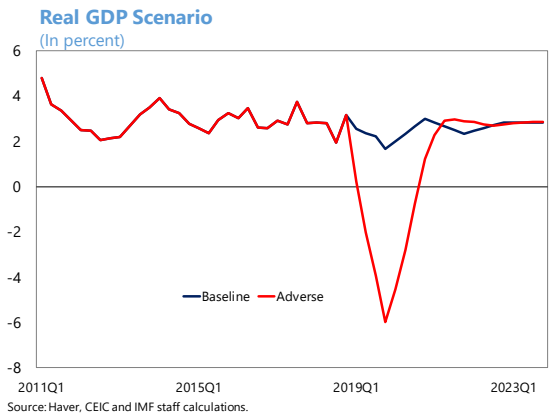
21. The Asian and Global Financial Crises represent a good benchmark from which to compare corporate default risks to the hypothetical stress scenario. During the Asian crisis the 12 (24) month PD registered 623 basis points (1200bps), which equates to an implied 12 (24) month PD of 6.2 percent (12 percent). This value is a composite of all the individual firm PDs. This suggests that during the Asian crisis half of corporate obligors had a default probability greater than 6.2 percent (12 percent) of defaulting within the next 12 (24) months. This is equivalent to an implied credit rating of CCC, which implies 'junk' rating, a clear sign of corporate distress. Corporate stress was more subdued during the GFC with the 12-month (24 month) PD registering 83 basis points. This is equivalent to an implied credit rating of BB+, which is one notch below investment grade.

22. Under the baseline stress scenario corporate default risks remain contained. Figure 8 illustrates the 12- and 24-month projected median PD of the corporate sector in the baseline and stress scenarios. While the earlier analysis of financial ratios forewarned a worrisome level of corporate debt and a rise in the number of weaker firms, as characterized by declining revenue and profitability, the results of the baseline scenario suggests a more nuanced reading. Mid- and small-sized firms have steadily deleveraged, the proportion of debt held by weaker corporates has fallen since 2013, and corporate cash balances have risen considerably.

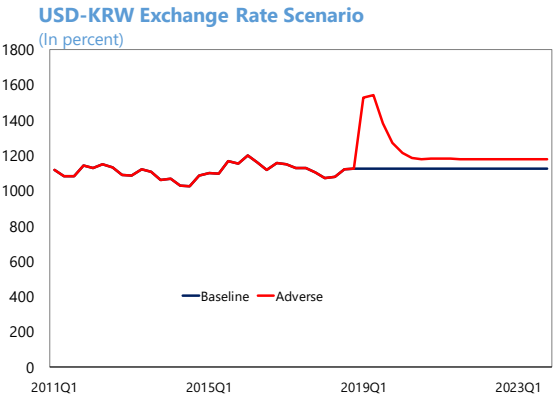
23. The hypothetical stress scenario shows that a tightening in financial conditions married to an external slowdown in growth would directly impact Korean firms' ability to honor their obligations and their probability of default. Corporate distance-to-default for Korean corporates, calculated as the face value of short-term liabilities plus half of the face value of long-term liabilities (the 'default barrier'), declines in the stress scenario.[4] This implies a narrowing gap between the asset value and the default barrier for corporates. Under the stress scenario the 12-month implied PD rises to around 50 basis points, which is around one-quarter of the maximum registered during the Asian crisis and around 60 percent of that registered during the GFC.

[4] Firm distance-to-default is defined as [(Market Value of Assets) – (Market Value of Liabilities)] / (Asset Volatility).

Figure 7. Korea: Non-Financial Corporate Stress Scenario



Source: Haver, CEIC and IMF staff calculations.



Source: Haver, CEIC and IMF staff calculations.

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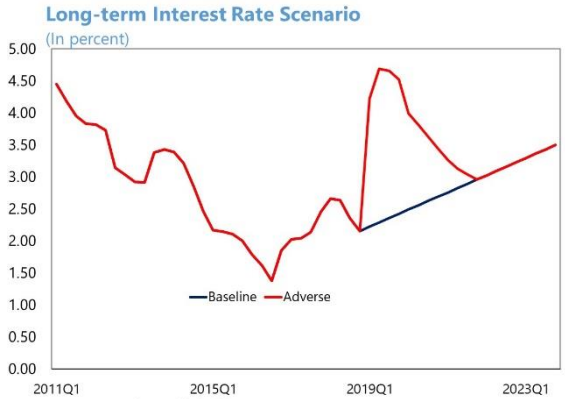
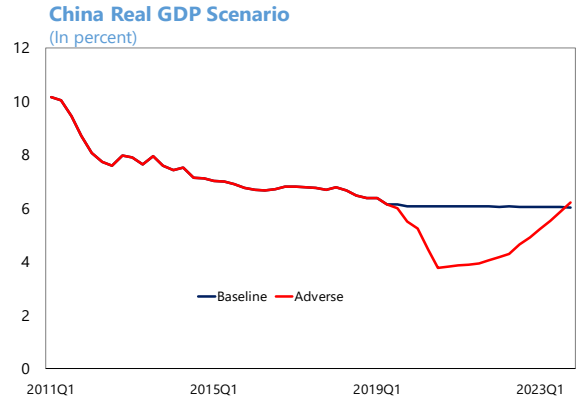
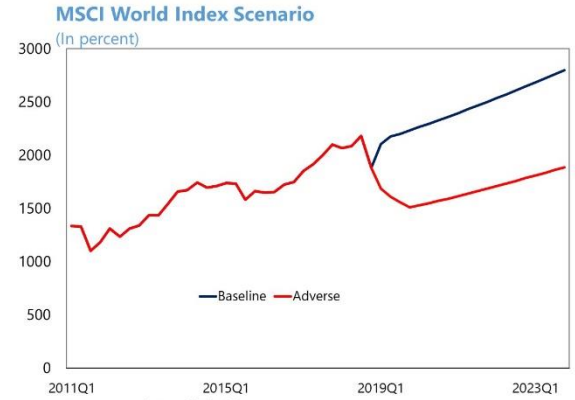


Source: Haver, CEIC and IMF staff calculations.

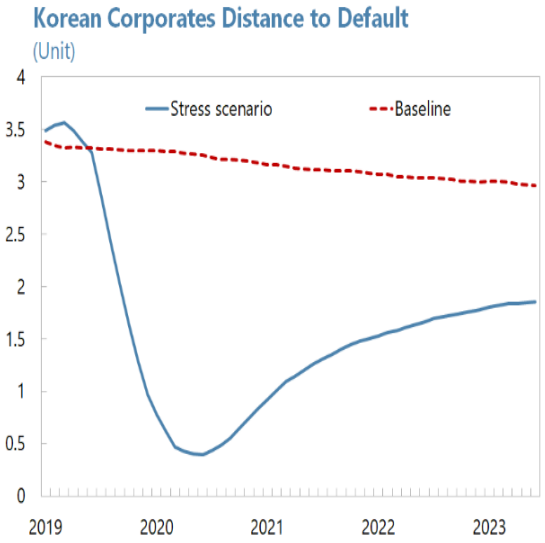


Source: Haver, CEIC and IMF staff calculations.

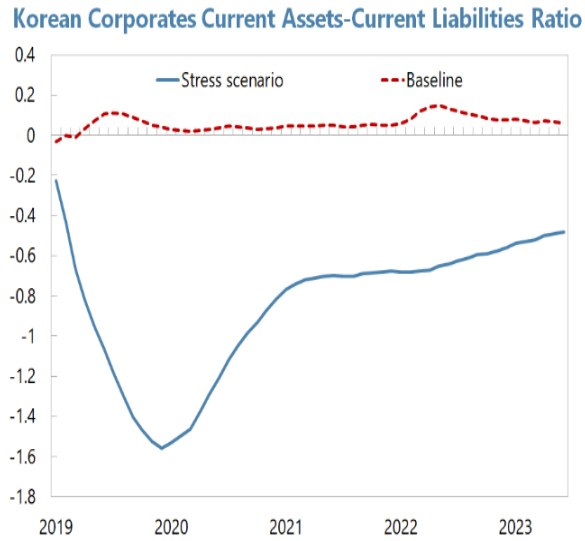


Source: Haver, CEIC and IMF staff calculations.

Figure 8. Korea: Response of Non-Financial Corporate Default Barrier

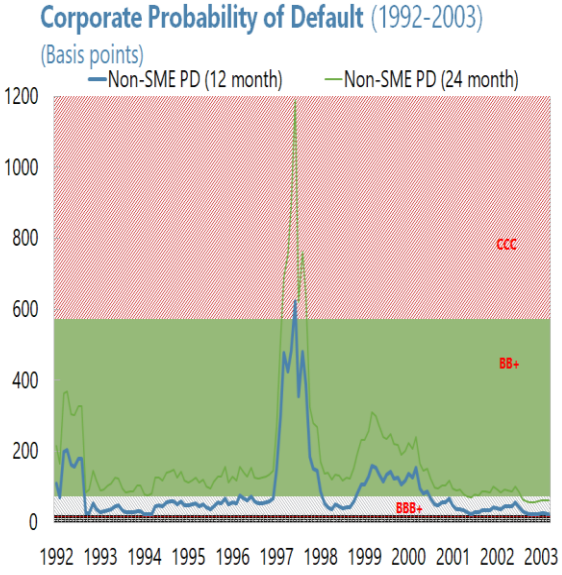


Source: S&P; CEIC; Authorities data; and IMF staff calculations.

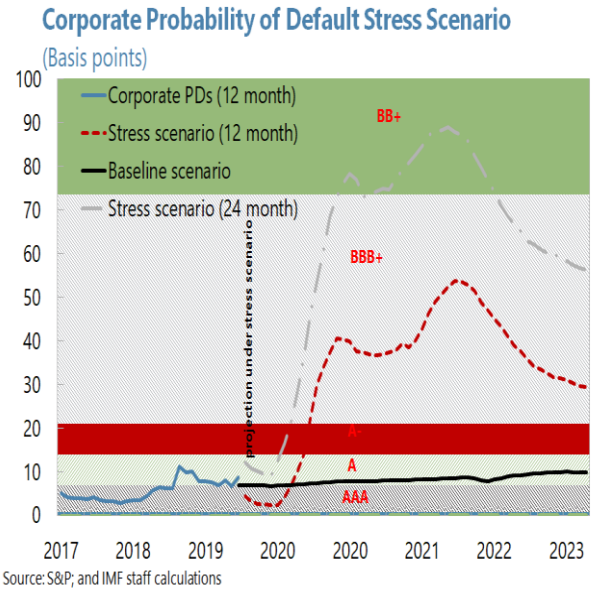


Source: S&P; CEIC; Authorities data; and IMF staff calculations.

Figure 9. Korea: Non-SME Corporate Default Risks

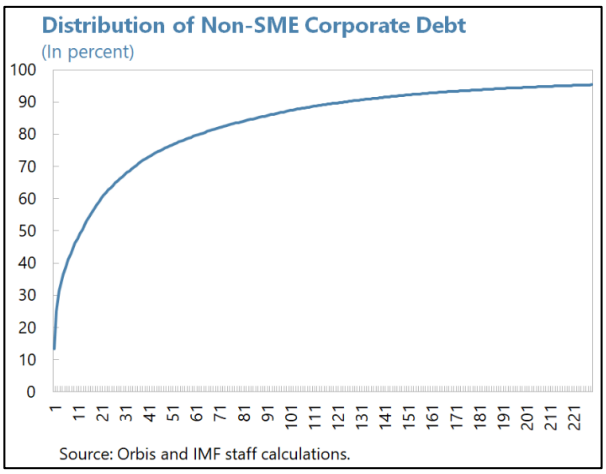


Source: S&P; and IMF staff calculations
Note: Historical estimates of corporate PDs are based on S&P information.

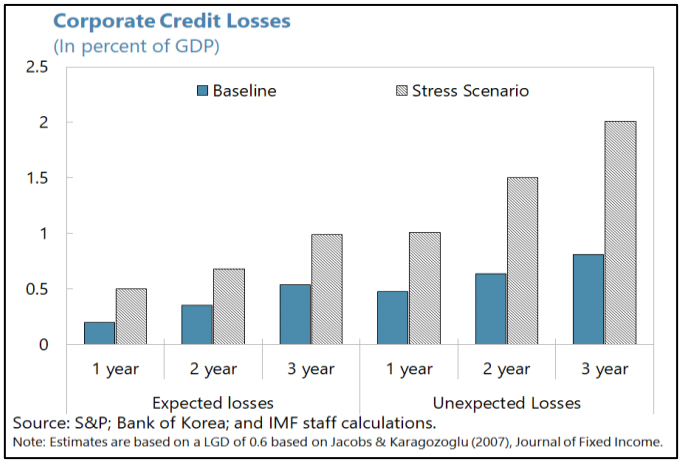


Source: S&P; and IMF staff calculations
Note: Historical estimates of corporate PDs are based on S&P information. Stress scenario is based on a global decline in growth and a tightening in financial conditions.

24. In the stress scenario potential losses from corporate defaults could top just over 2 percent of GDP. Based on non-financial corporate PDs in the baseline and stress scenario expected and unexpected credit losses are calculated. After three years, the cumulatively expected credit loss would be around 1.3 percent of GDP. The corresponding figure for unexpected credit losses is 2.1 percent of GDP. The low non-SME corporate credit losses in the stress scenario reflects: (i) a very large share of debt being market-based and investment grade; (ii) over 90 percent of non-SME corporate debt held by less than 100 firms, which are mainly conglomerate-affiliated and have since 2013 seen resilient ROAs, ICRs and liquidity ratios, unlike smaller corporates and; (iii) have relatively low leverage ratios—as measured by debt-to-asset-ratios—and carry a large amount of cash and equity on their balance sheets.[5]



25. In absence of micro balance sheet data on SMEs, there are limits to fully understanding the extent of corporate credit losses in a stress scenario. Korean SME firms are firmly integrated in the supply chains of larger corporates. For this reason, coupled with existing balance sheet vulnerabilities, it is likely that SME firms would be harder impacted in a stress scenario. Bank balance sheets are likely to be at significant risk since SME debt is based on bank loans. Estimates from bank stress tests suggest that the maximum cumulative bank losses from distressed SME loans in a stress scenario would total around 2 percent of GDP.[6]



[5] The expected loss is the amount a bank can expect to lose, on average, over a predetermined period when extending credits to its customers. Unexpected loss is the average total loss over and above the mean loss. It is calculated as a standard deviation from the mean at a certain level. It is also referred to as Credit VaR.

[6] See Korea Financial Stability Assessment Program technical note 'Korea: Systemic Risk Analysis'.

E. Summary and Conclusion

26. Corporate leverage in Korea is slightly elevated compared to peer countries. It is relatively spread between economic sectors, but more elevated in small-medium size enterprises. In contrast to conglomerate-affiliated corporates mid and small-sized firms have steadily deleveraged. Nonetheless, leverage remains high for SME firms.

27. Rising balance sheet vulnerabilities in small and medium-sized firms is a risk to bank balance sheets. There is a growing disparity in performance between large and small corporates. The number of firms reporting a negative ROA or a liquidity coverage rate below 1 has risen. Profit margins have fallen for the weakest firms and interest coverage ratios have declined for medium and smaller firms. The low-for-long interest rates has been a conducive environment for containing corporate balance sheet vulnerabilities.

28. Around one-quarter (28 percent of GDP) of corporate debt is considered at risk. Around 50 percent of corporate debt-at-risk is held by SMEs, all of which is owed to banks and linked to floating rates. Around 70 percent of banks' corporate loans are to SMEs, totaling around 20 percent of GDP and mostly secured against commercial and residential real estate. Despite low immediate exposure, non-SME firms remain a systemic source of risk for banks due to their interconnectedness with SMEs. This results in a strong correlation between bank and non-SME firm default risks.

29. Should risks materialize it would directly impact Korean firms' ability to honor their obligations and their probability of default. First, the amount of non-financial corporate debt-at-risk would rise in scenarios of a large unexpected hike in interest rates. Second, corporate default risks would rise for the large (systemically importance) corporates but remain below the default risks registered during the Asian and Global Financial Crises. Expected and unexpected credit losses from large firms, which hold around 60 percent of corporate debt, is expected to be manageable, however. Nonetheless, in absence of balance sheet data on SMEs, there are limits to fully understanding the extent to which the corporate sector poses a risk to financial stability.

HOUSEHOLD BALANCE SHEETS

A. Introduction

30. The objective of this paper is to document the evolution of Korean household debt, analyze its riskiness by exploring household balance sheet vulnerabilities, and uncover potential heterogeneity in risk across households due to demographics which may have implications for financial stability. The paper analyses micro household balance sheet data to assess: (i) where the pockets of household balance sheet vulnerabilities are; (ii) determinants of household debt-at-risk, including the role of macro-financial conditions; (iii) develop a model for the purpose of household balance sheet stress testing and to characterize risks to the stability of the financial system.

31. The main findings of this paper are as follows:

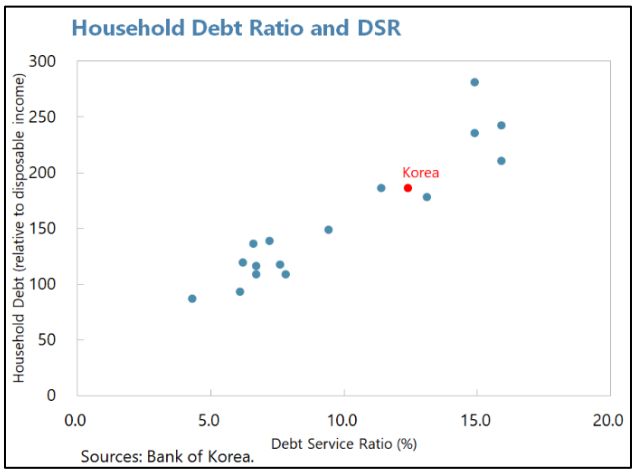
- Since 2013 the household leverage cycle in Korea has grown quickly. Household debt was 93 percent of GDP as of the second quarter of 2019, one of the highest levels in the OECD. The rise in debt has mirrored a continuous upward shift in the house price level and fall in the Korean neutral interest rate, which has helped stabilize debt service ratios. Rising house prices has helped ease borrowing constraints for existing homeowners;

- Korean households have significant asset concentration in real estate, even compared to other advanced countries. Approximately 53 percent of household debt is secured against real estate, and 70 percent of household wealth is linked to real estate. As a result, household leverage constraints are closely tied to the house price cycle;

- There has been little subprime lending, with most bank credit channeled to those households with the highest credit scores. The structure of the mortgage market has become safer in recent years, with a higher origination of fixed interest rate amortized loans. The average maturity of mortgages has also lengthened;

- However, around half of household debt is linked to floating interest rates and is structured as a bullet payment. Risks to household debt also stem from growing vulnerabilities to household balance sheets, driven by higher leverage. Balance sheets have weakened most for households headed by retirees, who hold around 20 percent of the total stock of household debt. Unlike other advanced economies, households do not necessarily disengage from the credit market as they age. As income volatility rises with age the ongoing demographic shift in Korea will likely increase risks to the stock of household debt going forward;
- According to the KOSTAT data, approximately 15 percent of the total stock of household debt (14 percent of GDP) is registered at-risk, defined as a household unable to meet debt servicing and consumption needs from disposable income. This equates to around one-third of Korea's total non-financial debt at-risk. Debt-at-risk is held by households that have (*i*) a debt service ratio above 40 percent; (*ii*) a loan secured on a second property; (*iii*) some unsecured credit loan borrowings for the purposes of living and property expenses and; (*iv*) a large share with retiree households, who tend to have more unstable income;
- Around 12 percent of household debt is held with households whose balance sheets are upside down, characterized by a debt-to-asset ratio above 100 percent. These households are concentrated in more elderly age groups and a more likely to have bullet payment structured loans;
- An empirical model developed on Korean household balance sheet data shows that whether a household's debt is registered at-risk is positively correlated with its debt-to-income and loan-to-value ratios, together referred to as the 'double trigger' of household default. The low for long interest rate environment in Korea has been helpful in containing household balance sheet vulnerabilities, and the amount of household debt-at-risk;

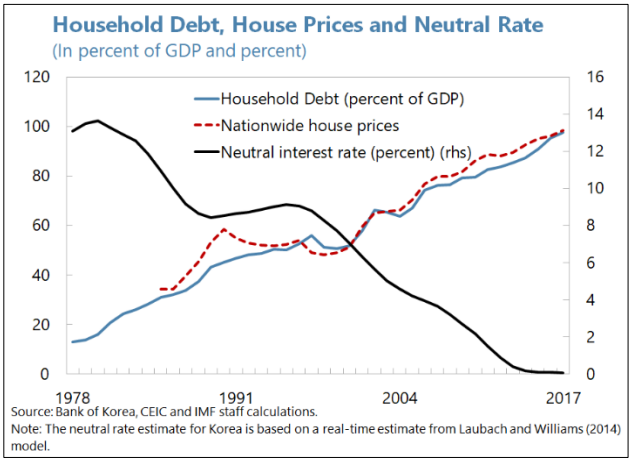
- Household stress tests suggest that household debt-at-risk and insolvencies would rise to income, interest rate and house price shocks. However, there is considerable heterogeneity across households. In terms of debt-servicing capacity retiree households are equally vulnerable to income and interest rate shocks, while younger households are more exposed to income shocks. This reflects the higher proportion of floating rate loans held with older households. Older households are also much more at insolvency risk from a house price shock than younger households given that more of their wealth is held in real estate;



- These findings reinforce the importance of macroprudential regulations in managing risks to household debt from balance sheet vulnerabilities. Policies should account for heterogeneity across households, and the specificities of the mortgage market in Korea, particularly the large share of floating rate and bullet payment debt.

B. Stylized Facts on Household Balance Sheets

32. Since 2013 household debt in Korea has grown quickly and is now among the highest in the OECD. A low interest rate environment and a weakening non-financial corporate sector is raising concern that household balance sheet vulnerabilities are accumulating, and which may pose a risk to financial stability. To understand the evolution of household debt and whether pockets of vulnerabilities may be developing, the analysis uses Korean household survey data to study the balance sheets of households at a granular level. The analysis will also examine the implications of demographics for risk to the stock of household debt.



33. The household leverage cycle has grown strongly since 2013. In recent years household credit from banks has grown faster than the historical trend. Household debt has risen from around 85 to 100 percent of GDP, which corresponds to a debt to disposable income ratio of 180 percent. Around 70 percent of the increase in household debt has been to purchase assets, mainly real estate. The household leverage cycle has diverged from the rest of the economy. As employment is the main source of income for households the household leverage cycle has historically moved in phase with the corporate profit cycle (the so-called 'Levy-Kalecki' relationship). Since 2014 the two

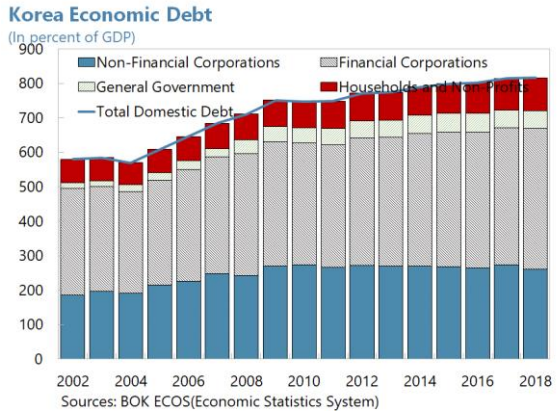
cycles have diverged, reflecting stronger household sector risk appetite compared to other economic sectors. Household debt has mirrored a rising residential house price level and a decline in the household lending rate (Box 1). The decline in rates has helped stabilize debt servicing despite higher household leverage.

34. Reflecting conservative bank lending practices there has been little subprime lending in Korea. Over 70 percent of bank loans have been channeled to those households with the highest credit scores. The riskiest bank loans, characterized as a borrower having a debt service ratio above 100, are concentrated in the highest credit worthy borrowers and almost entirely secured. In total, around 70 percent of total household bank loans are secured, mostly against real estate. The median household debt-to-income and loan-to-value ratios have remained stable at around 55 percent. Finally, the share of mortgages with a maturity greater than 10 years has steadily risen, currently standing at around 50 percent. Conservative lending practices help partly explain Korean banks sustained low profitability and NPL ratios, particularly when compared with regional peers.

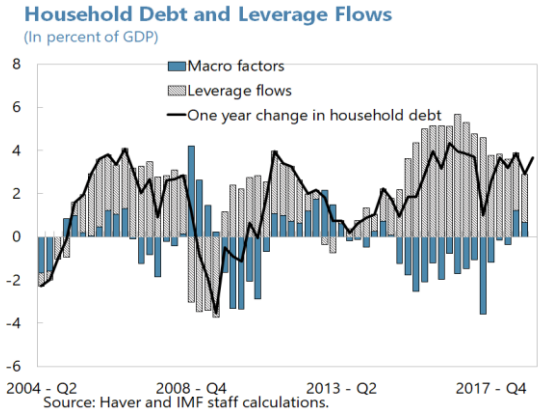
35. Nonetheless, there are risks to household debt related to the structure of outstanding bank loans, growing household balance sheets vulnerabilities and demographic aging. First, approximately 50 percent of household debt is linked to floating interest rates and is structured as a bullet payment. Bullet loans are riskier than traditional installment loans because (i) of the large payment due at the end; (ii) shorter average maturity of loans and; (iii) higher rollover risk. Second, over 30 percent of household debt is held by households that have a debt service ratio above the recently introduced (bank average) prudential ceiling of 40 percent. Third, household balance sheets have weakened since 2010 as leverage and debt service ratios have risen. Fourth, on both the assets (via real estate investment) and liabilities side (via Jeonse deposit), Korean household balance sheets are more exposed to real estate price fluctuations, even when compared to other advanced economies. Fifth, around a quarter of the total stock of household debt is held by households who are retired or close to retirement. Finally, a significant share of household debt is secured against a non-primary residence.

Figure 10. Korea: Household Debt Developments

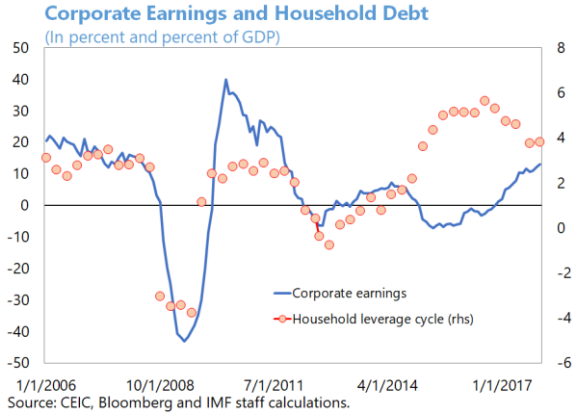
Economic leverage has risen due to higher HH debt.



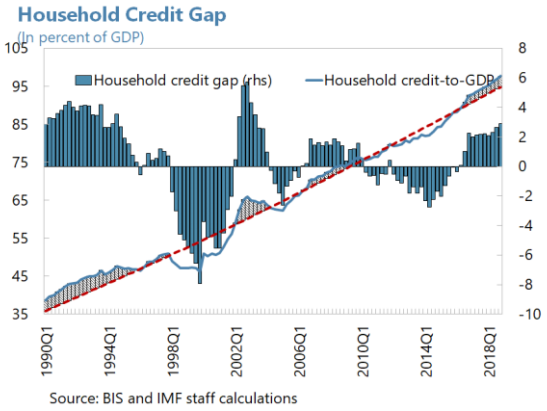
...resulting in a strong upswing in the HH leverage cycle.



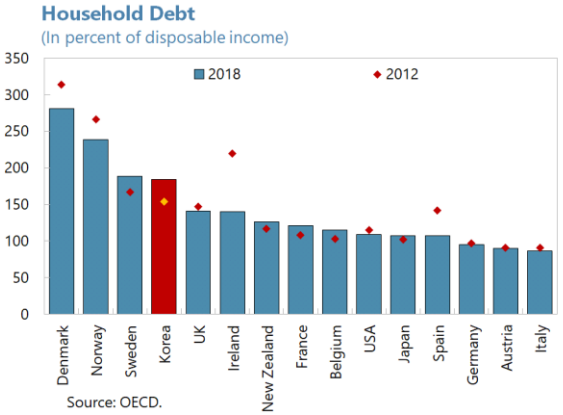
The HH leverage cycle has diverged from the corporate profit cycle.



The HH credit gap has been positive since 2014...



As a result, HH debt in Korea is above the OECD average.



The rise in HH debt has been mainly used to accumulate assets rather than finance consumption.

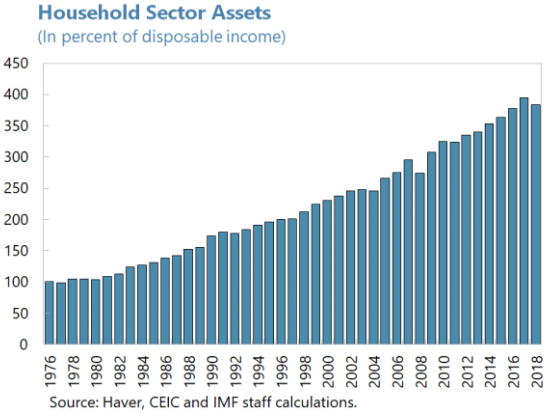
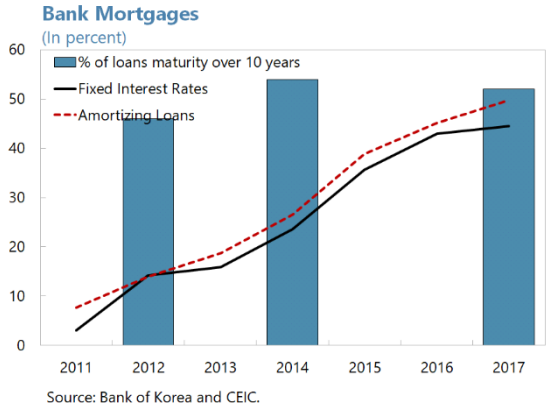


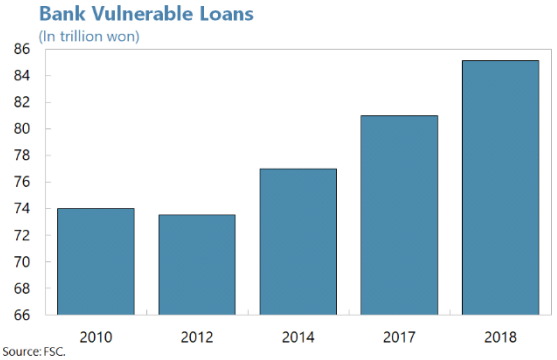
Figure 11. Korea: Channeling of Household Loans

Around 50 percent of mortgages are floating rates, bullet payment structured and have a maturity over 10 years.



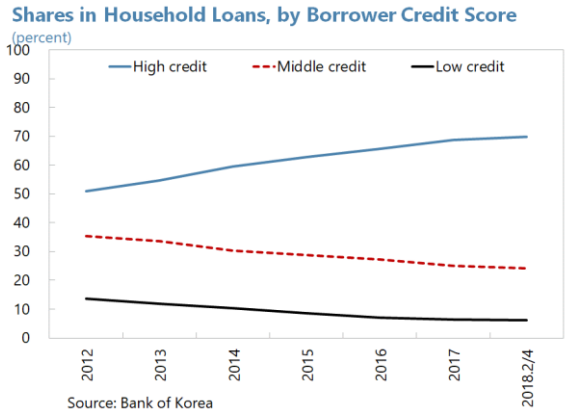
Source: Bank of Korea and CEIC.

Approx. 6 percent of loans are held by vulnerable HHs, defined as multiple borrowers with lowest credit scores.



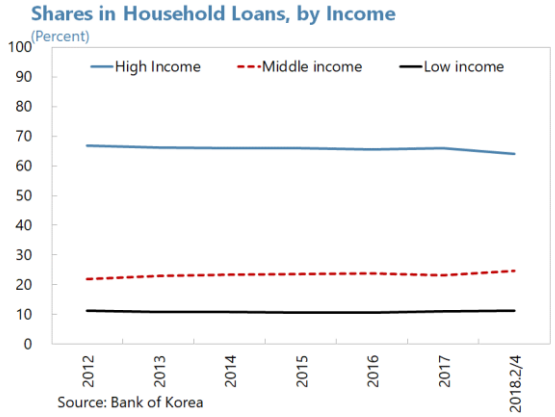
Source: FSC.
Note: Vulnerable loans are loans extended to households that owe multiple debts, in the bottom 30 percent income bracket, and/or with low credit ratings (rating in 7-10 range). These loans currently make up around 6 percent of total household debt.

Reflecting quite conservative bank lending practices, over 50 percent of HH loans highest credit scores…



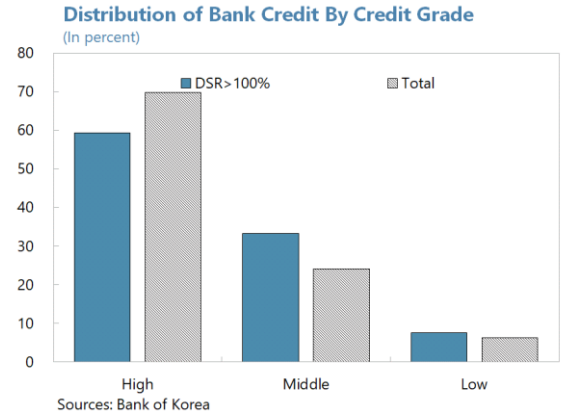
Source: Bank of Korea

… have gone to HHs with the highest credit scores and income.



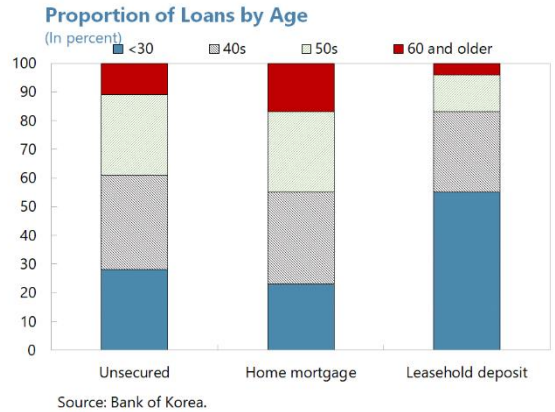
Source: Bank of Korea

The riskiest loans, characterized by a DSR>100 percent, are concentrated in the highest credit worthy borrowers.



Sources: Bank of Korea

A significant share of mortgages goes to households who are close to retirement or retirees.



Source: Bank of Korea.

Box 6. Household Debt Sustainability and House Prices

Korean household debt to income is relatively high and continues to grow and is linked to real estate prices. This box examines this issue using an approach grounded in macro time series analysis and that exploits fundamental macro-financial relationships. The analysis is based on a common trends model (a structural VAR framework with cointegration vectors). The model contains household debt ($cr_t - y_t$) , national residential house prices (p_t^h), the policy rate (i_t^{policy}), lending rate ($i_t^{lending}$), consumption and investment components of GDP (y_t). The data runs from 1986Q1 to 2018Q3.

$$\begin{pmatrix} \Delta cr_t - y_t \\ \Delta p_t^h \\ \Delta y_t \\ \Delta i_t^{policy} \\ \Delta i_t^{lending} \end{pmatrix} = a_0 + \Pi \begin{pmatrix} cr_t - y_t \\ p_t^h \\ y_t \\ i_t^{policy} \\ i_t^{lending} \end{pmatrix} + \sum_{i=1}^{l-1} \Pi_i \begin{pmatrix} \Delta cr_t - y_t \\ \Delta p_t^h \\ \Delta y_t \\ \Delta i_t^{policy} \\ \Delta i_t^{lending} \end{pmatrix} + e_t$$

To make judgements about the sustainability of Korean household debt by comparing current debt levels with "equilibrium" levels. Borrowing by homeowners is usually constrained by two factors: the size of the loan relative to the value of the property; the extent to which debt service payments are a burden on household incomes. Following Juselius and Drehmann (2015) and Juselius, *et al*. (2016) the following long-run restrictions are imposed

$$\hat{\beta} x_{t-1} = \begin{pmatrix} 1 & \psi_p & \psi_y & 0 & 0 \\ 1 & 0 & 0 & 0 & \xi \\ 0 & 0 & 0 & 1 & -\lambda \end{pmatrix} \begin{pmatrix} cr_t - y_t \\ p_t^h \\ y_t \\ i_t^{policy} \\ i_t^{lending} \end{pmatrix}$$

- *Leverage constraint.* The first relationship is between the household credit-to-GDP ratio and house prices. This relationship captures the well-known positive link between debt and asset prices, which may arise from the latter's use as collateral or, more generally, as a source of revenue or service streams (housing). It can be interpreted as a very rough proxy for aggregate leverage at market prices.

- *Debt-service constraint.* The second co-integrating relationship is between the credit-to-GDP ratio and the (average) lending rate on debt outstanding. This relationship captures the link between debt and interest payments, consistent with the notion that a lower interest bill allows households and firms to service the same stock of debt with lower income in the long run.

- *Loan markup.* A pass-through equation linking policy rates to the effective interest rates facing households.

The first two relationships pin down the *long-run equilibrium level of household credit-to-GDP ratio*, consistent with other variables in the system, namely asset prices (via the leverage gap) and the nominal lending rate (via the debt service gap). The credit-to-GDP ratio plays a key role in leading indicators of financial distress and has exhibited a clear upward trend in Korea.

The 3 long-run relationship assumptions are statistically significant at the 10 percent level.

Leverage constraint: $c_t - y_t = 2.89 + 1.4 \cdot p_t^h$

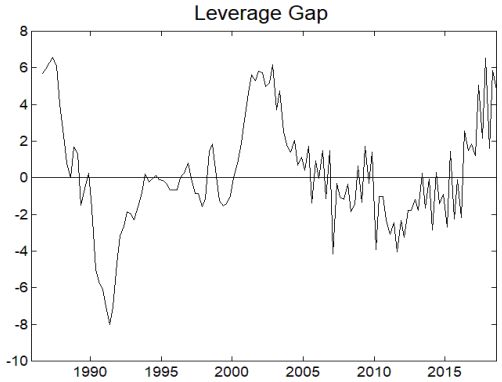
Debt service constraint: $c_t - y_t = -0.6 - 10.1 \cdot i_t^{lending}$

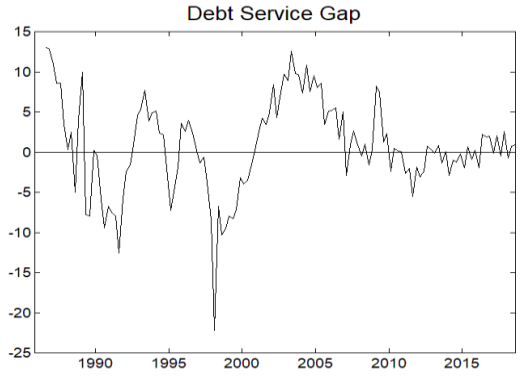
Loan markup: $i_t^{policy} = 1.3 - 2.1 \cdot i_t^{lending}$

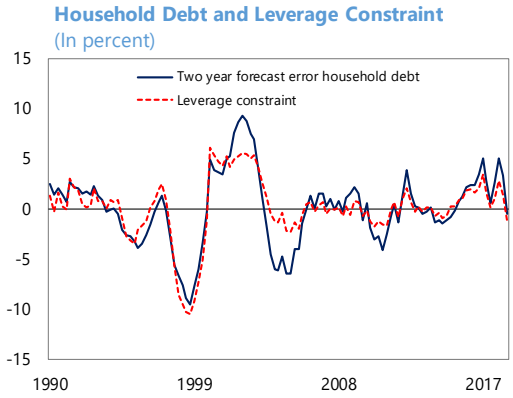
Higher asset prices have supported an elevated level of household debt. The long-run coefficients show that higher asset prices support higher credit-to-GDP ratios. A 1 percentage point reduction in the average lending rate allows borrowers to service an additional 10.1 percentage points of debt for the same income in the long run. Finally, there has been constant mark-up in the long run, so that the average lending rate increases by more than policy rates. Overall, the long-run relationships are robust.

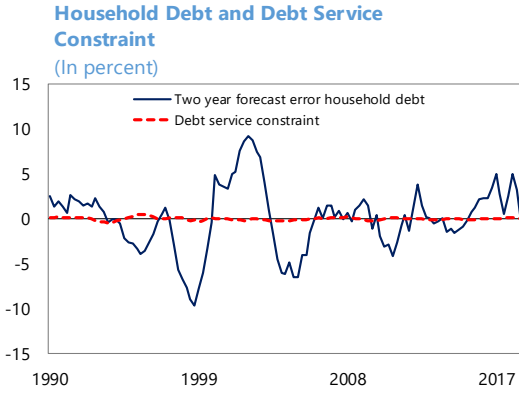
Box 6. Household Debt Sustainability and House Prices (Concluded)

The leverage and debt service cycles have diverged since 2013. The first set of charts depict the evolution of the corresponding leverage and debt service gaps. Since 2013, the debt service gap has remained contained, consistent with the low interest rate environment. In contrast, the leverage gap has risen steeply. This has occurred despite modest residential house price growth, which also helped put the leverage cycle on an upward trajectory. As a comparison, the leverage gap was low during the (commercial) real estate boom in the years leading up the Asian crisis. This reflects the fact that asset prices tend to run ahead of the credit-to-GDP ratio during booms, even as this ratio increases beyond historical trends. This makes borrowers look deceptively solid in the boom phase.







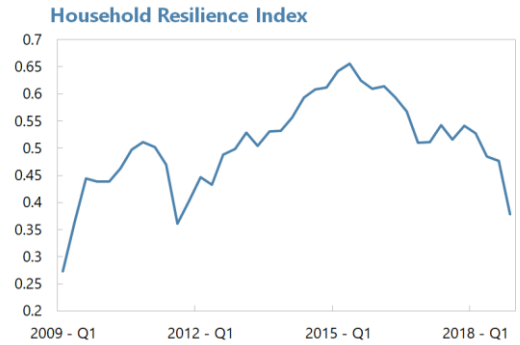


A fall in house prices will likely tighten household leverage constraints. The second set of charts illustrate the portion of the variation in household debt attributable to the leverage and debt service constraints. The estimates suggest that house prices have been the biggest factor explaining variation in household leverage. This implies that house prices and household debt and leverage are closely related. A significant house price fall would tighten household leverage constraints, and moderate household debt growth. The debt service burden, in contrast, has been less important for driving household debt. This finding is consistent with the 25-year persistent fall in lending rates in Korea.

36. Household balance sheet resilience has weakened since 2015, particularly for retiree households. A household resilience index is constructed and is derived on the difference between the net-worth ratio and the debt ratio (Figure 12).[7] The index started declining in early 2015, implying that while households continued to accumulate financial assets, household credit has grown at a faster pace. As a result, household leverage, as measured by debt-service and debt-to-income ratios, has risen across age groups, but particularly for retiree households.[8] These households (i) hold around 20 percent of the total stock of Korean household debt on their balance sheets; (ii) are the most levered, as measured by financial debt-to-asset ratio and; (iii) have suffered the largest fall in net worth of all age groups since 2010 (see Figure 13). However, household do actively manage their balance sheets, increasing (reducing) liquidity during an economic downturn (upturn).

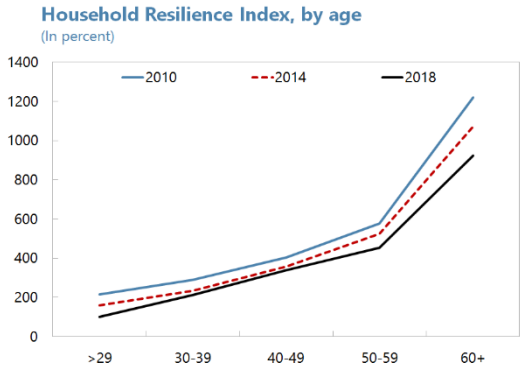
Figure 12. Korea: Household Balance Sheet Resilience

Household balance resilience has fallen since 2015, reflecting higher household leverage.



Source: DLX Haver and IMF staff calculations. The resilience index denotes the total asset ratio less twice the debt ratio.

Retiree household balance sheet has weakened most due to a decline in the value of household assets.



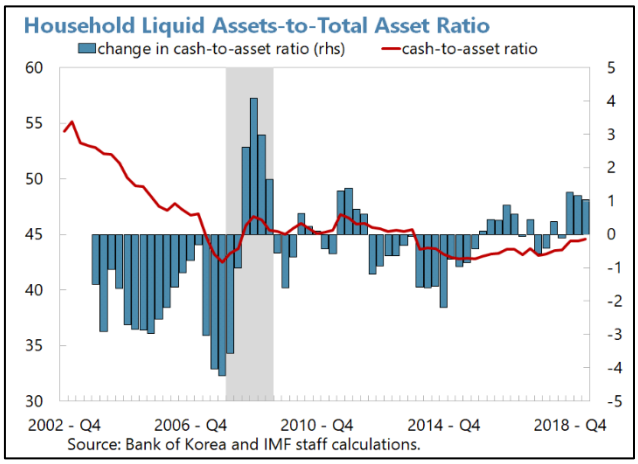
Source: Korea Survey of Household and Living Conditions and IMF staff calculations.

37. The authorities have tightened macroprudential policies to mitigate the financial stability risks from household debt. Loan underwriting standards have been tightened via stricter standards for calculating debt-to-income ratios. This included eliminating anomalies in the treatment of existing debt for those taking second mortgages and improving documentation of income. Moreover, given the high share of bullet and floating rate mortgages, borrowers have been incentivized to take safer mortgages. Policy measures have aimed to encourage borrowers to take out fixed interest rate amortizing loans, for example by easing LTV limits for such mortgages. Such loans carry a lower risk of becoming distressed if interest rates rise, or property prices decline. Stress tests on household balance sheets based on these scenarios are carried out in Section D.

[7] Resilience falls if, for a constant total-assets ratio, the debt ratio rises, and that resilience rises if, for a constant debt ratio, the total-assets ratio rises. This assumes a weight of plus 1 on the total-assets ratio and a weight of minus 2 on the debt ratio.

[8] The official retirement age in Korea is 55 years old.

38. There is heterogeneity in household balance sheet vulnerabilities, particularly across age cohorts. Around a fifth of household debt is held by retiree households. The liabilities of older aged households are more likely to have bullet structured loan payments and/or, a loan secured against a second property. Survey data also shows that as Korean households retire income volatility tends to rise while they also endure a larger fall in income, particularly when compared to retiree households in the United States. A large portion of the income earned by older Koreans comes either from wages or business income, while retiree households in the United States mostly earn their income from social security, pensions, and annuities (or public transfers). That is, the incomes earned by Korean seniors are less secure and stable than those earned by their United States counterparts. This partly explains why approximately 50 percent of household debt-at-risk—defined as debt held by a household that is unable to finance consumption and debt servicing from disposable income—is headed by an individual aged 50 and above.



39. Ongoing demographic shifts in Korea will likely increase risks for household debt. Due to a shallow social safety net, households tend to self-insure for retirement by accumulating assets during their lifetime. Therefore, unlike in other advanced economies, engagement with the loan market does not necessarily moderate as households age. Assuming past borrowing behavior is a guide to the future, as society ages an ever-larger share of household debt will be held with households that are characterized by relatively more unstable income. This will likely increase the proportion of debt held by borrowers-at-risk and, therefore, increase risks to the resilience of the stock of household debt going forward.[9] These factors also raise the probability of larger forced sell offs during a stress scenario, potentially resulting in much larger real estate price adjustments.

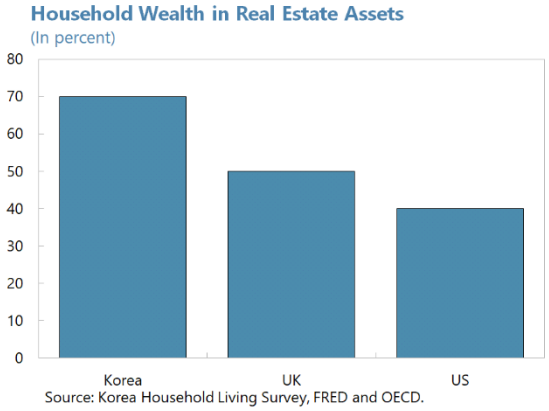
[9] Based on current trends over 50 percent of HH debt will be held by HHs aged 50 and above, around 10 percent higher than presently.

Figure 13. Korea: Household Balance Sheet Developments

HH has fallen for older aged HH and remain concentrated with the older aged….

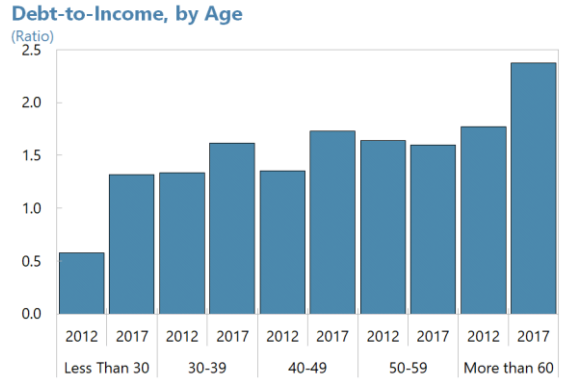
Sources: Korea Household Income and Expenditure Survey and IMF staff calculations.

…which is high by advanced economy standards.



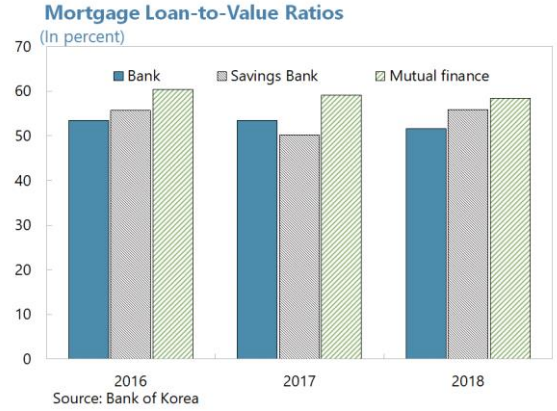
Source: Korea Household Living Survey, FRED and OECD.

HH leverage has grown for most age groups as banks borrowings have grown even faster.



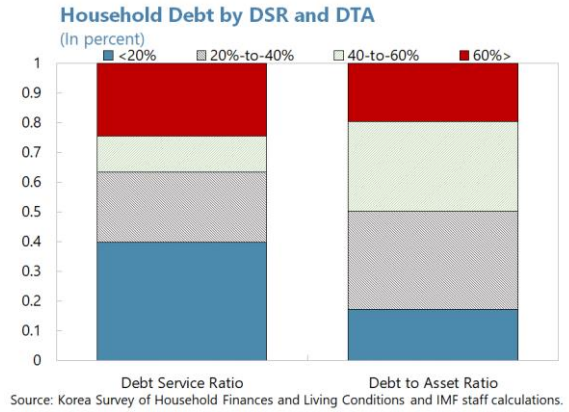
Sources: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.

However, household LTV ratios have remained relatively stable.



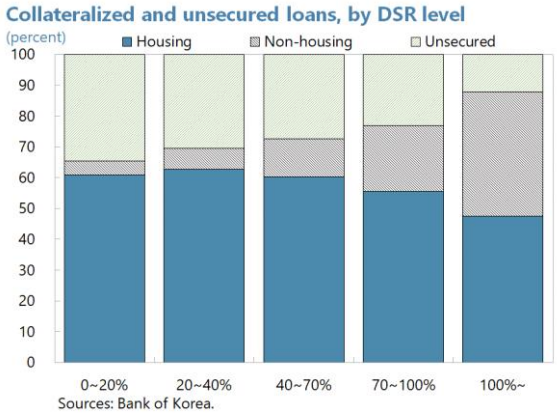
Source: Bank of Korea

Around 40 percent of HH debt is held by households with a DSR above 40 percent…



Source: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.

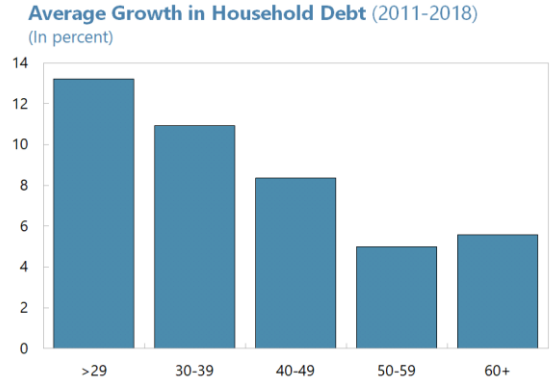
…but these loans are more likely to be secured against real estate and other assets.



Sources: Bank of Korea.

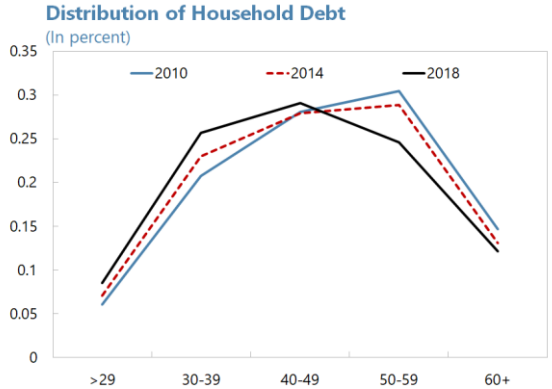
Figure 14. Korea: Household Debt and Demographics

Since 2011 HH debt has grown quickest for younger age groups...



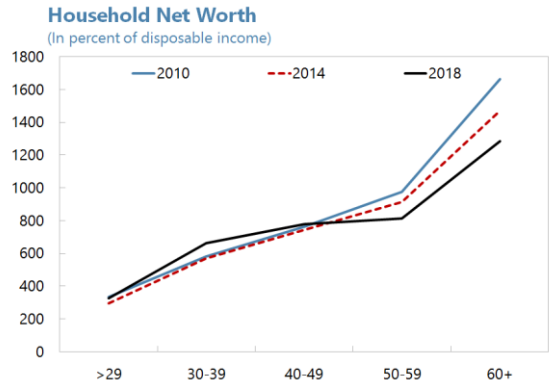
Source: Korea Survey of Household and Living Conditions and IMF staff calculations.

... which has shifted the distribution of household debt.



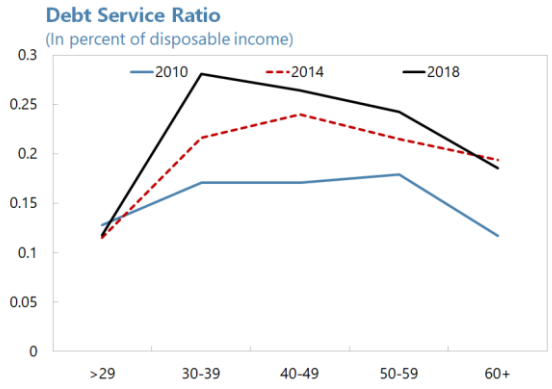
Source: Korea Survey of Household and Living Conditions and IMF staff calculations.

Household net worth has risen greatest for younger aged households and fallen most for older aged households.



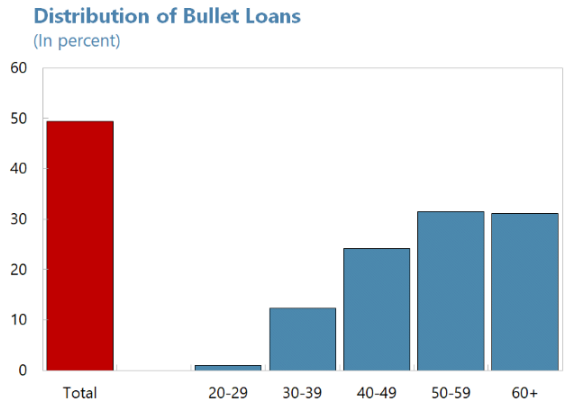
Source: Korea Survey of Household and Living Conditions and IMF staff calculations.

Since 2010 household debt servicing has risen for all age groups, reflecting higher leverage.



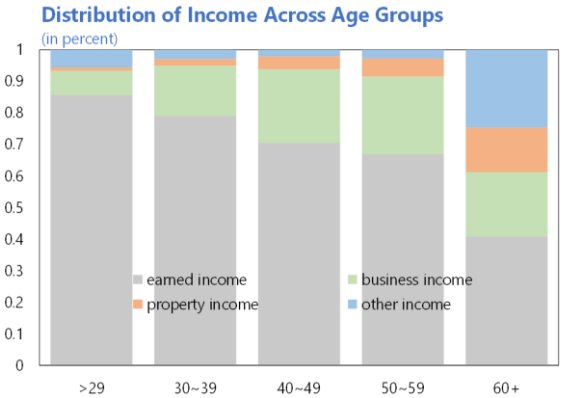
Source: Korea Survey of Household and Living Conditions and IMF staff calculations.

Around 50 percent of loans are structured as bullet payments and are concentrated in older aged cohorts.



Source: Korea Household Expenditure Survey and IMF staff calculations.

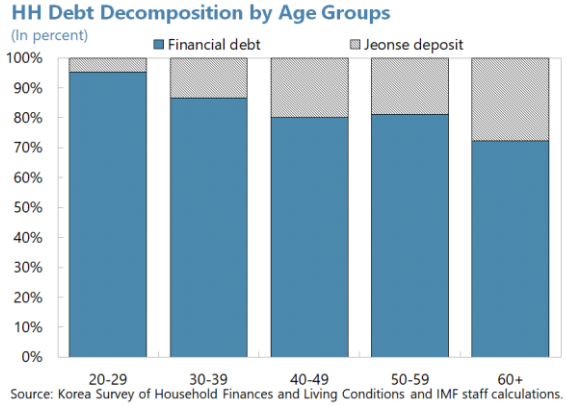
Households are mainly reliant on salaried income, but this declines with age.



Source: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.

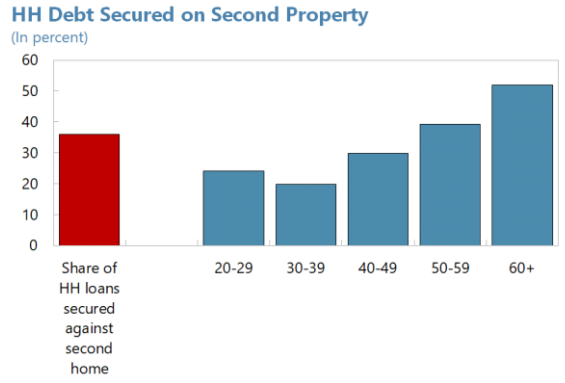
Figure 15. Korea: Demographics, Aging and Risks to Household Debt

Older aged HHs carry more Jeonse deposit debt since they are more likely to own multiple properties.



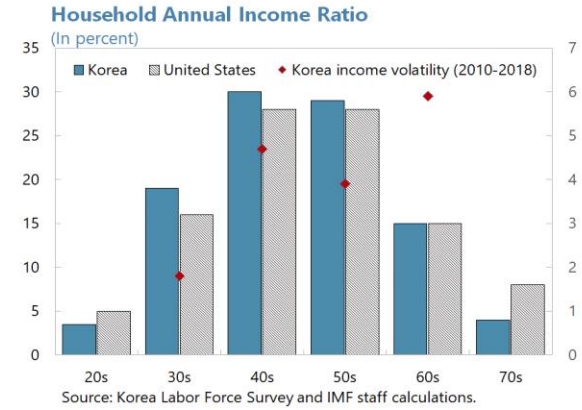
Source: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.

A significant share of HH debt is secured against a second property, most of which is concentrated in older aged HHs.



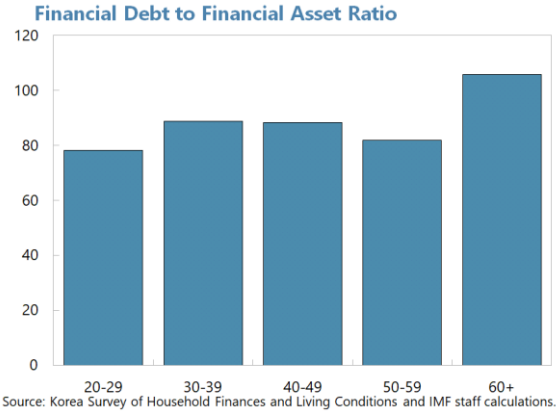
Source: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.

Korean HHs suffer a sharper fall in income following retirement and income volatility rises.



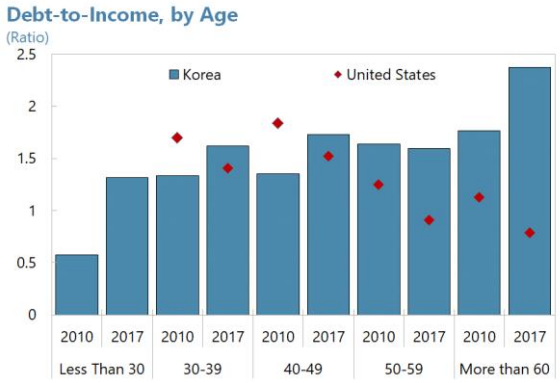
Source: Korea Labor Force Survey and IMF staff calculations.

Historically, HH leverage has tended to rise with age due to property being viewed as a source of retirement income.



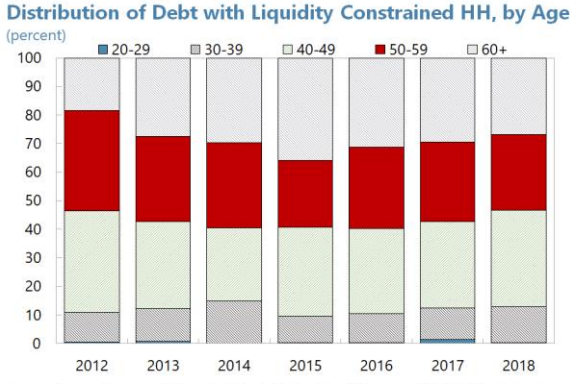
Source: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.

Unlike other advanced economies, engagement with the credit market does not necessarily decline with age.



Sources: CEIC and Federal Reserve Consumer Survey of Finance and IMF staff calculations.

A large share of HH debt-at-risk is held by older aged HHs, who are more likely to be liquidity constrained.



Source: Korea Survey of Household and Living Conditions and IMF staff calculations.

40. In summary, while banks have conservative lending practices there are a number of risks to household debt emanating from growing household balance vulnerabilities. First, a large share of household debt is held by households with a debt service ratio above 40 percent. Second, leverage has risen across age groups, as reflected in higher debt service and debt-to-income ratios, and net worth has declined. Third, a large share of household debt is secured against real estate rendering household balance sheets at risk from a sudden real estate price correction. Fourth, household assets are concentrated in one relatively illiquid—in the short-term at least—asset class. Finally, a weakening corporate sector, particularly SMEs, elevate risks to household income and, therefore, debt servicing capacity. Risks to household balance sheets from these vulnerailities are explored in subsequent sections.

C. Household Debt-at-Risk

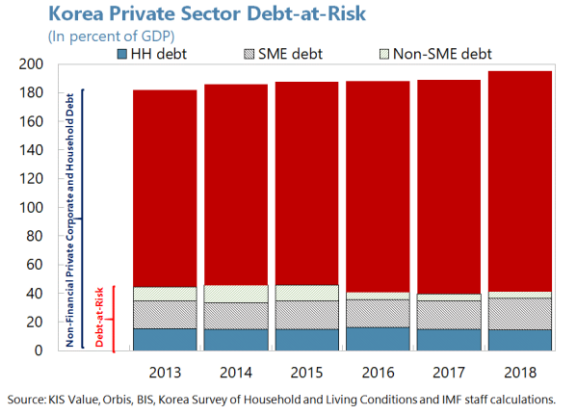
41. This section maps household balance sheet vulnerabilities to household debt liquidity and solvency risks. Data is taken from the Korean Household Expenditure Survey, which is composed for approximately 18,000 households. Several caveats should be noted with this survey. First, the debt data is based on households rather than individuals. Second, 20 percent of the sample changes each year.

42. As of 2018 around 15 percent (14 percent of GDP) of the total stock of household debt is 'at-risk'. Household debt-at-risk is based on a households' financial margin, which is defined as a household's ability to meet minimum consumption and debt servicing payments from disposable income (Box 7); if a household carries debt and has a negative financial margin its debt is deemed 'at-risk'. A household's financial margin is a liquidity risk measure and can therefore be viewed as a short-term solvency risk metric. The data shows that household debt-at-risk equates to around 14.3 percent of GDP. Around 85 percent of this is tied to a household with a debt service ratio above the recently introduced bank average prudential ceiling of 40 percent; (ii) 45 percent with households aged 50 and above, and who are more likely to have bullet payment structured loans; (iii) a loan secured on a second property and/or; (iv) have unsecured credit loan borrowings for the purposes of living and property expenses.

43. Empirical analysis suggests the probability that a household's debt is at-risk is determined by its loan-to-value, debt-to-income and debt-service ratios. Higher balance sheet leverage ratios are associated with a higher probability of household debt being at-risk. In particular, the closer debt-to-income and loan-to-value ratios—which together are known as the double trigger of mortgage default—are to 1, the higher the probability that a household's debt is at-risk (Figure 17). The estimates also show that the probability a household's debt is at-risk rises with a higher debt service ratio. The coefficient estimates show that households which hold larger net assets and higher income. These results reinforce the importance of macroprudential regulations in moderating financial risks from household balance sheets via limits on their leverage and debt servicing capacity.

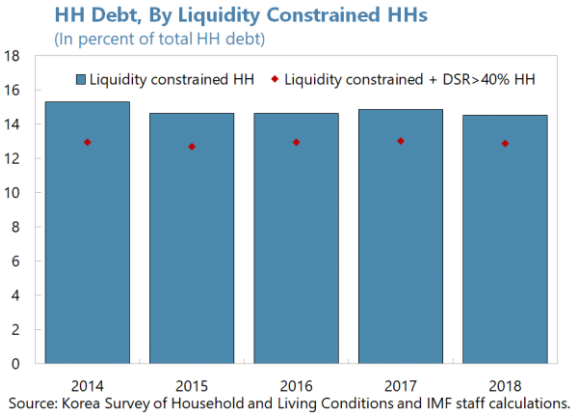
Figure 16. Korea: Household Debt-at-Risk

Around one-third of the share of total non-financial debt at-risk is held by the household sector.



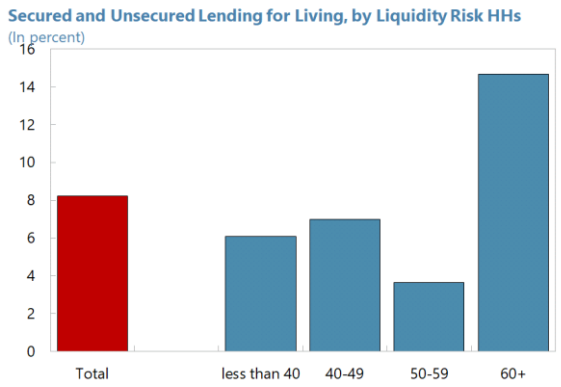
Source: KIS Value, Orbis, BIS, Korea Survey of Household and Living Conditions and IMF staff calculations.

Around 15 percent of HH debt is considered at-risk



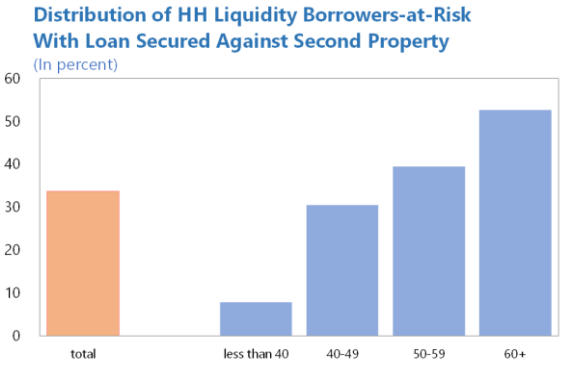
Source: Korea Survey of Household and Living Conditions and IMF staff calculations.

Over 50 percent of HH debt-at-risk is due to unsecured borrowing for living and property expenses.



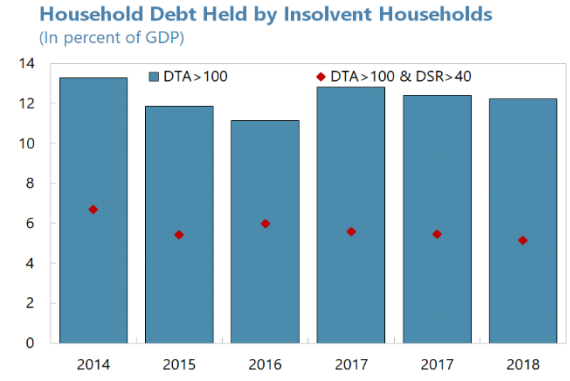
Source: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.

...along with a significant share of loans secured against a second property.



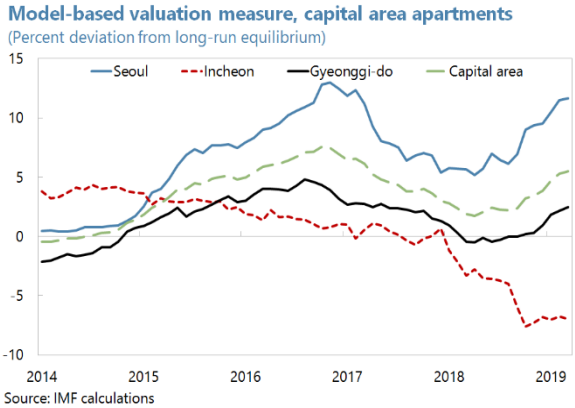
Source: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.
Note: Borrowers-at-risk are defined as having a negative financial margin defined as being unable to finance consumption and debt servicing from disposable income.

Around 12 percent of HH debt is held with households that have a debt-to-asset ratio above 100 percent.



Source: Korea Survey of Household Finances and Living Conditions and IMF staff calculations.

Thus far real-estate prices in Korea are broadly aligned with fundamentals. [1]



Source: IMF calculations

[1] See Korea Financial Stability Assessment Program technical note 'Korea: Macroprudential Framework and Tools'. Equilibrium real-estate prices are calculated using a spatial model, which also contains real income and rates.

Box 7. Household Debt (Borrowers)-at-Risk

Household debt-at-risk is defined as debt held by a household with a negative financial margin (FM). This FM captures a household's inability to meet its debt service, consumption and monthly rent payments from their disposable income and savings. This is defined as

$$financial\ margin = \frac{(consumption + debt\ service\ payment + monthly\ rent)}{(disposable\ income + 0.7 * savings)} > 1 \quad (1)$$

This assumes that 70 percent of savings (excluding insurance and pension) can be liquidated, without significant cost, to cover short-term expenditures. Based on a household's debt-at-risk a default probability can be calculated using

$$PD_i = \begin{cases} 0 & FM_i < 0 \\ 1 & FM_i > 1 \end{cases} \quad (2)$$

For households with an FM_i above 1 equation (2) sets the household's probability of default (PD_i) equal to 1. These household are first defined as borrowers-at-risk. If these borrowers-at-risk carry debt on their balance sheets, then their liabilities is registered under household 'debt-at-risk'.

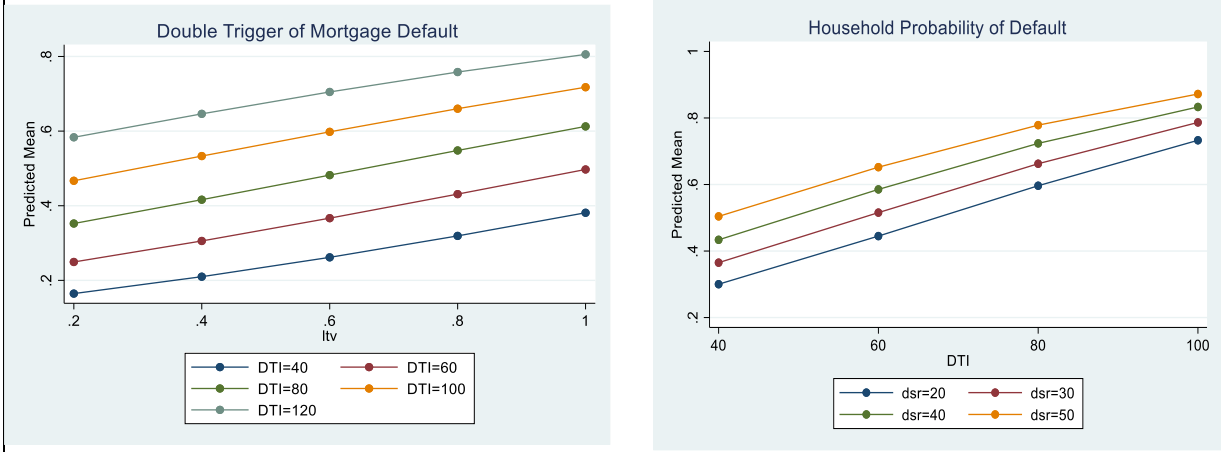
Box 8. Determinants of Borrowers-at-Risk

The analysis aims to understand the extent to which a households' ability to service their debt is influenced by their balance sheet characteristics and macro-financial conditions. A cross-section panel probit model explains the likelihood that a household could experience debt servicing difficulties:

$$P[PD_{it} = 1] = \beta_0 + \beta_1 DSR + \beta_2 LTV + \beta_3 DTI + \beta_4 Net\ Assets + \beta_5 income + \varepsilon_{it}$$

where PD_{it} is a binary variable taking a value of 1 if the household has a negative financial margin (i.e. its debt is at risk). The model relates the analysis of balance sheet indicators (DSR, LTV and DTI) on household leverage. The model aims to explain the tail of the distribution of household debt servicing capacity, and the evolution of predicted household debt-at-risk in the baseline macro-financial scenario. Data is taken from the Korean Household Expenditure Survey, which is composed of approximately 18,000 households.

Figure 17. Korea: Household Debt-at-Risk and Household Balance Sheet Leverage Ratios



44. Around 12 percent (11 percent of GDP) is held with households at solvency risk, defined as a debt-to-asset ratio above 100. Around half this amount is held with household who have a debt service ratio above the (bank average) prudential ceiling of 40 percent; 46 percent with households headed by a retiree or near-retiree individual and; (iii) a quarter have a bullet payment

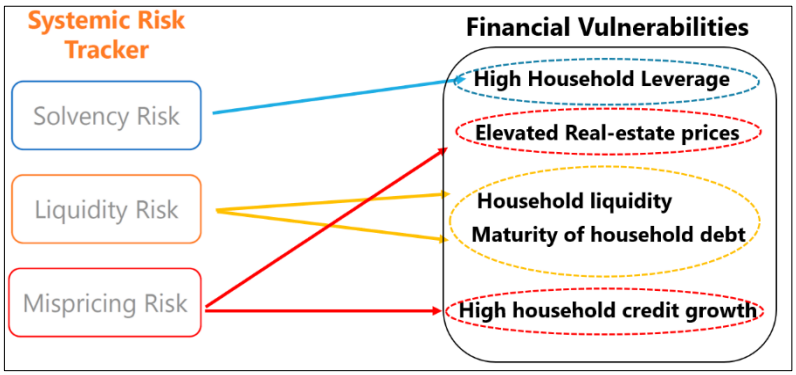
structured loan. These households have assets almost wholly concentrated in real estate, a relatively illiquid asset in the short-term. These figures should be tempered, however, by the low household non-performing loan ratio, which implies that while some household balance sheets may be upside down, income flows remain enough for most of these households to continue servicing their debt obligations. Indeed, the ratio of household debt-to-GDP held by households at liquidity and solvency risk stands at 4 percent.

D. Household Balance Sheet Stress Testing

45. To assess the solvency and liquidity resilience of the Korean household sector, household balance sheets stress tests are conducted jointly with the BoK, FSC and FSS. The stress test explores the extent to which household debt is at solvency or liquidity risk. The stress test data is based on the Survey of Household Finances and Living Conditions data. Three shocks are simulated: (i) house prices; (ii) interest rate; and (iii) household income. Given the excessive household asset concentration in real estate the first shock tests the resilience of household balance sheets to solvency risks; does a large house price shock result in a greater number of households with a wrong way up debt-to-asset ratio. The second and third stress shocks test household debt servicing resilience, as measured by a household's financial margin. A rise in the number of households with a negative financial margin would imply an increase in household debt-at-risk (Box 7). The intensities of income, house price, and income shocks on individual households are determined by distributions generated via Monte-Carlo simulation (Box 9).

46. Household stress tests suggest that household debt-at-risk and insolvencies would rise should downside risks materialize. However, there is considerable heterogeneity across households.

- *Stress scenario household debt-at-risk.*



- A 15 percent decline in income increases the proportion of household debt-at-risk by 6 percent of GDP from 13.7 to 19.6 percent of GDP. The estimates show that around 60 percent of the increase in household debt-at-risk is from a weakening in the balance sheets of households in their 40s and retirees. These age cohorts have in recent years witnessed greatest income volatility.

- A 200-basis point increase in interest rates increases the proportion of household debt registered at-risk, but the impact is smaller, with total household debt-at-risk rising from 13.7 to 17.0 percent of GDP. Retiree households are most at risk from a hike in interest rates, having an almost equal impact on their debt-at-risk as an income shock (around 1.6 percent of GDP). These households are much more likely to have a floating rate loan. This implies that the low for

long interest rate environment in Korea has been helpful for containing household balance sheet vulnerabilities. The stress tests show younger households are much less sensitive to interest rate hikes, who are more likely to have fixed rate mortgages.

- *Stress scenario household insolvency risk.*

- In a stress scenario risks to household debt from growing household solvencies remains more contained. In total, the proportion of household debt held with insolvent households increases by around 1.2 percent of GDP to an income shock and around 2.5 percent to a house price decline. This implies that the proportion of debt held by insolvent households following an income (house price) shock would rise from around its current 4 percent of GDP to 5.3 (6.6) percent of GDP.

- To a house price shock, retirees are at biggest risk of transitioning from debt-at-risk to insolvency. This reflects older aged households having more of their savings in real estate related assets and floating rate and/or bullet loans. Indeed, an interest rate hike has a larger impact on retiree household solvency than income shocks. In contrast an income shock is the bigger risk for younger aged household insolvency, having an almost equal impact as a house price shock.

47. Household stress tests suggest that in a shock scenario immediate risks to the financial system from rising household insolvencies would be manageable. While the stress tests show that a fall in income or hike in interest rates would significantly increase the proportion of household debt-at-risk, bank stress tests suggest household credit losses would amount to around 2.5 percent of GDP.[10] The widespread use of mortgage insurance schemes in Korea should also protect banks' capital.

48. To further strengthen the reslience of the financial sector to risks from shocks to household debt macroprudential policies should be strenghted further, including the introduction of a sectoral countercyclical buffer. This should cover secured and unsecured household lending and would build resilience and complement existing borrower-based measures. Banks, including internet-only banks, and other depository institutions are heavily exposed to households. Authorities efforts have focused on borrower-based measures such as limits on loan-to-value, debt-to-income, and debt service-to-income ratios. Especially when used in concert, they improve the resilience of household balance sheets, but may also suffer from diminishing effectiveness. A sectoral countercyclical buffer (SCCyB) targeting household exposures would allow banks to build up and release capital as risks from the household sector fluctuate over the credit cycle. It would further provide a buffer that could be released should the risks in the stress scenario crystalize, and also helping mute pro-cyclicality in bank lending.[11]

[10] See Korea Financial Stability Assessment Program technical note 'Korea: Systemic Risk Analysis'.

[11] See Korea Financial Stability Assessment Program technical note 'Korea: Macroprudential Framework and Tools' for more details.

Box 9. Household Balance Sheet Stress Testing

A conservative stress scenario is specified, where household savings and consumption to shocks is accounted for. The shock variables in the stress scenario—income, interest rates, housing prices and stock prices—impact households' debt repayment capacity from which household default risks can then be derived conditional on the intensities of individual shocks. There are three stages to calculating the solvency and liquidity risk to household debt.

1. Generation of shocks. The distribution of income, house and stock price shocks are derived from a Monte-Carlo simulation. The interest rate shock is proportional to the risk level of the household debt balance sheet, which is determined by debt service and debt-to-asset ratios

$$[1 + (DSR - 0.4)] * [1 + (DTA - 1)] * 100$$

The household sector stress test model is designed to ensure that each macro shock causes households' default risk to change through changes in micro financial indicators for individual households such as income, debt service amount (loan principal and interest) and assets.

Shock	Size
Income	-15 percent
House price	-16 percent
Interest rate	+200 basis points

The model assumes that consumption adjusts in response to an income and interest rate shock by 10 and 5 percent, respectively. These values are roughly in line with previous adjustments in crises.

2. Calculation of micro financial factors

Income shock. Income is defined as the sum of earned income and property income, which is derived from financial and real assets.

Assets price shock. There are three asset prices in the model: house, stock and the interest rate. Savings decline in response to a stock price or interest rates shock.

Interest payment shock. The interest rate shock leads interest payments to increase proportionally with debt and assumes that around 70 percent of household loans are linked to a floating rate

$$\begin{aligned} &interest\ payment\ after\ shock \\ &\quad = initial\ interest\ payment\ + 0.7(financial\ debt) \\ &\quad * interest\ rate\ shock\ to\ individual\ household \end{aligned}$$

Household consumption. The model assumes that consumption adjusts by 10 percent and 5 percent respectively after income and interest rate shocks.

3. Household debt-at-risk. In the stress scenario household debt is considered at-risk if the household financial margin is greater than 1

$$Financial\ margin\ = \frac{(consumption\ after\ shock\ +\ debt\ service\ payment\ after\ shock\ +\ monthly\ rent)}{(disposable\ income\ after\ shock + 0.7 *\ savings\ after\ shock)} > 1$$

This assumes that 70 percent of savings (excluding insurance and pension) is liquidated following the shock. A value greater than 1 would imply that payments for debt service, consumption and monthly rent exceed household disposable income and available savings.

4. Household solvency risk. In the stress scenario debt is considered at solvency risk if the household has a financial margin above 1 and the debt-to-asset ratio is above 100 percent

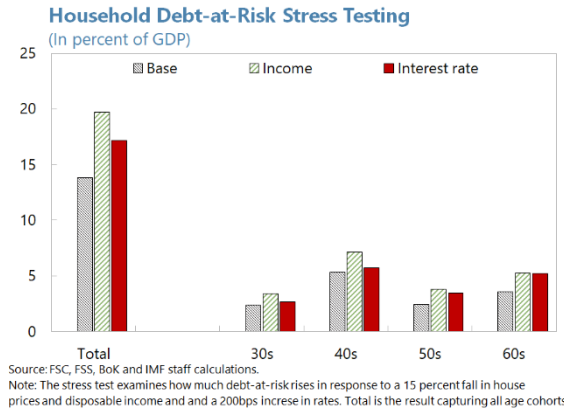
$$Financial\ margin\ = \frac{(consumption\ after\ shock\ +\ debt\ service\ payment\ after\ shock + monthly\ rent)}{(disposable\ income\ after\ shock + 0.7 *\ savings\ after\ shock)} > 1$$

and

Debt-to-Asset > 100%

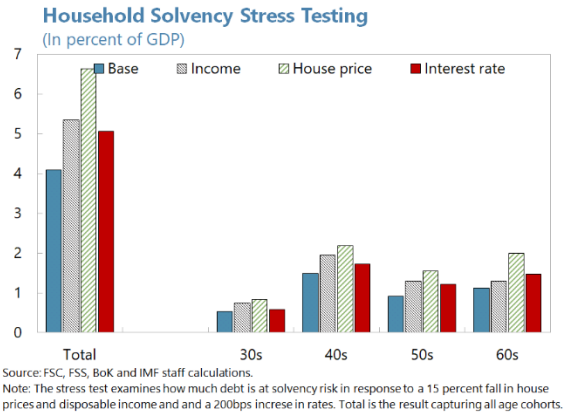
Figure 18. Korea: Solvency and Liquidity Stress Testing of Household Balance Sheets

HH debt-at-risk rises if income falls or interest rates rise.

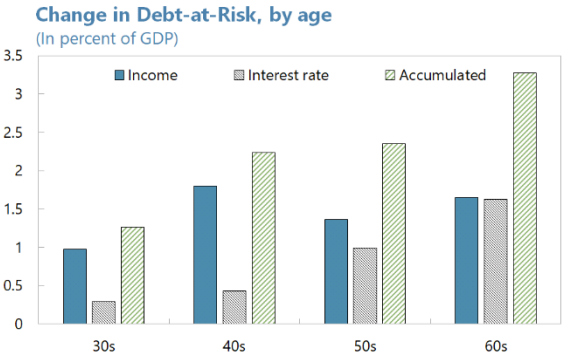


Source: FSC, FSS, BoK and IMF staff calculations.
Note: The stress test examines how much debt-at-risk rises in response to a 15 percent fall in house prices and disposable income and and a 200bps increse in rates. Total is the result capturing all age cohorts.

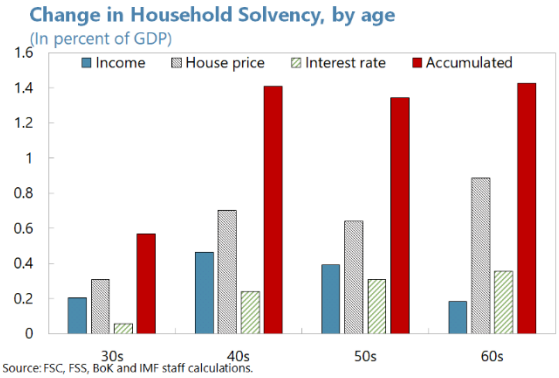
The amount of debt held on the balance sheets of insolvent HHs rises most when house prices decline.



Source: FSC, FSS, BoK and IMF staff calculations.
Note: The stress test examines how much debt is at solvency risk in response to a 15 percent fall in house prices and disposable income and and a 200bps increse in rates. Total is the result capturing all age cohorts.



Source: FSC, FSS, BoK and IMF staff calculations.
Note: The change in debt-at-risk is relative to the base. Accumulated is total of change in debt-at-risk from the income and interest rate shock.



Source: FSC, FSS, BoK and IMF staff calculations.
Note: The change in household solvency is relative to the base. Accumulated is total of change in household insolvency from the income, house price and interest rate shocks.

E. Summary and Conclusion

49. A rising trend of household indebtedness has resulted in growing household balance sheet vulnerabilities. Household debt in Korea is among the highest in the OECD. Households have continued to accumulate assets, mainly in real estate. While banks have maintained conservative lending practices risks to household debt emanate from growing household balance vulnerabilities. Household leverage has risen faster than the accumulation of assets. However, the low for long interest rate environment in Korea has been helpful in containing household balance sheet vulnerabilities. Some households – particularly older – have experienced a deterioration in their balance sheet net worth. Stress tests show that these vulnerabilities are significant concerns should downside risks materialize.

50. Korean households have significant asset concentration in real estate, even compared to other advanced countries. Approximately 53 percent of household debt is secured against real estate. Household leverage constraints are closely tied to house prices. While the residential real estate market appears to be broadly aligned with fundamentals with recent price increases limited to more local markets, an unexpected sudden adjustment in house prices will have a significant

impact on household net worth, stretching debt repayment capacity and tightening leverage constraints.

51. Around 15 percent of the total stock of household debt (14 percent of GDP) is currently considered 'at-risk'. Around 12 percent of household debt is held with households who has a debt-to-asset ratio above 100. The probability that a household's debt is at-risk is strongly correlated with loan-to-value, debt-to-income and debt-service ratios. In a stress scenario where household income declines, household debt-at-risk would increase by around 20 percent, and the share of debt held by households with insolvent balance sheets would increase by 1 percent of GDP. The impact of shocks on household balance sheets grow with age. Retiree households would be hit most, given their propensity for floating rate loans, higher leverage—as measured by debt-to-income—and less secure and stable income. This reinforces the importance of macroprudential regulations in moderating financial risks from household balance sheets via limits on their leverage and debt servicing capacity. Such policies should consider heterogeneity across households, and specificities of the mortgage market in Korea, particularly the large share of floating rate and bullet payment debt.

52. Given the high leverage of the household sector, the materialization of downside risks could result in a balance sheet recession. This would create feedbacks to the financial system by impacting housing loan demand and would also impact bank profitability through direct exposures and indirect exposures via loans offered to non-financial firms operating in sectors related to real estate.

53. Ongoing demographic shifts in Korea will likely increase risks for household debt. Assuming past borrowing behavior is a guide to the future, as society ages an ever-larger share of household debt will be held with households that are characterized by relatively more unstable income. This will likely increase the proportion of debt held by borrowers-at-risk households and therefore risks to the resilience of the stock of household debt going forward. These factors also raise the probability of larger forced sell offs during a stress scenario, potentially resulting in much larger real estate price adjustments.

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