REPUBLIC OF KOREA

SELECTED ISSUES

May 2019

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INTERNATIONAL MONETARY FUND

REPUBLIC OF KOREA

SELECTED ISSUES

April 23, 2019

Approved By
Asia and Pacific Department

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CONTENTS

TABLES

APPENDIX

EVOLUTION OF MACROPRUDENTIAL POLICIES IN KOREA

1.   **The primary aim of macroprudential policy is to secure financial stability by leaning against excess financial conditions**. FSB, IMF, and BIS (2011) define macroprudential policy as "a policy that uses primarily prudential tools to limit systemic or system-wide financial risk, thereby limiting the incidence of disruptions in the provision of key financial services that can have serious consequences for the real economy . . . ". Rather than managing inflation or the business cycle, as monetary policy aims to do, macroprudential policy tries to strengthen the financial system's defenses in the face of economic and financial shocks.

2.   **This Selected Issues chapter looks at (*i*) monetary policy and financial cycles; (*ii*) the evolution of macroprudential policies in Korea;** (*iii*) the efficacy in prudential policies in taming financial excess and building financial resilience and; (*iv*) the interaction between monetary policy and macroprudential policies.

A.   Monetary Policy and Financial Cycles: A Coordination Challenge

3.   **The financial sector is inherently procyclical and can amplify the real cycle.** This amplification occurs through price and quantity channels. Bank lending is procyclical because liabilities tend to increase by more than assets during a credit boom, thus raising leverage. Moreover, because financial conditions are positively correlated with overall economic activity, price-based market risk indicators also tend to be procyclical.

4.   **Risks to financial stability arising from excessive procyclicality highlights several coordination issues among policymakers**. These key factors include: (*i*) real and financial cycles operate at different frequencies; (*ii*) supply-side developments that constrain monetary policy in an inflation targeting regime; and (*iii*) monetary policy is too blunt an instrument for dealing with asset price bubbles. Each of these issues are explored in further detail for Korea.

Real and Financial Cycles Operate at Different Frequencies in Korea

5.   **The duration and amplitude of the financial cycle are not the same as those of the real cycle, which in real-time could lead monetary policymakers astray (Borio 2012).** Drehmann, Borio, and Tsatsaronis (2012) note that the financial cycle operates at a much lower frequency than the traditional business cycle, while Borio and Lowe (2002, 2004) show that widespread financial distress typically arises from the unwinding of financial imbalances that build while disguised by benign economic conditions characterized by stable and low inflation.

6.   **There is a weak relationship between the credit gap and inflation and real and financial cycles have tended to peak and trough at different dates in Korea**. A simple scatter plot of the credit gap and inflation from 1990 to 2018 does not report a statistically significant relation. Achieving price stability is therefore no guarantee that financial excess can be avoided.

Leverage and financial cycles have tended to be more persistent with a larger amplitude cycle than traditional business cycles. These findings for Korea are in line with those documented for other advanced and emerging market economies, which show real and credit cycle operate at different frequencies. A low degree of coherence between real and financial cycles potentially spells coordination difficulties for monetary policy if the framework targets multiple objectives.

Korea Credit Gap and Inflation
(In percent)

$y = -0.0211x + 2.4857$

Source: IMF Staff Calculations.

Korea Macro and Financial Cycles
(In percent)

Leverage cycle
Business cycle
Financial Cycle

Source: Authorities data and IMF staff calculations. The estimates are performed using a bandpass filter. The leverage cycle is calculated using the credit-to-GDP ratio; the business cycle is estimated using real GDP; the financial cycle is composed of credit-to-GDP ratio, house prices and total non-financial sector credit. Shaded areas represent peak-to-trough phases in real GDP growth

7.   Coordination difficulties for monetary policy could potentially result in looser monetary policy than would otherwise be warranted. Monetary policy may not be the optimal tool for leaning against financial cycles if it is expected to moderate business and inflation cycles at the same time. Multiple objectives may also overburden monetary policy, creating an expectation gap between what the central bank can achieve and what it can deliver.

Supply-Side Developments in Korea have Constrained Monetary Policy in an Inflation Targeting Regime

8.   Since the introduction of inflation targeting in 1999 in Korea positive supply-side developments have put downward pressure on inflation. This has constrained the room for monetary policy tightening. As inflation has declined, monetary policy rates have fallen, which, in turn, has depressed neutral interest rates. At the heart of this interpretation are two features: first, the neutral rate is defined as the rate that would prevail if actual output equaled potential output. Second, inflation is the key signal that output is not at its potential, sustainable level. This view presumes monetary policy only passively tracks the neutral rate over the medium term. Thus, the observed decline in real interest rates is purely a function of forces beyond the central bank's control.

9.   Various estimates of the neutral rate for Korea show a decline in the neutral real interest rate since the Asian crisis.[1] The decline in the neutral rate mirrors global financial trends and reflects, in part, the success of the Bank of Korea in moderating and stabilizing inflation. Since

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[1] The neutral rate cannot be directly observed, and the rate is model dependent.

credit booms have not, historically at least, been accompanied by higher inflation—reflecting positive supply-side developments and improved central bank credibility—monetary policy focused on price stability has not needed to tighten beyond the neutral rate to restrain a buildup in financial imbalances in Korea. Therefore, where low policy rates are consistent with low inflation, they may contribute to excessive credit growth and the buildup of asset bubbles and thereby sow the seeds of financial instability (Juselius and others 2016). These factors reinforce the need for prudential policies that mitigate the buildup of financial risk in a low-interest-rate environment.

Korea Neutral Interest Rate
(In percent)

Source: Authorities data and IMF Staff Calculations.
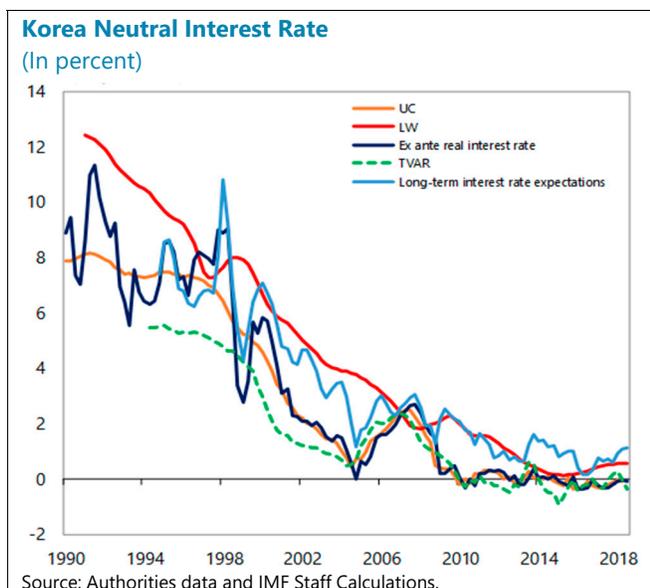
Monetary Policy Too Blunt for Dealing With Financial Imbalances.

10. **Monetary policy affects financial prices and quantities.** The risk-taking predicts that variations in monetary policy affects the effective risk appetite of financial intermediaries and, thus, shifts the supply curve for credit. Monetary policy impacts the price of risk and banks' interest margin, causing financial intermediaries to shift their supply of lending.

11. **Leaning against perceived deviation of financial prices from macro fundamentals relies on the assumption that higher rates will shrink an emerging financial or asset price bubble.** This proposition is tested by examining the link between monetary policy and equity prices. The link between stock prices and monetary policy is established via a risk-neutral general equilibrium environment, as in Galí 2014 and Galí and Gambetti (2015). The stock price (Q) is decomposed into fundamental (Q^f) and bubble (Q^b) components, $Q = Q^f + Q^b$. In a risk-free environment, the fundamental component is defined as the present discounted value of future dividends

$$q^f = const + \sum_{j=0}^{\infty} \Theta^j [(1-\Theta)E_t\{d_{t+k}\} - E_t\{r_{t+k}\}] , \tag{1}$$

The response of an asset price to a change in monetary policy can be expressed as

$$\frac{\partial q_{t+k}}{\partial \varepsilon_t^m} = (1 - \gamma_{t-1}) \frac{\partial q_{t+k}^f}{\partial \varepsilon_t^m} + \gamma_{t-1} \frac{\partial q_{t+k}^b}{\partial \varepsilon_t^m} , \tag{2}$$

in which $\gamma = Q^b / Q$ measures the relative size of the bubble component in the overall asset price. In response to a monetary impulse, the fundamental stock price can be traced out using

$$\frac{\partial q_{t+k}^f}{\partial \varepsilon_t^m} = \sum_{j=0}^{\infty} \Theta^j (1-\Theta) \frac{\partial d_{t+k+j+1}^f}{\partial \varepsilon_t^m} - \frac{\partial r_{t+k+j}}{\partial \varepsilon_t^m} \quad , \tag{3}$$

in which $\Theta = d/r < 1$ and d_t is the gross dividend yield, and r_t is the riskless real rate.

Under the conventional view that monetary policy can be used to prick asset price bubbles,

$$\frac{\partial r_{t+k+j}}{\partial \varepsilon_t^m} < 0 \quad \text{and} \quad \frac{\partial d_{t+k+j+1}^f}{\partial \varepsilon_t^m} \leq 0 \quad , \tag{4}$$

which implies that a tightening of monetary policy should cause a decline in the size of the bubble. Hence, the overall effect on the observed asset price should be unambiguously negative, independent of the relative size of the bubble. The response of the bubble component can be backed out via the gap between the empirical stock price and the fundamental stock price responses ($Q^b = \frac{\partial q_{t+k}^p}{\partial \varepsilon_t^m} - \frac{\partial q_{t+k}}{\partial \varepsilon_t^m}$) to a tightening in monetary policy.

12.   The focus is on the dynamic response of stock prices to an exogenous hike in the policy interest rate. The theoretical predictions in (4) are empirically tested for Korea, using a simultaneous equations model containing real GDP, the GDP deflator, KOPIX dividends, the short-term interest rate, and the KOPIX stock index from 1990Q1 to 2018Q2.

13.   Tighter monetary policy has not, historically at least, been associated with falling equity prices. The estimates show that the bubble component (Q^b) of asset prices does not fall in response to a rising policy interest rate. This effect is persistent and statistically significant, and consistent with the theory of rational bubbles.

Korea: Response of Bubble Component (Qb) to a Tightening in Monetary Policy (In percent)

Source: IMF Staff Calculations. The 3D-graphs of the time-varying relationship are to be read in the following way: along the x-axis the starting quarters are aligned from 1995:1 to 2017:2; on the y-axis the quarters after the monetary policy shock are displayed; and on the z-axis the value of the bubble component response to a tightening in monetary policy.

14.   The link between monetary policy and the financial quantities is also tenuous in Korea. In particular, does monetary policy tightening impact credit developments? This is examined by using two standard empirical models that are only differentiated in the way that they identify monetary policy shocks over the inflation targeting period (1999m1 – 2018m8). In model 1 the monetary policy shock is identified as in Christiano, Eichenbaum and Evans (1999) and in model 2 using the procedure in Rubio-Ramirez, Waggoner and Zha (2010).

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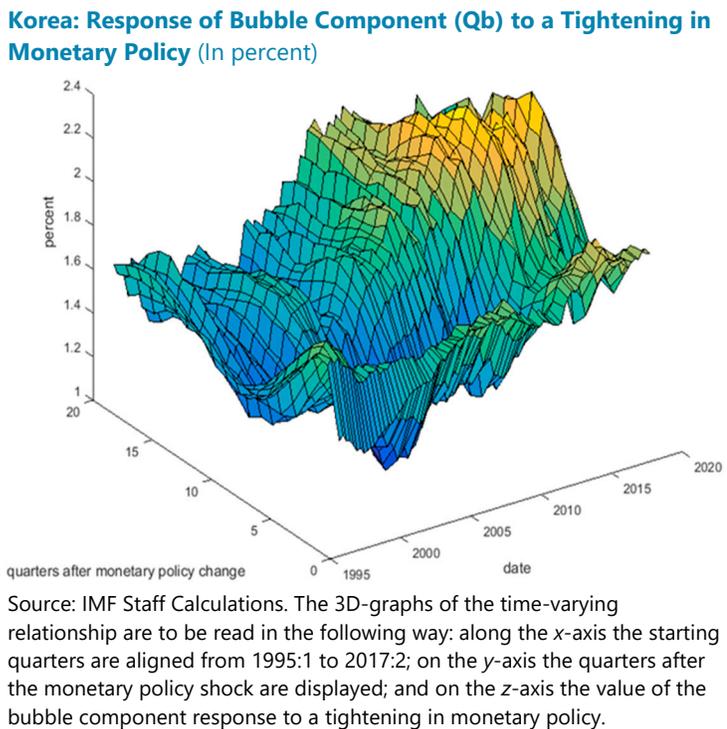
Figure 1. Impact of Contractionary Monetary Policy Shock on Financial Intermediaries
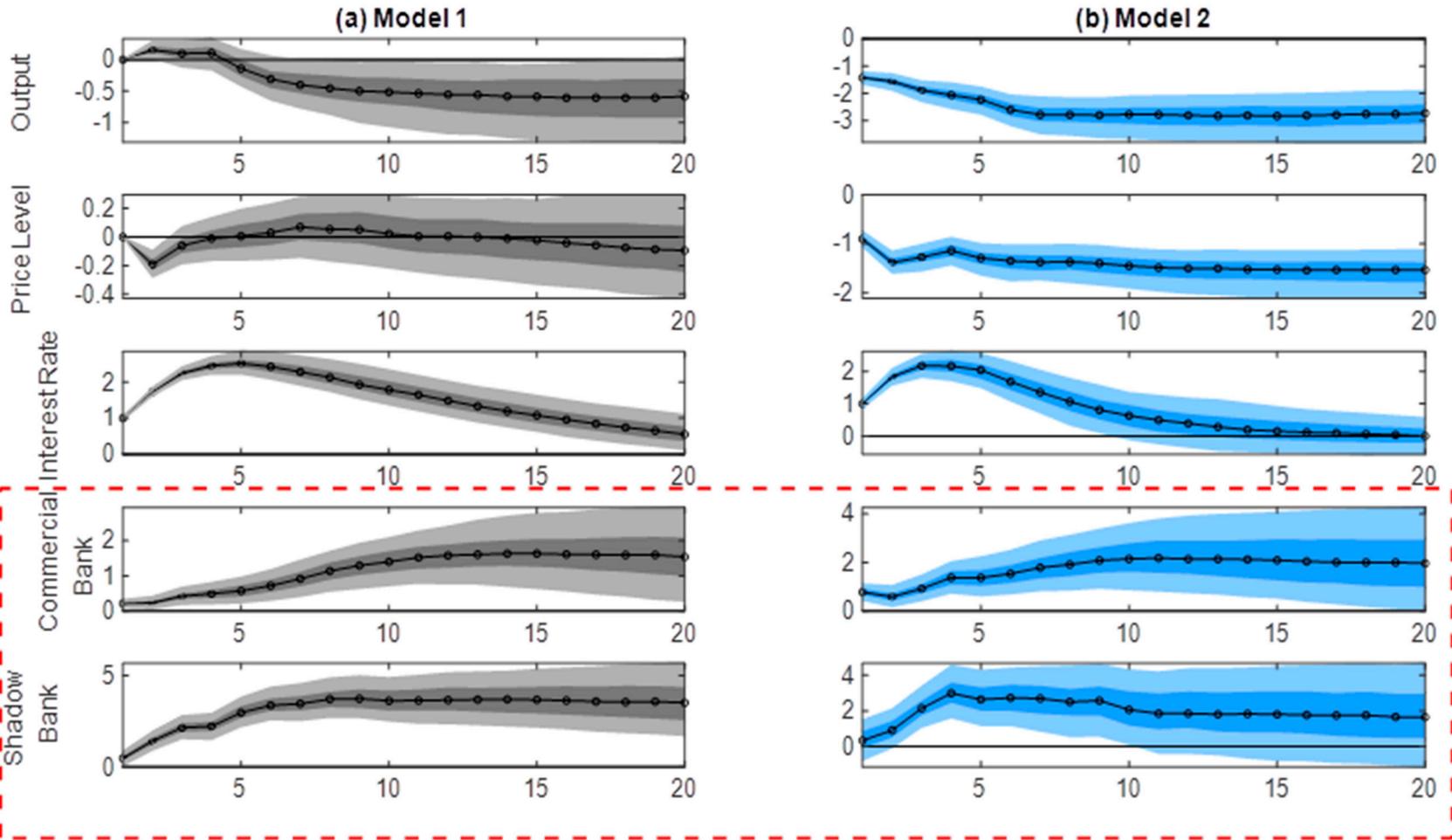
Source: IMF Staff Calculations.

Figure 2. Simulation of a "Leaning Against the Wind Monetary Policy"
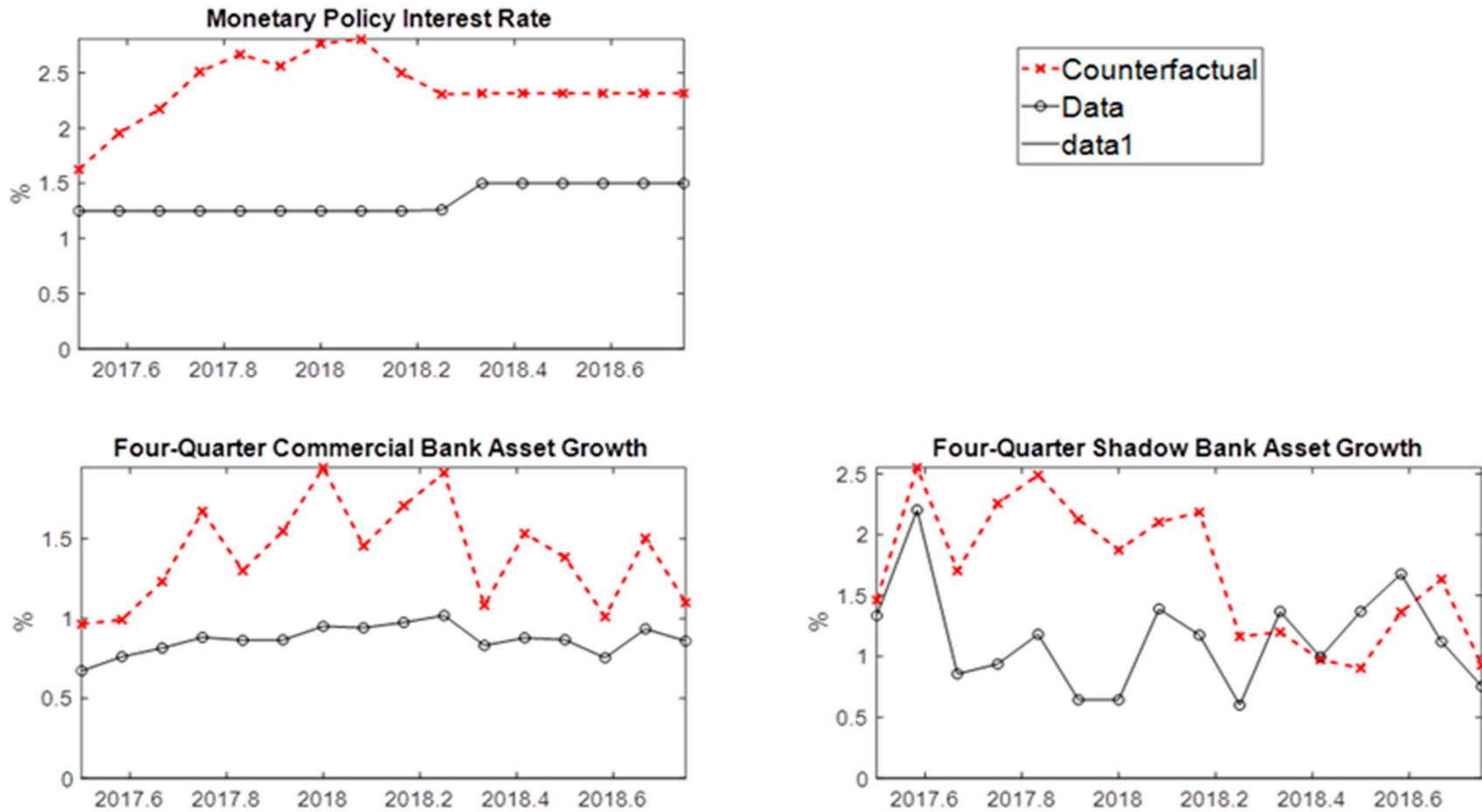
Source: IMF Staff Calculations.

15.   A surprise (100 basis point) non-systemic monetary policy tightening leads to a decline in GDP and the price level. However, there is an expansion in commercial and shadow bank assets. This effect seems to be robust across both model specifications. To put these findings into a historical perspective, the effects of a systemic monetary policy tightening in simulated against the counterfactual or no tightening. This is achieved by injecting a series of monetary policy surprises to leave policy rates up to 150 basis points higher over the past 18 months (2017m1 – 2018m7), implying a substantially tighter monetary policy than was realized. It is reasonable to expect that the public would not have immediately and fully understood this policy change, thereby, negating the Lucas critique. While this policy would have been effective in curbing output growth, expansion of commercial and shadow bank balance sheets would have accelerated. The value of commercial bank and NBFC assets would have grown between 3-to-6 percent faster over the last 18 months.

16.   Achieving the financial stability objective will require dedicated macroprudential policies, which can be better tailored to financial risks. The empirical evidence for Korea suggests that monetary policy alone has been less effective in taming financial and credit cycles during the inflation targeting period. Moderating real and financial cycles will require well-tailored macroprudential policies, which will also have fewer unintended consequences on other sectors of the economy and other policy objectives.

B. How Have Macroprudential Policies Evolved in Korea?

17.   This section explores two key questions: how have macroprudential policies evolved in Korea and their implementation have helped tame financial excess.

Macroprudential Policies in Korea

18.   The use of macroprudential policies in Korea have evolved in two ways. First, the macroprudential toolkit has been expanded. Second, macroprudential instruments have been used more aggressively over the financial cycle.

Korea: Use of Macroprudential Tools 1/
(Number of Policy Changes)

Source: IMFWP WP/11/238.
1/Note: Monetary tools refer to local and foreign currency deposit reserve requirements; bank prudential tools captures policy changes in loan-to-value ratios, loan loss provisions, capital requirements; loan-to-value ratios, debt service-to-income ratio, loan-to-deposit ratio and capital conversion buffer; other tools contains tax policy changes related to capital gains or stamp duty and local foreign currency lending banks' net open positions.

Korea: Reasons for Macroprudential 1/
(Number of Policy Changes)

Source: IMFWP WP/11/238.
1/ Note: Policies to tame the financial cycle include loan-to-value ratio, debt service-to-income ratio loan-to-deposit ratio, tax policy changes related to capital gains or stamp duty and local foreign currency lending banks' net open positions. Tools to build financial resilience include higher capital

19.   There has been a shift in the types of macroprudential tools used in Korea to safeguard financial stability. A database of macroprudential policies constructed by the IMF (2018) shows a move away from monetary macroprudential tools to broader borrower-based prudential instruments. There are several reasons for this shift. First, reserve requirements progressively lost their importance as a monetary policy tool following the Bank of Korea adopting interest rate policy and inflation targeting. Second, there has been a recognition that financial cycles, such as housing credit and house prices, have become longer, larger, and less synchronized with real and inflation cycles. In response, policymakers in Korea have increasingly resorted to prudential measures to moderate credit and asset price cycles. Third, there has been a shift toward explicit macroprudential objectives following the Asian financial crisis.

Korea Macroprudential Policies and Targeted Sectors
(Number of policy changes)

Source: BIS data and staff calculations
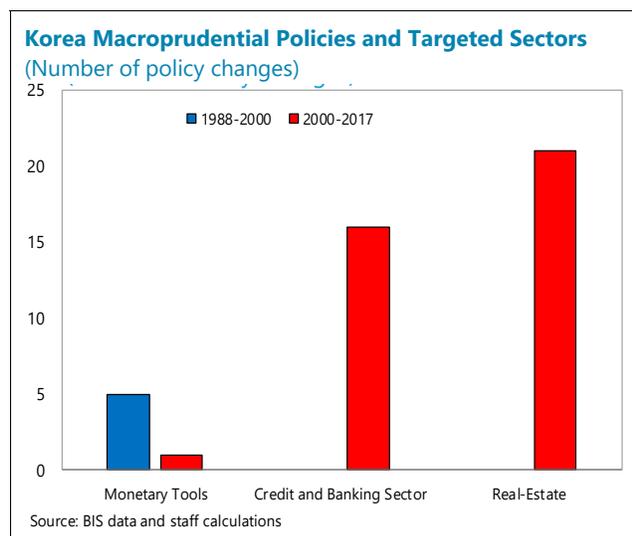
20.   Since the Asian crisis Korea has used prudential policies more actively to address financial cycles more systematically. A macroprudential policy index is constructed of prudential policies that principally target financial swings. The change in the aggregate macroprudential index has in general moved in phase with fluctuations in credit growth. Periods of higher credit growth have often been associated with tighter prudential policies and vice versa. The below charts illustrate aggregate 'macroprudential policy response curves' pre- and post-Asian crisis. The charts illustrate the probability of a tightening in macroprudential policies to credit and housing cycles, estimated using a logit model. Two findings stand out. First, the probability of macroprudential policies being tightened in response to a widening in the credit gap or house price growth in the period following the following the Asian crisis is significantly higher. Second, the macroprudential policy response has been non-linear, particularly with regards the housing market.

Korea Macroprudential Policy Cycle and Credit Growth
(Index)

Source: IMF and Authorities data.
Note: Shaded areas represent peak-to-trough epsides in real GDP growth.

Probability of a Tightening in Macroprudential Policies to Credit and Housing Cycles

Source: IMF Staff Calculations

Source: IMF Staff Calculations.
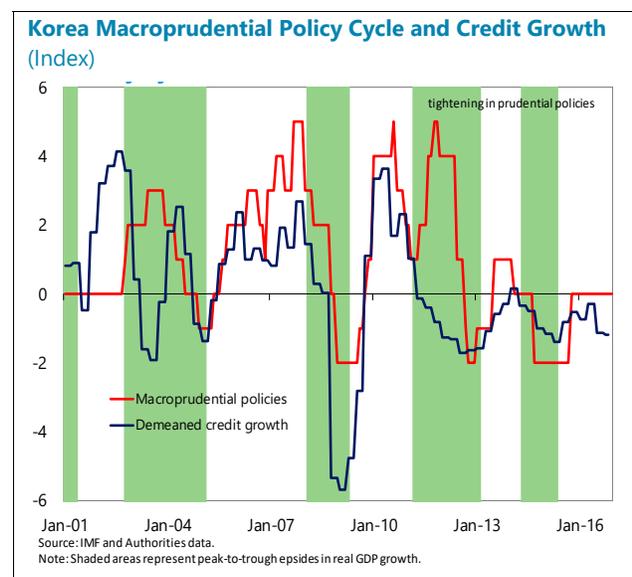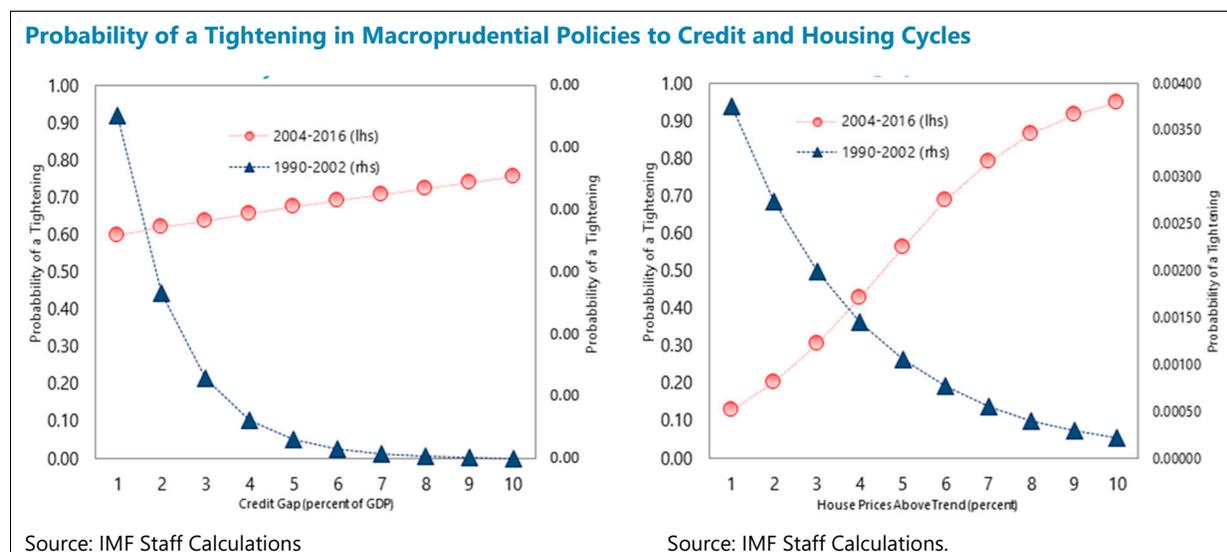
C. Have Prudential Policies Been Effective in Taming Financial Cycles?

21.   The effect of macroprudential policies on financial indicators is estimated using local projections. The projections are drawn from a robust regression that controls for the business cycle, monetary policy with fixed effects linking financial conditions and various macroprudential policy tools.[2] The response of financial conditions to a tightening in prudential policies is quantified using the observation equation:

$$f_t = a_0 + \beta_1 prudential\ instrument + \mathbf{DX_t} + \varepsilon_t \qquad (5)$$

where f_t captures the change in financial conditions to a change in macroprudential policies (β_1) while controlling for other factors contained in $\mathbf{X_t}$ (economic activity, VIX, monetary policy and interest rates). Monthly economic conditions are captured using a mixed frequency coincident index constructed using quarterly GDP and monthly retail sales, industrial production and service sector growth. Prudential policies are traced onto credit and house price growth using the following state equation:

$$f_t = \begin{bmatrix} credit \\ house\ price \\ NIM \\ NBFC\ credit \\ Stock\ prices \\ Money\ M2 \end{bmatrix} = \begin{bmatrix} \lambda_{1,t} \\ \lambda_{2,t} \\ \lambda_{3,t} \\ \lambda_{4,t} \\ \lambda_{5,t} \end{bmatrix} f_{t-1} + \xi_t \qquad (6)$$

$$where \qquad \lambda_{i,t} = \lambda_{i,t-1} + \vartheta_t$$

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[2] See Teulings and Zubanov (2013) for an explanation of an adjusted local projection method based on Jorda (2005).

22. **The focus here in on the 4 prudential instruments that have been used most often in Korea.** These include: (i) loan-to-value (LTV); (ii) debt service-to-income (DTSI) and; (iii) real estate tax; and (iv) rise in risk-weights and provisioning. Constraints on household lending, such as limits on loan-to-value and debt-service-to-income ratios, increase resilience to asset price and income shocks and reduce demand for housing loans. To more cleanly isolate prudential policy changes from other macroeconomic effects the model is estimated at a monthly frequency from 2002 to 2016.

Korea Real-time Coincident Indicator(Index)

Source: IMF staff calculations and Authorities data.
Note: The mixed frequency coincident indicator is constructed using quarterly GDP and monthly retail sales, industrial production and a service sector index.Shaded areas represent peak-to-trough slowdowns in real GDP growth, based on OECD estimates.

Source: IMF Staff Calculations.

23. **The macroprudential policy variables from IMF (2018) inform effects per policy action.** They do not control for the intensity of policy actions. The confounding effect of the endogeneity of the policies should also be kept in mind when interpreting the results. The introduction of macroprudential policies often reflects the external environment and the perception that surges in bank or bond capital flows may lead to destabilizing capital outflows in any subsequent reversal. To the extent that new macroprudential policies happen only after a period of discussion within the government, central bank, and other public authorities (such as financial regulators), the introduction of such policies often coincides with the late stages of the boom. To the extent that the boom subsides under its own weight, the introduction of the macroprudential policy and the subsequent slowdown of capital flows and credit growth would be a coincidence, not a causal effect. Thus, the results reported herein should be interpreted with some caution.

Korea Accumulated Response of House Prices to Tightening in Macroprudential Policies (In percent)

months after macropru tightening

Source: IMF Staff Calculations. The 3D-graphs of the time-varying relationship are to be read in the following way: along the *x*-axis the starting months are aligned from 2002:1 to 2016:6; on the *y*-axis the quarters after the macroprudential policy shock are displayed; and on the *z*-axis the value of the house price response to a tightening in macroprudential policy.

Figure 3. Accumulated Impact of a Tightening LTVs on Credit and Asset Prices in Korea
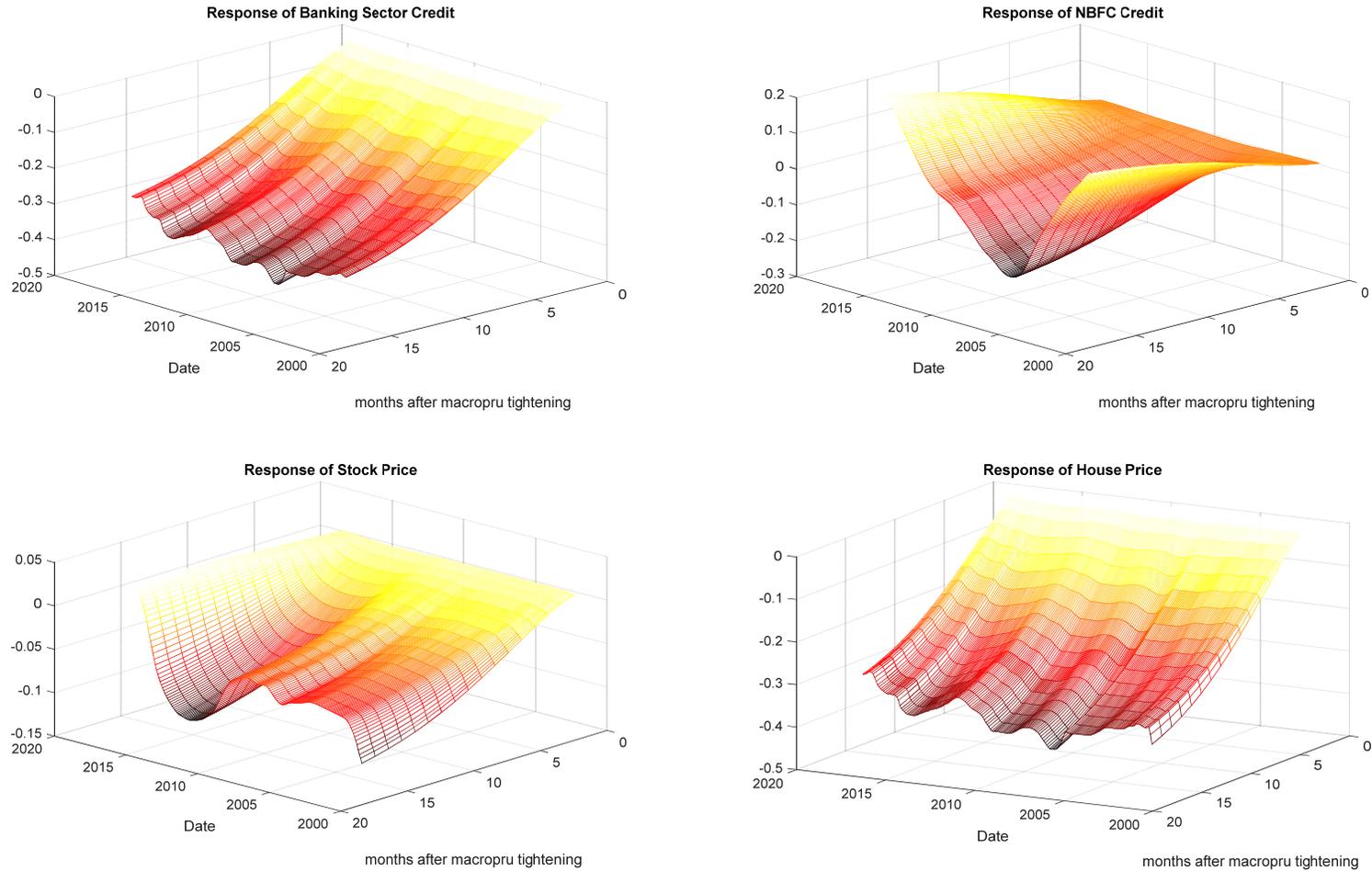
Response of Banking Sector Credit

Response of NBFC Credit

Response of Stock Price

Response of House Price

Source: IMF Staff Calculations. The 3D-graphs of the time-varying relationship are to be read in the following way: along the *x*-axis the starting months are aligned from 2002:1 to 2016:6; on the *y*-axis the quarters after the macroprudential policy shock are displayed; and on the *z*-axis the value of the credit response to a tightening in macroprudential policy.

Figure 4. Accumulated Response of Credit and House Price Cycle to a Tightening in DSTI Ratio
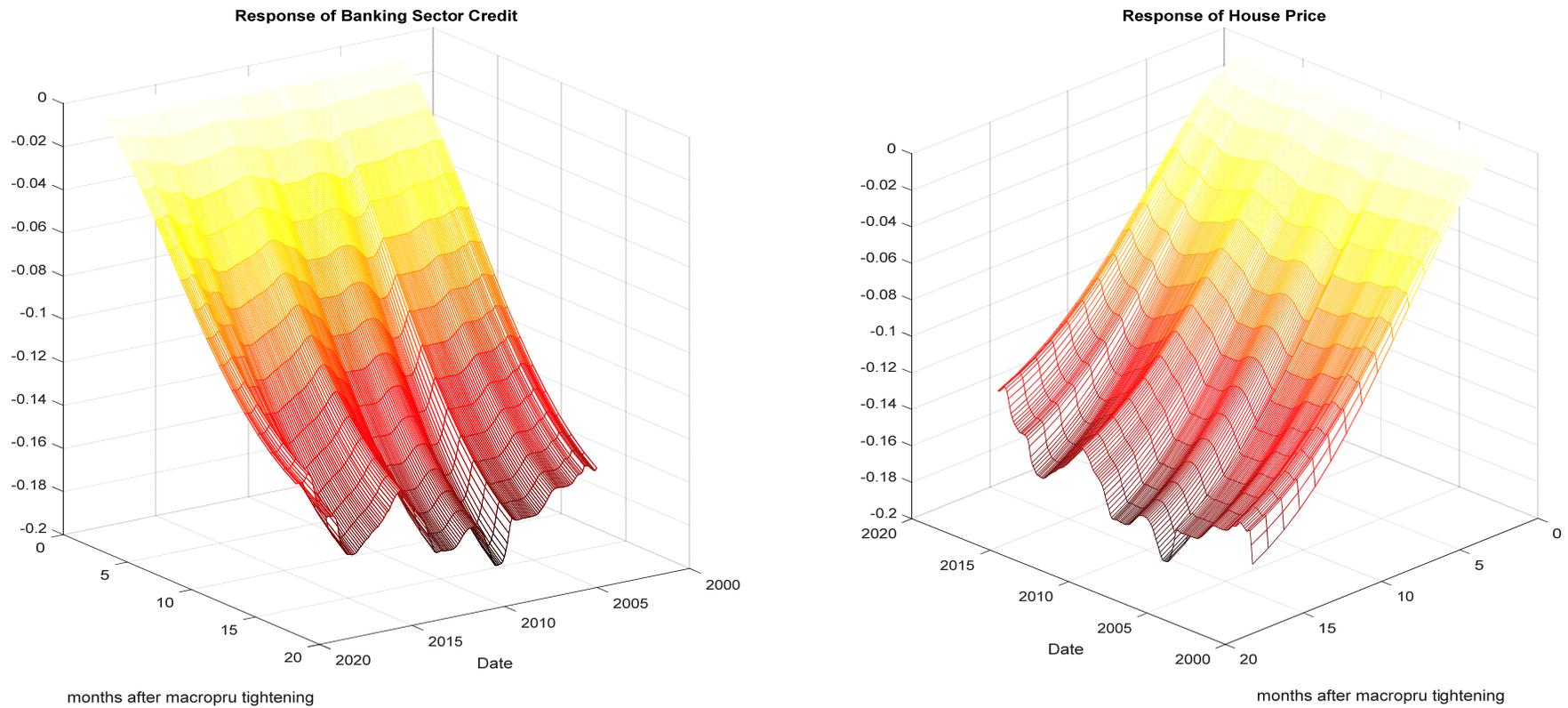
Response of Banking Sector Credit

months after macropru tightening

Response of House Price

months after macropru tightening

Source: IMF Staff Calculations. The 3D-graphs of the time-varying relationship are to be read in the following way: along the *x*-axis the starting months are aligned from 2002:1 to 2016:6; on the *y*-axis the quarters after the macroprudential policy shock are displayed; and on the *z*-axis the value of the credit response to a tightening in macroprudential policy.

24. **Macroprudential measures have had an effective impact on credit and housing cycles in Korea**. The dynamic responses show that changes in loan-to-value limits and risk-weighting appear, with a lag, to have their largest impact on the credit cycle. This outcome is perhaps not surprising, since loan-to-value limits work directly to limit credit demand. Dynamic estimates also show that real estate–specific measures, such as raising real estate–related taxes or tightening the loan-to-value ratio, help directly reduce real estate price inflation. The empirical evidence indicates that LTV and DSTI enhance the banking system's resilience to house price and income shock, and effectively dampen the procyclicality of credit and asset price growth in Korea. The lagged effect of some prudential measures on credit and asset prices suggests that macroprudential policies need to be forward looking to preempt financial excesses.

Korea: Impact of Prudential Policies on Credit and Housing Cycles
(In percent)

Source: IMF staff calculations; Authorities and IMF data.
Note: The model is based on a regression containing the macro prudential policy instrument, the monetary policy rate, the yield curve and economic activity. This equation is used to trace out local projections of the effect of macro-prudential policy on credit and housing cycles. The 20 month cumulated impact is presented in the chart.

How Effective Have Prudential Policies been in Building Financial Buffers

25. **Macroprudential policy buffers can help build financial resilience and help in the conduct of monetary policy, particularly during periods of heightened financial frictions**. When macroprudential buffers are available in times of financial stress, they can be released to maintain the provision of credit to the economy, thereby reducing the effects of financial shocks on output, and complementing monetary easing that would typically occur in such stressed conditions. Macroprudential buffers can help keep monetary transmission open under such conditions, especially when buffers can be relaxed.

26. **Bank based prudential tools, such as capital requirements or loan loss provisioning, are a central part of the macroprudential toolkit in Korea**. A macroprudential index is constructed of prudential tools that are principally aimed at building financial sector resilience: capital conversion buffer, reserve requirements, loan loss provisioning and changes in capital requirements, including risk-weights. Raising capital requirements serves both goals of macroprudential policy: preemption and

Bank Based Prudential Policies
(Index)

Source: IMF.
Note: Bank based prudential policies are those that aim to build financial sector resilience. These include loan loss provisioning, domestic and FX reserve requirements, regulations for funding and liquidity risks and capital conversion buffers. Note: Shaded areas represent peak-to-trough epsides in real GDP growth

resilience.[3] Higher bank capital requirements have several benefits from a financial stability perspective and provide a buffer that absorbs losses—in principal, bank capital plays a preventive role through greater incentives for better risk management. Risk-weights on specific loans, such as mortgages, can be raised to induce banks to hold extra capital and protect against unexpected losses that arise when default rates increase because of an economic downturn. The change in the index shows that such policies have tended to be tightened in periods just before an economic slowdown or during one.

27.   The overall efficacy of these prudential measures on financial sector resilience is examined using a regression equation containing a bank-based macroprudential index

$$y_{i,t} = a_0 + \beta_1 prudential\ index + \boldsymbol{DX_t} + \varepsilon_t \tag{7}$$

where $y_{i,t}$ is a measure of financial sector resilience and $\boldsymbol{X_t}$ contains controlling factors (market risk premia, monetary policy, economic activity). In this case 4 measures of financial resilience are tested: financial debt, non-core funding, Tier 1 bank leverage and the credit gap. Three of these measures have been shown to be good leading indicators of future financial stress and excess. Periods of faster growth and weaker financial sector resilience is often associated with a change in the composition of the liabilities side of banks' balance sheets. Banks become increasingly reliant on non-core funding, partly through greater debt issuance, and bank leverage often rises as bank assets increase while tier 1 capital remains unchanged.

28.   Bank-based prudential policies help build financial resilience. The empirical evidence suggests that a tightening in bank based prudential policies reduces financial vulnerabilities and creates financial space for banks. Bank leverage and non-core funding decline by a similar magnitude. Financial corporation debt and the credit gap also decline. Together, tighter bank based prudential policies encourage banks to rely more on their core funding. Bank-based prudential policies would also tame the financial cycle by shifting banks' risk-appetite.

Korea: 1-Year Cumulated Response Tightening in Prudential Policies (In percent)

Source: IMF staff calculations and authorities data.
Note: * in percent fo GDP

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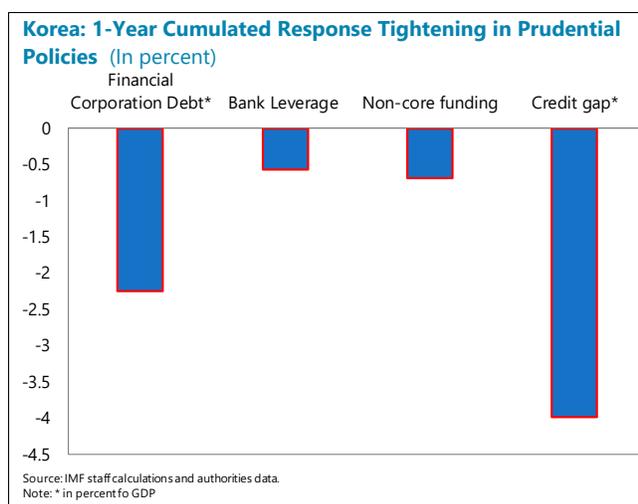
[3] It has been argued that higher capital ratios are associated with a higher probability of a crisis. This mechanism suggests that banks raise capital in response to higher-risk lending choices rather than as a buffer against a potential systemic crisis event in the economy. Such a finding is consistent with an empirical reverse causality mechanism reported in the data: the more risks the banking sector takes, the more markets and regulators are going to demand that banks hold higher buffers. See Jordà and others 2017.

D. Macroprudential Policies and Monetary Policy

29.   Monetary and macroprudential policies can sometimes complement each other and yield more effective outcomes. Bruno, Shim, and Shin (2015) find that macroprudential policies are not particularly effective when they lean in a direction opposite to monetary policy. Tightening macroprudential policy tools can dampen real economic activity. However, these effects can be countered by loosening monetary policy at the margin. Macroprudential policy can also give monetary policy more room to pursue its primary objective and help build buffers that can be relaxed in periods of financial stress. Such a policy can help keep monetary policy transmission open, preserving its effectiveness in the event of financial stress.

Korea Macroprudential Policy Cycle and Changes in Monetary Policy (Index)

Source: IMF and Authorities data.
Note: Shaded areas represent peak-to-trough epsides in real GDP growth Yellow circles reflect periods when growth in household debt moved in the opposite direction to real GDP growth
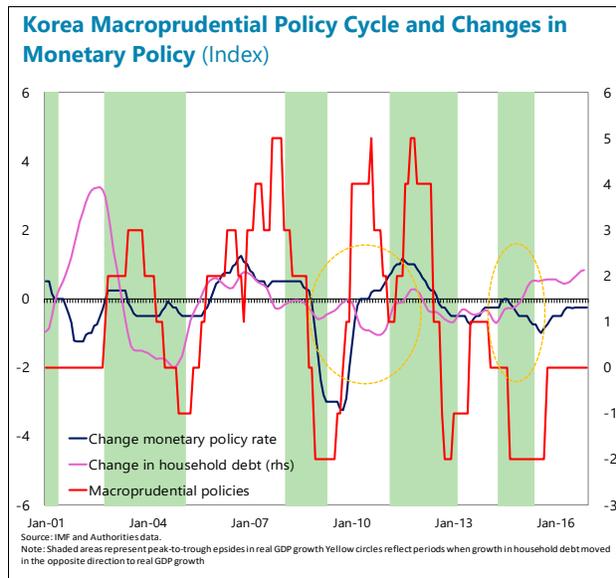
30.   Monetary and macroprudential policies in Korea have often complemented each other since the turn of the century. The chart shows that since 2001 tightening and loosening cycles in macroprudential and monetary policy cycles have tended to move in phase with one another. The pairwise correlation of these two policy cycles is positive and significant at around 0.6 (Table 1). Loosening episodes in macroprudential and monetary policy cycles have often coincided and occurred during periods of slower growth. Such episodes were also characterized by tighter financial conditions, as reflected by slower household debt growth. There are two caveats in the data, however. First, in 2010, as economic activity recovered following the global financial crisis, growth in household debt declined while macroprudential policies were tightened. Second, from late-2014 into all of 2015 economic activity slowed, while growth in household debt picked up as prudential policies were loosened.

Korea Response of Credit Gap to LTV Tightening with and without Monetary Policy (In percent of GDP)
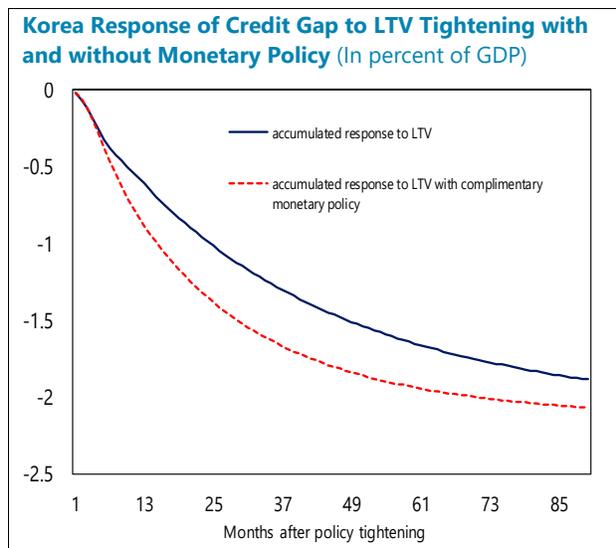
Table 1. Korea: Correlation of Monetary and Macroprudential Changes	
	Policy Rate Change
Policy Rate Change	1
Monetary Prudential Tools	0.59
Nonmonetary Prudential Tools	0.49

31.   Macroprudential and monetary policies share similarities and complementarities. Both affect credit demand, albeit in different ways. Monetary policy works by intertemporal allocation, bringing forward spending from the future or pushing it into the future. One way to bring spending forward is to lower interest rates so that economic agents can borrow more sooner. In contrast, macroprudential policy works by restraining borrowing. Monetary policy and macroprudential tools also affect financial risk taking by banks through the so-called risk-taking channel, whereas macroprudential regulation imposes equity constraints.

32.   In certain circumstances borrower-based prudential measures and monetary policy can complement one another. The chart illustrates the average response of the change in the credit gap—as a share of GDP—to a tightening in the LTV ratio, with and without monetary policy. The estimates show that the impact of the LTV ratio on the credit cycle is larger when macroprudential and monetary policy push in the same direction. However, these estimates should be interpreted with some caution. The simulations in the chart cover a sample period when fluctuations in real and financial cycles—as measured by real GDP and household debt—have often aligned, resulting in monetary macroprudential policies often pushing in the same direction. While there are an insufficient number of episodes in the current sample to robustly test the proposition, the estimates suggest that in cases where real and financial cycle are not aligned the benefits of complimentary monetary and macroprudential policies diminish.

33.   Macroprudential policies can also impact the banking system by affecting bank funding costs through the net interest margin (NIM). Banks NIM is a function of the compensation taken for items such as administrative costs, capital costs, risk premiums, and the banks' profit margins. Nondynamic macroprudential instruments, such as increased capital or reserve requirements, affect the NIM because they tend to increase banks' costs, which, to a certain extent, are passed on to customers in the form of an increased interest margin. The rule for regulation through the bank lending interest rate equation, which describes the relationship between monetary policy and macroprudential policy, is expressed as follows:

$$i_t^{lending} = i_t + \delta_t(z_t). \tag{8}$$

Equation (8) expresses banks' lending rate as a function of the policy interest rate and the interest margin (δ_t). The NIM is influenced by regulation (z_t), which is itself determined by non-time-varying regulations ($\bar{z}$), the credit gap, and the output gap (Ingves, Apel, and Lenntorp 2010; Shin 2011).

34. **Macroprudential policies can impact banks profitability.** Estimates from equation (9), which links macroprudential policies and the net interest margin, suggest that the impact of macroprudential policies on the monetary transmission mechanism via the banking system has grown since the Asian financial crisis. The influence of macroprudential policies on financial intermediaries reflects their more aggressive use, improved credibility, and increased financial deepening.

Korea Response of Banks' Net Interest Margin to a Tightening in Prudential Policies (Index)

Source: IMF Staff Calculations.

E.   Summary and Policy Implications

35. **Evidence for Korea suggests that financial stability will not necessarily materialize as a natural by-product of a so-called appropriate monetary policy stance.** Although the effects of monetary and macroprudential instruments may overlap, they are not perfect substitutes. Empirical evidence for Korea shows that macroprudential policy have made two active contributions to limit financial risks to the wider economy:

- Preempting aggregate weakness by limiting the buildup of risk, thereby reducing the occurrence of crises. Macroprudential policies can reduce the procyclical feedback between asset prices and credit.

- Reducing the systemic vulnerability by increasing the resilience of the financial system. By building buffers, macroprudential policy helps maintain the ability of the financial system to provide credit to the economy, even under adverse conditions.

36. **Policymakers should be mindful that macroprudential policy is not free of costs and that there may be trade-offs between the stability and the efficiency of financial systems**. For instance, when policymakers impose high capital and liquidity requirements on financial institutions, they may enhance the stability of the system, but they also drive up the price of credit. For macroprudential policy to contribute to financial stability and social welfare, its objectives need to be defined clearly and in a manner that can form the basis of a strong accountability framework.

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ARE FINANCIAL CONDITIONS AT RISK?

Tightening global financial conditions coupled with a slowing domestic economy and rising household leverage potential poses significant risks to the Korean economy. This chapter looks at the forecasting of risks to financial conditions based on current domestic and global macro and financial conditions. Financial conditions are expected to remain neutral in 2019, while tail risk financial condition outcomes in Korea have remain contained over the past year.

A.   Introduction

1.   External financial risks remain due to vulnerabilities, including rising corporate debt, house price misalignments and sovereign-banking sector links in some EU countries, domestically rising financial risks arise from higher household and corporate leverage. This chapter examines current domestic and global macro and financial conditions and links them to a distribution of possible financial condition outcomes in Korea. An important advantage of this approach is that it allows an assessment as to whether slower domestic growth/higher household leverage and/or a tightening in global financial conditions is net financial-critical and puts financial stability at risk in Korea.

B.   Construction of Financial Conditions in Korea

2.   To capture aggregate financial conditions a dynamic factor model is estimated.

$$\begin{bmatrix} y_{1,t} \\ y_{2,t} \\ \vdots \\ \vdots \\ y_{16,t} \end{bmatrix} = \begin{bmatrix} 1 \\ \lambda_{1,t} \\ \lambda_{2,t} \\ \vdots \\ \lambda_{16,t} \end{bmatrix} \begin{bmatrix} y_t \\ f_{t-1} \end{bmatrix} + \xi_t \tag{1}$$

3.   The model contains 16 variables, including bank and NBFC credit, bond spread, equity prices, broad and narrow money, credit developments based on BOK Loan Officer Survey, and measures of leverage including corporate bond issuance and household and corporate debt. This framework purges changes in the real cycle from financial conditions by including CPI inflation and a measure of economic activity, based on a mixed frequency coincident indicator containing real GDP (quarterly) and industrial production, a services index and retail sales (all monthly). The model also controls for financial conditions driven by changes in monetary policy by including a measure of reserve money.

4.   The model assumes that the weights of each variable in the factor ($\lambda_{i,t}$) can vary over time according to the following AR specification

$$\lambda_{i,t} = \lambda_{i,t-1} + \vartheta_t \tag{2}$$

5. **This assumption helps account for structural breaks and non-linearities in the dynamics between the financial variables**. Time-varying loadings can be thought of as an approach to network connectedness measurement.

C. Estimation Tail-Risks to Financial Conditions in Korea

6. **The idea follows work done on growth risks in Tobias, Boyarchenko, and Giannone (2016),** The estimation here, however, focuses on Korean financial conditions. The forecast of the distribution of financial conditions is constructed using quantile projections:

Figure 1. Korea: Financial Conditions Index

Source: Authorities' data and IMF staff calculations.
Note: The financial conditions index is constructed using credit growth from deposit money banks and non-bank financial corporates, house prices, the equity price, the spread between corporate and government debt at a 3 year horizon, household and corporate debt. The index is estimated using a factor model that allows for time-varying factor loadings.

$$FC_t = a_{p,q}^h p_t + \beta_{a,q}^h Agg_t + \gamma_{y,q}^h y_t + \theta_{f,q}^h f_t + e_t \tag{3}$$

where FC_t is the measure of financial conditions in Korea (as charted in the policy note), and in which **p**, **Agg**, **y** and **f** correspond to the principal components of the price of risk (asset prices and risk spreads), financial leverage (household and corporate debt-to-GDP ratio, corporate bond issuance, NPLs, bank risk-weighted assets), domestic real economic conditions (real GDP growth, exports, IP), and global or foreign variables (global growth and financial risk sentiment). This approach disentangles the contribution of changes in the price of risk from evolving financial leverage (a concern in Korea) and shocks to the external environment when it comes to forecasting risks to overall financial conditions in Korea. It thereby provides insight into which variables signal tail risks to financial conditions in Korea.

D. Risk to Financial Conditions

7. **Distribution of Financial Risks in Korea**. Based on current domestic macro and financial conditions and the global risk environment as of the 3rd quarter of 2018, the median projection and high probability outcome suggests that financial conditions in Korea over the next 4 quarters will remain quite neutral, implying no real tightening in the ability of firms and households to obtain new financing. The distribution of outcomes reports a median FCI estimate of around 0. In an extreme event with tail-risks materializing, financial conditions in Korea would expect to tighten considerably, with the FCI falling from its current level of 0 to -2. This would have significant repercussions for the real sector.

Figure 2. Financial Conditions-at-Risk
(2018.Q3: 4-qtr horizon)
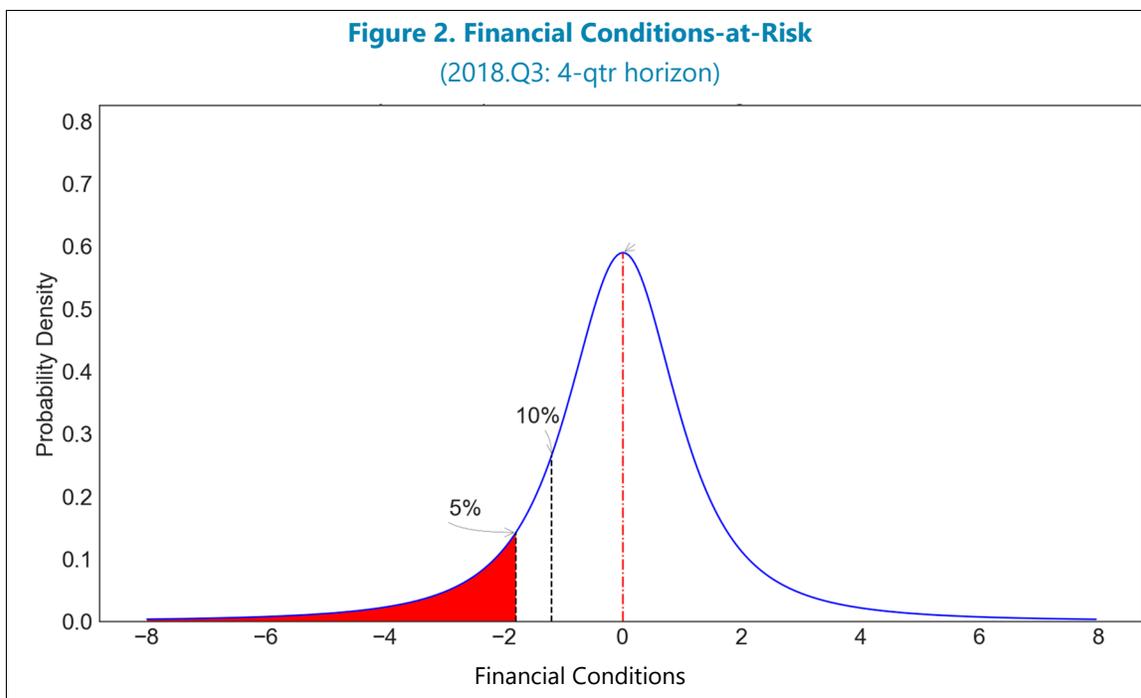
8.   Tail-risk financial outcomes remain contained in Korea. Rising financial stress risks in Korea would be associated with a more negatively skewed distribution and a fatter negative tail (higher kurtosis). Figure 3 illustrates rolling estimates of the tail of the distribution (the 5th quantile) of financial conditions since 2010 based on the quantile regression equation (1). The estimate shows that since 2010 financial stability tail-risks have not substantially risen; the tail of the distribution has not become fatter or more skewed, which would signify greater financial risks.

Figure 3. Financial Conditions Tail Risk (5%) (Index)
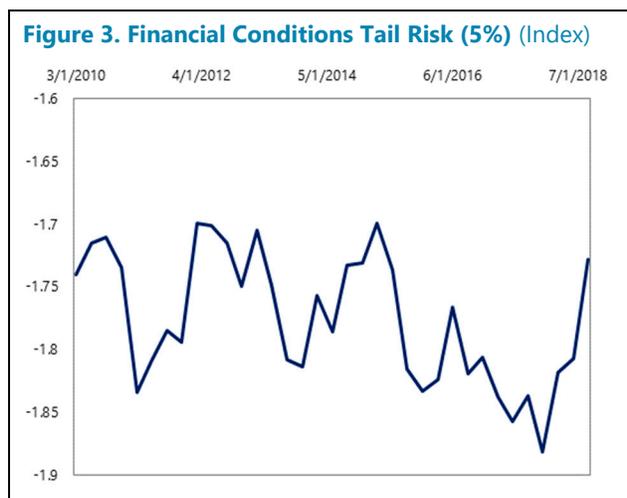
9.   The materialization of tail-risk outcomes to financial conditions in Korea is susceptible to external financial conditions. Figure 4 shows that should external financial conditions tightening (as proxied here by a standard deviation shock in the VIX) financial conditions in Korea would tighten, and the probability of tail-risk outcomes in the financial sector would grow considerably. This is perhaps unsurprising given high household debt, much of which is linked to floating rates.

Figure 4. Financial Conditions-at-Risk to VIX Shock
(2018.Q3: 4-qtr horizon forecast)
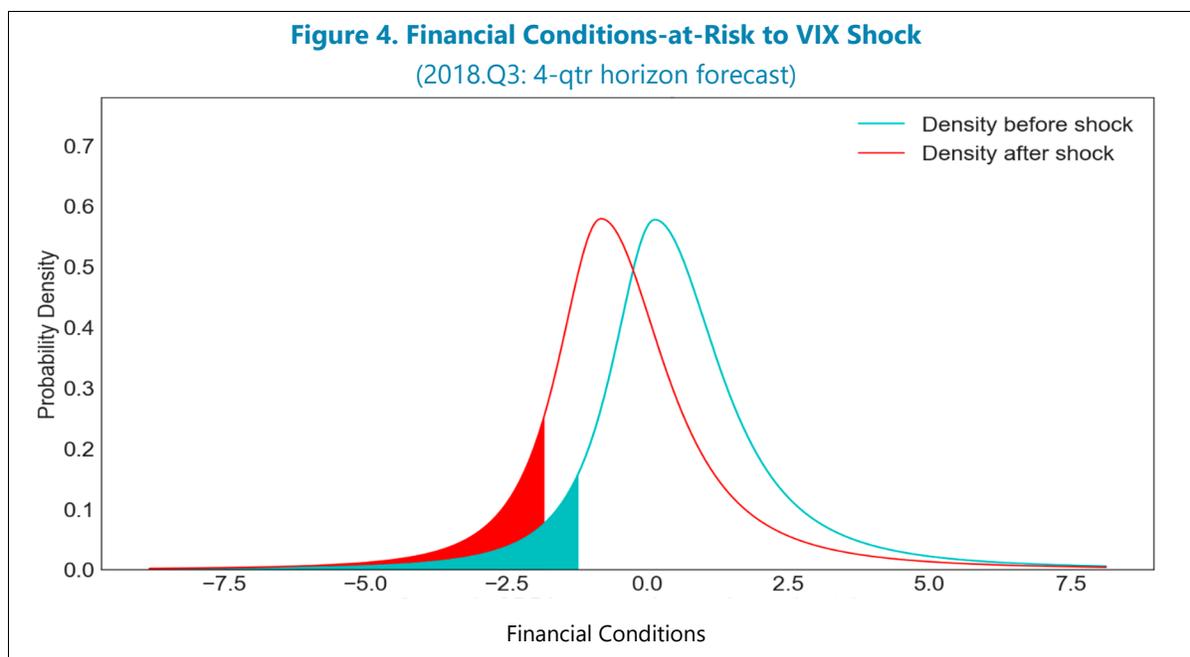
10. **Link to authorities' views.** The finding that financial risks remain contained in 2018 are in line with the BOKs own financial stability index published in the December 2018 Financial Stability Report.

E. Policy Implications

11. **Tail risk financial condition outcomes in Korea from recently evolving domestic and external real and financial condition have not grown over the past year**. Should tail-risks materialize financial conditions are expected to tighten considerably, with significant repercussions for the real sector. The analysis underscores the importance of policymakers maintaining heightened vigilance regarding risks to financial conditions during periods of benign macro conditions that may provide a fertile breeding ground for the accumulation of financial vulnerabilities. Changes in the domestic price of external risk is a potent signal of imminent threats to financial conditions in Korea, and can be useful for the swift deployment of monetary easing and macro prudential policy actions.

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LABOR MARKET SLACK AND THE OUTPUT GAP IN KOREA[1]

A. Introduction

Output gap estimates are needed to inform policy discussions. Given that labor is the most important input into the production, estimates of available capacity on the labor market are in turn informative for output gap estimates. However, the traditional measure of unemployment yields an incomplete picture of the true degree of under-utilized resources on the labor market. This Selection Issues Paper, first formulates a simple multivariate filter, based on Blagrave et al. (2015), with a strong link between labor market slack and the output gap through a production function. We then discuss how the traditional measure of unemployment can broadened to yield a more complete picture of available resources on the labor market in Korea. We use this data to estimate the multivariate filter and show how using broader measures of available labor resources affect the estimated output gap

1.   **Estimates of output gaps are key inputs into macroeconomic policy making.** The output gap denotes the difference between the actual and potential output, where the latter often is defined as the maximum level of output an economy can produce without generating inflationary pressure (Okun, 1962). An estimate of the output gap is thus key for policymakers, as it helps inform their view on the appropriate stance of policy.

2.   **Output gaps are usually estimated using either a production function or filtering methods.** The simplest method relies on a univariate statistical filter, such as the Hodrick-Prescott (HP), which smooth out fluctuations in output at business cycle frequencies (DeMasi, 1997). The production function approach is an alternative. This approach considers all input to the production separately. By combining the smoothed version through a production function one can arrive at a measure of potential output (see e.g. Giorno et al., 1995). Another alternative is a multivariate filter (MVF) approach. This approach works by estimation of a system of economic equations with observed and unobservable variables. For recent examples see Blagrave et al. (2015) or Alichi et al. (2017).

3.   **The degree of labor market slack is informative for the output gap calculation.** The motivating observation, is that information about the degree of under-utilization of labor market resources (slack) is important to appropriately assess whether the economy is operating above or below potential. Economically, a labor market operating above potential will create an upwards pressure on wages which in turn lead to inflationary pressure. Conversely, idle labor market capacity will create downwards pressure on wages, which in turn will cause disinflation.

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4. **This paper proposes a modified multivariate filter (MVF) with a tight link between labor market slack and the output gap.** Generally, lower labor market utilization than potential should be associated with an economy running below capacity, i.e. a negative output gap. This is because 1) labor is the most important input into the production function, and 2) idle workers on the labor market means that the economy could potentially produce a higher level of output if all workers were employed. To capture this basic idea, we modify the MVF by Blagrave et al. (2015) by tying output and labor market slack closer together through a production function.

5. **The paper also contributes by discussing how to broaden the measure of labor utilization.** Usually labor market utilization is measured through regular unemployment. This concept is well-defined but does not fully capture the degree of under-utilized resources on the labor market. First, it does not include the number of workers outside the labor force who are ready to take employment. Second, it does not contain part-time workers who are willing and able to work longer hours. To partly address these issues, we construct an alternative measure for labor market slack, which augments the traditional measure of unemployment on the extensive margin. We argue that this measure provides a more complete measure of resource utilization on the labor market, e.g. as witnessed by a clearer relationship with inflation (the Phillips Curve).

6. **The remainder of the paper is organized as follows.** We first formulate a revised multivariate filter (MVF), where labor market slack and the output gap are tied together through a production function (Section B). We then discuss how to augment unemployment to better measure idle resources on the labor market in Korea (Section C). Drawing the method and data presented, Section D presents estimates for labor market slack and output gaps. Finally, Section V concludes.

B. A Multivariate Filter With Labor Market Gaps

7. **This section presents a multivariate filter augmented with a tighter link between the output gap and labor market slack.** The filter is a modified version of the MVF presented in Blagrave et al. (2015), which we modify in three ways given this paper's focus on the labor market. First, we introduce an equation that links output, TFP, and employment through a production function. This allows us to write the output gap as a combination of labor market slack and TFP deviations. Second, we introduce a bloc of equations to separate trend and cyclical TFP. Third, we formulate the model such that it allows for a flexible representation of labor market utilization ranging from ordinary unemployment to a broader measures of non-utilized resources on the labor market (empirical measures to be discussed in Section C).

8. **The filter takes point of departure in a production function.** Specifically, we assume that output can be represented using a Cobb-Douglas production function that takes capital (K), employment (E), and total factor productivity (A) as input.

$$Y = AK^{\alpha}E^{1-\alpha}. \tag{1}$$

This equation can be rewritten using that employment (E) is the product of the potential labor force (PLF) and the non-employed fraction of this potential labor force (u).

$$Y = AK^{\alpha}[(1-U)PLF]^{1-\alpha} \tag{2}$$

Notice, that the definition of both PLF and u will vary below as we use different measures of labor market slack. When regular employment is used, u is measured using regular unemployed workers as percent of PLF which will be measured as the actual labor force. When broader measures are used, u is measured using augmented unemployment in percent of PLF which is the augmented labor force.

9.   The output gap can be written as a function of the TFP gap and labor market slackness. Based on equation (2) we can write the output gap (y) as the sum of a the TFP gap (a), and labor market slack (u).[2]

$$y = a + (1-\alpha)u \tag{3}$$

Here the output gap (y) is expressed as percent deviation from potential GDP ($\bar{Y}\_t$), while the TFP gap (a) is expressed in percent deviation from the structural level of TFP ($\bar{A}\_t$). Finally, the labor market gap is expressed as the deviation (in percentage points) of the degree of under-utilization of labor from the structural degree of under-utilization ($\bar{U}\_t$). In addition, we allow the output gap to be stochastic shocks. That is, we allow the output gap to change temporary without corresponding change in the TFP or labor market gap.

$$y_t = \phi y_{t-1} + \epsilon_t^Y \tag{4}$$

This stochasticity represents the uncertainty surrounding the output gap estimates. Indeed, the actual output gap is not observed why it can only be estimated with a significant degree of uncertainty, which is represented by the error term (ϵ_t^Y) in equation (4).

10.   Structural TFP is modelled as a stochastic process. This process is governed by a long-term deterministic growth rate (G^{SS}), as well as stochastic shocks that can shift both the TFP level ($\epsilon_t^{\bar{A}}$) or temporary change the growth rate (ϵ_t^G) of TFP.

$$\bar{A}\_t = \bar{A}_{\{t-1\}} + G_t + \epsilon_t^{\bar{A}} \tag{5}$$

$$G_t = \theta G^{SS} + (1-\theta)G_{\{t-1\}} + \epsilon_t^G \tag{6}$$

The stochastic process for TFP is illustrated in Figure 1. Here G^{SS} is the long-term rate that TFP will grow according to absent any stochastic shocks. $\epsilon_t^{\bar{A}}$ is a stochastic shock that can permanently increase or decrease the level of TFP. Finally, ϵ_t^G is a shock to the growth rate in TFP, which temporarily causes the growth rate of TFP to fall below, or rise above, the long term growth rate G^{SS}.

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[2] This equation is derived by logging equation (2) and subtracting the expression for potential GDP. We assume that capital is at its structural level.

11.   The level of structural under-utilization of labor market resources is modelled as a

stochastic proces. The structural level of labor market under-utilization is governed by a long run steady state level, $\bar{U}^{ss}$, which will materialize absent any stochastic shocks. The structural level of labor market utilizatoin is also affected by (1) transitory shocks to the level ($\epsilon_t^{\bar{U}}$), and (2) the realization of a stochastic trend ($g\bar{U}_t$). The stochastic trend is added to allow for more permanent deviations from the long run steady state level. Economically, such deviations can be brought about by a demand shock which creates hysteresis effects as unemployed workers skills are depleted after a prolonged period of unemployment (Blanchard and Summers, 1986). The structural level of under-utilization of labor market resources can also increase following a supply shock, which renders the skill set of a certain fraction of the potential labor force obsolete (Braun et al., 2009).
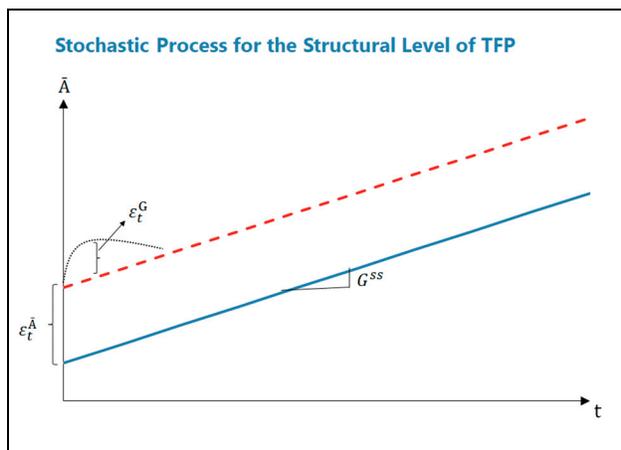
$$\bar{U}_t = \tau_4 \bar{S}^{ss} + (1 - \tau_4)\bar{U}_{t-1} + g\bar{U}_t \;\; + \epsilon_t^{\bar{U}} \tag{7}$$

$$g\bar{U}_t = (1 - \tau_3)g\bar{U}_t + \epsilon_t^{g\bar{U}_t} \tag{8}$$

The process for under-utilization of labor market resources is illustrated in Figure 2. Here $\bar{U}^{ss}$ is the steady state level of under-utilization which would materialize in the absence of any shocks. $\epsilon_t^{\bar{U}}$ is a stochastick shock which temporarily raises the structural level of under-utilization. $g\bar{U}_t$ is a stochastic trend, and shocks to this raises the structural level in a more persistent way (Figure 2).

12.   The labor market gap is defined as the difference between actual and structural under-utilization of labor market resources.

$$u_t = \bar{u}_t - u_t \tag{9}$$

$$u_t = \tau_2 u_{t-1} + \epsilon_t^u \tag{10}$$

This means that a positive gap implies that the labor market operates above potential, while a negative gap means it operates below potential (equation 9).[3] In addition, the labor market gap is subject to stochastic shocks representing the uncertainty surrounding the correct level of the gap (equation 10).

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[3] This formulation is done to make the interpretation of the labor market gap consistent with the interpretation of the output gap.

13.   A Phillip Curve links the output gap to inflation. As a final equation we include a New Keynesian Phillips curve in the filter (Gali, 2015).

$$\pi_t = \lambda\pi_{t+1} + (1-\lambda)\pi_{t-1} + \beta y_t + \epsilon_t^\pi \tag{9}$$

This equation links current, future, and past inflation with the output gap. This captures the idea that a positive output gap (an economy operating above potential) is expected to generate cost pressures which in turn generates inflation as companies pass on the higher costs to their consumers. The existence of both current, future, and past inflation in the equation captures the inertia in the price setting process. The equation also includes a stochastic shock term (ϵ_t^π), which allows for inflation to also be affected by other shocks.

Stochastic Process for Structural Under Utilization of Labor Market Resources
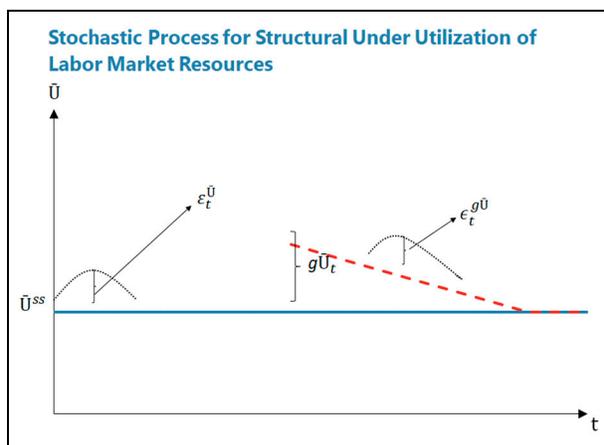
C.   Measuring Under-Utilization of Labor Market Resources

14.   A key empirical input into the output calculation is the degree of under-utilization of labor market resources. To estimate the filter presented in Section B and get measures of the output gap one an empirical measure for U_t. Often this is done by feeding in a measure of unemployment (Blagrave et al, 2015). Empirically, unemployment can be measured either using survey data (from the labor force survey) or register data (on the number of recipients of unemployment benefits). In Korea, only survey base data is published, which shows that the unemployment rate since 1980 has varied around 3-4 percent of the labor force with a spike in 2000 and later in 2009.

Unemployment Rate
(Percent of labor force)

Sources: Haver Analytics.
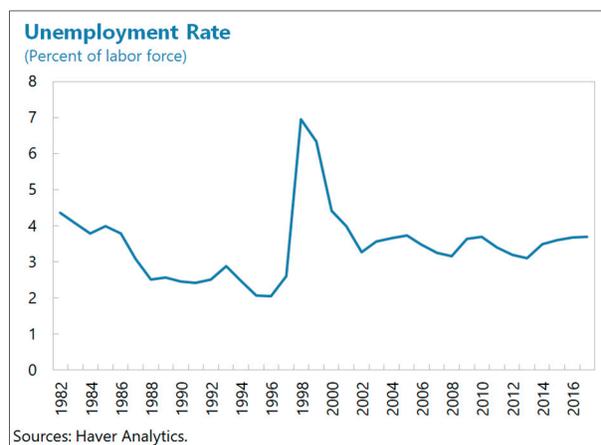
15.   However, the regular unemployment rate does not fully capture degree of under-utilization of resources on the labor market. According to the international definition of unemployment, workers are categorized as unemployed if they are (i) without work; (ii) available to start work within two weeks; and (iii) actively engaged in job searching activities (International Labor Organization, 2018). This definition is narrow, however, and does not fully captures the degree of slack on the labor market. Indeed, wider definitions include both an additional external and internal margin (International Labor Organization, 2018). The additional internal margin includes persons that are without work, but are not able to start without two weeks, or are not actively engaged in job searching activities. The additional external margin includes workers that are already employed but

want to work more hours. The former group is classified as outside the labor force as per the traditional classification, while the latter group is classified as employed.

16. **This is also manifested in a weak relationship between inflation and regular unemployment.** Economically, the relationship between inflation and regular unemployment is captured in the Phillips curve (Phillips, 1958). This relationship is expected to be tight and negative, as lower cyclical unemployment creates an upwards pressure on wages. As labor is the most important input into the production function, the higher wages will translate into higher inflation. For most countries the Phillip curve relation is indeed found to be negative (Bhattarai, 2016). However, for Korea the relation is weak, and not negative for all time periods (Bhattarai, 2016). One interpretation of this result is that unemployment in Korea does not fully capture the degree of unutilized labor market resources.

17. **We construct broader measures of labor market under-utilization.** Both measured are computed by extending the traditional measure for unemployment along the extensive margin. First, we augment the unemployment by including discouraged workers expressed in percent of the labor force (also extended with discouraged workers). Discouraged workers are workers of the legal working age that wants to work, and have been looking for a job over the last year, but are not currently engaged in job search. Second, we augment unemployment with persons that are classified as inactive for unspecified reasons. These are reasons other than childcare, house-keeping, schooling, old age, or disabilities. The alternative measures for labor market slack are depicted below. The levels hovers around 5.5 and 10.5 percent, respectively, and generally shows more volatility on business cycle frequency than the regular unemployment measure. Our measures relate to the *Labor Utilization Indicator 2* published by Statistics Korea, which augments regular unemployment with workers that potentially are in the labor force. However, the short time period of this series precludes us from using this as input to the filter. We consider the measure with discouraged workers most relevant as it is confined to workers relatively close to the labor market, while still being broader than the regular unemployment measure.

Labor Market Slack Measures
(Percent)

Source: Haver Analytics.

Labor Market Slack Measures
(Deviation from Average, Perecentage Points)

Source: Haver Analytics.
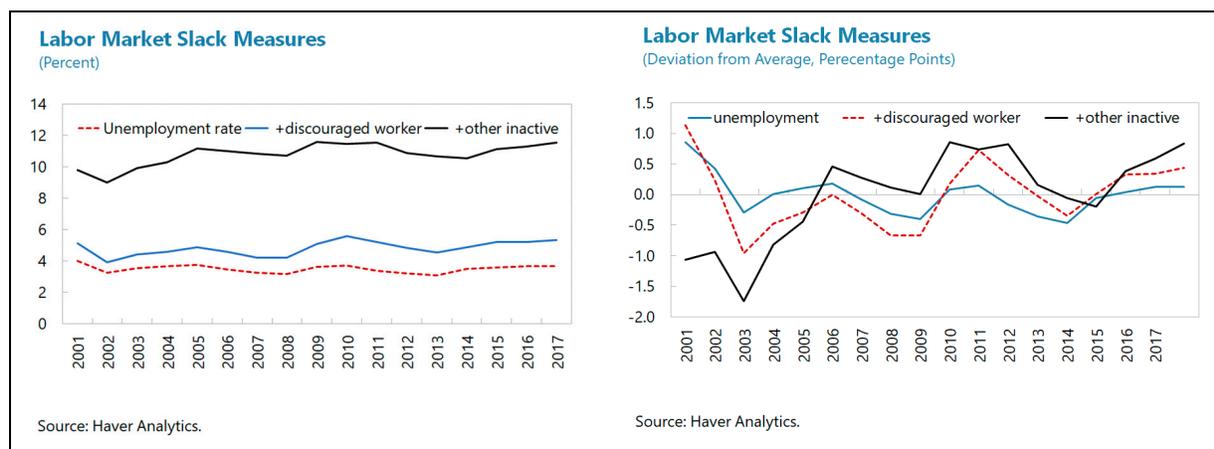
18. **The broader measure of under-utilization yields a negative Phillips Curve.** The figure below shows the relationship between the alternative measure of under-utilization including

discouraged workers and inflation. Unlike regular unemployment this measure yields a negative relationship between inflation since 2001. This suggests that this broader measure better measures under-utilization of resources, as a larger degree of under -utilization is associated with a higher value of inflation.
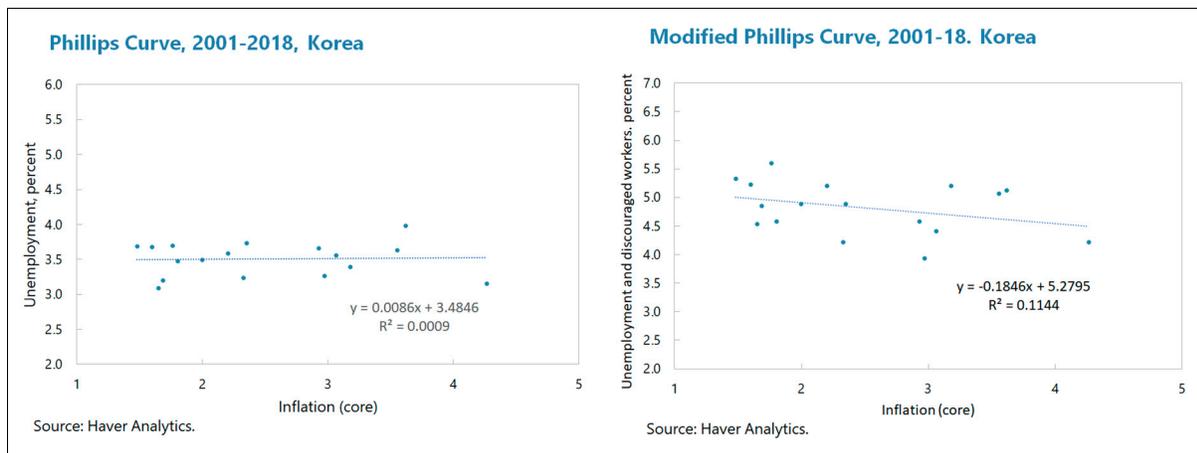
19.   Below we estimate the output gap using regular unemployment as well as the broader measures of labor market under-utilization. We do this within the multivariate filter framework formulated in Section B**.** This will allow us to gauge how the chosen measure of underutilization affect the estimated output gap.

D. Results

20.   This section provides estimates of the output gap during the period 2007-2023. The model is estimated using annual data from 2001 for the gross domestic product, inflation, employment, TFP, unemployment along with the alternative measures for labor market slack outlined above. Up to 2017 historical data is used, and for 2018-23 forecasts are applied. The parameters in the model are estimated using Bayesian estimation.[4]

21.   The estimated output gap based on regular unemployment. According to this estimation the output gap was around +1 percent in 2007/08 before it turned negative in 2009. It went back to up to slightly below 1 percent in 2010-11, before it turned negative again in 2012. From 2012 to 2014 the gap widened to around -0.8 percent before it started to narrow. The output gap generally has the same sign as the labor market, although 2010, 2012, and 2013 are exceptions. Such exceptions

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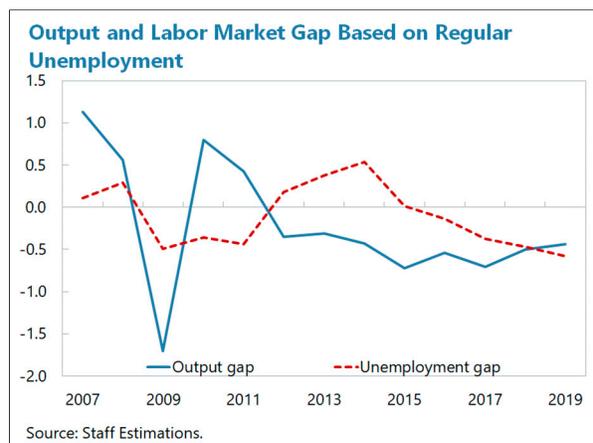
[4] For details on the model estimation see IMF Working Paper "Labor Market Slack and the Output Gap" (forthcoming).

are possible if the TFP gap pull in the opposite direction of the labor market gap. From 2018 and onwards the output gap displays a close correlation with the labor market gap, however, as TFP is projected to evolve according to potential.

22.   The estimated output gap based on unemployment augmented with discouraged workers. Here, we augment our measure of under-utilization from regular unemployment to regular unemployment plus discouraged workers. This produces a more volatile labor market and output gap, and more consistency between the two measures up to 2012. Both the output and labor market gap deteriorate more in 2009, but during 2012-17 the unemployment gap remains positive while the output gap is negative. From 2017 and onwards the two gaps are projected to move in tandem.

Output and Labor Market Gap Based on Regular Unemployment + Discouraged Workers

Source: Staff Estimations.
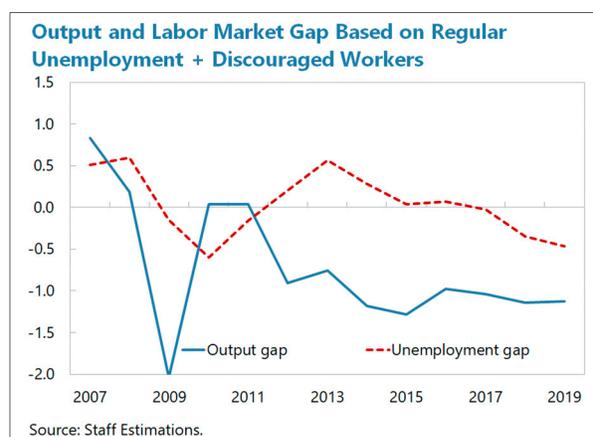
23.   The estimated output gap when using unemployment augmented with workers classified as inactive for unspecified reasons. This also shows a volatile labor market gap, while the output gap is broadly similar to the gap produced when using regular unemployment. This measure indicates the largest labor market gap in 2017, and produces a consistent labor market and output gap from 2017 onwards.

Output and Labor Market gap Based on Regular Unemployment +Inactive Workers for Unspecified Reasons

Source: Staff Estimations.
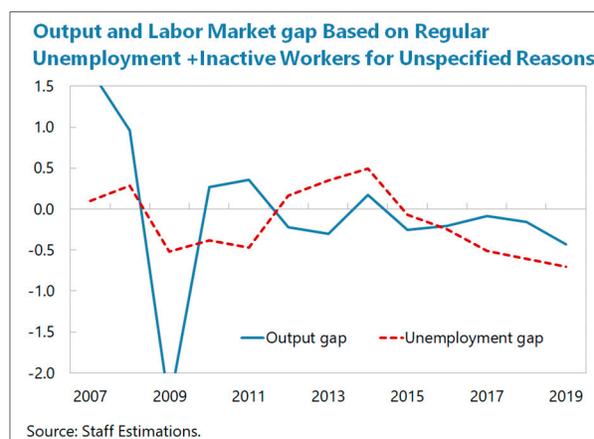
24.   Summarizing the robust findings across all three models. First, up to 2017 the labor market and output gaps display somewhat conflicting signals, with some years of opposite signs. This is because deviations in TFP from trend also contribute to the output gap. Second, from 2017 both the output and labor market gap are projected to be negative across all models. This is because TFP is projected to grow according to trend, why the only factor contributing to the output gap is the labor market gap. Third, the labor market gaps computed using broader measures of under-utilization than regular unemployment display larger fluctuations. The results based on the slack measure with discouraged workers (paragraph 22) may be most relevant for the reasons laid out above (paragraph 17).

E.   Conclusion

25.   This paper draws on existing MVF literature to formulate a model with a link between the output gap and under-utilization of labor market resources. We do this starting from the basic observation that lower labor market utilization *ceteris paribus* should be associated with an

economy running below capacity. To capture this basic idea, we modify the MVF by Blagrave et al. (2015) by tying output and labor market slack together through a production function.

26.   We also discuss how to best measure under-utilization of labor market resources in Korea. Often labor market under-utilization is measured by the unemployment rate. Although well-defined, this measure does not fully capture the amount of under-utilized resources on the labor market. Specifically, it does not capture the workers outside the labor force that are able and willing to work, but are not currently engaged in active job-search. To address this, we construct an alternative measures for under-utilization, which augments regular unemployment with workers outside the labor force that are potentially able to take an incoming job offer. We show that this measure produces a more standard Phillip curve, than when only using unemployment.

27.   We feed the revised measure of under-utilization into the revised MVF model to produce estimates for the labor market and output gap. Three robust conclusions across the models emerge. First, up to 2017 the estimated labor market and output gaps display somewhat conflicting signals, with some years of opposite signs. This is because deviations in TFP from trend also contribute to the output gap. Second, from 2017 onwards both the labor market and output gap is projected to be negative across all models, as TFP is projected to grow according to trend. Third, in general the labor market gaps computed using broader measures of utilization display a higher degree of variation on business cycle frequency.

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WHAT FISCAL POLICY CAN DO TO INCREASE EMPLOYMENT IN KOREA[1]

Boosting employment is a key priority in Korea, both in the short and longer term. The paper analyzes the measures Korea has adopted or planning. It finds that it would be critical to review periodically the impact of the large number of fiscal programs to support of SMEs. Fiscal incentives should be targeted to firms and activities that are more likely to promote long-lasting employment gains. Active Labor Market Policies could be enhanced by increasing spending on training and employment services. While there is scope to increase public employment, job creation in the public sector should be driven by the need to develop or expand services that cannot be provided adequately by the private sector. It should also take into account the possible impact on public sector productivity and the possible crowding out of private jobs. The paper empirical analysis indicates that Korea's employment, especially among women, can also be supported by increasing public spending on early childhood education and care and by easing labor regulation on regular contracts.

A. Introduction

1.   Boosting employment is a key priority in Korea, both in the short and longer term. In the near term there is need to prop-up job creation, which has been week in 2018 and so far in 2019, reflecting cyclical and structural factors. In the longer term it is crucial to support labor participation and employment to counter the expected impact of adverse demographics on the working population, which will slowdown economic growth and increase the fiscal burden of pensions and healthcare.

2.   Korea's employment rate of the population aged 15 to 64 was nearly 67 percent in 2018, 5 percentage points higher than in 2000. Korea's employment rate was lower than the OECD average of about 69 percent in 2018. This is due to the low employment rate among females, which, at about 57 percent was 7 percentage points lower than the OECD average.

3.   At 76 percent, males' employment rate was slightly higher than the OECD average in 2018. However, this masks some underlying issues in Korea's job market. Korea's long-term unemployment is comparatively very low. The share of those unemployed for 12 months or longer was only 0.9 percent in Korea, compared with an OECD average of 30.5 percent. This is partly due to a lack of income support for unemployment, which often induces jobseekers to settle for a job as quickly as possible, regardless of its quality or the career prospects it might offer (OECD, 2018a). Moreover, compared to other OECD countries Korea stands out for having a relatively high share of temporary and self-employed workers, at 21. 9 percent and 25.5 percent, respectively, compared to an OECD average of 11.2 and 15.8, respectively, in 2016.[2]

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[1] Prepared by Edda Zoli.

[2] An analysis of Korea's labor market duality is presented in Schauer (2018).

Female Employment Rate in OECD Economies
(Age 15-64, percent)

Source: OECD.

Male Employment Rate in OECD Economies
(Age 15-64, Percent)

Source: OECD.
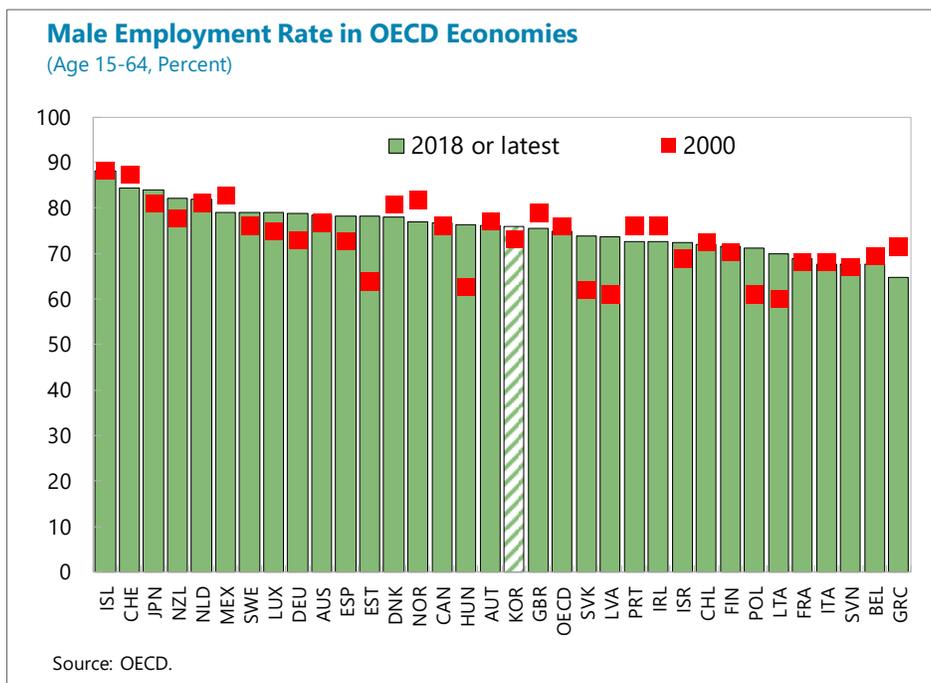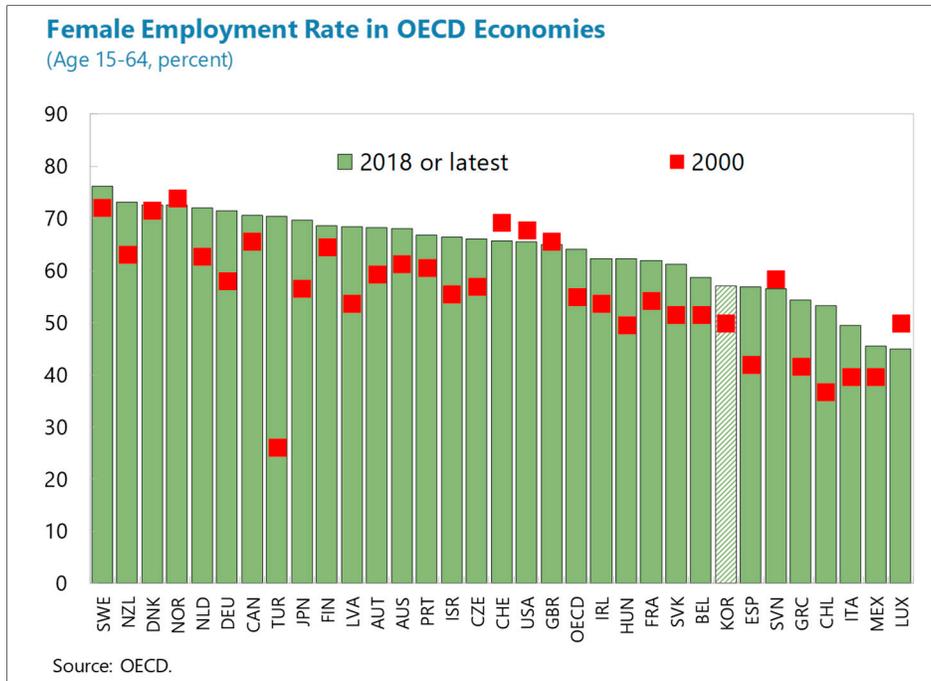
4.   The increase in Korea's employment rate seems to have stalled since 2017. Twelve-month employment growth declined sharply in 2016 and early 2017. Since then it has been steady, hovering just over 1 percent for firms with less than 300 employees, and slightly higher for bigger companies.

Korea: Employment rate
(Age 15-64, percent)

Source: Haver Analytics.

Korea: Emplyment growth by Firm Size
(12-month growth, percent)

Firms with less than 300 employees
Firms with more than 300 employees

Source: CEIC.
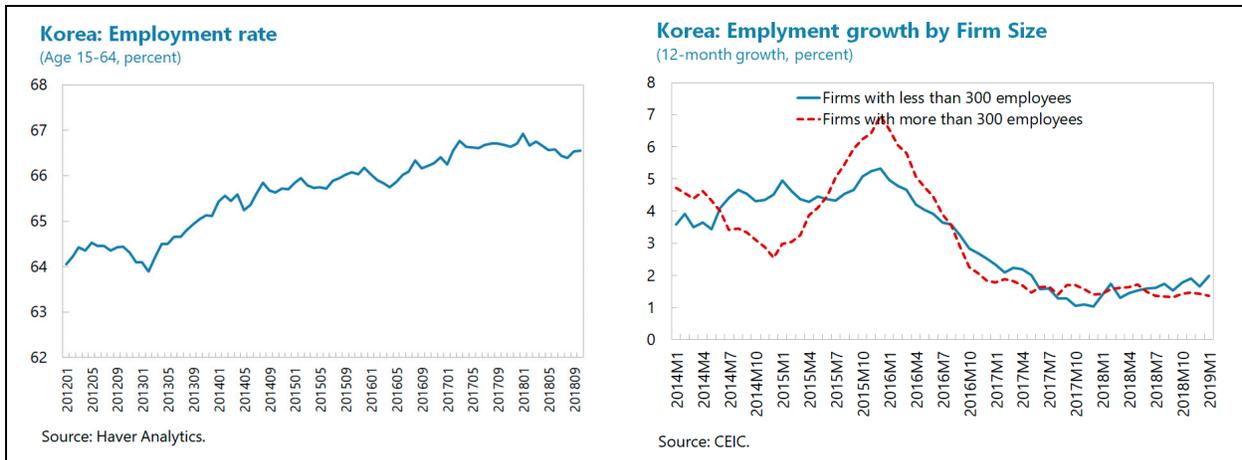
B. Review of Korea's Main Policies for Employment Support[3]

5.   Creating jobs and support employment is one of the main goal of the Korean government. Korea has used or is considering using a number of policies to support employment, including transfers to SMEs to create or preserve jobs, Active Labor Market Policies (ALMPs), and boosting public employment. These measures are reviewed in turn.

Support to SMEs

6.   In Korea policy support to employment creation often takes the forms of fiscal support to SMEs.[4] Korea is the OECD country with the largest share of firms with less than 250 employees (Figure). The share of employees in micro firms with less than 9 employees is also one of highest among OECD economies. The concentration of SMEs in labor-intensive sectors makes them the main source of job creation. Indeed, firms with less than 300 employees accounted for about 80 percent of the employment gains in 2017.[5]

Employees by firm size, 2015 or latest
(Percentage share of total employees)

Firms with 1-9 employees
Firms with 20-49 employees
Firms with more than 250 employees
Firms with 10-19 employees
Firms with 50-249 employees

Source: OECD.

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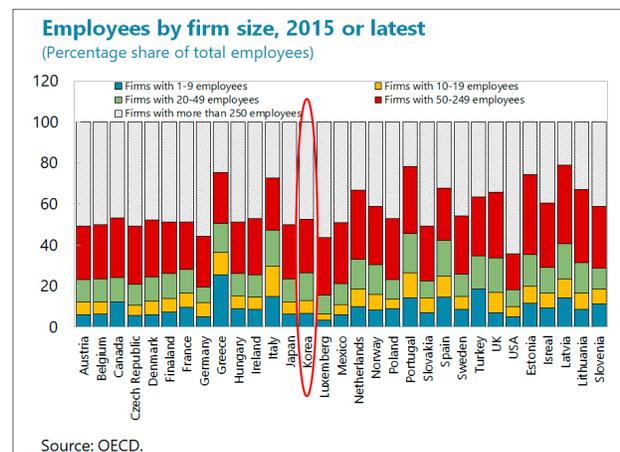
[3] IMF (2018a) provides a thorough analysis of policies to support youth employment specifically.

[4] The definition of SMEs in Korea has changed over time. Until 2014, it was based on the number of regular workers, sales, capital and total assets, with the thresholds varying by industry. To reduce firm incentive to stay small to continue receiving the favorable SME treatment, the definition was changed in 2015 to total assets and sales.

[5] The international evidence on job creation by SMEs is mixed. For example, Ayyagari and others (2011) find higher job growth in small firms in a panel of 99 countries, including emerging economies, but other studies do not support these findings. For example, Haltiwanger, Jarmin, and Miranda (2013), using a large set of U.S. companies find that once firm age is controlled for, there is no systematic relationship between firm size and employment growth. This result points to the important role of business start-ups and young businesses, rather than small firms, in job creation.

7.   Many countries maintain schemes to support small businesses, such as reduced corporate tax rates for profits under a certain threshold, special tax allowances for investment by small firms, or tax preferences for (venture) capitalists who invest in small enterprises. The case in favor of these preferential treatment is generally based on the argument that, in the absence of intervention, SMEs are at disadvantage relative to their larger competitors.

8.   As of 2017, Korea had in place 288 central government programs and over 1000 programs at the local government level to support SMEs (OECD, 2018b). Central government spending on such programs is estimated at around 0.8 percent of GDP in 2017. The government provides large-scale support to SMEs also through credit guarantees, which were the second largest in the OECD, at 3.8 percent of GDP in 2016. In addition, SMEs are assisted through preferential treatment in public procurement and several tax preferences.[6] For instance, the reduction in combined corporate and personal rates on capital gains rates due preferential corporate income tax rates for SMEs compared to larger companies was estimated at 13 percentage points in 2014, one of the highest among OECD economies (OECD, 2015).

9.   Do these forms of fiscal support to Korea's SMEs help job creation and preservation? The empirical evidence on the employment effect of fiscal incentives to SMEs in Korea is scant, partly due to data limitations. Park and others (2017) find some positive and significant impact of fiscal support to SMEs on employment over 2011-2013 in firms from different sectors. Studies by MOSF and KIPF (2018) find a positive, but small impact of tax credits for SMEs on employment. However, it is not obvious whether employment gains supported by fiscal incentives are merely temporary or, instead, are associated with improvements in productivity and long-term profitability. For example, Chang's (2016) evaluation of Korea's 2009 public programs to support SME finance concludes that recipients experienced lower productivity growth than non-recipients.

10.   SMEs' difficulty in creating jobs is also related to the fact that Koreans, especially young people, often are unwilling to work for SMEs as they provide fewer training opportunities and wages are considered low. Given that, providing subsidies to SMEs might not be an effective way to boost employment there. Rather, helping SMEs becoming more productive and dynamic would make them more attractive to the youngsters. Hence, subsidies should be better focus on R&D activities that would help make SMEs more dynamic, rather than protecting jobs in weak firms. In Korea the marginal tax subsidy rate on R&D by SMEs is high compared to some other OECD countries (Figure). Nevertheless, there might be scope to re-orient some other forms of fiscal support currently extended to SMEs toward their R&D activity. Indeed, empirical analysis on advanced economies, based on firm-level and industry-level data, indicates that R&D tax incentives have a larger effect for small firms than larger companies (IMF, 2016). Also, evaluation studies on selected advanced economies suggest that R&D tax incentives for small firms are two to three times more effective in promoting R&D investments than for an average size firm (IMF, 2016). Moreover, it would be important also to support young and innovative firms that are more likely to achieve

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[6] These include, for example, accelerated depreciation for facility investment by SMEs, allowing SMEs to carry back losses to apply against income in the previous year (OECD, 2015).

productivity gains and long-lasting increases in employment rather than provide subsidies based on firm size.

11.   **The analysis above suggests the following policy implications:**

- Given the large number of fiscal programs in support of SMEs, it would be important to regularly monitor and periodically review their impact. There may be a need to set up a comprehensive and integrated database on the different programs.

- Instead of extending subsidies only on the basis of firm size, it would also be critical to identify firms that are more likely to attain increases in productivity and profitability, and bring about long-lasting employment gains, such as young and innovative firms.

- To make SMEs more attractive to youth, it would be important to design fiscal incentives that would help SMEs to become more productive and dynamic.

- Given that that R&D tax incentives for small firms are particularly effective in promoting investment, consideration should be given to re-orient some other forms of fiscal support currently extended to SMEs toward their R&D activity.

Tax Subsidy Rates on R&D Expenditures, 2017

Source: OECD.
The 1-B index is an indicator representing a notional level of tax subsidy rate under different scenarios. It is based on a number of assumptions and calculations specific to each country. International comparability may be limited.
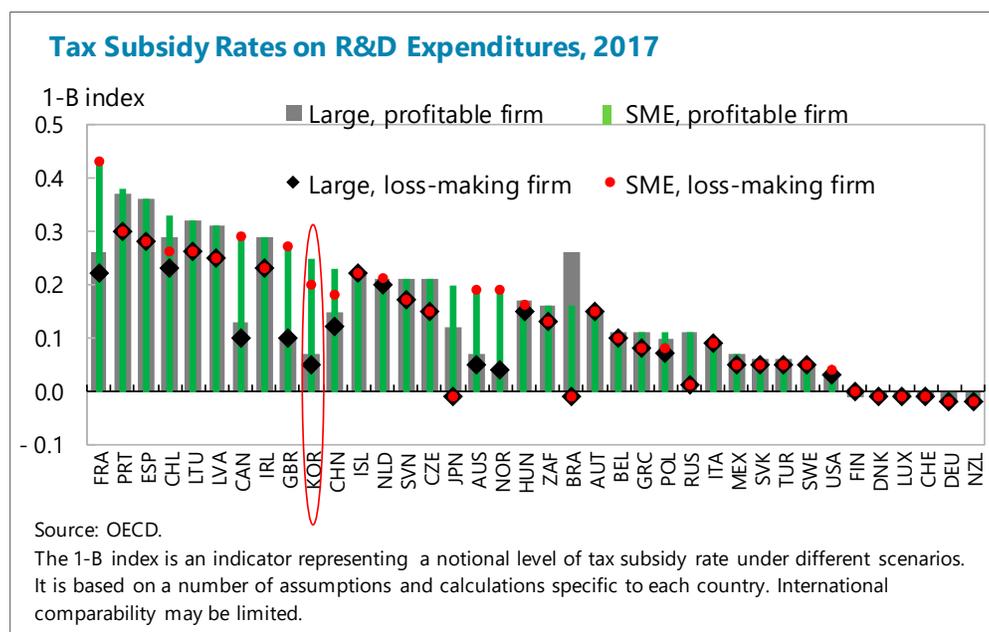
Active Labor Market Policies

12.   **Active labor market policies (ALMPs) are government programs to support employment and help the unemployed.** According to the OECD definition, programs specifically designed to support employment include (1) public employment services (PES), such as placement and related services; (2) training; (3) employment incentives (i.e., incentives for recruitment or to

facilitate continuing employment); (4) direct job creation (typically in the public sector); (5) start up incentives to promote entrepreneurship; (6) subsidies for the employment of persons with a permanently (or long-term) reduced capacity to work. Programs to help the unemployed include various types of unemployment benefits as well as programs facilitating early retirement of older workers who are assumed to have little chance of finding a job.

13. **At 0.4 percent of GDP, Korea's spending on measures to support employment is close to the OECD average, but the composition of this spending raises some issues.** Korea ALMPs are largely focused on direct job creation, with this spending category representing more than half of government expenditure on employment support in 2016 (Figure). This is a much larger share than the OECD average, which is about 13 percent. About 21 percent of direct job creation spending was targeted at workers above the retirement age of 65 years in 2018. ALMP spending for the working-age population is therefore somewhat lower than data suggest. Alternative fiscal instruments (e.g., targeted transfers) would probably be more efficient and effective tools to support the elderly.

Expenditure on Active Labour Market Programs by Category, selected OECD Countries
(Percent of GDP)

Legend:
- Start-up incentives
- Direct job creation
- Sheltered and supported employment and rehabilitation
- Employment incentives
- Training
- PES and administration

Source: OECD.
Note: PES stands for Public Employment Services and Administration.

Expenditure on Active Labour Market Programs by Category, Selected OECD Countries
(Share of Total)

Source: OECD.
Note: PES stands for Public Employment Services and Administration.

14.   In addition, Korea's spending on PES is relatively low: only 0.04 percent of GDP and about 10 percent of employment supporting ALMPs. Conversely, the average spending on PES among OECD economies is 0.1 percent of GDP and nearly 28 percent of the total spending on employment supporting ALMPs. Low spending on PES may hinder their effectiveness, as documented in a number of studies (e.g., Crepon et al., 2005; Petersen et al., 2013). Korea's spending on training is also lower than the OECD average, and a relatively small share of total expenditure on employment supporting ALMPs.

15.   Korea devotes more than 13 percent of its ALMPs expenditure to employment incentives, for about 0.05 percent of GDP in 2016, according to OECD data. This is the second item—after direct job creation— on which Korea spends the most.[7] The rationale for these incentives is to compensate firms that would hire or preserve jobs in the event that a worker's productivity is temporarily lower than the wage for some reason. Sufficient improvement in the worker's productivity— through learning-by-doing, training, or company direct monitoring— is supposed to be the essential condition for maintaining employment after the expiry of the subsidy period. It is not clear the extent to which individual cases are reviewed and monitored periodically in Korea. Without adequate monitoring, there is a risk that these types of employment incentives be kept in place over an extensive period of time to preserve employment, regardless of workers' productivity.

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[7] Korea's spending on employment incentives may be even higher. According to Park (2016), Korea's spending on employment incentives in 2016 was about 0.2 percent of GDP, with 20 employment incentives in operation under four ministries for a total budget of 2.8 trillion won.

16.   The international experience suggests that hiring and wage subsidies can be effective in boosting employment if appropriately targeted (IMF, 2012). But the effectiveness of these subsidies in increasing employment depends on the degree to which they reduce hiring that would have occurred also without the subsidies or lead employers to substitute one type of individual for another to take advantage of the subsidy. There are indications that Korea's employment incentives might not be well targeted. For example, there are incentives to support hiring of highly educated workers, even though companies would likely hire competent talent voluntarily even without the subsidy (Park, 2016).

17.   The analysis above suggests the following policy implications:

- There is a need to reconsider the composition of ALMPs.

- Spending on public employment services that support job-matching and on training should increase.

- Consideration should be given to supporting income for the over 65 through targeted transfers rather than spending on employment support.

- It would be important to periodically review the effectiveness of employment incentives and reassess whether they are properly targeted.

Public Sector Employment

18.   At less than 8 percent, Korea's share of employment in general government relative to total employment is one of the lowest among OECD countries. The wide cross-country variation in government employment size partly reflects national choices about the role of government. Among advanced economies, the Nordic countries (Denmark, Norway and Sweden) employ a relatively large proportion of their population in the provision of public services, other countries such as Korea and Japan employ much smaller shares. It has to be noted, however, that these data reflect employment in general government, excluding SOEs. In Korea about 80 percent of people employed in the central government was between 35 and 54 years of age in 2015.

Employment in General Government, 2015
(Percent of Total Employment)

Source: OECD.

Employment in Central Government by Age
(Share of Total Employed, percent)

Sources: OECD.
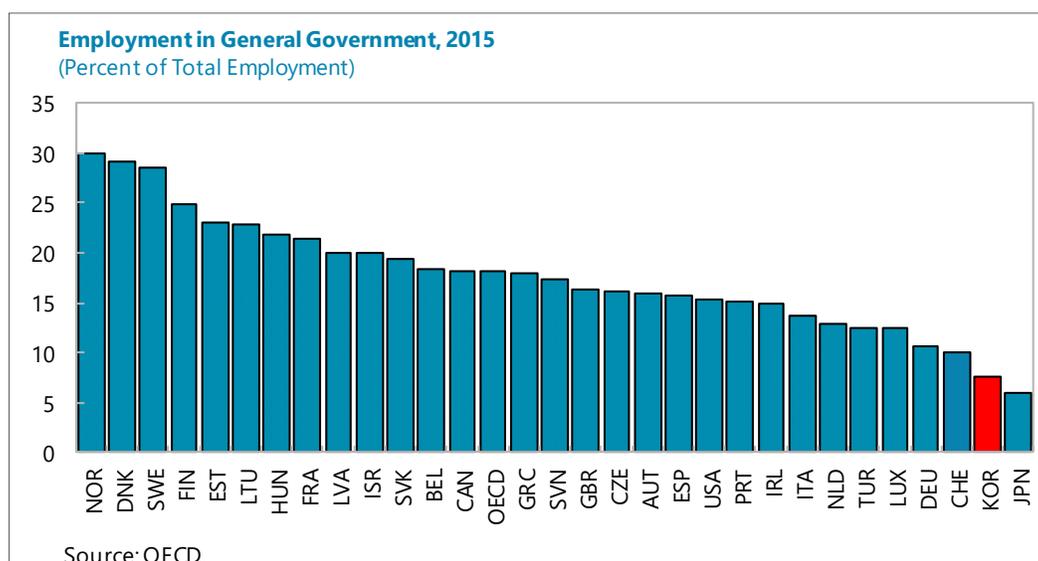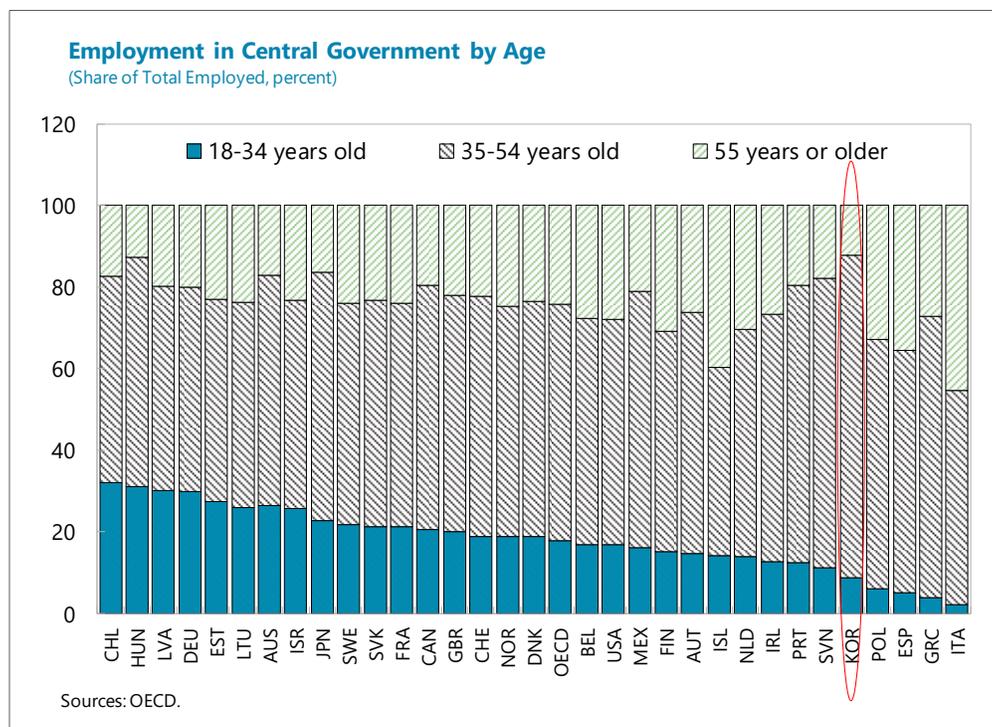
19.   **Given the relatively low share of public employment in total employment, the Korean government is considering expanding public sector jobs, as part of its strategy to boost employment, including among the youngsters.**[8] Expanding public sector employment can be an effective way to reduce unemployment in the short term, providing a stabilizing effect during recessions or in relatively disadvantaged regions. However, there are questions on whether expanding public sector jobs is an efficient tool to boost employment for the whole economy in the longer term (Algan, Cahuc and Zylberberg, 2002; Caponi, 2017).

20.   **Economic theory suggests that the public employment's impact on the labor market depends on whether the production of the public sector is a substitute to that of the private sector.** In that case, it could result in crowding out of private jobs. Public jobs that produce pure collective goods (such as justice or defense) are less likely to have adverse effects on private employment than other types of jobs, such as those in transport, education and health, where private production is possible. The empirical literature on the impact of public employment on labor market performance is scant, but typically confirms the prediction that expanding public employment may result in the crowding out of private jobs. For example. Algan, Cahuc and Zylberberg (2002) find that in a group of OECD countries in 1960–2000, on average the creation of 100 public jobs may have eliminated about 150 private sector jobs.

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[8] The government is planning to expand public sector jobs by 810,000 by 2022 (MOEF, 2018). In the 2019 budget the government indicated the intention to increase social services jobs by 60,000 to 94,000 and civil service jobs (e.g., policy officers and) by 21,000.

21.   Employment conditions in the public sector also play an important role in determining the impact of public jobs on private employment. Public jobs that pay attractive wages and, or, offer benefits, tend to attract more workers, and could crowd out some private jobs (IMF, 2016b). While data on the compensation differential between the public and private sector is not readily available for Korea, data on other advanced economies suggest that public-sector wages tend to be slightly higher relative to the private sector, particularly for low-skilled workers (Postel-Vinay, 2015). When comparing benefits from public and private sector jobs, factors such as job security and wage progression system need also to be taken into account.

22.   The analysis suggests the following policy implications:

- Public sector job creation should be linked to developing or expanding services that cannot be provided adequately by the private sector.

- In creating public jobs, it would be important to assess and take into account the possible impact on public sector productivity.

- Consideration could be given to conducting comparisons between public and private sector wages to obtain information to on wage differential which can inform wage setting and hiring conditions in the public sector.

C.   Understanding the Drivers of Employment Rates: An Empirical Analysis

23.   Assessing the appropriate fiscal policy measures to support employment requires an understanding of the drivers of the employment rate. These include structural factors that affect individuals' decisions to supply labor; policies, institutions, and noneconomic factors that influence the prospect of finding or retaining a job; and cyclical factors. Some policies, such as the tax-benefit system, directly shape the incentive to supply labor; others, such as the employment protection legislation, may influence labor demand. Other measures, such as spending on training and employment services, affect the ability to find employment. Long-lasting changes in demand for workers' skills could also affect labor force participation and, hence, employment (IMF, 2018b).

24.   To better understand the role that fiscal policies can play in supporting employment, an empirical analysis of the determinants of employment rates is carried out using cross-country panel regressions in OECD economies since 1985. Previous empirical studies on the determinants of employment rates in advanced economies include Garibaldi and Mauro (2002), Bassanini and Duval (2006), and Fiori et al. (2012). In addition to updating earlier empirical evidence, the present estimates focus specifically on the role of fiscal policy variables (e.g., ALMPs and the tax-benefit system), while controlling for cyclical and structural factors that may affect employment, including secular changes in the demand for labor.

25.   The dependent variable is the employment rate (for men and women in primary age—15-64 years—together and separately).[9] The policy variables include: the labor tax wedge, defined as the ratio between the average tax paid by a single-earner family and the corresponding total labor cost for the employer[10]; the wedge between the tax rates of second earners and single individuals, which could affect especially women's decision to seek and retain employment; public expenditure on ALMPs; and the indicator of stringency of employment protection regulations for permanent workers (EPL).[11] Policies that help reconcile work inside and outside the household are proxied by public spending on early childhood education and care as a percent of GDP, and number of weeks of job-protected parental leave available to mothers.

26.   Control variables include the output gap, to account for the cyclical position of the economy. The ratio of employment in the service sector relative to employment in the industrial sector, the share of urban population, trade openness, and exposure to technological progress (measured as in Chapter 3 of the April 2018 World Economic Outlook) are introduced among the regressors to capture the potential shifts in the demand for different types of labor due to structural transformation.[12] The share of the population within a specific gender group with tertiary education is included to control for the possible impact of education level on labor market participation and employment. Wage-setting institutions and frameworks are proxied by the union density. Country and time fixed effects were also included in the model. Variables that are likely to be endogenous (e.g., the output gap, ALMPs) are included in the specification with one-year lag.

27.   The estimation results indicate that fiscal policy can play an important role in promoting employment. The coefficients on public expenditure on AMLPs and childcare spending are positive and statistically significant for both men and women, but larger for the latter. A high wedge between the tax paid by a worker and the corresponding total labor cost for the employer is found to have a negative and significant relation with employment, in line with results from previous literature (e.g, Fiori et al., 2012). Conversely, the wedge between the tax rates of second earners and single individuals is estimated not have a significant impact on employment.

28.   Longer leave available to mothers is found to have a positive and significant impact on female employment. The stringency of employment protection regulations for permanent workers is also a significant factor in explaining female employment: more rigid regulation is associated with lower female employment rate.

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[9] A detailed variable list, with definition and sources is presented in the Appendix.

[10] From a theoretical point of view, the net effect of higher taxes on labor supply is ambiguous. As higher labor taxes reduce net wages, individuals may respond by working more to maintain their income. On the other hand, by lowering the relative return to work, higher taxes may lead to lower participation.

[11] Disaggregated spending on different ALMPs (e.g., training, employment incentives, etc.) was also included in some model specifications. However, because of limited data availability, empirical results were not robust.

[12] IMF (2018b) offers a thorough discussion of possible drivers of long-lasting changes in demand for workers' skills, including the secular expansion of the service sector and technological progress that allow automation of routine jobs.

29.   Among the control variables, as expected, employment depends on the phase of the business cycle. The econometric results also confirm that certain structural transformations that may shift the demand for certain types of workers have a significant effect on employment. Higher education is also positively associated with employment rates for both men and women. Instead, the variable capturing the degree of unionization is found not to have a significant impact on employment.

Strictness of Employment Protection in OECD Economies
(Regular Contracts, 2013)

Source: OECD.
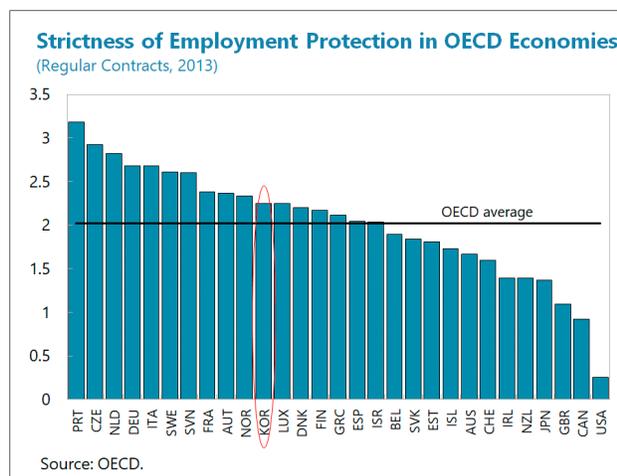
30.   The results suggest fiscal measures that can support employment in Korea. The evidence points to the effectiveness of family-friendly policies in promoting job market participation, especially among women. In Korea public spending on early childhood education and care was almost 0.9 percent of GDP in 2013, higher than the OECD average of 0.7 percent, but 0.5 percentage points lower than the average to the OECD countries that spend the most on this item.[13] Given low female employment rate, it would be critical to boost this spending item further. Reducing the labor tax wedge to encourage individuals to keep working and seek employment does not seem as critical in Korea, as the country's tax wedge is relatively low.

31.   The results also suggest that female employment in Korea can also be supported by the relaxation in employment protection for regular workers, which was stricter than the OECD average in recent years. Korea has particularly tight restrictions on dismissal of regular workers. Fiscal measures can play an important role in facilitating the implementation of reforms to make the job market more flexible. Higher spending on ALMPs could accompany reforms to lower employment protection. As looser firing restrictions can initially result in higher unemployment, providing more job training and matching services can reduce the risk of extended unemployment spells. Several countries, including the Netherlands (2009), Finland (1992), and Portugal (1990) have simultaneously lowered employment protection and increased spending on ALMPs (IMF, 2014, 2016b).

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[13] 2013 is the latest year for which cross-country comparable data on public spending on early childhood education and care is available for most OECD economies.

Drivers of Employment: Regression Results			
	All	Women	Men
ALMP(-1)	**0.05**	**0.08**	**0.05**
P-value	0.00	0.00	0.00
Labor tax wedge	**-0.18**	**-0.16**	**-0.14**
P-value	0.00	0.00	0.00
Childcare spending	**3.38**	**6.11**	**1.68**
P-value	0.00	0.00	0.00
Job-protected maternity leave	**0.02**	**0.05**	0.01
P-value	0.00	0.00	0.33
EPL	0.53	**-2.17**	1.86
P-value	0.42	0.01	0.76
Output gap (-1)	**0.20**	**0.19**	**0.22**
P-value	0.00	0.02	0.00
Trade openess (-1)	**0.04**	**0.10**	**0.05**
P-value	0.00	0.00	0.00
Relative service employment	**-0.04**	**-0.03**	**-0.05**
P-value	0.00	0.00	0.00
Union Density	0.00	-0.04	-0.04
P-value	0.94	0.30	0.27
Exposure to technology	**0.62**	-0.04	0.24
P-value	0.00	0.90	0.10
Tertiary education	**0.10**	**0.15**	**0.11**
P-value	0.00	0.00	0.00
R-squared	0.93	0.93	0.86
Estimation period	1985-2014	1985-2014	1985-2014
Number of observations	558	558	558
Bolded coefficients are significant at at least 5 percent.			

D.   Conclusion and Policy Implications

32.   Boosting employment is a priority for Korea both in the near and longer term. The Korean government has in place and is implementing a number of policies to support job creation, including transfers to SMEs to create or preserve jobs, ALMPs, and an expansion of public employment. The review of measures in place suggests that there is scope to enhance their design and implementation.

33.   Korea has set up a large number of fiscal programs to support of SMEs, with the aim of creating or preserving jobs. To maximize the effectiveness of these measures it is critical to review their impact periodically. There may be a need to establish a comprehensive and integrated database on the different programs. To make SMEs more attractive to youngsters, it is important to focus on fiscal incentives that could help SMEs to become more productive and dynamic. Given that R&D tax incentives for small firms are particularly effective in promoting their investment, consideration should be given to re-orient some other forms of fiscal support currently extended to SMEs toward their R&D activity, which would help SMEs to become more profitable and dynamic. Moreover, rather than providing subsidies based only on firm size, focus should be on firms that are

more likely to experience improvements in productivity and long-term profitability and produce long-lasting employment gains, such as young and innovative firms.

34. **ALPMs could be enhanced and used more effectively to boost employment in Korea.** Public spending on training and employment services that support job-matching is small in international comparison and could be boosted. It would be important to periodically review the effectiveness of employment incentives and reassess whether they are properly targeted.

35. **There is scope to increase public employment, given that Korea's share of public sector employment relative to total employment is low.** Nevertheless, job creation in the public sector should be driven by the need to develop or expand services that cannot be provided adequately by the private sector. In expanding public employment, it would be important to assess and consider the possible impact on public sector productivity. To minimize the risk that expanding public employment may result in the crowding out of private jobs, wage setting and hiring conditions in the public sector should take into account the compensation differential vis-à-vis the private sector.

36. **The empirical analysis on the determinants of employment in OECD economies provides an indication that fiscal policies that can support employment in Korea.** There is scope to increase public spending on early childhood education and care, given its effectiveness and Korea's low female employment rate. Korea's employment, especially among women, can also be supported by easing regulation on regular contracts, which has been comparatively strict in recent years. Fiscal policy can play an important role in facilitating reforms to enhance the flexibility of the job market.

Appendix: Variable List, Definition and Data Sources

Employment Rate: The ratio of employed people to the population in primary age, age 15-64. Source: OECD employment database.

Output Gap. Source: WEO.

Exposure to Technological Progress: The interaction between the relative price of investment and the country's exposure to routinization through its initial occupational mix. The latter consists of scores that rely on occupation-level measures by Autor and Dorn (2013), which order occupations by their share of routine tasks, and then use the employment shares of these occupations to construct country-level measures of routinizability. Source: Chapter 2 of the April 2018 WEO.

Ratio of Employment in the Service Sector Relative to Employment in the Industrial Sector. Source: Chapter 2 of the April 2018 WEO.

Share of Urban Population. Source: World Bank, World Development Indicators database

Education: Share of Population within Each Gender Group with Tertiary Education. Source: Barro-Lee Educational Attainment data set.

Labor Tax Wedge: Ratio between the average tax paid by a single-earner family (one parent at 100 percent of average earnings with two children) and the corresponding total labor cost for the employer. Source: OECD Tax database.

The wedge between the tax rates of second earners and single individuals is computed as the ratio of tax second earner to tax single individual, following Chapter 3 of the April 2016 WEO. Source: OECD.

Public Spending on ALMP: active labor market program spending per unemployed person in percent of GDP per capita. Source: OECD

Trade Openness. Source: WEO

Union Density: net union membership as a proportion of wage earners in employment. Source: OECD employment database.

Public Spending on Early Childhood Education and Care as percent of GDP. Source: OECD.

Job-Protected Maternity Leave: total number of weeks of job-protected maternity, parental, and extended leave available to mothers, regardless of income support. Source: OECD.

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IMPLEMENTING MAXIMUM WORKING HOURS: INTERNATIONAL PRACTICES [1]

Korea is cutting the maximum number of weekly working hours from 68 to 52. Several other countries have introduced similar limits. While regulations and implementation differ across countries and industries, they typically have resulted in a reduction in working hours. In Korea, it will be important to monitor implementation to ensure an effective and widespread decrease in hours worked across sectors. The implications for firms and productivity will need to be assessed regularly.

1.   Among advanced economies, there has been a long secular decline in annual hours worked. This tendency has been driven by broad convergence of legal standards and technological advances, against the backdrop of empirical evidence showing a negative correlation between working hours and productivity (Pencavel, 2014). Korea's average hours worked per employee are the second highest in the OECD and about 19 percent above the OECD average.

Average Yearly Hours Worked Per Person Employed

Source: OECD.

Productivity and Working Hours in OECD Economies, 2016

Source: OECD.
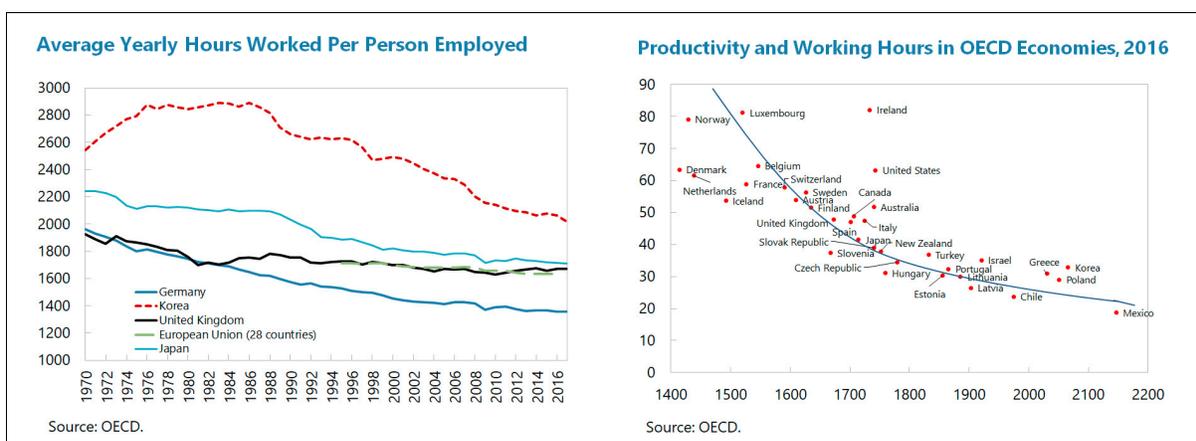
2.   On March 20, 2018, Korea promulgated an amendment to the country's 1997 Labor Standards Act in order to reduce working hours. Before the amendment, Korea's Labor Standard Act stipulated that workers could work up to 52 hours a week and be paid a 50 percent premium for overtime. However, due to the ambiguity on whether "one week" included weekends, employees were in effect allowed to work an additional 16 hours during the weekend, for a maximum total of 68 hours per week. Under the revised law, weekends are instead included in the definition of the weekly working period, so the maximum allowed working hours are reduced to 52 per week.[2] Exceeding the limit is allowed as long as *average* weekly working hours does not exceed 52 hours over a reference period. This reference period was initially set at three months, but will likely be extended to six-months, following an agreement between the government and the Labor Council.

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[1] Prepared by Edda Zoli.

[2] For employees under 18 the new ceiling is 35 hours per week. Five industries, including transport and health care, are exempt from the limits, while twenty-six were exempt under the previous rules.

Implementation will be phased in over a three-year period, starting with large companies and the public sector. Management positions are exempted from working hours regulations.[3]

3.   **Several other countries have in place legal limits on weekly working hours.** Nowadays, 40-hour or less is the most prevalent limit for regular weekly hours in advanced economies. Caps on maximum working hours including overtime have been in place in EU members for over 20 years and have just been introduced in Japan.

4.   **In the European Union the legislation on maximum working hours leaves flexibility of implementation.** The 1993 Council Directive 93/104/EC (later superseded by the Directive 2003/88/EC of the European Parliament) established 48 hours as the maximum average working time for each seven-day period, but this can be calculated over a reference period of four months (Art. 6). Member states had a three-year period to introduce legislation consistent with the Directive. Beside excluding certain sectors (e.g., transportation), the directive also introduced the possibility of derogation to the weekly limit in the following cases:

- *For managers and professional staff.* Derogation is permitted when, "on account of the specific characteristics of the activity concerned, the duration of the working time is not measured or predetermined, or can be determined by the workers themselves, and particularly in the case of managing executives or other persons with autonomous decision-taking powers, family workers or workers officiating at religious ceremonies" (Article 17).

- *When an individual worker decides to "opt out" of the 48-hour limit by signing an agreement.* This is permitted provided that the principle of protection of workers' health and safety is guaranteed. Employers are not allowed to compel workers to work more than 48 hours if they are not willing to sign an opt-out (Article 18).

5.   **Modalities of implementation of the working hours caps vary across the EU, but, on average, 16 percent of workers continue to work 48 hours or more weekly**. Collective bargaining and agreements have a major role in defining working time standards. There are also significant differences in the application of the opt-out option from the weekly maximum of 48 hours. Five countries (Bulgaria, Cyprus, Estonia, Malta and the U.K.) allow the individual opt-out with no restrictions. In eleven countries (e.g., France, Germany, Spain) it is possible only in limited cases—typically in the health and/or emergency sectors or for jobs demanding a significant amount of on-call time. In the other twelve EU members (e.g., Italy) the opt-out option is not allowed. For the 12 EU countries for which data are available, the share of the labor force working 48 hours or more weekly has declined to 12 percent in 2010 from 22 percent in 1991—before the enactment of the Working Hours Directive (Eurofound, 2010, 2016).

6.   **In the U.K., individuals can opt-out of the working hours limits irrespective of the sector of activity or occupation.** According to a 2011 survey, in 32.4 percent of the workplaces there was at least one worker who had signed an opt-out agreement. In 15.6 percent of workplaces

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[3] Pursuant to the Enforcement decree 34 of the Labor Standard Act.

all employees had signed an opt-out agreement. Opt-out agreements were more prevalent in private than public sector workplaces. They were the most frequent (40 percent) in the business services sector, which includes non-financial professional occupations, such as lawyers. Surveys suggest that there is broad based support for the opt-out amongst U.K. business, long-hours workers, and the wider public (Department for Business Innovation and Skills, 2014). Nevertheless, there have been claims that in some cases employees are pressured in to signing the opt-out, which is not permitted under the Working Time Directive.

7.   **In spite of the opt-out option, the number of employees working in excess of 48 hours in the U.K. decreased by 15 percent between 1997—before the adoption of the Directive— and 2013.** About 13 percent of the labor force was working over 48 hours per week in 2013. Long-hours working is generally more prevalent in high income and highly skilled occupations (Department for Business Innovation and Skills, 2014).

8.   **In contrast to the UK, working hours limits are particularly strict in France**. The legal maximum is a weekly average of 44 hours over three months, and 48 working hours in a given week. Company level agreements are allowed up to the limit of a weekly average of 46 working hours over three months. However, executives are typically not subject to working time limitations.

9.   **Japan also introduced a legislation on maximum working hours in 2018.** The law envisages a cap of 100 hours a month on overtime, with a limit of 720 hours of overtime a year (corresponding to an average of 15-16 hours a week). White-collar workers with annual incomes of more than 10.75 million yen (about 100,000 US$) are exempted, as for them there is no distinction between regular working hours and overtime. This category includes product developers, financial traders, bankers, consultants and researchers. Given the opposition's objection that this could be a loophole, a provision was added allowing white-collar workers to give up the exemption status if they so wish. In that case, the distinction between regular working hours and overtime would apply to them, and they would be subject to the overtime cap. The legislation will become effective in April 2019 for large firms, and April 2020 for SMEs.

10.   **The international experience with caps on working hours suggests that they can be an effective way to reduce hours worked.** While implementation differs across countries, in the EU flexibility to the regulation is typically introduced by (i) allowing weekly working hours temporarily exceed the limit, provided that they do not surpass the ceiling on average over a reference period;(ii) consenting derogation for managers, professional staff and specific working categories. Only five EU members permit individual workers to opt-out with no restrictions. In spite of this flexibility, hours worked declined across EU countries.

11.   **In Korea, it will be important to ensure a widespread implementation of working hours ceilings across sectors.** Korea's hours worked per employee are well above the OECD average, and the new maximum working hour limit is high relative to the EU limits. Effective implementation of Korea's new legislation will be essential to improve people well-being and support female labor force participation and fertility. The impact on firms and their productivity will have to be regularly evaluated.

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INDUSTRIAL STRUCTURE AND ITS MACROECONOMIC IMPLICATIONS IN KOREA[1]

A. Introduction

1.   After a remarkable growth spurt over several decades averaging above 6 percent, Korea's economic growth has been slowing significantly for the last two decades. The growth rate declined to 4.3 percent in 2000s, and to 2.8 percent in 2010s. The volatility of growth has also declined since the 2000s, which is commonly observed in the advanced countries with economic development, such as "Great Moderation" during the 2000s in the U.S. (e.g., Blanchard and Simon, 2001; Kim and Nelson, 1999; Stock and Watson, 2003). Although in the long run economic growth and stability can be determined by various structural factors including population aging and development stages, the development path of Korea's industrial structure can also play an important role.

GDP Growth and Volatility
(In percent; standard deviation of growth rate)

Sources: Bank of Korea; IMF staff calculations.
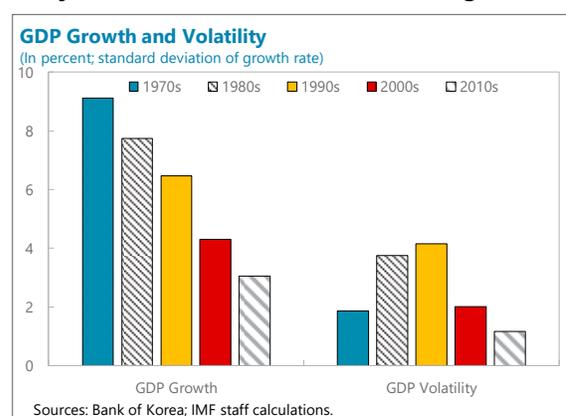
2.   Korean economy has become more concentrated and interconnected through the 2000s. The economy has become more concentrated in a few manufacturing industries, while interconnectedness across industries has risen via vertical relationships. At the same time, the importance of international trade has increased with a growing participation in global value chains (GVCs). The rise of economic concentration and interconnectedness could become the sources of macroeconomic instability as macroeconomic fluctuations are primarily the results of many microeconomic shocks at the sectoral or firm-level (e.g., Gabaix, 2011; Carvalho and Gabaix, 2013; Foerster et al., 2011).[2] In addition, Acemoglu et al. (2017) show how tail macroeconomic risks can be created from the propagation of microeconomic shocks through the input-output network. In this regard, the recent decline in GDP volatility does not necessarily secure the economic stability in the future. Against this background, this paper attempts to shed light on the role of industrial structure in determining Korea's economic growth and stability.

3.   The structure of this paper is as follows. In Section B, we present overall industrial structure of the Korean economy and its changes over time using the data at the sector-level and industry-level, while the macroeconomic developments in the sectoral and industrial levels will be described in the following Section C. Section D explores the implications of structural changes in industrial structure for economic growth and stability. Specifically, we empirically examine the role of

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[1] Prepared by Dongyeol Lee (APD). The author is particularly grateful to Tarhan Feyzioglu (APD) and Johanna Schauer (SPR) for their invaluable discussions and comments.

[2] It should be noted that specialization may also generate higher productivity through economies of scale and selection leading to the growth of productive firms/industries, which has arguably been at play in Korea over several decades.

vertical and trade linkages, through which the economic shocks can be propagated, in determining productivity growth. Section E concludes and discusses policy implications.

B.   Industrial Structure: Concentration and Interconnectedness[3]

4.   The manufacturing and service sectors account for most of GDP. The share of manufacturing in GDP has increased over the economic development from 12.7 percent in 1970s to 31.6 percent in 2010s. Meanwhile, the share of services has been stable around 60 percent while the other sectors (non-manufacturing and agriculture) have declined over time in the share of GDP.

Sectoral Share in GDP
(In percent of GDP)

■ Manufacutring ▨ Services ■ Non-manufacturing ■ Agriculture

Sources: Bank of Korea; IMF staff calculations.
Notes: Agriculture includes Agriculture, Forestry, and Fishing; Non-manufacturing includes Mining/Quarrying, Electricity/Gas, Water Supply, and Construction.
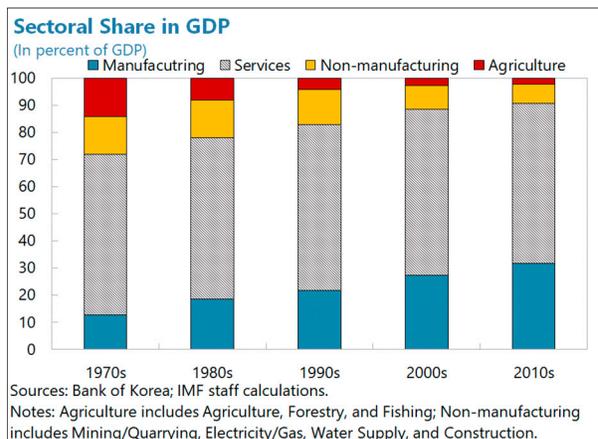
5.   The manufacturing sector is highly concentrated in a few key industries while services are not much concentrated. Korea's industrial structure has followed a *U*-shaped relationship between economic development and diversification in manufacturing, but this relationship is not found in services.[4] As the economy develops, the manufacturing sector first diversifies and it starts specializing relatively late stages of economic development: that is, the share of the three largest industries has declined to 41.9 percent in 1990s, but it has increased to 57.6 percent in 2010s.[5] However, in services the share of top three industries has declined over several decades, reaching at 39.5 percent in 2010s.[6]

Industrial Share in Manufacturing
(In percent of total manufacturing value added)

■ Food ▨ Texitile ■ Chemicals ■ Basic metals
▨ Electronics ■ Transportation □ Other ▲ Top 3

Sources: Bank of Korea; IMF staff calculations.

Industrial Share in Services
(In percent of total services value added)

■ Wholesale/Retail ▨ Real estate ■ Pubilc admin./Defense
■ Education □ Other ▲ Top 3

Sources: Bank of Korea; IMF staff calculations.

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[3] In this section, we use both sector-level and industry-level data from national accounts (1970-2017), and World Input-Output Database (WIOD) (2000-2014) to study the overall industrial structure of the Korean economy and its changes over time.

[4] The hump or *U*-shaped relationship of economic development and diversification (or specialization) is generally observed in many advanced economies (e.g., Imbs and Wacziarg, 2003; Cadot et al., 2011).

[5] Food, textiles, chemicals, and basic metals have been the three largest share manufacturing industries in 1970s and 1980s, while electronics, transportation, and chemicals have been the main manufacturing industries since 2000s.

[6] Wholesale and retail trade, real estate, public administration and defense, and education have been the three largest share industries in services.

6. **The industry has been highly interconnected with other industries through the input-output relationships.** Overall domestic vertical linkages (the share of intermediate input in total output) have increased to 47.1 percent in 2009 from 44.3 percent in 2000, but they have remained stable afterwards. At the sectoral level, upstream and downstream linkages are high at above 50 percent in manufacturing while vertical linkages in services remained below 40 percent.[7] Moreover, in manufacturing vertical linkages have increased until the global financial crisis (GFC) when they started to decline, while vertical linkages have remained stable in services.

Upstream Linkage: Sector
(In percent)

Sources: World Input-Output Database; IMF staff calculations.
Notes: Upstream linkage denotes the ratio of intermediate input supply to other industries in sectoral output; Agriculture includes Agriculture, Forestry, and Fishing; Non-manufacturing includes Mining/Quarrying, Electricity/Gas, Water Supply, and Construction.

Downstream Linkage: Sector
(In percent)

Sources: World Input-Output Database; IMF staff calculations.
Notes: Downstream linkage denotes the ratio of intermediate input purchase from other industries in sectoral output; Agriculture includes Agriculture, Forestry, and Fishing; Non-manufacturing includes Mining/Quarrying, Electricity/Gas, Water Supply, and Construction.

7. **Upstream and downstream linkages in the three major manufacturing industries (i.e., electronics, transportation, and chemicals) have declined slightly in the aftermath of GFC.**[8] Upstream linkages are highest in chemicals at almost twice higher than electronics and transportation. On the other hand, downstream linkages show similar levels in all three industries at around 60 percent.

Upstream Linkage: Manufacturing Industry
(In percent)

Sources: World Input-Output Database; IMF staff calculations.
Notes: Upstream linkage denotes the ratio of intermediate input supply to other industries in industrial output.

Downstream Linkage: Manufacturing Industry
(In percent)

Sources: World Input-Output Database; IMF staff calculations.
Notes: Downstream linkage denotes the ratio of intermediate input purchase from other industries in industrial output.

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[7] Upstream (downstream) linkage is defined as the share of intermediate input supply (use) in sectoral or industrial output, which measures the intensity of connectedness to other industries as upstream sellers (downstream buyers).

[8] The three largest industries are determined based on the share of GDP in 2014: (i) Electronics includes "Computer, electronic and optical products" and "Electrical equipment"; (ii) Chemicals includes "Chemical and chemical products" and "Basic pharmaceutical products and preparations"; (iii) Transportation includes "Motor vehicles, trailers and semi-trailers", and "Other transport equipment" (see Table A.2 in Appendix for detailed list of industries).

8.   The Korean economy has become noticeably interconnected to the global economy through the trade relationships during the 2000s. The share of export and import in total output has increased by about 5 percentage point each in the aftermath of GFC. At the sectoral level, manufacturing is substantially higher in export and import linkages while it also has shown a sharp increase during the 2000s.[9] In services, however, export and import linkages have remained stable at around 5 percent and 3 percent, respectively.

Export Linkage: Sector
(In percent)
Sources: World Input-Output Database; IMF staff calculations.
Notes: Export linkage denotes the ratio of export to other countries in sectoral output; Agriculture includes Agriculture, Forestry, and Fishing; Non-manufacturing includes Mining/Quarrying, Electricity/Gas, Water Supply, and Construction.

Import Linkage: Sector
(In percent)
Sources: World Input-Output Database; IMF staff calculations.
Notes: Import linkage denotes the ratio of import from other countries in sectoral output; Agriculture includes Agriculture, Forestry, and Fishing; Non-manufacturing includes Mining/Quarrying, Electricity/Gas, Water Supply, and Construction.

9.   At the industry-level, major manufacturing industries have shown a sharp increase in export and import linkages after the GFC. Electronics and transportation show about twice higher export linkages than chemicals while import linkages are highest in electronics.

Export Linkage: Manufacturing Industry
(In percent)
Sources: World Input-Output Database; IMF staff calculations.
Notes: Export linkage denotes the ratio of export to other countries in industrial output.

Import Linkage: Manufacturing Industry
(In percent)
Sources: World Input-Output Database; IMF staff calculations.
Notes: Import linkage denotes the ratio of import from other countries in industrial output.

10.   Looking at trade linkages by trading partners, export and import linkages to China have shown a drastic increase over the 2000s in major manufacturing industries. During the same periods, trade linkages to the U.S. and Japan have declined noticeably in major manufacturing industries. Especially, electronics shows the most drastic structural changes in trade linkages: that is, export and import linkages to China have increased significantly while the linkages to the U.S. have declined substantially over last 15 years. This represents that the Korean economy has been exposed

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[9] Export (import) linkage is measured as the share of gross export (import) to (from) other countries in sectoral or industrial output.

to the recent drastic changes in GVCs—that is, the increasing presence of China in the global trade.[10] It should also be noted that export and import exposures to the top three trading partners account for almost 50 percent of total trade linkages in major manufacturing industries, except for export linkages in transportation industry.

Export Linkage: Manufacturing Industry
(In percent)

Sources: World Input-Output Database; IMF staff calculations.
Notes: Export linkage denotes the ratio of export to other countries in industrial output.

Import Linkage: Manufacturing Industry
(In percent)

Sources: World Input-Output Database; IMF staff calculations.
Notes: Import linkage denotes the ratio of import from other countries in industrial output.

C. Macroeconomic Development: Economic Growth and Volatility

11.   Manufacturing and services have been key contributors to economic growth. The contribution of manufacturing and services to GDP growth has been declining while the contribution from these sectors still explain most of GDP growth. It is also notable that the decline in the contribution to growth is observed across all industry sectors.

12.   Contribution to growth is highly concentrated in a few major manufacturing industries and it has become more concentrated over time. Electronics contributes almost half of the manufacturing growth since 2000s. Largest three industries' growth contribution has been only 26.5 percent in 1980s, but it has been almost 70 percent since 2000s. The service sector has been less concentrated in growth contribution while the share of major three industries' contribution has remained at around 30-40 percent since 1980s.

Sectoral Contribution to GDP Growth
(In percent)

Sources: Bank of Korea; IMF staff calculations.
Notes: Agriculture includes Agriculture, Forestry, and Fishing; Non-manufacturing includes Mining/Quarrying, Electricity/Gas, Water Supply, and Construction.

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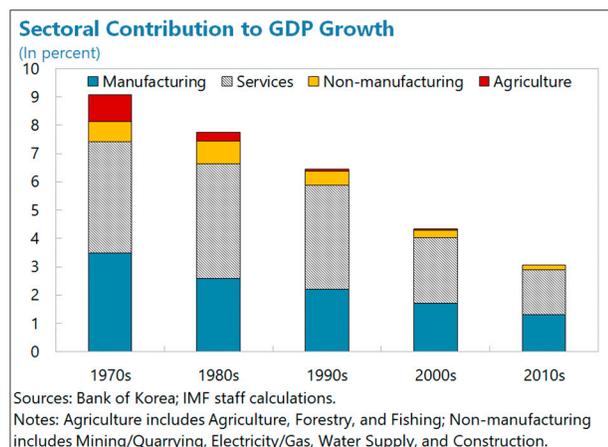
[10] The substantial increase in trade linkages to China over the 2000s may relate to the growing emergence of China's presence in the global economy, especially after China joined the World Trade Organization (WTO) in 2001.

Industrial Contribution to GDP Growth: Manufacturing
(In percent)

Legend: Food, Textile, Chemicals, Basic metals, Electronics, Transportation, Other, Top 3

Sources: Bank of Korea; IMF staff calculations.

Industrial Contribution to GDP Growth: Services
(In percent)

Legend: Wholesale/Retail, Real estate, Pubilc admin./Defense, Education, Other, Top 3

Sources: Bank of Korea; IMF staff calculations.

13.   Growth volatility has remained high until 1990s in all industry sectors, but it has declined afterwards. Although high volatility in 1990s partly reflects the Asian Financial Crisis, the standard deviation (volatility) of growth has declined substantially through the 2000s, consistent with overall GDP growth volatility. The level of growth volatility has been higher in manufacturing than in services and other sectors in 2000s, which may relate partly to higher concentration and interconnectedness in manufacturing and its rise in the recent period.

Sectoral GDP Volatility
(In standard deviation)

Legend: 1970s, 1980s, 1990s, 2000s, 2010s

Categories: Manufacutring, Services, Non-manufacturing, Agriculture

Sources: Bank of Korea; IMF staff calculations.
Notes: Agriculture includes Agriculture, Forestry, and Fishing; Non-manufacturing includes Mining/Quarrying, Electricity/Gas, Water Supply, and Construction.
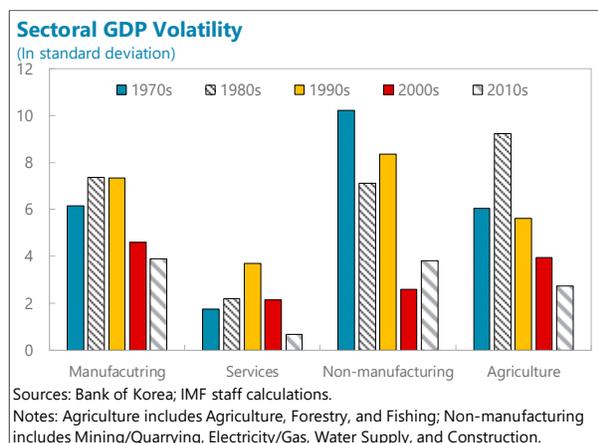
14.   The potential factors of economic instability may be embedded in the Korean economy despite the recent decline of overall growth volatility. At the industry level, electronic and transportation—the two largest share manufacturing industries through the 2000s—have been relatively volatile compared to other manufacturing and service industries. Domestic or external shocks can be easily transmitted to the whole economy due to Korea's industrial structure of high concentration and interconnectedness around a few major industries which are relatively volatile and also are dominated by a few large firms.[11]

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[11] The industry concentration indices (the top three firms' market share or Herfindahl-Hirschman index)—computed using the "Mining and Manufacturing Survey" by Korea Fair Trade Commission—for the top 3 industries (i.e., electronics, transportation, and chemicals) are also highly concentrated by the small number of firms.

Industrial GDP Volatility: Manufacturing
(In standard deviation)

Sources: Bank of Korea; IMF staff calculations.

Industrial GDP Volatility: Services
(In standard deviation)

Sources: Bank of Korea; IMF staff calculations.
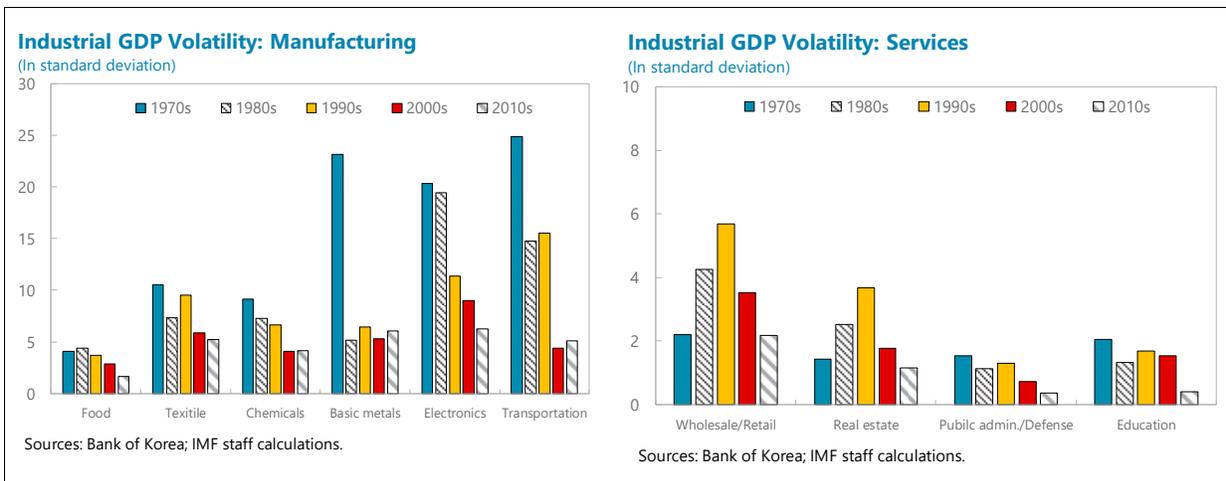
D. Industrial Structure and Macroeconomic Implications

15.   Economic shocks can be propagated to domestic industries via domestic upstream/downstream linkages to other industries or via export/import linkages to foreign countries. Input supply to other industries and input purchase (use) from other industries can act as a transmission channel of domestic shocks (Figure (a)). In addition, an industry can directly export/import products or services to/from foreign countries or it can be indirectly linked to foreign countries through upstream/downstream linkages to other industries which are involved in exports/imports with foreign countries (Figure (b)).[12] Direct and indirect trade linkages to foreign countries can play a role in transmission of external shocks.

Economic Shock Propagation Channel

(a) Domestic Industry Growth Shock

(b) External Country Growth Shock

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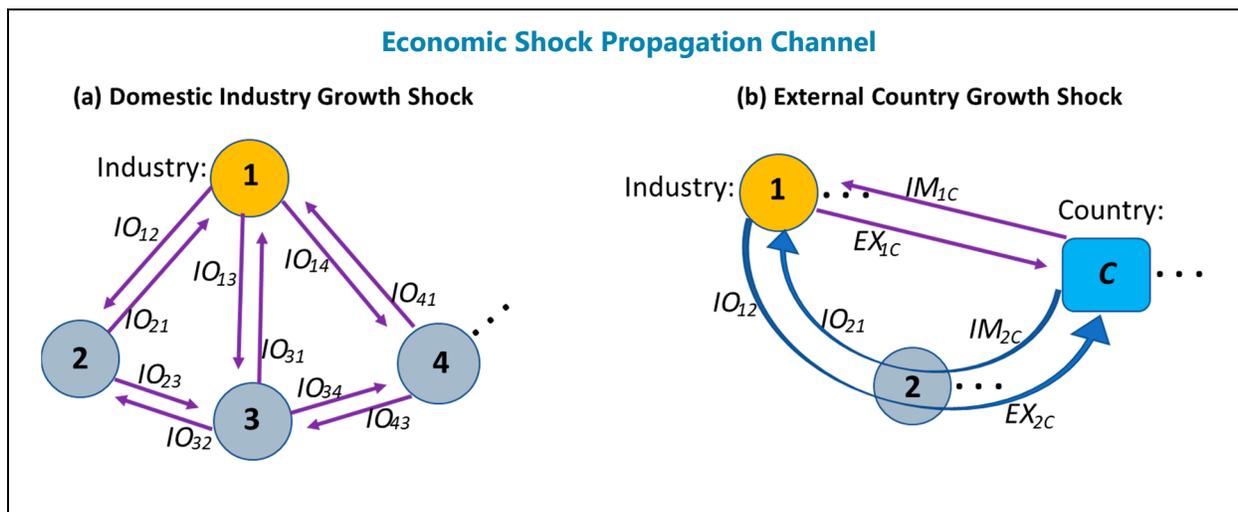
[12] This paper considers only direct (first-order) trade and vertical linkages between Korea and other countries as well as between two industries, as in the existing literature (e.g., di Giovanni and Levchenko 2010; di Giovanni et al. 2018). For simplicity and empirical identification purposes, we assume indirect (higher-order) effects are not likely to be large empirically, although Acemoglu et al. (2016a) and other network literature introduce both direct and indirect trade and/or vertical linkages using a Leontief inverse matrix.

16.   The role of vertical and trade linkages in transmission of economic shocks can be empirically analyzed using the industry-level international input-output data of WIOD (2000-2014). Estimation specification extends Acemoglu et al. (2016) to be more applicable to the Korean economy. Acemoglu et al. (2016) studies the impacts of four different industry-level demand and supply shocks—that is, China import penetration, federal spending, TFP growth, and foreign-patenting growth shocks—on the US industry growth. Our model focuses on the role of network linkages in the transmission of economic shocks: (i) the role of domestic vertical linkages in transmission of supply shocks from domestic sources (domestic industry shocks); and (ii) the role of direct and indirect trade linkages in transmission of supply shocks from external sources (external country shocks). For external country shocks, our model focuses on the transmission of GDP growth shocks from Korea's three largest trading partners, China, the U.S., and Japan.

17.   Domestic industry shocks and external country shocks can be propagated through upstream/downstream linkages and export/import linkages. For external shocks, we focus on the transmission of GDP growth shocks from Korea's three largest trading partners (China, the U.S., and Japan). We examine the transmission of domestic and external growth shocks on industry's labor productivity growth which may have important implications for Korea's long-term economic growth. The estimation equation is set up as:

$$\Delta lnLP_{it} = \alpha_0 + \alpha_1\, lnLP_{it-1} + \alpha_2 \Delta lnK_{it} + \beta_1 UP_{it}^{DM} + \beta_2 DN_{it}^{DM} + \beta_3 OWN_{it}^{EX} + \beta_4 OWN_{it}^{IM} + \beta_5 UP_{it}^{EX} +$$
$$\beta_6 DN_{it}^{IM} + \mu_i + \delta_{st} + \varepsilon_{it} \tag{1}$$

where $UP_{it}^{DM} = \sum_j IO_{ijt} \times \Delta lnY_{jt}$; $DN_{it}^{DM} = \sum_j IO_{jit} \times \Delta lnY_{jt}$;
$OWN_{it}^{EX} = \sum_C EX_{iCt} \times \Delta lnY_{Ct}$; $OWN_{it}^{IM} = \sum_C IM_{iCt} \times \Delta lnY_{Ct}$;
$UP_{it}^{EX} = \sum_C \sum_j IO_{ijt} \times EX_{jCt} \times \Delta lnY_{Ct}$; $DN_{iCt}^{IM} = \sum_C \sum_j IO_{jit} \times IM_{iCt} \times \Delta lnY_{Ct}$

where LP_{it}, Y_{it} and K_{it} denote industry i's labor productivity, real value added, and capital intensity (capital/labor ratio); IO_{ijt} and IO_{jit} denotes industry i's upstream and downstream linkages; EX_{iCt} and IM_{iCt} stand for export and import linkages (see Table A.1. in Appendix for detailed data descriptions and sources). μ_i, δ_{st}, and ε_{it} denote industry fixed effects, sector-year fixed effects, and error terms, respectively. The superscripts DM, EX, and IM denote domestic, export, and import, while the subscripts i, s, C, t denote industry, sector, country, and year, respectively.

18.   Industry growth is estimated to be significantly affected by both downstream domestic industry shocks and own export shocks (Table 1). The estimation results on Equation (1) show that: (i) supply-side domestic industry shocks have larger downstream effects (due to supplier shocks) than upstream effects (due to customer shocks)—industries are more likely to be affected by seller's growth shocks rather than buyer's growth shocks;[13] and (ii) external country shocks are propagated to domestic industries mainly through its own (direct) export linkages—

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[13] The result is consistent with Acemoglu et al.'s (2016) theoretical and empirical findings. Theory predicts that supply-side shocks propagate more strongly to downstream customers than to upstream suppliers because supply-side shocks affect the prices faced by customer industries, creating powerful downstream propagation.

industries being highly involved in exports directly to foreign countries are significantly affected by the country's growth shock.[14] Separate estimation for manufacturing industries demonstrates that the propagation of domestic industry shocks via both upstream and downstream linkages is significant while the external shock propagation via direct export linkages is also effective. Other control variables have expected signs: that is, lower productivity industries have a higher growth (i.e., convergence or catch-up) while industries with higher capital intensity growth are growing faster.

### Table 1. Korea: Economic Shock Propagation: Baseline Result

Dependent variable: Labor productivity growth

	Total industry			Manufacturing		
	Domestic	External	Both	Domestic	External	Both
	[1]	[2]	[3]	[1]	[2]	[3]
Lagged log(labor productivity)	-4.717*	-6.523**	-5.997**	-2.062	-4.137*	-4.146
	(2.789)	(2.436)	(2.499)	(3.652)	(2.291)	(2.404)
Capital/labor growth	0.561***	0.567***	0.556***	0.669***	0.707***	0.659***
	(0.058)	(0.056)	(0.058)	(0.107)	(0.108)	(0.110)
Upstream domestic shock	0.082		0.100	0.767		1.031**
	(0.416)		(0.435)	(0.473)		(0.407)
Downstream domestic shock	1.619***		1.628***	0.795***		0.734**
	(0.354)		(0.363)	(0.231)		(0.251)
Own export shock		4.331	4.840*		4.490	5.843*
		(2.932)	(2.815)		(3.186)	(2.948)
Own import shock		-4.422	1.994		-0.354	12.60
		(17.14)	(15.64)		(21.03)	(19.56)
Upstream export shock		0.040	0.037		0.053	0.035
		(0.044)	(0.046)		(0.066)	(0.065)
Downstream import shock		0.502	0.267		0.284	-0.278
		(0.536)	(0.469)		(0.750)	(0.690)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year fixed effect	Yes	Yes	Yes	No	No	No
Year fixed effect	No	No	No	Yes	Yes	Yes
Observations	532	532	532	196	196	196
R^2-within	0.688	0.664	0.694	0.714	0.693	0.728
Number of industries	38	38	38	14	14	14

Notes: 1) Constant is included in all specifications.
2) ***, **, * indicate levels of significance at 1%, 5%, 10%, respectively.

19.   The estimated average productivity growth impacts from domestic industry shocks and external country shocks are non-negligible. First, the left panel chart shows the average impact of domestic and external shocks on productivity growth of total industry. For domestic industry shocks, growth shocks in chemicals (one standard deviation) are estimated to have the largest productivity impacts (0.52 percentage point) mainly due to its high vertical linkages to other industries and high volatility, while growth shocks in electronics and transportation are also expected to have substantial productivity impacts. For external country shocks, China's growth shocks would have the largest productivity impacts for total industry (0.26 percentage point) as the

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[14] This result may relate to the important role of intermediate input export in productivity growth (e.g., Kasahara and Rodrigue, 2008; Keller, 2002; Lee, 2019).

Korean economy is most highly linked to China via trade linkages, while growth shocks in the U.S. and Japan would have smaller but substantial productivity impacts. Second, the right panel chart illustrates the average impact of domestic and external shocks on productivity growth of manufacturing industry. The relative size of productivity impact is consistent with the results for total industry, while the effects are expected to be larger than twice for manufacturing which is highly interconnected with other industries via vertical linkages and with foreign countries via trade linkages. Lastly, the overall impact of each one standard deviation domestic and external shocks is estimated to 1.4 percentage points for total industry and 3.2 percentage points for manufacturing. The estimates highlight that the economic shocks in the largest three industries and/or in the top three trading partners can lead to large swings in the overall economy by the transmission of shocks through vertical and trade linkages.

Impact of Domestic and External Shock on Productivity: Total Industry
(In percentage point)

Source: IMF staff calculations.
Note: The bars (left axis) denote the average impact on 1 standard deviation increase in each industry's value added growth and each country's GDP growth, computed using average upstream/downstream, export/import linkages for total industry in 2014 and the significant coefficients of shock variables from specification [3] for total industry of Table 1.

Impact of Domestic and External Shock on Productivity: Manufacturing
(In percentage point)

Source: IMF staff calculations.
Note: The bars (left axis) denote the average impact on 1 standard deviation increase in each industry's value added growth and each country's GDP growth, computed using average upstream/downstream, export/import linkages for manufacturing in 2014 and the significant coefficients of shock variables from specification [3] for manufacturing of Table 1.

20.   The growth shocks in the top five manufacturing industries are propagated to other Korean industries mainly through downstream effects (Table 2). However, the propagation via direct export linkages are estimated to be insignificant but the sign and magnitude are broadly consistent with the baseline results. The finding confirms that the French firm-level findings of di Giovanni et al. (2017) apply to the Korean economy at the industry-level: that is, the small number of large industries exhibit higher trade and vertical linkages and significantly contribute to the transmission of domestic and external shocks.

Table 2. Korea: Economic Shock Propagation via Top 5 Manufacturing Industries

Dependent variable: Labor productivity growth

	Total industry			Manufacturing		
	Domestic	External	Both	Domestic	External	Both
	[1]	[2]	[3]	[1]	[2]	[3]
Lagged log(labor productivity)	-5.021*	-6.456**	-6.159**	-1.415	-4.326*	-3.599
	(2.668)	(2.394)	(2.472)	(3.623)	(2.306)	(2.837)
Capital/labor growth	0.570***	0.568***	0.567***	0.704***	0.706***	0.698***
	(0.057)	(0.055)	(0.057)	(0.114)	(0.108)	(0.119)
Upstream domestic shock	-0.037		-0.021	-0.083		-0.061
	(0.588)		(0.604)	(0.761)		(0.817)
Downstream domestic shock	1.130***		1.067***	1.232***		1.177***
	(0.340)		(0.302)	(0.378)		(0.325)
Own export shock		4.020	4.160		4.336	4.429
		(2.943)	(2.818)		(3.074)	(2.692)
Own import shock		-5.961	-0.861		-4.209	1.529
		(16.34)	(16.46)		(19.00)	(20.63)
Upstream export shock		0.036	0.026		0.059	0.051
		(0.059)	(0.068)		(0.071)	(0.084)
Downstream import shock		0.620	0.418		0.487	0.229
		(0.509)	(0.480)		(0.657)	(0.678)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year fixed effect	Yes	Yes	Yes	No	No	No
Year fixed effect	No	No	No	Yes	Yes	Yes
Observations	532	532	532	196	196	196
R^2-within	0.666	0.665	0.671	0.699	0.695	0.709
Number of industries	38	38	38	14	14	14

Notes: 1) Constant is included in all specifications.
2) ***, **, * indicate levels of significance at 1%, 5%, 10%, respectively.

21.   The propagation of external country shocks through downstream and direct external linkages are robust to individual country shocks (Table 3). The results highlight the significant role of downstream linkages and direct export linkages in the transmission of domestic industry shocks and external country shocks for growth shocks in China and Japan, which is consistent with specification [3] in the baseline results from Table 1. However, for the U.S. growth shocks, domestic downstream effects are significant while direct export effects are estimated to be negative but without significance for total industry. In addition, for manufacturing industries, domestic upstream effects are also estimated to be significant for the U.S. and Japan.

Table 3. Korea: Economic Shock Propagation: Individual Country Shock

Dependent variable: Labor productivity growth

	Total industry			Manufacturing		
	China	U.S.	Japan	China	U.S.	Japan
Lagged log(labor productivity)	-6.644**	-4.538*	-4.497	-5.124	-2.056	-1.399
	(2.687)	(2.655)	(2.774)	(3.167)	(3.591)	(3.541)
Capital/labor growth	0.555***	0.575***	0.576***	0.655***	0.696***	0.682***
	(0.057)	(0.058)	(0.058)	(0.113)	(0.091)	(0.084)
Upstream domestic shock	0.055	0.175	0.418	0.843	0.865*	0.964**
	(0.401)	(0.407)	(0.348)	(0.480)	(0.442)	(0.383)
Downstream domestic shock	1.698***	1.642***	1.449***	0.852***	0.817***	0.702*
	(0.350)	(0.339)	(0.322)	(0.269)	(0.240)	(0.362)
Own export shock	7.072***	-8.470	49.09**	7.290***	-2.423	57.33*
	(2.233)	(5.426)	(21.37)	(2.069)	(7.138)	(27.23)
Own import shock	-11.24	23.75	42.64	-0.692	131.9	58.17
	(17.63)	(66.81)	(36.21)	(17.06)	(96.91)	(42.48)
Upstream export shock	0.088	-0.509**	-0.849***	0.032	-0.464	-1.461**
	(0.064)	(0.213)	(0.226)	(0.050)	(0.367)	(0.646)
Downstream import shock	0.700	-3.929	-1.070	0.264	-7.653**	-1.067
	(0.503)	(2.471)	(1.245)	(0.559)	(3.419)	(1.753)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year fixed effect	Yes	Yes	Yes	No	No	No
Year fixed effect	No	No	No	Yes	Yes	Yes
Observations	532	532	532	196	196	196
R^2-within	0.698	0.699	0.704	0.728	0.741	0.742
Number of industries	38	38	38	14	14	14

Notes: 1) Constant is included in all specifications.
2) ***, **, * indicate levels of significance at 1%, 5%, 10%, respectively.

E. Concluding Remarks

22.   Specialization in a few key industries has increased the exposure of the economy to domestic and external shocks in Korea. The electrical and electronic equipment industry has contributed almost half of the growth in the manufacturing sector since early 2000s. The dominant industries are highly interconnected with other domestic industries via upstream/downstream linkages and with foreign markets via export/import linkages. Moreover, these industries are dominated by a few large firms.

23.   The empirical analysis suggests that tighter vertical and trade linkages have increased the vulnerability of the economy to domestic and external shocks. The estimation results show that: (i) domestic industry shocks have larger downstream effects than upstream effects; and (ii) external country shocks are propagated to Korean industries mainly through direct export linkages. Moreover, the overall impact of each one standard deviation shocks in the largest three industries and/or in the top three trading partners is estimated to be 1.4 percentage points for total industry and 3.2 percentage points for manufacturing. This highlights that the economic shocks in a few large manufacturing industries and/or in major trading partners can lead to large swings in the

REPUBLIC OF KOREA

overall economy by the transmission of shocks through vertical and trade linkages. The findings imply that diversification of industrial structure would help mitigate the macroeconomic instability from the propagation of economic shocks.

24.   Moreover, high trade linkages to China and the U.S. may lead to the Korean economy to be vulnerable to the unfavorable economic episodes in these countries. For instance, given high trade linkages to these countries, the recent trade tensions between China and the U.S. are expected to have significant impacts on the economic growth and stability in Korea. Therefore, further efforts are needed to mitigate a concentrated economic structure, which may include promoting fair competition between large corporations and smaller firms, fostering innovation especially in SMEs, and reducing the regulatory burden on firms, especially in the service sector.

Appendix I. Data

	Table A.1. Korea: Data Description and Source	
Variable	Description	Source
GDP (Y_C)	Real gross domestic product of country C	IMF World Economic Outlook
Real value added (Y_i)	Industry i's gross value added /i's price level in gross value added	World Input-Output Database (2016)
Labor productivity (LP_i)	Industry i's real value added /i's total hours worked by employee	World Input-Output Database (2016)
Capital-labor ratio (K_i)	Industry i's nominal capital stock/ (i's price level in gross value added×total hours worked by employee)	World Input-Output Database (2016)
Upstream linkage (IO_{ij})	Industry i's input supply to industry j/i's gross output	World Input-Output Database (2016)
Downstream linkage (IO_{ji})	Industry i's input purchase from industry j/i's gross output	World Input-Output Database (2016)
Export linkage (EX_{iC})	Industry i's export to country C/i's gross output	World Input-Output Database (2016)
Import linkage (IM_{iC})	Industry i's import from country C/i's gross output	World Input-Output Database (2016)

Table A.2. Korea: List of Industries

Industry Sector	ISIC Rev.4	Description
Agriculture (3)	A01	Crop and animal production, hunting and related service activities
	A02	Forestry and logging
	A03	Fishing and aquaculture
Manufacturing (14)	C10-C12	Food products, beverages and tobacco products
	C13-C15	Textiles, wearing apparel and leather products
	C16	Wood and of products of wood and cork, except furniture; etc.
	C17-C18	Paper and paper products; printing and reproduction of recorded media
	C19	Coke and refined petroleum products
	C20-C21	Chemicals and chemical products; basic pharmaceutical products and preparations
	C22	Rubber and plastic products
	C23	Other non-metallic mineral products
	C24	Basic metals
	C25	Fabricated metal products, except machinery and equipment
	C26-C27	Computer, electronic and optical products; Electrical equipment
	C28	Machinery and equipment n.e.c.
	C29-C30	Motor vehicles, trailers and semi-trailers; other transport equipment
	C31-C32	Furniture; other manufacturing
Non-manufacturing industry (4)	B	Mining and quarrying
	D	Electricity, gas, steam and air conditioning supply
	E36-E39	Water collection, treatment and supply; sewerage; waste collection, treatment and disposal activities; materials recovery; etc.
	F	Construction
Services (17)	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
	G46	Wholesale trade, except of motor vehicles and motorcycles
	G47	Retail trade, except of motor vehicles and motorcycles
	H49-H52	Land and via pipelines, water, air transport; warehousing and support activities
	H53	Postal and courier activities
	I	Accommodation and food service activities
	J58-J60	Publishing activities; motion picture, video and television programme production, sound recording and music publishing activities; etc.
	J61	Telecommunications
	J62-J63	Computer programming, consultancy and related activities; information service activities
	K64-K66	Financial service activities; insurance, reinsurance and pension funding; activities auxiliary to financial services and insurance activities
	L	Real estate activities
	M69-M75	Legal and accounting activities; activities of head offices; management consultancy activities; architectural and engineering activities, technical testing and analysis; scientific research and development; advertising and market research; other professional, scientific and technical activities; veterinary activities
	N	Administrative and support service activities
	O84	Public administration and defence; compulsory social security
	P85	Education
	Q	Human health and social work activities
	R-S	Other service activities

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