2020 BOK Knowledge Partnership Program

2020 BOK Knowledge Partnership Program

Nepal

Nepal

BANK OF KOREA

Financial Stability : Institutional Aspects and Implications of Macroprudential Policy

m.bok.or.kr

BANK OF KOREA

BANK OF KOREA

dongguk UNIVERSITY

नेपाल राष्ट्र बैंक
Nepal Rastra Bank

2020 BOK Knowledge Partnership Program with Nepal

Financial Stability : Institutional Aspects and Implications of Macroprudential Policy

2020 BOK Knowledge Partnership Program with Nepal

Research Participants

Senior Advisor	Huh, Jinho (Former Deputy Governor, Bank of Korea)
Research Team	Hyun, Junghwan (Professor of International Trade, Dongguk University, PM) Kim, Kyunghun (Professor of Economics, Hongik University) Ha, Hong-youl (Professor of International Trade, Dongguk University) Cho, Jeonghwan (Outside researcher, Dongguk University) Lim, Nam-kyun (Assistant Researcher, Dongguk University) Park, Soo-bin (Assistant Researcher, Dongguk University)
Local Research Team	Mr. Anuj Dahal (Director, Bank Supervision Department, Nepal Rastra Bank) Mr. Bibek Koirala (Deputy Director, Bank Supervision Department, Nepal Rastra Bank) Mr. Danda Prasad Kharel (Deputy Director, Banks and Financial Institutions Regulation Department, Nepal Rastra Bank) Mr. Prithu Sharma Binadi (Assistant Director, Banks and Financial Institutions Regulation Department, Nepal Rastra Bank) Mr. Sagar Gautam (Assistant Director, Bank Supervision Department, Nepal Rastra Bank)

2020 BOK Knowledge Partnership Program with Nepal

Financial Stability : Institutional Aspects and Implications of Macroprudential Policy

Contents

List of Tables

List of Figures

List of Boxes

Executive Summary

This report is a policy consultation report that is aimed at sharing Bank of Korea (BOK)'s unique policy experience and knowledge about financial stability with Nepal Rastra Bank (NRB). It deals with two major topics relevant for financial stability. The first one is policy responses of central banks to COVID-19 and the other is a step-by-step plan to develop an advanced macro stress testing framework in Nepal. There is a minor topic that is macroprudential policy measures that NRB may adopt in the near future.

This report is organized as follows. Chapter Ⅰ briefly explains why we select the major two topics and show the outline of the report. Chapter Ⅱ overviews the economy and the financial system in Nepal. Chapter Ⅲ examines the evolution of COVID-19, policy responses of NRB, BOK and other central banks, and finally suggests several important factors that NRB must consider in making policies regarding the COVID-19 pandemic. Chapter Ⅳ extensively explains the development history of BOK's macro stress testing framework. Specifically, it describes main features and algorithms of BOKST-07 model, SAMP and NBFI in detail and finally suggests a step-by-step approach to establish Nepalese macro stress testing. Chapter Ⅴ introduces other useful macroprudential policy measures that NRB may consider to adopt.

In Chapter Ⅲ, the report finds that NRB responds to COVID-19 using credit expansion policy, such as benchmark rate cut, temporary relaxation of regulatory requirements, and credit injection to distressed businesses. It emphasizes that although these policy measures are effective to mitigate the impact of COVID-19 shock right now, they will cause several serious problems that have negative long-run effects such as credit misallocation, soaring NPLs, and forming zombie firms. Specifically, massive liquidity injection

enables distressed firms to survive and maintain employment. However, it hampers efficiency of credit reallocation that will reduce potential economic growth and productivity. Furthermore, it is a stylized fact that fast and massive loan expansion results in growing NPLs with a time lag, which will undermines the stability of individual banks and the whole banking system. To avoid soaring NPLs, NRB continuously extends loans to distressed firms to keep them survive, which creates another problem, namely zombie firms. Thus, Chapter Ⅲ recommends that NRB should selectively allocate liquidity to maximize the impact of credit injection. One way is to focus on allocating credit to key supplier firms in supply chains. Then, the firms will extend trade credit to their client firms and receive less trade credit from their suppliers. Also, it suggests NRB to monitor liquidity buffers and the efficiency or stability of credit allocation.

Chapter Ⅳ articulates critical requirements with which NRB must satisfy to develop macro stress testing framework. It suggests a two track approach. As a short-term plan, NRB first sets up data collection process and makes banks to create and report data used in macro stress tests. Then, using the data collected from banks, NRB can develop an earlier version of macro stress test model that focuses on several large banks, not the entire banking system. By operating the model, NRB can accumulate practical knowledge and experience regarding the tests and recognize what NRB should add to the model. As a long-term plan, NRB must set a goal of developing a model like BOKST-07 model. The BOKST-07 model rules out a case in which multiple shocks occur simultaneously and a case in which an initial shock has non-trivial second-round effects. Thinking it the other way around, it is much easier and simpler to set up the model. It is a good strategy for NRB to set up a simple one like the BOKST-07 model as a steppingstone. Given that derivative and security markets are under-developed in Nepal, the model would be suitable for Nepal if it considers interbank exposures. In the future, based on the model, it is necessary to develop a more complex macro stress test model that can consider the effects of crisis transfer and feedback.

In chapter Ⅴ, we evaluate the macroprudential policies of neighboring emerging countries that NRB can refer to, given that NRB must develop their ability to find potential factors that may cause new systemic risks, analyze the impact of the financial market, and formulate response policies. Improvements commonly required in these emerging countries can be summarized as follows. First, an institutional system that can manage stability of the financial market as a whole based on a strong legal basis should be established. This can improve the efficiency of macroprudential policies. Second, the means of finding and evaluating potential risk factors should be developed. For this, it is necessary to improve the data management and processing system, which is also the first step to develop the macro stress testing. Third, cooperation between departments that establish and implement macroprudential policies should be improved further.

As the topics that the report covers are urgent and important issues that NRB addresses, the BOK's policy experience and knowledge and the related policy suggestions of this report definitely contribute to NRB's policymaking and financial stability in Nepal.

I. Introduction

In April 2020, the Bank of Korea (BOK) appointed Dongguk University as a research institute to conduct a Knowledge Partnership Program (BOK-KPP) with Nepal Rastra Bank (NRB), the central bank of Nepal. The consultation topic is "Financial Stability: Institutional Aspects and Implications of Macroprudential Policy", which was determined under the mutual consent of the BOK and NRB.

After the global financial crisis, NRB have endeavored to strengthen financial stability. To do so, NRB took several measures to stabilize the financial system. For example, during the 2009-2011 period, it stopped granting new banking licenses and introduced a regulatory limit to the ratio of credit to deposits and core capital. NRB started publishing a financial stability report in 2012. Importantly, after the global financial crisis, NRB started conducting stress tests for the banking sector because managing systemic risk plays an important role in ensuring financial stability in Nepal. However, NRB has not yet developed a sophisticated and comprehensive framework for macro stress testing. Until now, NRB adopted a bottom-up approach and did not employ a modular approach. Therefore, Dongguk University chose a specific topic related to macro stress testing. Namely, Dongguk University intends to recommend a step-by-step approach to building up a brand new advanced macro stress testing framework, focusing on presenting a feasible and effective development plan. This plan will facilitate NRB setting up its own macro stress testing framework. We also examine the current status of macroprudential policy measures in emerging countries, and discuss the effects of these measures on financial stability.

Meanwhile, the COVID-19 pandemic is now ongoing, evolving as a serious global social and economic risk factor that damages almost all countries' employment, consumption, exports, imports, and outputs. All central banks throughout the world immediately responded to the COVID-19 shock. Nonetheless, there is a growing concern about its short- and long-term effects on the economy and financial system since no one knows when it will end. Hence, this year policy response to COVID-19 is selected as a special topic. This paper shares a policy approach by providing how the BOK responded to the COVID-19 shock, evaluates NRB's policy response to it and suggests several

important policy suggestions.

This study is jointly conducted with NRB as presented in <Table 1-1>.

<Table 1-1>
Responsibility of the Research Members of NRB and Dongguk University

Contents	Main	Supporting
Ⅰ. Introduction	Junghwan Hyun	
Ⅱ. The Macroeconomy and the Financial System in Nepal		
1. Nepalese Economy	Danda P Kharel	Bibek Koirala
2. Nepalese Financial System	Prithu Sharma Binadi	Sagar Gautam
Ⅲ. Policy Responses to the COVID-19		
1. COVID-19 and Its Economic Effects	Junghwan Hyun Hong-Youl Ha	
2. BOK's Policy Responses to COVID-19		
3. Responses to COVID-19 in Nepal	Prithu Sharma Binadi Bibek Koirala	Sagar Gautam Danda P Kharel
4. Policy Responses to COVID-19 over the World	Hong-Youl Ha Junghwan Hyun	
5. Important Consideration in Policy Making	Junghwan Hyun	
Ⅳ. Step-by-Step Plan to Develop a Macro Stress Testing Framework for Nepal		
1. General Characteristics of Macro Stress Testing	Kyunghun Kim	
2. The BOK's Macro Stress Testing	Junghwan Hyun	
3. The Current Status of Macro Stress Testing of NRB	Sagar Gautam	Danda P Kharel
4. Step-by-step Plan for Nepalese Macro Stress Testing	Kyunghun Kim Jeonghwan Cho	
Ⅴ. Macroprudential Policy Measures in Emerging Countries and Their Impact on Financial Stability	Kyunghun Kim	

II. The Economy and The Financial System in Nepal

1. Nepalese Economy

In the recent year, the Nepalese economy has passed through a gradual structural transformation. As of FY 2019/20, the primary sector, which comprises agriculture and forest and mines, is 28% of the GDP, which was 32% five years ago. The secondary sector consisting of the construction, industry, and energy industries has remained stable at 14% during this period, whereas the share of service sector changed to 58% of GDP from 54% during the same period.

The 15th periodic plan (FY 2019/20 to 2023/24) of the Government of Nepal (GoN) sets an ambitious target of achieving an average economic growth rate of 10.3% per annum in five years. The monetary policy of FY 2019/20 was primarily devised to assist the periodic plans and fiscal policy of FY2019/20. Monetary policy focus was on interest rate stability, price stability (inflation within 6%), external sector stability (maintain foreign exchange reserves sufficient to cover the prospective imports of goods and services for at least 7 months), financial stability (consolidation and strengthening of BFIs), and mobilizing financial resources for increasing domestic production to help achieve the government's growth target of 8.5% in FY 2019/20. The monetary policy of FY 2019/20 was primarily devised in such a way that it would assist the periodic plans and fiscal policy of FY2019/20. However, due to the challenges brought about by COVID-19 in the last quarter of FY 2019/20, the confined growth has been estimated to be 2.3%, while most other targets have been within the target set by monetary policy. The following are some of the important economic indicators of Nepal as of fiscal year FY 2019/20 which ended in mid-July 2020.

- Economic Growth: The average growth rate has stood at about 4.3% during last decade. The growth rate during 2015/16 was 0.59% due to a devastating earthquake and economic blockade along the Indo-Nepal border. Growth rebounded to about 7% from FY 2016/17 through FY 2018/19. In FY 2019/20, the economy is estimated to have grown by 2.3% against the target of 8.5% due to the unprecedented supply and

demand shock and containment measures in the context of COVID-19. The total GDP of Nepal stands at NRs 3.8 trillion (USD 30 billion) which is approximately 0.03% of total world GDP.

- External Trade: In FY 2019/20, exports increased by 0.6% to NRs 97.71 billion, compared to an increase of 19.4% in FY 2018/19. Imports decreased by 15.6% to NRs 1,197 billion in FY 2019/20 as against the former year's increase of 13.9%. In FY 2019/20, the export were 2.6% of GDP while imports were great at 31.8%. Nepal has been facing problems of persistent trade deficit over the last five decades and the gap between exports and imports widened over the years. The trade balance was -13.6% of GDP in FY 2000/01 and -41% of GDP in FY 2018/19. The gap narrowed in FY 2019/20 to -29.2% of GDP, mainly due to reduced imports in the context of COVID-19.

- Foreign Exchange Reserves: As of mid-July 2020, the foreign exchange reserve of the country increased to $11.6 billion from $9.5 billion in mid-July 2019. The reserve balance is sufficient to finance imports of goods and services for 12.7 months against the target of at least 7 months as set in the monetary policy of FY 2019/20.

- International Investment Position (IIP): Net IIP stood at a surplus of Rs. 271.96 billion in mid-July 2020, an increase of 44% from NRs 188.86 billion in mid-July 2019. Nepal's Foreign assets and liabilities stood at NRs 1,467.79 billion and NRs 1,195.83 billion respectively in mid-July 2020.

- Balance of Payments (BOP): Despite the ever-increasing trade deficit, workers' remittances helped maintain the BOP balance. The BOP, which was NRs 189 billion in FY 2015/16, deteriorated to NRs 82 billion in 2016/17, to NRs 1 billion in 2017/18 and further to NRs -67 billion in 2018/19. However, it has improved to NRs 282 billion in FY 2019/20 due to substantial import reduction but minimal impact on inward

remittance in the context of COVID-19. The current account balance in FY 2019/20 improved to NRs -32 billion from NRs -265 billion in FY 2018/19 and NRs -246 in FY 2017/18, but deteriorated from NRs -10 billion in 2016/17.

- Workers' Remittances: Workers' remittances are the largest source of foreign currency earnings in Nepal. Remittance to GDP stood at about 25% over the last several years, which was among the highest in the World. Remittances supported external sector financing and international trade and was the largest source of foreign currency for Nepal. Remittances decreased by 0.5% in FY 2019/20 compared to last fiscal year and reached NRs 875 billion.

- Savings: Gross domestic savings as percentage of GDP has increased over the years and has stood at 18% of GDP in FY 2019/20. Gross national savings as percentage of GDP, however, is higher at 46% in FY 2019/20 due to the remittance and other transfer flows to Nepal.

- Capital Formation: Gross capital formation to GDP, which was 56.6% in 2018/19, is estimated to decline to 50.2% in 2019/20. Higher capital formation compared to national savings have created resource gap in Nepal since 2016/17. Such gap reached as high as 8.1% of GDP in 2017/18.

- Inflation: Inflation has moderated in the recent years mainly due to political stability and easing of the supply side constraints such as electricity. The average consumer inflation stood at 6.15% in FY 2019/20 compared to 4.64% a year ago. YoY consumer price inflation stood at 4.78% in mid-July 2020 compared to 6.02% a year ago. The annual average food and beverage inflation stood at 8.16% in FY 2019/20 compared to 3.09% in FY 2018/19.

- Government Finance: Nepal recently implemented fiscal federalism, with the federal government in the center together with 7 provincial governments and 753 local governments. With this transition, resource mobilization and expenditures were largely decentralized. Federal government expenditure was 29% of GDP while revenue was 22.3% of GDP in FY 2019/20. Capital expenditure that year was 5% of GDP, while recurrent expenditure accounted for 21% of GDP and financial expenditure accounted for 3% of GDP. Recurrent expenditure has increased from 64.5% of total expenditure in FY 2018/19 to 71.8% in FY 2019/20.

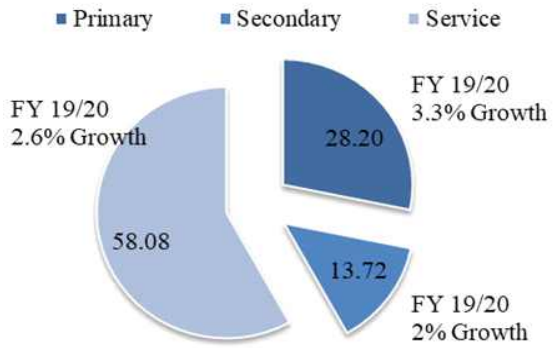
  Outstanding government debt stands at NRs 1,419.04 billion in mid-July 2020, (37.7% of GDP). Out of total outstanding public debt, the amount of foreign debt is NRs 805.83 billion (21.4% of GDP) and domestic debt is NRs 613.21 billion (16.3% of GDP). Foreign debt to GDP has increased from 17.2% in FY 2018/19 to 21.4% in FY 2019/20 and domestic debt has risen from 13.1% in FY 2018/19 to 16.3% in 2019/20. Government revenue in FY 2019/20 stands at NRs 841 billion, an increase of 0.2% compared to FY 2018/19 while expenditure decreased by -1.5% in FY 2019/20 and reached to NRs 1094 billion.

- Monetary Sector: Monetary sector has expanded rapidly in Nepal during the last decade. Financial deregulation, NRB branch and licensing policy, financial literacy, payment technology, increase in access to finance and resource mobilization from remittances can be taken as the main driving factors for such speedy monetization. M2/GDP ratio has increased from 67% in 2010/11 to 112.3% in 2019/20 and Deposit/GDP ratio has increased from 60% in 2010/11 to 102% in 2019/20. Broad money increased by 18.1 % in 2019/20 compared to earlier year.

<Figure 2-1>

Composition of the Economy

(unit: %)

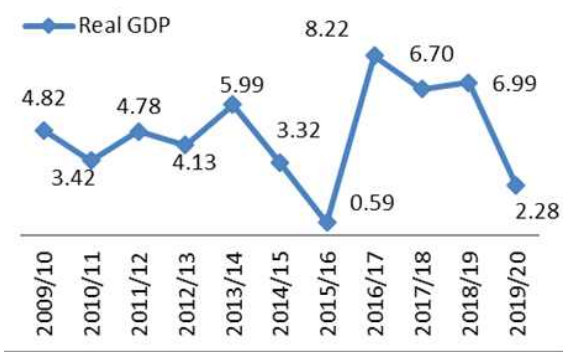


Source: Nepal Rastra Bank

<Figure 2-2>

GDP Growth

(unit: %)

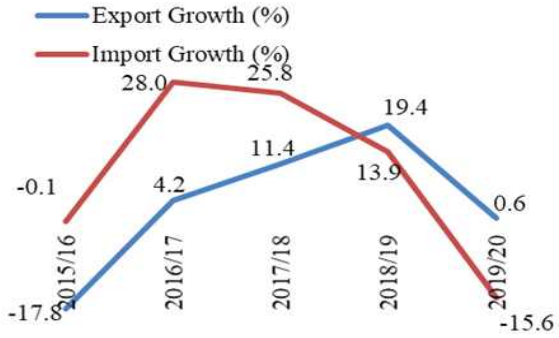


Source: Nepal Rastra Bank

<Figure 2-3>

Export and Import Growth

(unit: %)

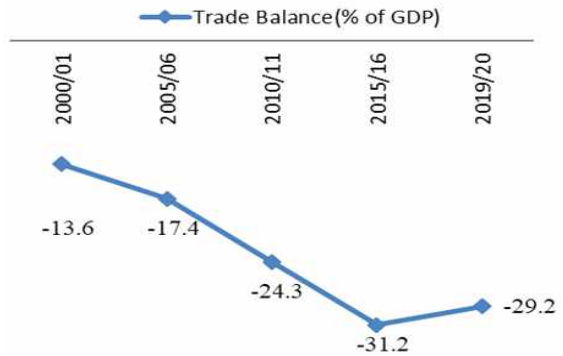


Source: Nepal Rastra Bank

<Figure 2-4>

Ratio of Trade Balance to GDP

(unit: %)

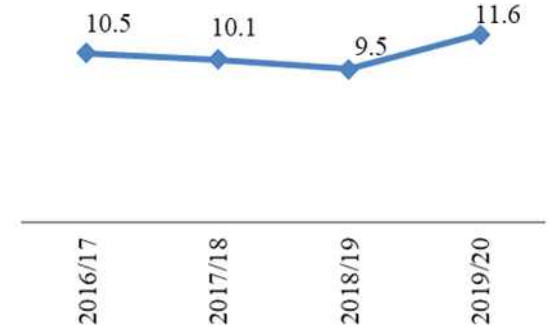


Source: Nepal Rastra Bank

<Figure 2-5>

FX Reserve

(unit: NRs. Billion)

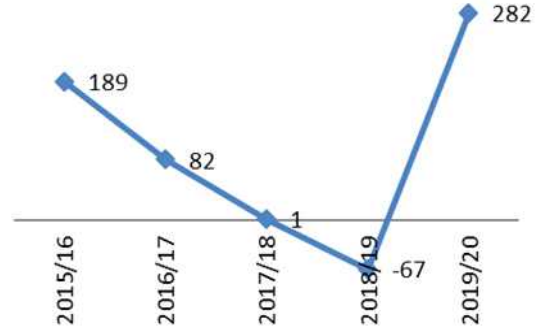


Source: Nepal Rastra Bank

<Figure 2-6>

Balance of Payment

(unit: NRs. Billion)

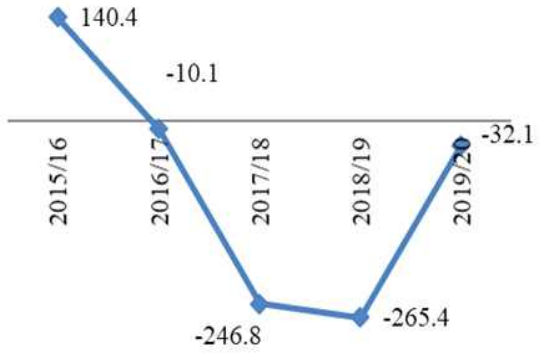


Source: Nepal Rastra Bank

<Figure 2-7>

Current Account Balance

(unit: NRs. Billion)

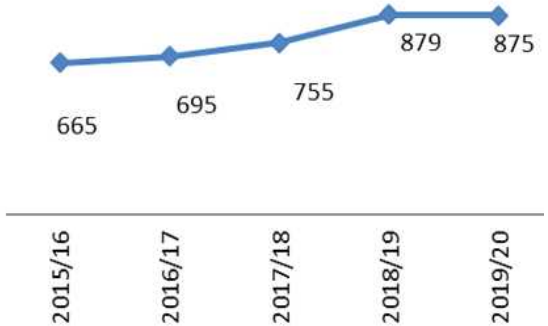


Source: Nepal Rastra Bank

<Figure 2-8>

Remittance

(unit: NRs. Billion)

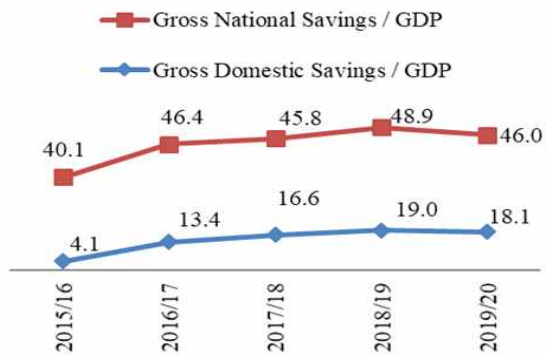


Source: Nepal Rastra Bank

<Figure 2-9>

Savings Position

(unit: %)

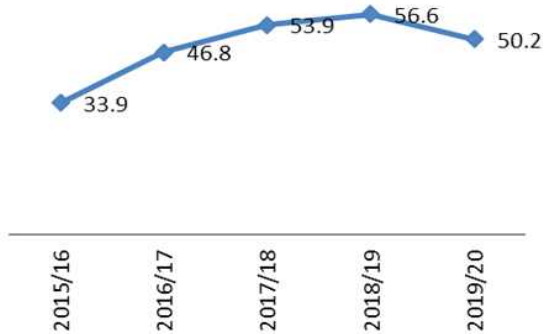


Source: Nepal Rastra Bank

<Figure 2-10>

Gross Capital Formation to GDP

(unit: %)



Source: Nepal Rastra Bank

<Figure 2-11>

Consumer Price Index

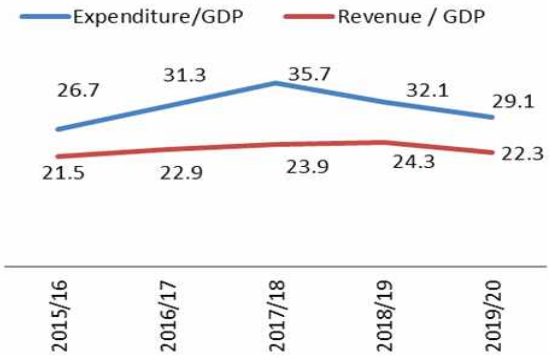
(unit: %)

Source: Nepal Rastra Bank

<Figure 2-12>

Expenditure and Revenue Position

(unit: %)

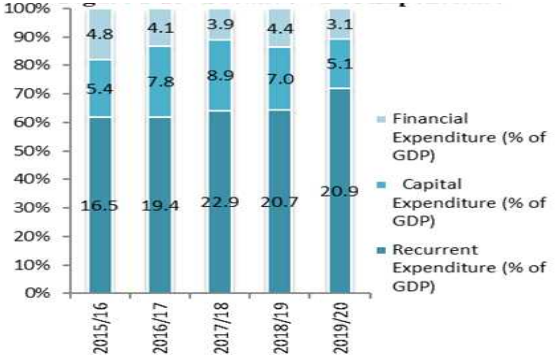


Source: Nepal Rastra Bank

<Figure 2-13>

Breakdown of Expenditure (to GDP)

(unit: %)

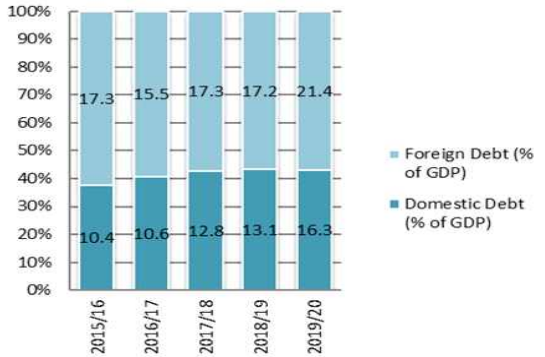


Source: Nepal Rastra Bank

<Figure 2-14>

Debt Position to GDP

(unit: %)



Source: Nepal Rastra Bank

<Figure 2-15>

Revenue Growth

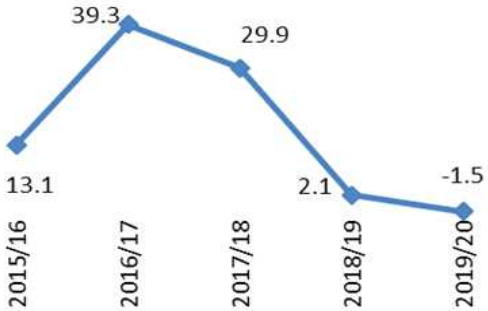
(unit: %)

Source: Nepal Rastra Bank

<Figure 2-16>

Expenditure Growth

(unit: %)

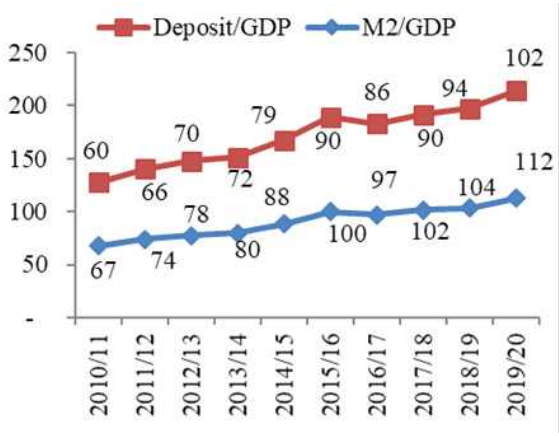


Source: Nepal Rastra Bank

<Figure 2-17>

Deposit and M2 to GDP

(unit: %)



Source: Nepal Rastra Bank

2. Nepalese Financial System

Nepal Rastra Bank (NRB) is the central bank of Nepal. NRB regulates and supervises banks and financial institutions (e.g., commercial banks, development banks, finance companies, microfinance financial institutions, and infrastructure development banks) and other institutions involved in foreign exchange transactions and payment and settlement services in the country. The Nepal Rastra Bank Act of 2002 provides NRB with the authority to license, regulate, and supervise BFIs inside the territory of Nepal and also assures the autonomy of the central bank. The Securities Board of Nepal (SEBON) regulates the securities market, which is comprised of the stock exchange, listed companies, central securities depository, stockbrokers, merchant bankers, credit rating agencies, mutual funds, application supported by blocked amount (ASBA) members and depository participants. The Insurance Board is the insurance sector's regulatory authority of Nepal. The securities market in Nepal is regulated and supervised by Securities Board of Nepal. Contractual saving institutions- the Employees Provident Fund (EPF) and Citizen Investment Trust (CIT) are regulated by the Ministry of Finance.

As of mid-July 2020, the Nepalese financial system consists of 27 licensed commercial banks ("A" class institutions), 20 development banks ("B" class institutions), 22 finance companies ("C" class institutions), 85 micro-finance financial institutions ("D" class institutions), 39 insurance companies, 1 reinsurance company, 1 stock exchange, and one each of reinsurance company, the Employees Provident Fund, Citizen Investment Trust, Postal Saving Bank, Deposit and Credit Guarantee fund, and Credit Information Centre. There are additional 34,837 cooperatives regulated and monitored by the Department of Cooperatives. As of mid July 2020, 196 BFIs have undergone mergers and acquisition (after NRB introduced Merger Bylaw 2068 (B.S.) aimed at strengthening financial stability). The licenses of 150 BFIs were revoked, thereby forming 46 BFIs. The total number of BFIs licensed by NRB decreased to 155 in mid-July 2020 from 171 in mid-July 2019, and is expected to decrease further since NRB took the policy of big mergers (merging of commercial banks) and no further licensing of microfinance financial institutions.

The following indicators provide a synopsis of the Nepalese financial system.

- Deposit: Deposits increased by 18.7% in the FY 2019/20 as compared to an increase of 18% in the previous fiscal year. Fixed and savings deposit constitute 48% and 32% respectively, while current and call deposits are 10% of total deposits each. The deposit to GDP reached 102% in FY in 2019/20 from 93.5% in FY 2018/19.

- Credit: Credit expansion was affected for the fiscal year due to the COVID-19 lockdown. Private sector credit expanded by 12.6% during the FY 2019/20 as compared to a growth of 18% in the previous fiscal year. The ratio of total private sector credit to GDP reached to 87% in FY in 2019/20 from 84.11% in FY 2018/19. As in FY 2019/20, largest credit exists in Wholesale and Retail sector (20.29%) followed by production (16.4%), and construction (10.6%). Services Industries account for 9.1% of total credit. Category-wise term loan accounts for 22% of total loan while demand and working capital loan accounts for 21.5% of total loan. Similarly, real estate exposure stands at 5% of the total loan outstanding in FY 2019/20.

- Interest rate and Liquidity: The weighted average deposit rate of Commercial Banks declined from 12.13% in FY 2018/19 to 10.11% in FY 2019/20. Similarly, the weighted average lending rate of commercial banks declined from 6.6% in FY 2018/19 to 6% in FY 2019/20. Total liquid asset to deposit ratio of BFIs improved from 25.06% in FY 2018/19 to 27.90% in FY 2019/20.

- Assets Quality: Non-performing Loans of BFIs stands at 1.9% of total loans in, an increase from 1.5% in mid July 2019/20. The loan loss provision at in mid-July 2020 stood at NRs 78.60 billion, as compared to NRs 54.89 billion in mid-July 2019. The increase in the provision signifies the increasing risk evaluation in the financial sector, particularly in the context of COVID-19.

- Capital Adequacy: The capital adequacy ratio (CAR) of BFIs remained well above the minimum standard required by NRB. The total capital to risk weighted exposures stood at 14.16% in mid-July 2020, which was 14.29% in mid-July 2019. Also, the core capital to risk weighted assets stood at 12.01% in mid-July 2020 as compared to 11.58% in mid-July 2019.

- Profitability: The overall profitability of the banking sector decreased by 20.62% in mid-July 2020 and reached NRs 58.92 billion from NRs 74.23 billion in mid-July 2019. This decrease in the profitability in the current fiscal year may be largely attributed to the impact of COVID-19, among other issues.

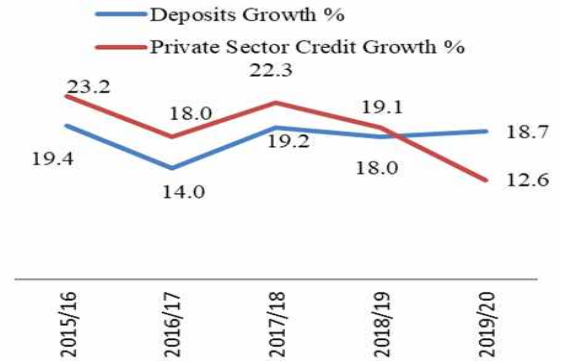
- Access to Financial Services: The branches of the BFIs reached 9,765 in FY 2019/20 compared to 8686 in FY 2018/19 and out of the total 753 local levels, commercial banks extended their branches to the 747 level. The population served per branch of BFI stands at 3,072. A study carried out by NRB in 2019 showed that about 61% of the population had a saving account in the BFIs.

- Capital Market: As in mid-July 2020, market capitalization stands at NRs 1,792.77 billion, which is 47.6% of GDP. BFIs occupy about 78.2% of total market capitalization, followed by hydropower (4.7%) and manufacturing and procession (4.2%). The total number of listed companies in the NEPSE is 212, with total market capitalization of NRs 1793 billion, which is 45.3% of GDP. The total shares listed in Nepal Stock Exchange Limited is 4.8 billion, with a paid-up value of NRs 473.4 billion.

<Figure 2-18>

Deposit and Credit Growth

(unit: %)

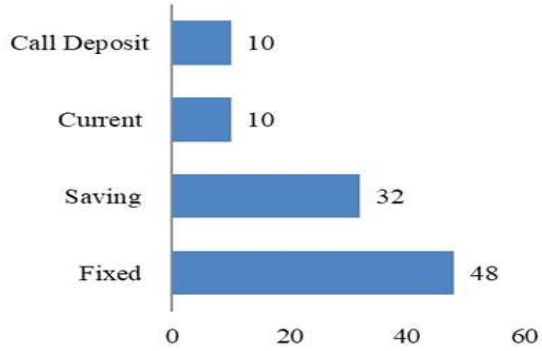


Source: Nepal Rastra Bank

<Figure 2-19>

Deposit Composition

(unit: %)

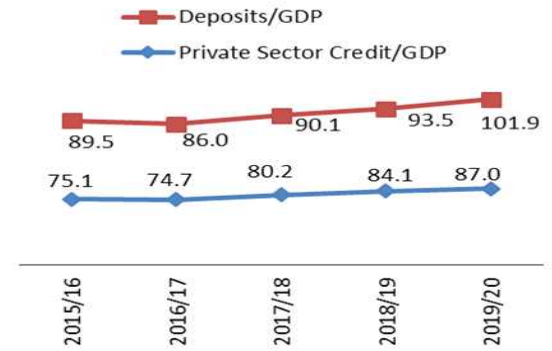


Source: Nepal Rastra Bank

<Figure 2-20>

Deposit and Credit to GDP

(unit: %)

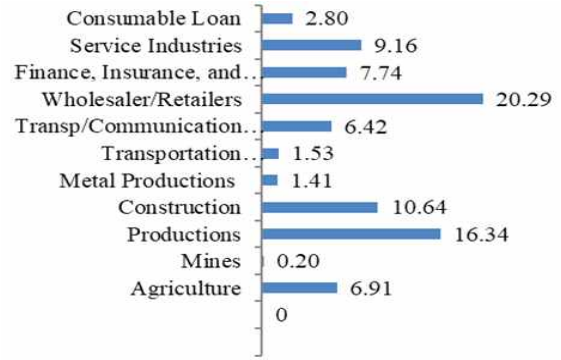


Source: Nepal Rastra Bank

<Figure 2-21>

Sector-wise Credit

(unit: %)



Source: Nepal Rastra Bank

<Figure 2-22>

Product-wise Loan

Source: Nepal Rastra Bank

<Figure 2-23>

Deposit and Lending Rate

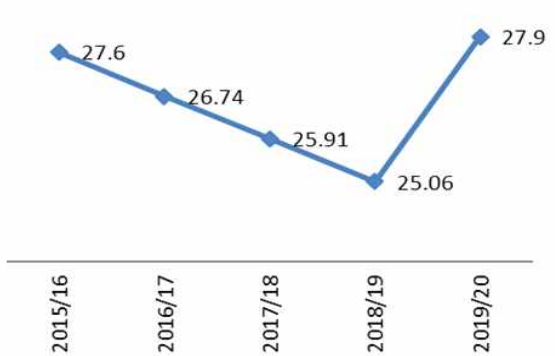
(unit: %)

Source: Nepal Rastra Bank

<Figure 2-24>

Total Liquid Assets/Total Deposit

(unit: %)

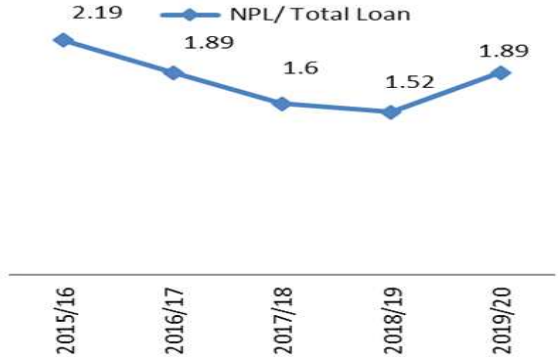


Source: Nepal Rastra Bank

<Figure 2-25>

NPLs/Total Loan

(unit: %)

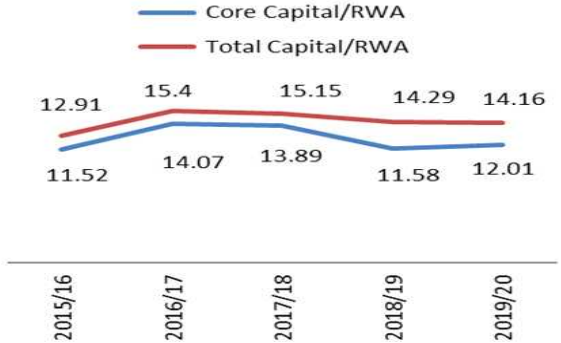


Source: Nepal Rastra Bank

<Figure 2-26>

Capital Position

(unit: %)

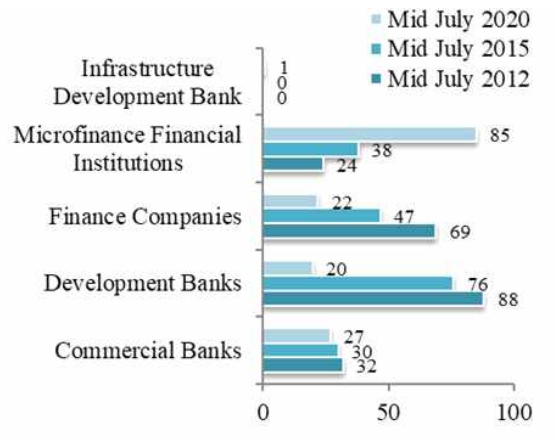


Source: Nepal Rastra Bank

<Figure 2-27>

Number of Financial Institutions

(unit: number)

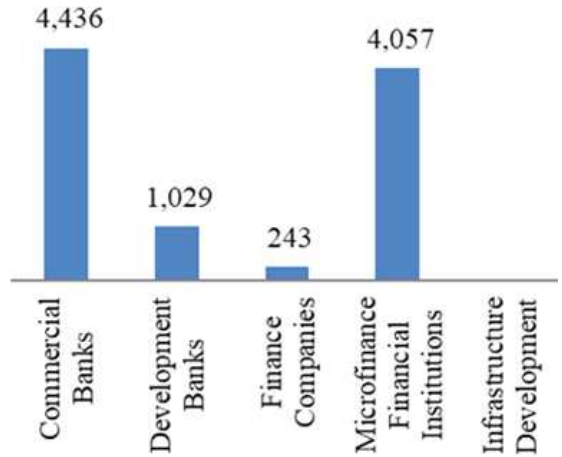


Source: Nepal Rastra Bank

<Figure 2-28>

Number of Branch

(unit: number)



Source: Nepal Rastra Bank

<Figure 2-29>

Assets and Liabilities

(unit: %)

Source: Nepal Rastra Bank

3. Strengths, Weakness, Opportunities and Threats of Nepalese Economy and Financial System

The economic and financial indicators of the Nepalese economy and financial system highlight the followings strengths/opportunities:

- The foreign exchange reserve position remains strong and growing, and it can finance imports of goods/ services for almost a year. The net international investment position is in the surplus position. Foreign exchange volatility is well managed due to its pegging with the Indian currency and because there is no portfolio investment. Partial capital account convertibility exists in Nepal, allowing FDI, which has helped contain capital outflows and any possibility of a sudden stop in capital flows.

- Balance of Payment is in a surplus. Although the current account is in deficit, it has improved since last year.

- Although there was a slack in remittances in May and June, remittance flow has started to improve as of July 2020. The decrease in remittance was as low as .5% in FY 2019/20 which is less than the anticipated decrease.

- Inflation is within the target set by NRB. Inflationary pressure in the economy remains minimal.

- Due to COVID-19, the use of digital platforms, e-commerce, ATMs and digital banking systems have rapidly increased, which has helped in moving Nepal towards a digital economy.

- Nepalese Banks are well-capitalized and asset quality remains good as indicated by the low level of non-performing loans (NPL). However, NPL levels are expected to increase in coming periods as the scope for

regulatory relaxations is reduced. The liquidity positions of banks remain strong as indicated by increasing liquidity ratio and low level of CCD of banks. Reduced lending interest rates are an additional factor that will support entrepreneurship and help reduce the corporate interest burden.

- Nepal can benefit from the demographic dividend given that the number of people going abroad to work has decreased this fiscal year and many experienced workers have returned to Nepal as a consequence of COVID-19. There is a huge scope of human resource mobilization in agriculture, industry, and construction, which can help with import substitution and can support economic growth.

- There has been remarkable shift in the structure of the economically active population as the size of economically active stands at 54.20 percent (Central Bureau of Statistics, 2014). Also, the literacy level is increasing: 67.91 in 2011 as compared to 54 percent in 2001 (Central Bureau of Statistics, 2014) causing the supply of educated workforce to increase. An educated workforce together with rapid technology adoption will support long run economic growth. As a consequence of Covid-19, the number of people going abroad for employment has decreased and experienced workers have returned to Nepal. Nepal can thus benefit from the demographic dividend given that there is huge scope of human resource mobilization in agriculture, industry, construction and technology which can help in import substitution and support economic growth.

- The resource allocation structure adopted in Nepal presents an opportunity as resources allocation are mutually divided among three tiers of government; The Debt to GDP ratio remains low at 37.7% and reform actions under fiscal federalism presents an opportunity to boost economic growth.

In addition, the Nepalese economy faces the following weakness/threats.

- Nepal has a weak export base and imports are 12 times exports. A large and widening trade deficit poses a threat to the BOP, particularly if remittance shrinks due to COVID-19. Since global remittances have plummeted due to COVID-19 and Nepalese workers abroad are returning to their homes, remittances may not be a sustainable and dependable source of foreign currency, which can pose an additional challenge to an import-based economy.

- Government expenditure (29% of GDP) is higher than government revenue (22.3% of GDP) which is typical of developing countries like Nepal. However, the recurrent expenditures are almost two-thirds of total expenditures and only 17.5% constitutes capital expenditure. There is limited room for fiscal manoeuvre and this poses an additional challenge to bringing fiscal support to COVID-19 affected industries and business.

- The steep drop in tourists due to COVID-19 lockdown is a fundamental challenge to Nepal because tourism is another huge source of Nepal's foreign income. The multiplier effect of tourism with other businesses and industries is further expected to decrease demand for goods and services within the country, confining it to necessary things only.

- There has been reduced demand for private sector credit due to COVID-19, which is another challenge to supporting economic growth. Private sector credit growth has declined during the current fiscal year and the challenge is to continue supporting lending in bad times to decrease the pro-cyclicality of the financial system.

III. Policy Responses to the COVID-19

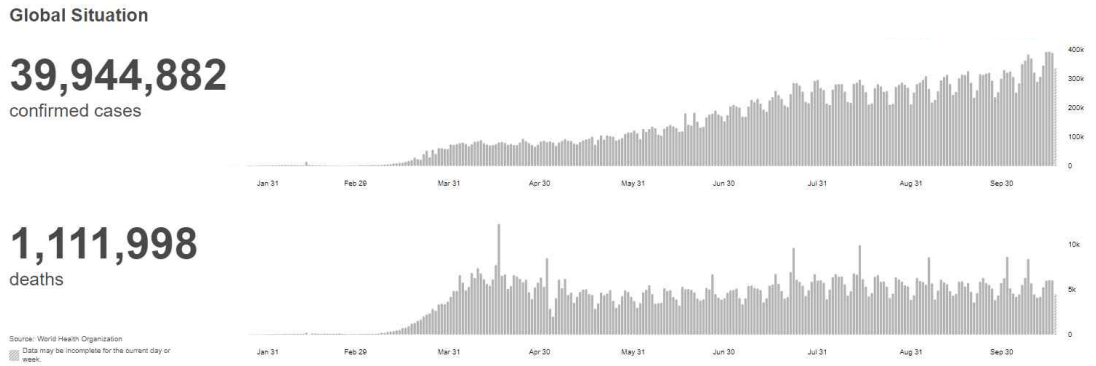
1. COVID-19 and Its Economic Effects

A. Outbreak of COVID-19

In January, the world was a mere onlooker when COVID-19 broke out in China. Now the world is in the middle of a COVID-19 pandemic. As shown in Figure 3-1, the number of confirmed cases has been steadily increasing and the number of deaths worldwide has reached 1.1 million as of October 19, 2020.

<Figure 3-1>

Global Trend of Cases and Deaths



Source: World Health Organization (WHO)

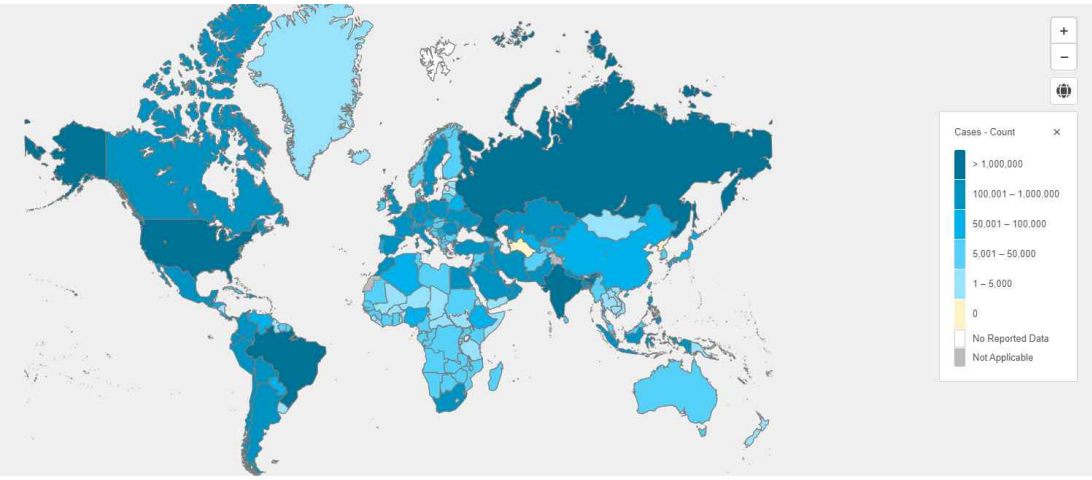
Figure 3-2 also shows the global situation of the COVID-19 pandemic (cumulative cases). The situation is serious in the United States, Russia, Brazil, India, Finland, and the United Kingdom (UK). It is apparent that COVID-19 has spread throughout the world, although the extent of seriousness differs between countries.

The situation is gloomy since it is becoming clearer that the pandemic will not be mollified in the near future. Maybe, it could be, but the cost would be more expensive than we previously thought. For instance, Bill Gates, a co-founder of Microsoft, revealed his opinion that it will be over at the end of 2021, after millions of people have died (The Economist, 2020). Unfortunately, this is an optimistic view, not a pessimistic one, because he assumes that the mass

production of a vaccine will be realized in 2021 (The Economist, 2020).

<Figure 3-2>

Global Situation of COVID-19 Cases (as of August 19, 2020)



Source: World Health Organization (WHO)

B. Economic Effects of COVID-19

COVID-19 has had serious effects, via various channels, on the real economy as well as the financial system.

COVID-19 is an infectious disease that spreads between people via mouth and nose secretions. It is known that the virus is transmitted through droplets that an infected person exhales or sneezes. Some infected people naturally recover without even knowing that they were being infected, while others have symptoms and have difficulty recovering from it, some even pass away. Therefore, people cannot detect whether they are with an infected person or realize if they themselves are infected or understand how severe the health damage they will suffer might be.

As Borio (2020) pointed out, the COVID-19 pandemic has three unique features.

- It is totally exogenous and not driven by financial imbalances or financial instability.

- It is uncertain that we will know when it will end and how the situation will evolve.

- It is a global phenomenon because it spreads worldwide in an extremely short time. The sub-prime mortgage crisis that occurred in the U.S. had serious adverse effects on other countries; it spilled over to European countries and contributed to the global financial crisis. But it took a relatively long time to have adverse effects globally.

The nature of COVID-19 causes serious and various economic effects and amplifies its adverse effects and makes economic agents more risk-averse.

(1) Effects on the Real Economy

There are various channels through which COVID-19 affects the real economy. Here we briefly explain some channels rather than extensively examining them because the KPP is not an academic study.

- The fear of getting infected changes consumers' attitudes and consumption habits in the direction of decreasing consumption activity, which affects the real economy under the following channel : consumption $\downarrow$ $\rightarrow$ sales $\downarrow$ & inventory $\uparrow$ $\rightarrow$ production $\downarrow$ $\rightarrow$ unemployment $\uparrow$ $\rightarrow$ consumption $\downarrow$. That is, decreasing consumption forms a vicious cycle of reducing both demand and supply.

- Another channel that seems more serious is : consumption $\downarrow$ $\rightarrow$ sales $\downarrow$ & inventory $\uparrow$ $\rightarrow$ unit cost or average production cost $\uparrow$ $\rightarrow$ unemployment $\uparrow$ ($\because$ labor belongs to variable input) $\rightarrow$ $\rightarrow$ consumption $\downarrow$ $\rightarrow$ $\cdots$ $\rightarrow$ if profit $<$ 0 $\rightarrow$ closing businesses $\rightarrow$ production and consumption $\downarrow$.

- Also, businesses have quarantine expenses and temporarily shut down costs due to COVID-19, which push up production costs. The problem is

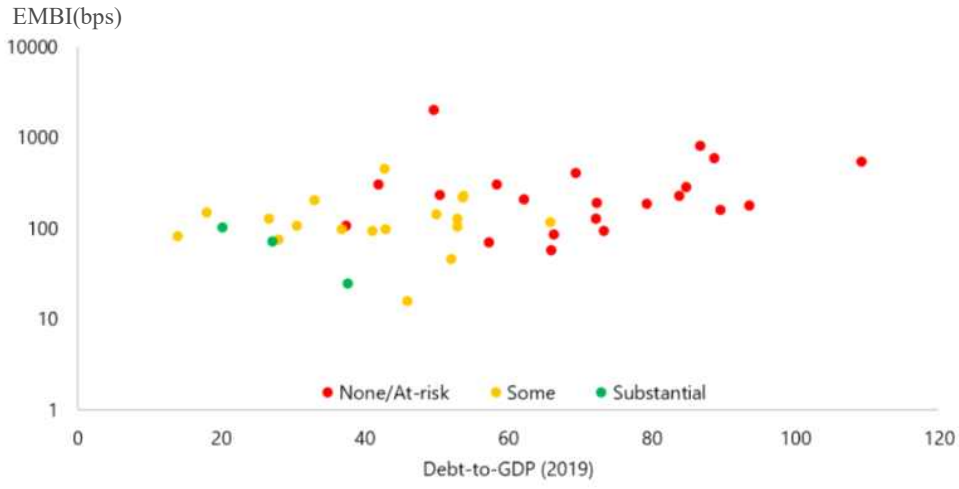
that these costs have nothing to do with the productivity of firms and just increase average cost curves.

- As an economy slows down, lenders have a reasonable incentive to tighten their lending practices and become more risk-averse. Then, even businesses with a profitable investment plan have difficulty obtaining external finance. Firms that are already financially constrained before the outbreak of COVID-19 have a higher possibility of default and little access to external financing.

- As governments in almost all countries have supported COVID-19 stricken businesses using fiscal policy measures, fiscal deficits and government debt have soared. If the pandemic lasts longer than expected, then the government has little fiscal space to financially support them. Furthermore, due to the economic downturn, tax revenue is expected to decline. In sum, a fiscal deficit would become a growing concern for many countries, especially emerging markets and developing countries.

<Figure 3-3>

Fiscal Space of Emerging Market Economies



Source: Mühleisen et al. (2020)

- COVID-19 has a direct effect on tourism and the aviation industry and

retail businesses, which indirectly affects other industries through inter-industry relations.

- The dynamic uncertainty of COVID-19 hinders job creation, credit creation, and new investment because businesses do not predict when it will end. This leads to a prolonged economic downturn.

<Table 3-1>

Global Economic Outlook

(unit: %)

	2019	2020	2021
World Output	2.9	-4.9	5.4
Advanced Economies	1.7	-8.0	4.8
United States	2.3	-8.0	4.5
Euro Area	1.3	-10.2	6.0
Germany	0.6	-7.8	5.4
France	1.5	-12.5	7.3
Italy	0.3	-12.8	6.3
Japan	0.7	-5.8	2.4
United Kingdom	1.4	-10.2	6.3
Canada	1.7	-8.4	4.9
Other Advanced Economies	1.7	-4.8	4.2
Emerging Markets & Developing Economies	3.7	-3.0	5.9
Emerging & Developing Asia	5.5	-0.8	7.4
China	6.1	1.0	8.2
India	4.2	-4.5	6.0
ASEAN-5	4.9	-2.0	6.2
Emerging & Developing Europe	2.1	-5.8	4.3
Latin America and the Caribbean	0.1	-9.4	3.7
Brazil	1.1	-9.1	3.6
Mexico	-0.3	-10.5	3.3
Middle East and Central Asia	1.0	-4.7	3.3
Saudi Arabia	0.3	-6.8	3.1
Low Income Developing Countries	5.2	-1.0	5.2

Source: IMF(2020), World Economic Outlook Update

- Advanced countries, such as the U.S., Canada, and the UK, that are most severely affected, the labor demand for foreign workers plunges.

Developing countries that exported labor to advanced countries before the outbreak of COVID-19, are experiencing a sharp and large reduction in remittances (capital inflows), causing a serious imbalance of payments.

(2) Effects on the Financial System

COVID-19 is now a growing concern for the financial authorities as it hampers the functioning of the financial system (e.g., weakening of intermediation functioning). It is evident that 80 countries have now resorted to the IMF's financial aid.

- Uncertainty worsens information asymmetry. With information asymmetry increasing, lenders become reluctant to extend loans because they cannot distinguish good firms from bad firms. Under excess demand for credit, interest rates pick up.

- As the economy enters a recessionary stage, the loan default rates of lenders increase. To avoid being under-capitalized, banks are willing to withdraw existing loans, which leads to excess demand for credit.

- As the financial market becomes unstable, the flight to quality phenomenon appears in the financial markets. Then, financial asset prices, such as stock prices and high yield bond prices, decrease. With the values of financial assets diminishing, some asset holders sell them at highly discounted prices, triggering a subsequent fall in asset prices.

- When an economy depends heavily on remittance and has a pegged exchange rate regime, its economy is vulnerable to a sudden fall in remittances. If the economy suffers from a chronic current account deficit, the situation is worsening because remittances cannot play a role in the offsetting current account deficit, which results in the draining of foreign currencies from foreign reserves.

- Since no one knows when the COVID-19 pandemic will end, it causes dynamic uncertainty for both domestic and global economies. Given that policy makers have limitations on financial availability, financial supports on individuals and businesses affected by the COVID-19 should be provided on a conservative basis. However, policy makers have shown a tendency to provide massive funds to them over the last 6 months (the first phase of the crisis), even though policy makers do not know how long the pandemic will last. Policy making with a short horizon will cause another economic disaster in the near future. Given that the COVID-19 pandemic is ongoing and that the policy space is limited due to debt sustainability, growing countries are assessed as having limited space to make additional discretionary fiscal policy. Then, the monetization of debt is left as the only solution, even though historically it has always ended in a financial crisis.

2. BOK's Policy Responses to COVID-19

Now, we introduce policy responses of the BOK to COVID-19. Before delving into it, it is very useful to take a look at the governance framework of financial authorities in Korea <BOX 3-1>. Briefly speaking, the BOK took a sole role in monetary policy and cooperated with the FSC and the Financial Supervisory Service (FSS) in the area of financial supervision. Particularly, as shown in BOX 3-1, the FSS also conducts macroprudential policy and establishes its own macro stress testing framework (K-STAR).

Here, we focuse on the BOK's monetary and credit policy responses to COVID-19.

<Box 3-1>

Governance Framework of Financial Authorities in Korea

The financial authorities in Korea include the Ministry of Strategy and Finance (MOSF), the Financial Supervisory Commission (FSC), the Bank of

Korea (BOK), the Financial Supervisory Services (FSS), and the Korea Deposit Insurance Corporation (KDIC).

First, the MOSF takes responsibility for policies regarding the domestic economy, fiscal budget, foreign exchange, and international financial issues.

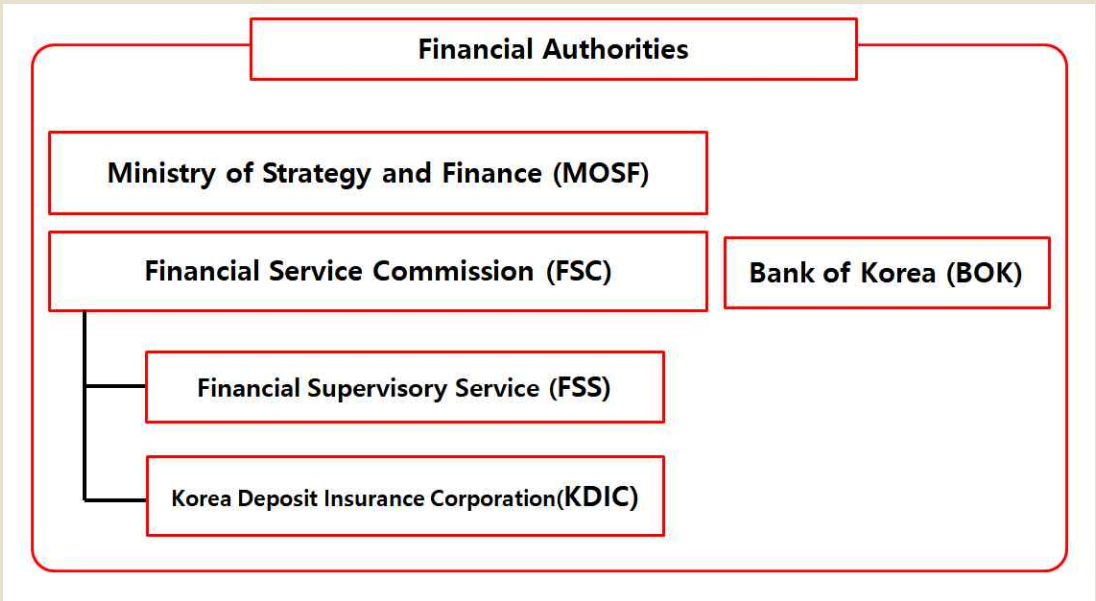
Second, the FSC is a government agency that has a legislation power regarding financial acts (e.g., the Banking Act and the Electronic Financial Transaction Act). It is the primary financial regulator among FSC, BOK, FSS, and KDIC.

Third, the FSS implements and executes financial supervisory policies determined by the FSC, conducts onsite examinations on financial institutions. Next, KDIC, just like its name, takes deposit insurance and troubleshoots distressed depository institutions.

Last, the BOK formulates and implements monetary and credit policies to maintain price stability. To ensure financial stability, it also takes responsibility for macroprudential policy (this is not its statutory duty) and cooperates with other financial watchdogs. For instance, it conducts joint onsite examinations with the FSS and the KDIC.

<Figure 3-4>

Governance Framework of Financial Authorities in Korea



Source: Bank of Korea

A. The BOK's Policy Responses

As COVID-19 started spreading in Korea in February 2020, the BOK took sequentially preemptive policy actions to maintain financial stability and boost the economy.

<Table 3-2>

Categories of Policy Responses

	Policy Response
1	- Base rate cut
2	- Bank intermediated lending support facility
3	- Market stabilization measures
4	- Foreign exchange market stabilization measures

The policy responses taken by the BOK can be sorted into 4 categories, shown in <Table 3-2>. This section introduces benchmark rate cuts, credit support for businesses, lending facilities for financial institutions, and FX measures, respectively.

(a) Base Rate Cut

① Base Rate Cut by 50bp (2020.3.16.)

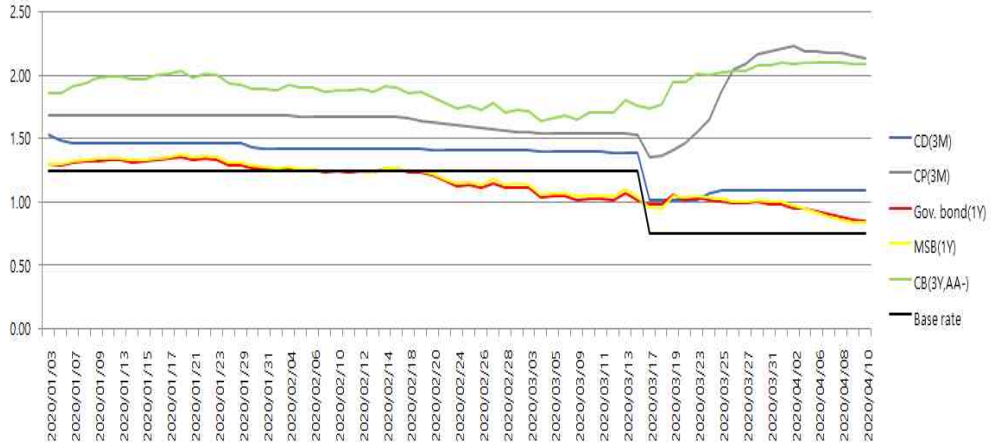
As the global economy and domestic economy slowed down significantly due to the COVID-19 pandemic, the Monetary Policy Board of the BOK held a special meeting on March 16 to cut the benchmark interest rate by 50 basis points, from 1.25% to 0.75%. This took effect on March 17.

The interest rate cut had a direct effects on short-term market interest rates, presented in Figure 3-5. However, its effect on corporate paper (CP) rates disappeared shortly after the cut and CP rates turned to increase two days after the cut. Corporate bond (CB) rates were not lowered following the base rate cut. The fact that CP and CB rates were not stabilized even after the base rate cut indicates how serious the financial market conditions were this past March.

<Figure 3-5>

Interest Rate Trend in March 2020

(unit: %)



Source: ECOS (Economic Statistics System of the BOK)

<Box 3-2>

Statement of Decision on the Base Rate

The BOK revealed the reason why it lowered the base rate and the future direction of its monetary policy, as presented below.

Since the last Monetary Policy Board meeting, concerns about global economic slowdown have deepened with COVID-19 spreading globally.

The spread of the outbreak also resulted in a significant increase in the volatility of major price variables, including stock prices and exchange rates, in domestic and global financial markets and a sharp fall in international oil prices. The Board, therefore, judged that further monetary policy accommodation was called for to ease volatility in the financial markets and reduce the effects on future economic growth and inflation.

Considering the high level of uncertainty regarding financial and economic conditions at home and abroad, the Board will maintain its accommodative monetary policy stance going forward so as to reduce the downside risks to the real economy and ease volatility in the financial markets.

Source: Bank of Korea (2020c)

② Additional Base Rate Cut by 25bp (2020.5.28.)

The Monetary Policy Board held a general meeting in April in which it decided not to lower the base rate because it was too early to assess the effect of the base rate cut on the economy and the financial system in Korea.

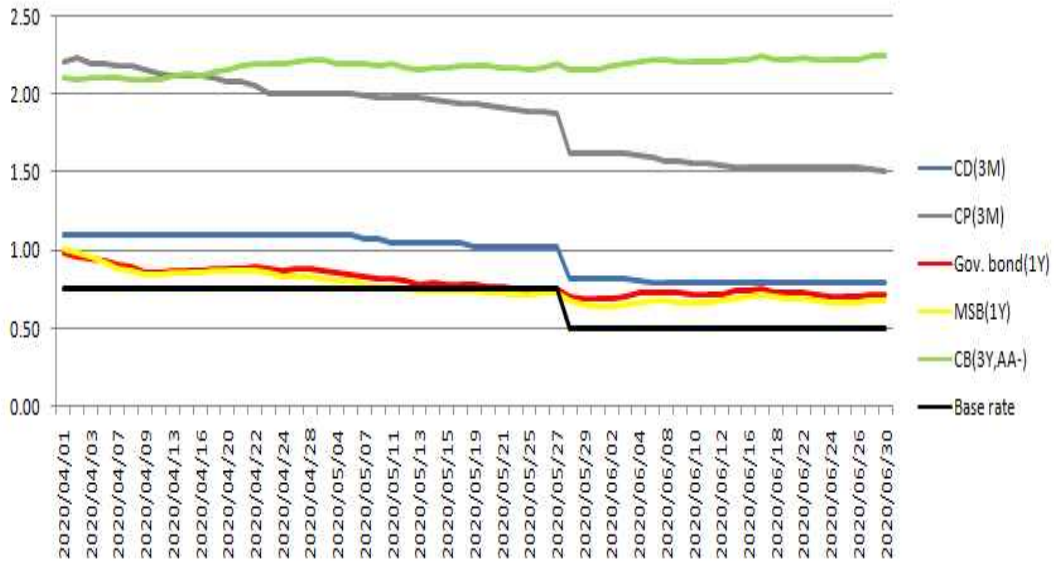
In May, the Board held a regular meeting and decided to decrease its base rate from 0.75% to 0.50% since the Korean economy seemed to enter into a recessionary phase due to the COVID-19 shock. The Board anticipated that the domestic growth of the economy would continue to be in a slump due to the ongoing COVID-19 pandemic, while the world economy continuously shrank.

This time, following the base rate cut, CP rates were stabilized, but CB rates were not, indicating that even companies with high credit ratings underwent difficulties in financing in the public debt market.

<Figure 3-6>

Interest Rate Trend around the Base Rate Cut

(unit: %)



Source: ECOS (Economic Statistics System of the BOK)

(b) Bank Intermediated Lending Support Facility

① Increasing Total Ceiling for the Facility

This is the first action that the BOK took in response to COVID-19. On February 27, 2020, the BOK extended financial support to self-employed businesses and small or medium-sized enterprises (SMEs) that were seriously affected, increasing the ceiling on the Bank Intermediated Lending Support Facility to 30 trillion won (previously set to 25 trillion won).[1)]

<Table 3-3>

Increasing Total Ceiling for Facility

	Contents
Scale of Support	- 5 trillion won, 10 trillion won in bank loans 1) 1 trillion won to SMEs in Seoul, 4 trillion won to regional SMEs 2) Loans will be limited to 1 billion won per business, 2 billion won in bank loans
Target for Support	- Loans for working capital with one year maturities by SMEs suffering from the spread of COVID-19 1) wholesale, retail, accommodation, food services, recreation, and transportation industries 2) Small and medium-sized manufacturers having difficulties in procuring raw materials and parts from China and in exporting to China
Terms of Proportion of the Support	- 50% of the loans handled by banks from the effective date to the end of September 2020
Lending Rate	- Loans extended as part of these measures will be made at a rate equal to 0.75% per annum
Effective Date	March 9, 2020

Source: Bank of Korea (2020a)

The fund was intended to provide financial assistance to tourism and retail businesses as well as exporting and importing firms. Four trillion won were channeled to local SMEs. Particularly, since the Daegu-Gyeongbuk regions were the most seriously affected, a large portion of the fund was provided to SMEs operating in these regions to promote the recovery of their economies. Meanwhile, another 1 trillion won was provided to start-up firms and job-creating businesses with the aim of maintaining economic growth and employment.

1) As of September 28 2020, 30 trillion won is equivalent to 25.5 billion U.S. dollars.

These measures were expected to improve the financial conditions of business owners and SMEs that were struggling with COVID-19 through the expansion of financial availability (up to 12 trillion won in bank loans) and the alleviation of the interest burden.

<Table 3-4>

Second-round Bank Intermediated Lending Support Facility

	Details
Scale of Support	- 1 trillion won to SMEs in Seoul - 4 trillion won to regional SMEs - Loans will be limited to 500 million won per business
Target for Support	- SMEs (including individual business owners) in services industry - manufacturing industry (selected by the heads of the BOK regional offices
Terms of Support	- (basic support) 50% of outstanding loans extended by banks - (additional support) for individual business owners and low-credit corporations, 75-100%
Interest Rate	- 0.25% per annum
Effective Date	- May 18 2020

Source: Bank of Korea (2020b)

The BOK decided to extend the ceiling on the Bank Intermediated Lending Support Facility from 30 trillion won to 35 trillion won, as COVID-19 was expected to last longer than expected. In other words, the BOK enabled itself to provide financial support to SMEs. This action was aimed at financially supporting SMEs (including individual business owners), which are financially constrained (BOK, 2020l).

This measure is the second-round support facility following the initial increase (5 trillion won) taken on February 27. Consequently, the BOK allocated 10 trillion won to SMEs that were negatively affected by the COVID-19 shock (BOK, 2020l).

Under these two measures, a new program under the bank intermediated lending support facility was established to financially support SMEs affected by COVID-19, as shown in <Table 3-5>. About a third of the total ceiling, 10 trillion won, was allocated to the new program.

<Table 3-5>

Credit Support for SMEs

(unit: trillion won)

	Ceiling	
	Before	After
Support Program for Trade Financing	2.5	2.5
Support Program for New Growth Engine Development and Job Creation	10.0	11.0
Program for Stabilization of SME Lending	6.5	5.5
Support Program for Regional Enterprises	5.9	5.9
Support for SMEs Affected by COVID-19	0.0	10.0
Total	25.0	35.0

Source: Bank of Korea (2020a)

② Cut the Interest Rate on the Bank Intermediated Lending

In the same day, the interest rate decision body at the BOK decided to cut the interest rate on the Bank Intermediated Lending Support Facility from 0.50-0.75% to 0.25%. It took effect on March 17.

<Table 3-6>

Interest Rate Adjustment

	Before	After
- Support Program for Trade Financing - Support Program for New Growth Engine Development and Job Creation - Support Program for Small-scale Business Owners	0.50%	0.25%
- Support Program for Local Enterprises - Support Program in Response to COVID-19	0.75%	0.25%

Source: Bank of Korea (2020c)

This decision is intended to reinforce banks' incentives to lend to SMEs, alleviate the interest costs of SMEs, and promote SMEs' financial conditions.

The interest rate cut was especially designed to support programs for regional SMEs and SMEs affected by COVID-19 to strengthen financial help to small business owners and local SMEs.

(c) Market Stabilization Measures

① Expanding the Range of Institutions for Open Market Operations

The BOK enlarged the scope of participant institutions for RP transactions as well as eligible securities by adding 11 non-bank financial institutions to the eligibility list of RP transactions (5→16 institutions). This was temporarily effective from April 2020 to July 2020. This measure was introduced to facilitate faster and wider liquidity supply to the financial market.

<Table 3-7>

Eligible Financial Institutions

	Financial Institutions
Current	- 17 domestic commercial banks - 4 foreign bank branches - 5 non-bank financial institutions (Korea Securities Finance Corp., Mirae Asset Daewoo, Samsung Securities, Shinyoung Securities, NH Investment & Securities)
Newly Included	- 11 non-bank financial institutions (Shinhan Investment, Hyundai Motor Securities, KB Securities, Hi Investment & Securities, Kiwoom Securities, Korea Investment & Securities, and Eugene Investment & Securities, Kyobo Securities, Daishin Securities, DB Financial Investment, and Meritz Securities)

Source: Bank of Korea (2020d)

② Expanding the Securities Eligible for Open Market Operations

The BOK expanded the scope of securities eligible for open market operations. This measure was aimed at enhancing the collateral availability of participants in open market operations. Also, it is intended to facilitate the liquidity supply channels. It took effect on April 1 and the effect will last until the end of March 2021.

- (Outright transactions) MBSs issued by Korea Housing Finance Corporation, debentures issued by 3 specialized banks[2)]

▪ (RP transactions) debentures issued by 3 specialized banks, general bank debentures, special bonds issued by nine public organizations[3)]

<Table 3-8>

Eligible Financial Institutions

	Outright Transaction	RP Transaction
Current	- Government bonds - Government-guaranteed bonds	- Government bonds - Government-guaranteed bonds - Monetary Stabilization bonds - MBSs issued by Korea Housing Finance Corporation
Newly Included	- MBSs issued by Korea Housing Finance Corporation - Debentures issued by 3 specialized banks	- Debentures issued by 3 specialized banks - General bank debentures - Special bonds issued by 9 public organizations

Source: Bank of Korea (2020d)

However, the newly eligible collateral is limited to collateral only for repurchase (RP) transactions with the BOK. The BOK set the maximum ratios on debt securities when credit risks exposed by the securities were larger than those of government bonds and MSBs as a means of risk management.

This measure had a similar effect to the action taken on March 12, 2020. Namely, it was intended and anticipated to expand the availability of newly eligible debentures, improving short-term financial markets. Plus, this measure was expected to facilitate the issuers of newly eligible bonds for financing by enabling them to issue more bonds (by improving their issuing conditions).

③ Broadening of Eligible Collateral for BOK Lending Facilities

The BOK enlarged the scope of the eligible collateral that lenders provided when the BOK extended loans to them. This measure took effect on April 1, 2020.

2) Korea Development Bank (KDB), the Industrial Bank of Korea (IBK), and the Export-Import Bank of Korea

3) Bonds issued by KEPCO, Korea Expressway Corporation, Korea Gas Corporation, Korea Land & Housing Corporation, Korail, Korea Rail Network Authority, K-water, and Korea SMEs and Startups Agency (BOK, 2020d).

Before this measure, the eligible collateral included ⅰ) government bonds, ⅱ) monetary stabilization bonds (MSBs) and ⅲ) government-guaranteed bonds.

Now, ⅳ) debentures issued by the Korea Development Bank (KDB), ⅴ) debentures issued by the Industrial Bank of Korea (IBK), ⅵ) debentures issued by the Export-Import Bank of Korea (EXIM Bank) and ⅶ) MBSs issued by the Korea Housing Finance Corporation (KHFC) have been added to the eligible collateral list for lending facilities. The KDB, the IBK, and the EXIM Bank are state-owned banks and the KHFC is a state-owned finance company that provides housing loans.

<Table 3-9>

Broadening of Eligible Collateral for Lending Facilities

	Eligible Collateral
Before	- Government bonds - Monetary stabilization bonds (MSBs) - Government guaranteed bonds
Newly Included	- MBSs issued by the Korea Housing Finance Corporation (KHFC) - General bank debentures - Debentures issued by 3 specialized banks - General bank debentures - Special bonds issued by 9 public organizations

Source: Bank of Korea (2020f)

By enlarging the scope of eligible collateral, the BOK expected to supply more liquidity through loans to banks, if necessary, in order to meet credit demand. Furthermore, this action was intended and expected to mitigate commercial banks' burden of collateral provision. In addition, this measure was expected to facilitate state-owned banks (KDB, IBK, EXIM Bank, and KHFC) to issue additional bonds by improving their issuing conditions.

④ Lowering Collateral Ratio for Guaranteeing Net Settlements

Financial institutions participating in net settlements should provide eligible securities, as collateral, equivalent to 70% of their net settlement amounts. The BOK decided to lower the ratio of collateral from 70% to 50% to reduce the

financial burden of participating institutions.[4] This action became effective on April 10, 2020.

<Box 3-3>

Previous Plan to Increase the Ratio of Collateral

Due to COVID-19, the BOK postponed a previously announced plan to increase the ratio by 10 percentage annually and eventually achieve the ratio of 100%. As a result, the required collateral amount would be decreased by 10.1 trillion won.

<Table 3-10>

Changed Plan to Increase the Collateral Ratio of Net Settlements

	Current	2020.4.	2020.8.	2021.8	2022.8.	2023.8.	2024.8.
Before	70%	70%	80%	90%	100%	100%	100%
Changed		50%	50%	70%	80%	90%	100%

Source: Bank of Korea (2020b)

⑤ Broadening of Eligible Collateral for Net Settlements

The BOK decided to temporarily enlarge the eligible collateral for net settlements, adding bonds issued by public institutions with a high credit rating and bank debentures, as shown in <Table 3-11>.

4) On March 30, 2020, the total amount of collateral pledged by financial institutions was 35.5 trillion won according to the BOK (BOK, 2020i). Net settlement amounts are determined on a multilateral net basis and finally settled at the BOK-wire (large-settlement system operated by the BOK). This collateral is used to provide settlement liquidity if a participant in net settlement across financial institutions fails to settle their obligations at the BOK-wire.

<Table 3-11>

Eligible Collateral Securities for Net Settlements

	Eligible Collateral Securities
Before	- Government bonds - Monetary Stabilization Bonds (MSBs) - Government-guaranteed bonds - KDB bonds, IBK bonds, KEXIM bonds, and KHF MBS
Newly Included	- Debentures issued by the National Agricultural Cooperative Federation and Nonghyup Bank, the National Federation of Fisheries Cooperatives and Suhyup Bank - Banking institutions established by the Bank Act - Bonds issued by nine public institutions

Source: Bank of Korea (2020b)

⑥ Launch of Corporate Bond-Backed Lending Facility

On April 16, the BOK decided to establish a new lending scheme called 「Corporate Bond-Backed Lending Facility (CBBLF)」, which was effective on May 4. This new lending scheme was aimed at providing financial institutions (including securities companies and insurance companies) enough liquidity to survive COVID-19, if the shock is prolonged (BOK, 2020k).

This measure belongs to unconventional monetary policy that the Fed and other central banks took in response to the global financial crisis.

Under the CBBLF, banks, securities firms, and insurance firms can borrow by providing corporate bonds with high credit ratings (at least AA-) as collateral. The maturity is up to 6 months and the effective date is May 4, 2020.

The CBBLF has a feature of standing lending facility. Thus, financial institutions have free access to it and receive credit whenever they provide eligible corporate bonds to the BOK.

This measure is introduced to stabilize the corporate bond market by providing immediate credit to financial institutions. The lending rate is set as the MSB rate (182 days), plus a fixed premium (0.85%p)[5)]

5) As of April 14 2020, the rate is 1.54% (BOK, 2020k).

<Table 3-12>

Features of Corporate Bond-Backed Lending Facility

	Details
Eligibility to Borrow	- (bank) 16 domestic banks, 23 foreign bank branches - 15 securities firms (participants in open market operations) - 6 insurance companies (equity capital ≥ 3 trillion won)
Ceiling	- (total) 10 trillion won - (each institution) 25% of its equity capital
Term	- up to 6 months
Eligible Collateral	- high-quality corporate bonds(rated at least AA-) issued by private enterprises with 5 years of remaining maturity or less
Lending Rate	- MSB rate (182 days) + 0.85%p
Withdrawal	- lump-sum payment (installment ×)
Interest Payment	- payment at maturity
Feature	- standing lending facility - temporary (3 months from the effective date)

Source: Bank of Korea (2020g)

⑦ Establishment of an SPV to Purchase Corporate Bonds and Commercial Paper

As the COVID-19 pandemic is ongoing, credit risk aversion, high credit spreads, and conservative lending standards exist in the financial market. Hence, the BOK, together with Financial Services Commission and Korea Development Bank (KDB), set up a plan to establish an SPV that purchases corporate bonds and commercial papers. The initial amount of liquidity injection via purchases of corporate bonds and commercial papers are 10 trillion won.

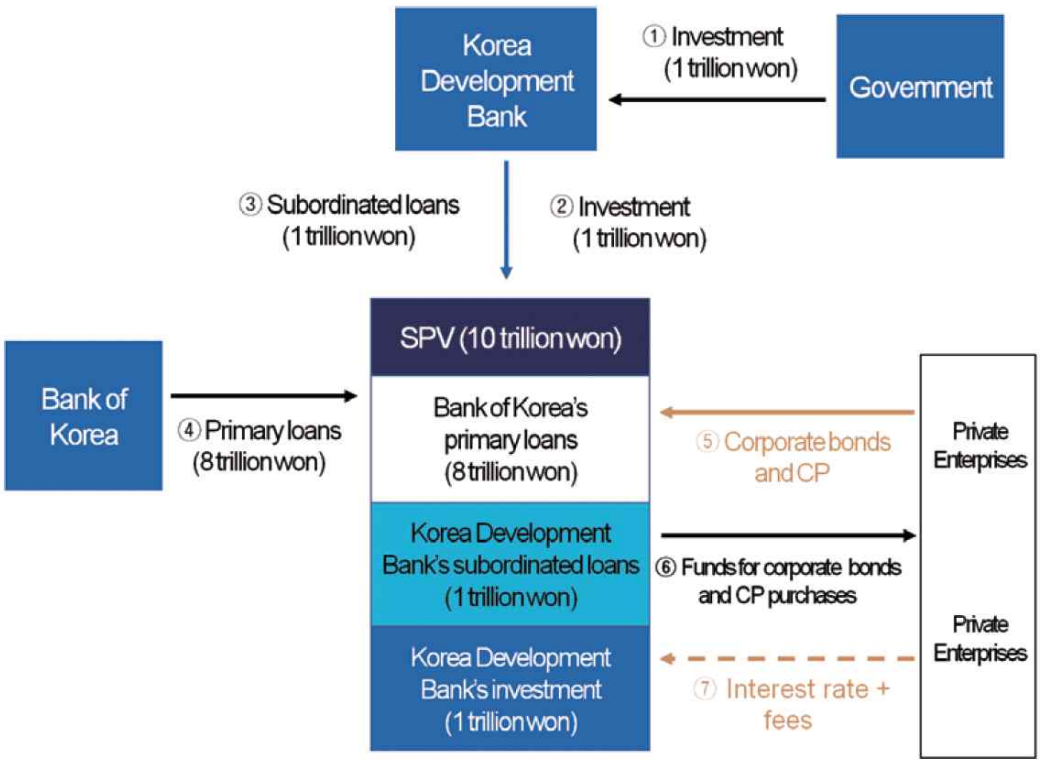
Corporate bonds with low credit ratings and commercial papers were eligible for the purchase program because it could be helpful to assuage credit risk aversion and ensure financial market stability. However, junk bonds do not meet an eligibility criterion.

On July 14, the SPV was established as a limited company and started purchasing corporate bonds and commercial papers. The BOK funded 8 trillion won to the SPV, while the KDB and the government financed 1 trillion won, respectively. The SPV is scheduled to purchase corporate bonds and commercial papers during a temporary period from July 14, 2020 to January 13, 2021 and

will be terminated in 4 years.

<Figure 3-7>

Financial Structure of the SPV



Source: Bank of Korea(2020h)

<Box 3-4>

The Focused Interview with the BOK

One of issues related to COVID-19 that concerns a central bank is that many people mistakenly think that COVID-19 can be transmitted through coins or banknotes.

To gather some information, we had a focused interview with four members of the Currency Department at the BOK on August 27.

COVID-19 affects payment habits in two ways. In one direction, it increases the demand for cash, especially precautionary demand, because it belongs to a negative economic shock. Since cash is a safe asset, people are more willing to hold cash, which is a kind of flight-to-quality. In the other direction, due

to social distancing, people are now forced to change their payment habit and shopping patterns towards adopting contactless payment instruments and online shopping, which naturally results in a decreasing transaction demand for cash. Auer et al. (2020) point out that the concerns are higher in countries where more small denomination banknotes are prevalent.

Participant List

Name	Affiliation
Hyun, Junghwan	Dongguk Univ.
Kim, Kyunghun	Hongik Univ.
Kim, Chunghwa	Bank of Korea
Yi, Byungchang	Bank of Korea
Cho, Sungwook	Bank of Korea

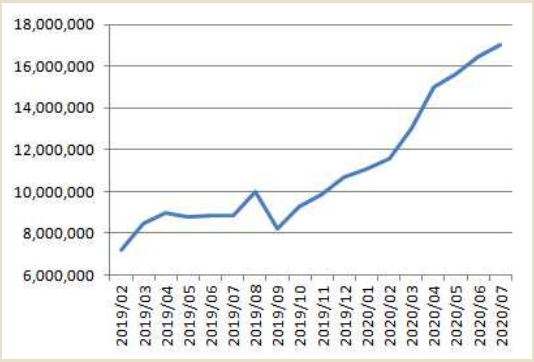
As far as the precautionary demand is concerned, it seems to have increased after the COVID-19 pandemic occurred, as shown in <Figure 3-8> and <Figure 3-9>. According to the BOK, the increasing demand for banknotes is a stereotypical reaction to an economic shock, as took place in 2008 when the global financial crisis occurred.

Also, although it has not become a serious concern in Korea that banknotes may be spreading the coronavirus, credit card usages dramatically increased after the outbreak of COVID-19, suggesting a fall in transaction demand for banknotes. Hence, we can conjecture that an increase in cash demand stems from a precautionary demand, not from a transaction demand. Particularly, the demand for large bills is increasing sharply. As shown in <Figure 3-8>, the net increase in 50,000 denomination banknotes almost doubled during the first 7 months of 2020. The net issuance of 10,000 denomination banknotes was negative in 2019, whereas it turned to increase sharply since this March when the COVID-19 pandemic spread in Korea. As of August 2020, the Currency Department has no plan to respond to a possibility that banknotes and coins can be a medium to spread the virus.

In sum, since small denomination banknotes are usually used in retail and

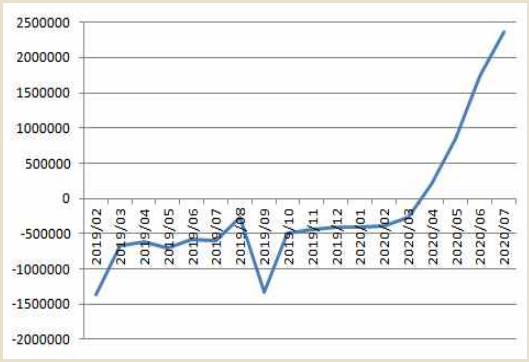
daily transactions, their demand may have decreased due to concerns about viral transmission via cash. However, with precautionary demand increasing, the demand for large denomination banknotes has been increasing because cash is a stable store of value.

<Figure 3-8>
Change in Net Issue of 50,000 Denomination Banknote



Note: Change in net issue is calculated on a year-on-year basis. The 50,000 denomination banknote is the largest bill in Korea
Source: Economic and Statistics System (BOK)

<Figure 3-9>
Change in Net Issue of 10,000 Denomination Banknote



Note: Change in net issue is calculated on a year-on-year basis
Source: Economic and Statistics System (BOK)

(d) Foreign Exchange Market Stabilization Measures

① Swap Arrangement with U.S. Federal Reserve (2020.3.19.)

The Federal Reserve System announced the establishment of central bank liquidity swaps (swap line) in order to provide sufficient U.S. dollar liquidity to other countries (BOK, 2020d). In sum, U.S. dollar liquidity facility provides U.S. dollar liquidity in amounts up to $60 billion. This swap line is temporary and will last for six months (terminated on September 30, 2020).

At this time, the Federal Reserve System also had swap lines with the Reserve Bank of Australia, the Banco Central do Brasil, the Bank of Korea, the Banco de Mexico, the Monetary Authority of Singapore, the Sveriges Riksbank, the Danmarks Nationalbank, the Norges Bank, and the Reserve Bank of New

Zealand.[6)]

This swap line is expected to maintain the stability of exchange rates and maintain the confidence of foreign exchange market participants.

<Figure 3-10>

Won/U.S. Dollar Exchange Rate

(unit: won)

Source: ECOS (Economic Statistics System of the BOK)

On 19 March, despite the announcement of the swap line, the foreign exchange market did not stabilize. But as the market participants' expectations became more homogeneous in considering the swap line as a potential great help to stabilizing the foreign exchange market, the Won-U.S. dollar exchange rate began to decrease and the Korean Won stopped losing its value relative to U.S. dollar, as shown in Figure 3-10.

Using the U.S. dollar liquidity provided by the swap line, BOK was able to conduct competitive U.S. dollar loan facility auctions (BOK, 2020e). The detail in the auction is presented in Table 3-13. For reference, under the Dutch (single rate) auction, the BOK picked the lowest rate and applied the rate to all accepted bids. Under multiple-rate auction (variable rate basis), each submitted rate is applied to a corresponding accepted bid.

The first competitive auction of U.S. dollar loan facility was conducted on

6) The Federal Reserve also has standing U.S. dollar liquidity swap lines with the Bank of Canada, the Bank of England, the Bank of Japan, the European Central Bank, and the Swiss National Bank (FRS, 2020).

March 30, 2020 (BOK, 2020f). The total amount offered was 12 billion U.S. dollar. 2 billion dollar is for 7-day tenor and 10 billion dollar is for 84-day tenor.[7] The amount auctioned off was equivalent to 8.72 billion dollar : 7.92 billion dollar for 84-day tenor and 800 million dollar for 7-day tenor.

<Table 3-13>

Competitive US Dollar Loan Facility Auctions

	Contents
Timing and Volumes	- will be decided on an as-needed basis
Duration	- maximum duration is 88 days
Eligibility	- all banks (include foreign banks' branches, KDB, IBK, EXIM Bank)
Auction Type	- competitive auction : lending rates will be determined in each auction - Dutch (single rate) auction or variable rate auction
Range of Bid Amounts	- (minimum) 1 million U.S. dollar - (maximum) will be set for each operation
Collateral	- (initial amount) KRW-denominated collateral amounting to 110% of the KRW value of the U.S. dollar loan. - (revaluation) on a weekly basis - (add-on margin) when revalued collateral is less than 105% of the KRW value of the USD loan, add-on is calculated as (110% of the loan - current value of the loan). - (Eligible collateral) ⅰ) government bonds, ⅱ) government-guaranteed bonds, ⅲ) MSBs, ⅳ) cash, ⅴ) debentures issued by banking institutions (established by the Bank Act), ⅵ) MBSs issued by the Korea Housing Finance Corporation (KHFC)

Source: Bank of Korea (2020i)

② Ease of FX market stability rules (2020.3.26.)

The BOK, along with the Ministry of Economy and Finance (MOEF), the Financial Services Commission (FSC), and the Financial Supervisory Service (FSS) collaboratively decided to relax the foreign exchange market stability rules since uncertainties in capital outflows and inflows arose due to the COVID-19 (BOK, 2020j).[8]

7) Competitive U.S. dollar loan facility auctions were conducted on April 7 (8.5 billion dollars), April 14 (4 billion dollars), April 21 (4 billion dollars), April 27 (4 billion dollars) and May 6 (4 billion dollars).

Particularly, two main measures were taken this time. First, a rule, 「the levy on financial institutions' non-deposit FX liabilities」 was temporarily lifted from April to June. The rule is a 0.1% tax levy on non-deposit FX liabilities, which are mature within a year. In addition, installment payments to financial institutions were permitted subject to the rule.

Second, the FX liquidity coverage ratio (LCR) was temporarily decreased from 80% to 70% during the 3 months from March to May. The LCR is defined as a ratio of high-quality liquid foreign assets to net cash outflows during a month (BOK, 2020j). The formula of the ratio is presented below.

$$LCR = \frac{high-quality\ liquid\ \text{foreign}\ assets}{net\ cash\ outlfows\ during\ the\ upcoming\ 1\ month} \times 100 \geq 80\%$$

8) The principal authority is the MOEF. The FX market stability rules were introduced during the global financial crisis to control capital flows (e.g., short-term borrowings).

<Table 3-14>

BOK Policy Responses to the COVID-19

Policy Response Measures		Objectives	Major Details
Base Rate	Cut the base rate by 75 basis points	Promote real economic recovery and ensure financial stability	- 1.25% → 0.50%
Bank Inter-mediated Lending Support Facility	Raised ceilings and lowered the interest rate on the lending support facility	Support SMEs affected by COVID-19	- Total ceiling : 25 trillion won → 30 trillion won → 35 trillion won - Lending rate : 0.5%～0.75% → 0.25%
Market Stabilization Measures	Broaden the range of institutions eligible for open market operations	Reinforce the basis for the Bank of Korea to supply liquidity	- The range of institutions eligible for RP transactions was broadened: 7 institutions eligible for Monetary Stabilization Bond transactions and 4 primary dealers
	Broaden the range of collaterals eligible for open market operations		- The range of securities eligible for outright transactions was broadened: MBSs issued by the Korea Housing Finance Corporation and debentures issued by 3 specialized banks - The range of securities eligible for RP transactions was broadened: debentures issued by 3 specialized banks, general bank debentures, and bonds issued by 9 public organizations
	Broaden the range of eligible collateral for lending facilities		- The range of eligible collateral for lending facilities was expanded: MBSs issued by Korea Housing Finance Corporation, debentures issued by 3 specialized banks, general bank debentures, bonds issued by 9 public organizations

Source: Bank of Korea (2020h)

<Table 3-14> (Continued)

BOK Policy Responses to the COVID-19

Policy Response Measures		Objectives	Major Details
Market Stabilization Measures	Improved collateral availability of financial institutions	Reinforce the basis for the Bank of Korea to supply liquidity	- The ratio of collateral for guaranteeing net settlements was lowered from 70% to 50% - The eligible collateral for guaranteeing net settlements was broadened: General bank debentures, bonds issued by 9 public organizations
	Corporate Bond-Backed Lending Facility	Stabilize the corporate bond market and improve funding conditions for financial institutions	- Ceiling: 10 trillion won - Rate: yield on Korean Monetary Stabilization Bonds + 85bp - Eligible collateral: high-quality corporate bonds issued by private enterprises with remaining maturity of 5 years or less
	Set up an SPV to purchase lower-rated corporate bonds and commercial papers	Provide liquidity to the credit market	- Size: 10 trillion won - Funding structure: BOK's primary loans (8 trillion won), KDB investment (1 trillion won), subordinated loans (1 trillion won)
Foreign Exchange Market Stabilization Measures	FX swap line with Federal Reserve	Improve foreign currency funding conditions	- Size: 60 billion U.S. dollars - Competitive U.S. dollar loan facility auctions took place (a total of 19.872 billion U.S. dollars was supplied)
	Relaxation of FX regulations		- Ceilings on the FX derivative positions of domestic banks (40%→50%) and foreign bank branches (200% →250%) were raised - Levy on financial institutions' non-deposit FX liabilities were exempted from the levy for 3 months

Source: Bank of Korea (2020h)

B. The Effect of the COVID-19 Shock on Corporate Financial Soundness

The BOK conducted an earlier analysis on the effect of the COVID-19 shock on corporate financial soundness. The Bank estimated how firms' liquidity conditions change under stress scenarios of a decrease in sales and adverse financial markets.

This section briefly introduces the process and results of the analysis because it will be of benefit for NRB to identify important policy implications, although the Nepalese and the Korean industries have different structures.

(1) Corporate Financial Conditions

As the COVID-19 spreads, domestically and worldwide, economic activity in Korea shrank considerably, causing corporate firms to experience unexpected poor performance. If the situation is prolonged, lowered sales and profits result in a deterioration in firms' financial conditions and liquidity availability.

Still, the loan delinquency rate remained at a low level of 0.50% below the long-term average (0.77%). Due to the drastic measures of the BOK, as explained above, the financial market seemed stable and bank loans were readily accessible if firms chose to borrow.

However, some indicators revealed increasing risks. For instance, during the first 5 months, the credit rating up-down ratio, calculated as upgraded firms divided by downgraded firms, showed 0.2 below 1. For the firms listed, the probability of default rose from 1.5% in December 2019 to 2.5% in March 2020.

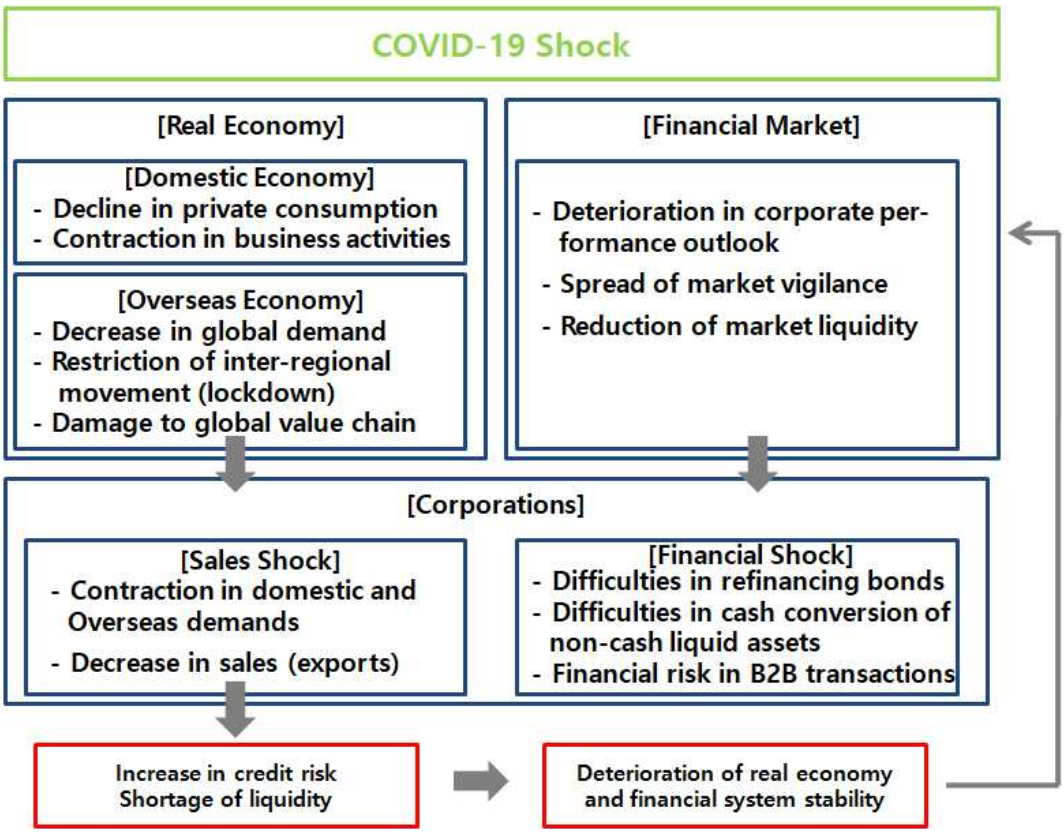
Particularly, firms in general retail, accommodation, food services, leisure services, petro-chemicals, automobiles and air transport, are more likely to be negatively affected because these industries suffered from extremely decreased domestic and external demand caused by social distancing and travel restrictions.

(2) Stress Test Scenario

The BOK designed expected spillover channels of the COVID-19 shock, as shown in <Figure 3-11>. The COVID-19 shock affects the real economy and the financial market. In turn, the effect on the real economy creates a sales shock to corporations, while the spillover effect creates a financial shock to corporations. The sales shock leads to an increase in credit risks and a shortage of liquidity, which further deteriorates the real economy and stability in the financial system.

<Figure 3-11>

Expected Spillover Channels of the COVID-19 Shock



Source: Bank of Korea (2020k)

For the sales and financial shocks, two scenarios arise. The first scenario, the baseline scenario, assumes that the sales and financial shocks will be ongoing for domestic industries until the second quarter of this year and for exporting firms until the third quarter of this year. The second scenario, a severe scenario,

assumes that these two shocks are ongoing until the end of this year, and after the disappearance of the shocks, the recovery from the shocks will take 6 months. <Table 3-15> represents examples of sales shocks.

<Table 3-15>

Sales Shock Scenarios for Vulnerable Industries

		S1	S2
Domestic Industries	General Retail	-7.2%	-9.6%
	Accommodation & Food Services	-22.2%	-33.3%
	Leisure Service	-22.7%	-35.9%
	Film & Entertainment	-52.4%	-75.6%
Industries Related to Overseas Demand	Petro-chemicals	-27.2%	-30.2%
	Automobiles	-24.8%	-27.3%
	Air Transport	-61.7%	-68.4%
	Travel	-66.7%	-71.5%
	Shipping	-28.0%	-31.0%

Source: Bank of Korea (2020k)

(3) Test Results

(a) Change in Financial Soundness

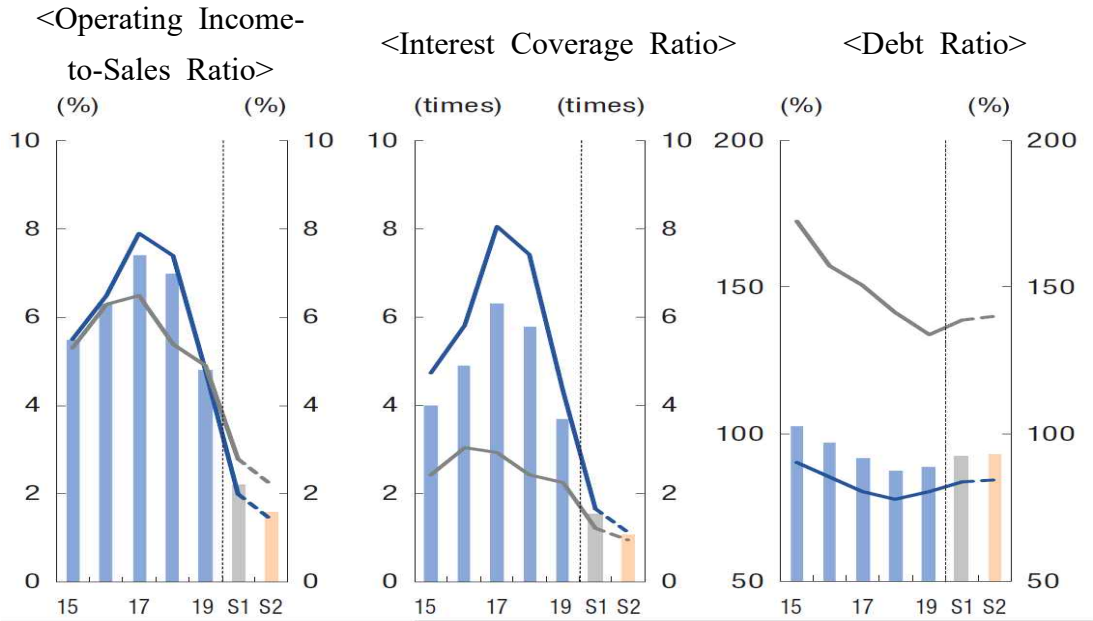
Overall, key financial soundness indicators deteriorate in response to the sales shock caused by the COVID-19 pandemic.

- Operating income-to-sales ratio: it falls from 4.8% to 2.2% (1.6%) in S1 (S2).

- Interest coverage ratio: this ratio is defined as operating income divided by interest expense and indicates firms' capacity to repay debt. It decreases from 3.7 to 1.5 (1.1) under S1 (S2). The share of firms with interest coverage ratios below 1 increases from 32.9% to 47.7% (50.5%) under S1 (S2).

▪ Debt ratio: increases from 88.8% to 92.3% (93.1%) under S1 (S2). The share of firms with debt ratio above 200% increases from 37.9% to 39.9% (40.5%) under S1 (S2).

<Figure 3-12>
Changes in Major Indicators of Corporate Financial Soundness



Source: Bank of Korea (2020k)

(b) Liquidity Shortfall

Liquidity shortfall ($SL_{S1,\ S2}$) is measured for the firms with total current assets and operating income less than current liabilities, using the below formula. The sample is firms under external auditing.

$$SL_{S1,S2} = \sum_i \left| \begin{array}{l} cash\,equivalent\,assets_{i,\,S1,\,S2} \\ +\,(inventory + accounts\,receivables)_i \times cash\,conversion\,rate_{S1,S2} \\ +\,operating\,losses - current\,liabilities_i \times (1 - refinancing\,rate_{S1,S2}) \end{array} \right|$$

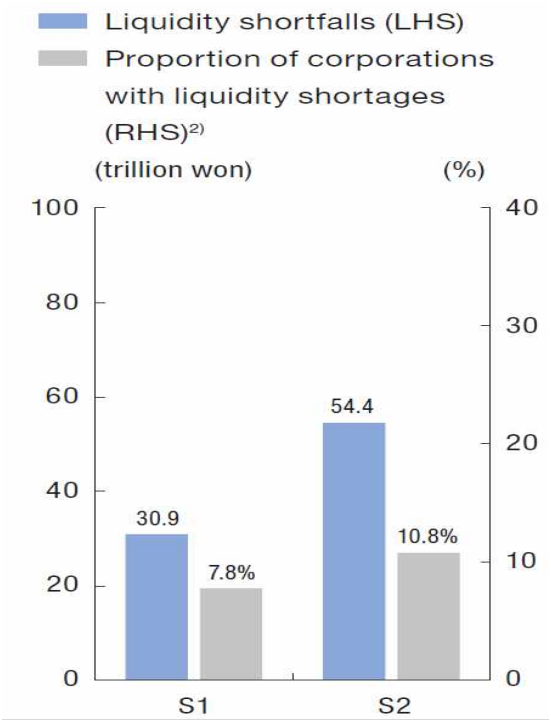
① All Sample Firms

The liquidity shortfall is estimated to 30.9 trillion (54.4 trillion) won under S1

(S2). The share of firms in liquidity shortfall account for 7.8% (10.8%) under S1 (S2). The financial debt amounts of firms in liquidity shortfall are estimated to 91.6 trillion won, which is 11.4% of the whole debt size of the sample firms, under S1. The estimation increases to 164.7 trillion won under S2, which is equivalent to 20.4% of the entire debt size of the sample firms.

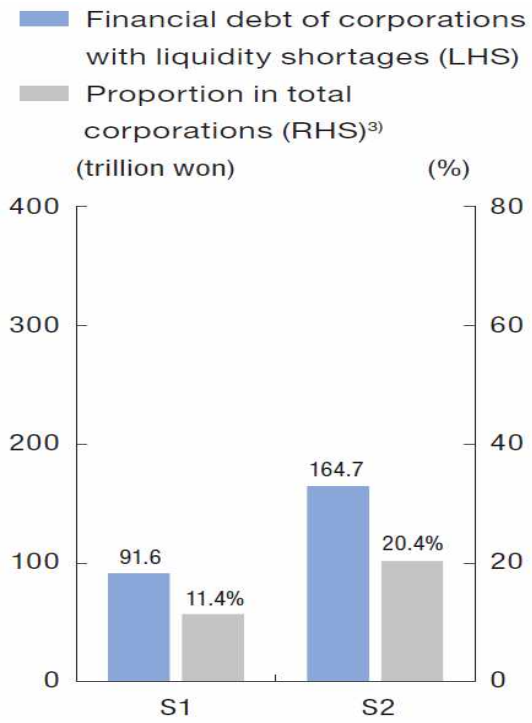
As of October 7, it seems certain that the COVID-19 pandemic will last into 2021. Thus, there is a high possibility that the effects of the pandemic may be more severe than the results of S2.

<Figure 3-13>
Liquidity Shortfalls



Source: Bank of Korea (2020k)

<Figure 3-14>
Financial Debt of Firms under Liquidity Shortfalls



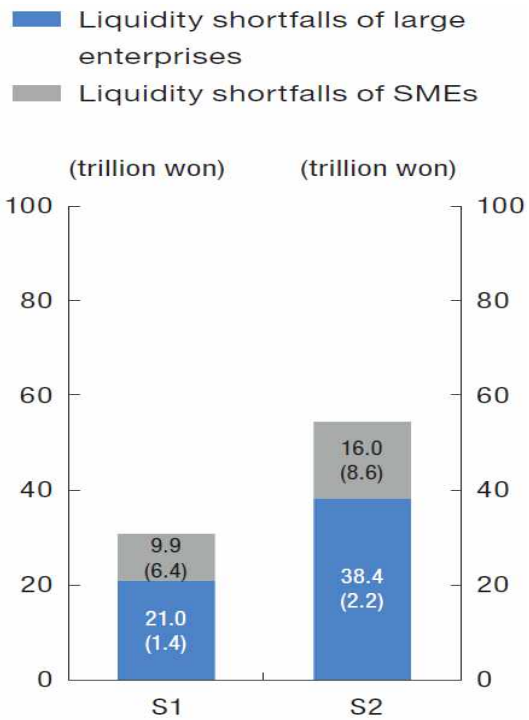
Source: Bank of Korea (2020k)

② Large Firms and SMEs

Sorting sample firms into two groups (Large firms and SMEs), liquidity shortfalls are estimated again for each group. The liquidity shortfall for large firms is 21.0 trillion won (38.4 trillion won) under S1 (S2), while the amount

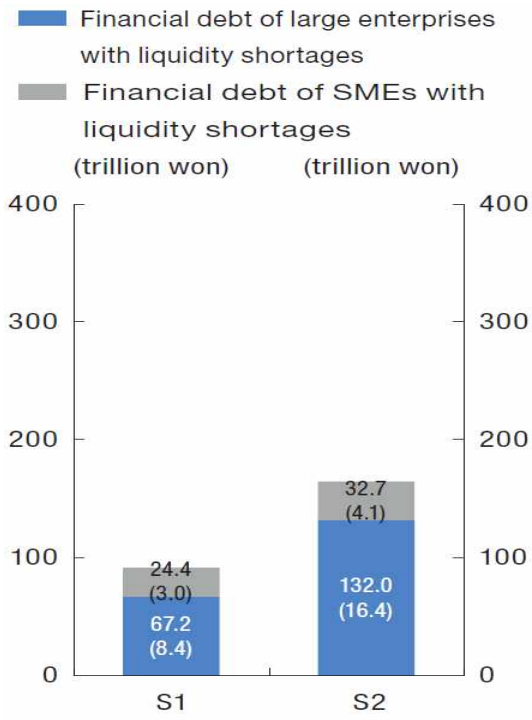
for SMEs is 9.9 trillion won (16.0 trillion won) under S1 (S2). The proportion of large firms and SMEs under liquidity shortfalls respectively accounts for 1.4% (2.2%) under S1 (S2) and 6.4% (8.6%) under S1 (S2).

<Figure 3-15>
Liquidity Shortfalls of Large Firms and SMEs



Source: Bank of Korea (2020k)

<Figure 3-16>
Financial Debt of Large Firms and SMEs under Liquidity Shortfalls



Source: Bank of Korea (2020k)

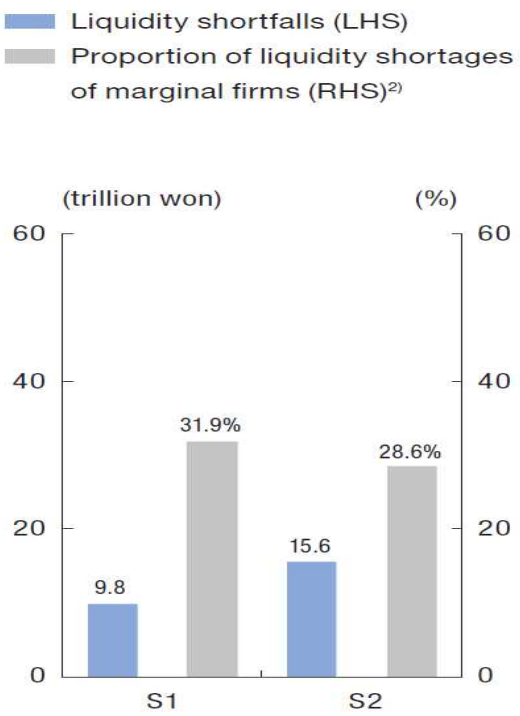
In sum, the amount of liquidity shortfall for large firms is greater than those for SMEs, while more SMEs suffer from liquidity shortfalls than large firms do.

③ Marginal Firms

The BOK simply defines marginal firms as firms with an interest coverage ratio below 1 and determines the liquidity shortfalls of marginal firms. The shortfall is expected to reach 9.8 trillion (15.6 trillion) won under S1 (S2). These amounts account for 31.9% (28.6%) of the total liquidity shortfall under S1 (S2).

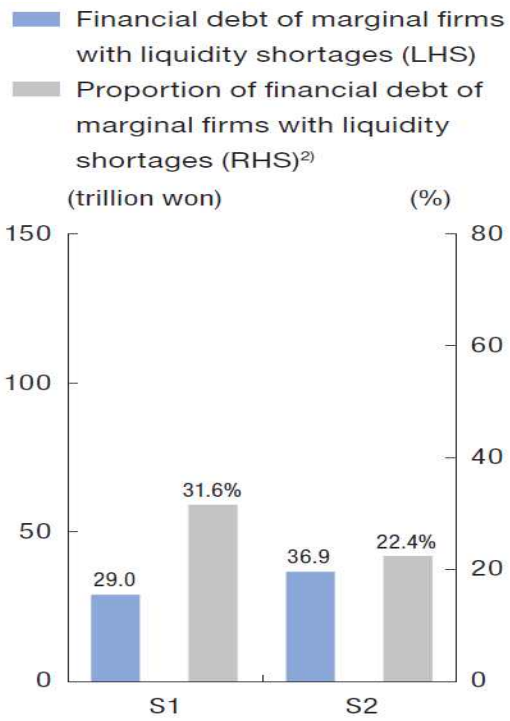
Furthermore, financial debt of marginal firms is estimated to be 29.0 trillion (36.9 trillion) won under S1 (S2), which is equivalent to 31.6% (22.4%) of the entire financial debt of firms with liquidity problems.

<Figure 3-17>
Liquidity Shortfalls of Marginal Firms



Source: Bank of Korea (2020k)

<Figure 3-18>
Financial Debt of Marginal Firms under Liquidity Shortfalls



Source: Bank of Korea (2020k)

④ Evaluation

The above analysis is a static analysis and does not consider that many firms may become distressed, causing their interest coverage ratios to go below 1. If the COVID-19 shock persists until the end of this year, then more firms will belong to the group of marginal firms. Consequently, with the share of marginal firms increasing, the adverse effects on these firms will become more severe.

Under the emergency credit programs implemented by the BOK, the corporate sector will not suffer from liquidity shortage. This sufficient liquidity definitely facilitates the survival of firms, while it is doubtful whether ample liquidity

provision promotes firms' efficiency or investment. One thing for sure is that liquidity provision increases the share of marginal firms, which ostensibly brings out negative externalities on the corporate sector.

3. Responses to COVID-19 in Nepal

A. Overview

The COVID-19 Pandemic is one of the costliest economic debacles in the history of mankind. Governments around the world have implemented containment measures such as closing borders, lockdowns, quarantines and travel restrictions to contain the spread of COVID-19. This has resulted in unprecedented impact to the global economy. It has disrupted the supply-side chains and depressed aggregate demand, which will ultimately result in strains in corporate and household cash flows alike.

<Table 3-16>

World Economy Outlook

Indicators	2019	2020(estimate)
World Output	2.9%	-4.9%
Advanced Economies	1.7%	-8.0%
Emerging Markets	3.7%	-3.0%
Low Income Developing Economies	5.2%	-1.0%
Nepal GDP Growth (Own Estimate)	6.7%	2.3%
World Trade Volume	0.9%	-11.9%

Source: International Monetary Fund

The initial adverse economic impact of COVID-19 is expected to have further ramifications, including falling incomes and rising unemployment, reduction in private investment and consumption, decline in economic activity and deterioration of corporate balance sheets. Supply disruption and demand-deficient economic contraction have already caused severe losses, which will ultimately reflect in financial systems, though this will appear gradually. The pandemic is feared to bring long-lasting effects, with lower potential output and retarded

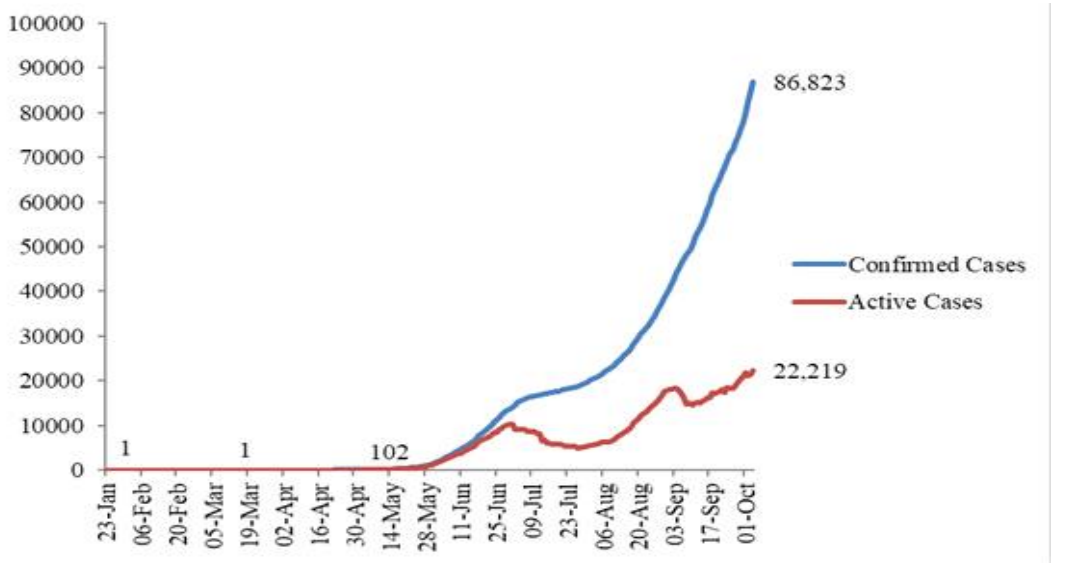
growth. <Table 3-16> summarizes the International Monetary Fund Economic Outlook for 2020.

Nepal's GDP growth is estimated at 2.3% in 2019/20 a revision from the estimated growth of 6.7% before COVID-19. As of 4th October, out of 86,823 confirmed cases, 64,069 have recovered and 535 died with remaining 22,219 active cases in Nepal. There has been a sudden spike in cases since the beginning of August and the number of cases has been above 2000 per day since the start of October 2020.

<Figure 3-19>

Cases of COVID-19 in Nepal

(unit: person)



Source: Nepal Rastra Bank

In order to contain COVID-19, the Government of Nepal (GoN) has taken measures lacing the safety and lives of Nepalese as the upmost priority and taking cautious measures to minimize the effect of COVID-19 on the economy. The GoN responded to containing the spread of COVID-19 by closing its border with the neighbours as early as March, when the number of cases was in the lower single digits. After an initial 3-month nationwide lockdown beginning in 24th March and subsequent regional lockdowns and preventive orders indifferent forms, the economic activity in Nepal has been severely affected, and has been

focused mainly on assuring supply of basic goods and services only.

While it is easy to anticipate the lasting economic impact of COVID-19 on the Nepalese economy, the exact impact cannot be measured, given the uncertainty of the pandemic. Further, the impact of COVID-19 is not only quantitative.

<Table 3-17>

NRB's Online Survey Findings

	Major Findings
1	During Lockdown, only 4% of business/industries were operating at full capacity (agro-related business/industries, health and social sector), 35% were operating at sub-par capacity and 61% of the businesses/industries were completely shut down (education, hotels/restaurant, real estate, transportation and storage industries).
2	Business/industries laid off 22.5% of the employees (where temporary, contractual and daily wage earners comprised more than one-third of the total employee). Hotels & restaurants were the major sector that laid off the most employees.
3	Employee salaries were reduced by around 18.2%. Hotels & restaurants and transportation & storage businesses were the major sectors lowering the salaries more than other sectors.
4	74.3% of businesses held loans from banks and financial institutions and 8.7% held savings and credit cooperatives.
5	96.7% industries/businesses had to face a 73.8% reduction their business, 0.9% had to face a 15.4% reduction, while 2.4% had no impact on their business level.
6	It takes around 9 months for industries/businesses to rebound to normal operation.
7	20% of the respondents received interest relaxation as directed by Nepal Rastra Bank to banks and financial institutions.
8	Major Problem identified by businesses and industry were included lack of working capital, supply disruption of produced goods, decreased market demand, etc.
9	Small and medium scale industries were hard hit by the pandemic.
10	Interest subsidy, flexible repayment reschedule, income tax facility, additional working capital loan facility, loan restructuring, etc. are the support expected by industries /businesses.

Source: Nepal Rastra Bank

NRB conducted an online survey to analyze the impact of COVID-19 on

Nepalese economy, industry/business and employment. The survey was conducted in 52 districts out of 77 districts throughout the country from 8th June to 24th July this year. Based on the responses received from 674 industries/businesses, the major findings are presented in <Table 3-17>.

(1) Economic Indicators Before and After the COVID-19

The impact of COVID-19 on the Nepalese economy for fiscal year 2019/20 (July to July) may be analyzed by the following indicators of the economy and financial system.

- External Trade: YoY export, which increased by an average of 24% every month till March 2020, decreased since April till such growth for exports was 0.6% in mid-July 2020. Exports improved in August 2020 with YoY growth of 8.9%. YoY import decreased throughout the fiscal year, but rapidly declined since April 2020 and it contracted by 15.6% in year end mid-July 2020 and 19.6% in August 2020. Overall, the contraction in import and export resulted in trade balance of －29.2% for fiscal year 2019/20. Such balance was －38.2% in fiscal year 2018/19 and was forecasted to reach －40.4% in 2019/20.

- Foreign Exchange Reserves: Foreign exchange reserve position improved from USD 9.4 billion in August 2019 to USD 11.6 billion in mid July 2020 and 12 billion in August 2020. Improvement occurred in May, June and July is attributed to decreased foreign currency expenses to support declining imports in the context of COVID-19. Foreign reserve is adequate to support merchandise and services import for 15.6 months.

- Balance of Payments (BOP): BOP was in surplus by approx. NRs. 1 billion in FY 2017/18 but turned deficit of NRs. 67.4 billion in FY 2018/19. At the beginning of FY 2019/20 (August 2019), BOP balance was positive by NRs. 6 billion. Contraction in import due to COVID-19 rapidly increased BOP surplus of NRs. 36.6 billion in April 2020 to

surplus of NRs282.4 billion in fiscal year end (mid-July 2020).

- Workers Remittance: The number of Nepalese going for foreign employment declined by 20.5% in FY 2019/20. Remittance grew by 16.5% in FY 2018/19 to reach a figure of NRs. 879 billion but decreased by 0.5% to NRs. 875 billion by the end of current FY 2019/20 (mid-July 2020). Remittance contracted after March due to COVID-19 but rebounded in August 2020 with a YoY growth of 23%.

- Tourism: The number of tourists arriving in Nepal declined from monthly figure of above 100,000 in February to almost nil in April May, June and July (less than 100) due to COVID-19. Loss of tourism revenue will hamper multiple service sectors including travel and hotels and is expected to have multiplier effect resulting in decreased demand across many manufacturing and service sectors.

- Inflation: Average consumer inflation for FY 2019/20 (July-July) stood at 6.15%. Consumer inflation declined from 6.95% in August 2019 to 4.78% in July 2020 and 3.49% in August 2020. YoY inflation decreased particularly from May 2020 partly because of contraction in demand due to COVID-19 but with no supply-side shocks.

- International Investment Position (IIP): The net IIP remained at a surplus of Rs.271.96 billion in mid-July 2020. Nepal does not have any portfolio investment. So capital volatility and capital movements were not observed.

- Monetary Sector: The 91-day Treasury bill rate dipped from 4% in March 2020 to 1.3% in July 2020.Broad money (M2) growth was uniform and as per target growth of 18%. YoY growth for net foreign assets was high during May (16%), June (27.7%) and July (28.7%) and reached NRs. 1328 billion in mid-July 2020. The electronic payment has increased radically in recent months both in terms of number and volume ascribable to on-going period of preventive orders and regional

lockdowns.

- Government Budgetary Operations: Revenue collection (based on banking transactions) stood at NRs. 793.78 billion in 2019/20 while expenditure was NRs. 1,038 billion. Revenue collection was less than expenditure after March 2020 in the context of COVID-19.

<Figure 3-20>

Export Growth (YOY)

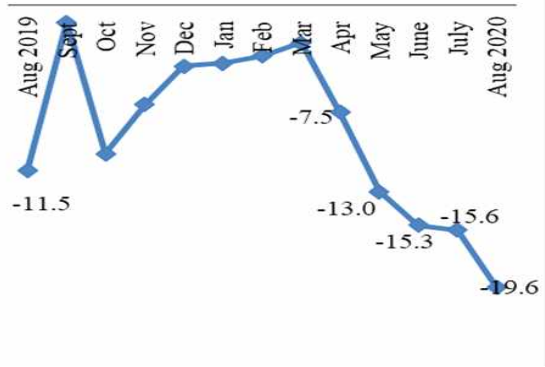
(unit: %)

Source: Nepal Rastra Bank

<Figure 3-21>

Import Growth (YOY)

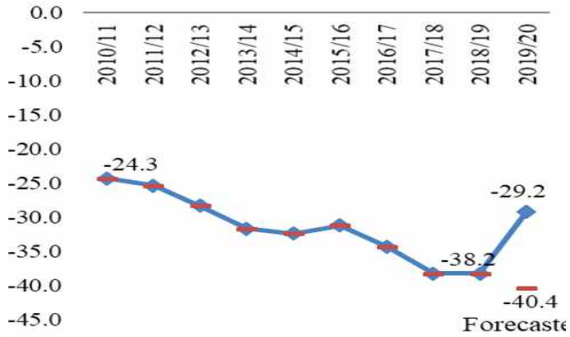
(unit: %)



Source: Nepal Rastra Bank

<Figure 3-22>

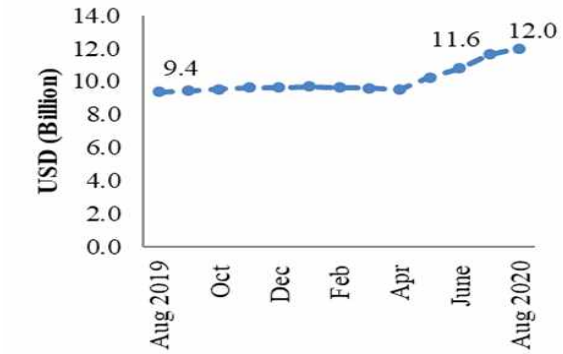
Trade Balance



Source: Nepal Rastra Bank

<Figure 3-23>

Foreign Reserve

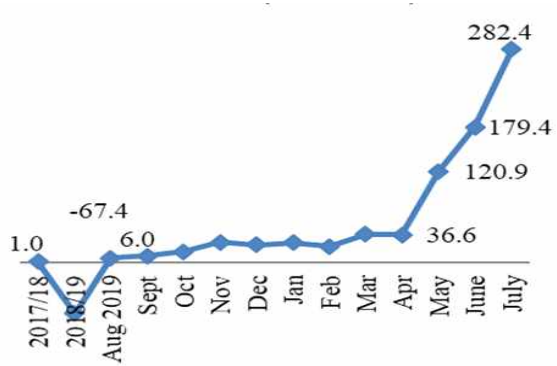


Source: Nepal Rastra Bank

<Figure 3-24>

Balance of Payment

(unit: NRs Billion)

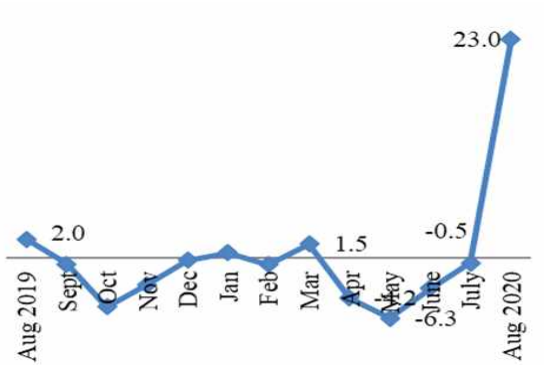


Source: Nepal Rastra Bank

<Figure 3-25>

Remittance Growth (YOY)

(unit: %)

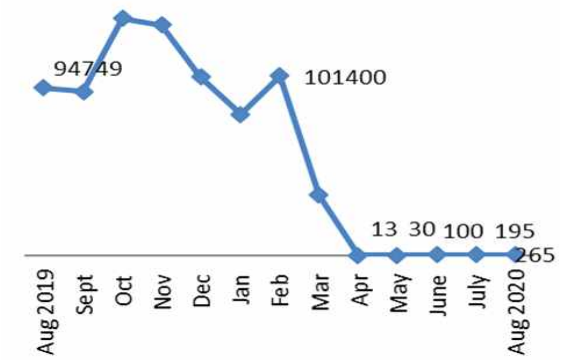


Source: Nepal Rastra Bank

<Figure 3-26>

Tourist Arrival

(unit: number)



Source: Nepal Rastra Bank

<Figure 3-27>

CPI Inflation (YOY)

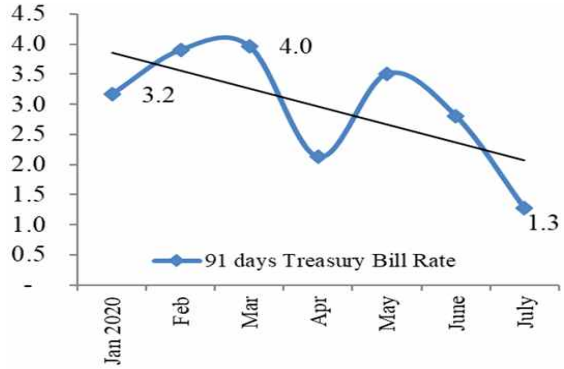
(unit: %)

Source: Nepal Rastra Bank

<Figure 3-28>

Treasury Bill Rate (91days)

(unit: %)



Source: Nepal Rastra Bank

<Figure 3-29>

Net Foreign Asset Growth (YOY)

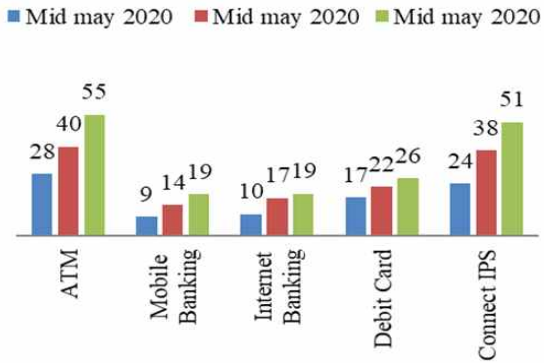
(unit: %)

Source: Nepal Rastra Bank

<Figure 3-30>

Payment Transaction

(unit: NRs Billion)

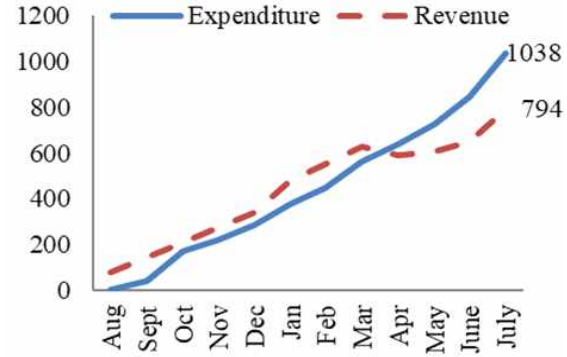


Source: Nepal Rastra Bank

<Figure 3-31>

Government Budgetary Operations

(unit: NRs Billion)



Source: Nepal Rastra Bank

(2) Financial Indicators Before and After the COVID-19

- Capital Adequacy: The capital adequacy ratio (CAR) is calculated by dividing eligible regulatory capital by total risk weighted exposure (RWE). The CAR of the commercial banks in Nepal declined from about 14% at the start of FY 2019/20 to 13.34% in April 2020 but improved to 14% in July 2020. Capital adequacy has been well above the regulatory minimum requirement of 11%. The improved CAR is mainly attributed to the low level of non-performing loans and regulatory adjustments allowed on good loans given the difficulties of COVID-19.

- Asset Quality: Banks in Nepal currently report non-performing loans on a quarterly basis. Non-performing assets of commercial banks have increased to 2% in July 2020 from 1.2% in July 2019. NPL levels slightly increased during the reporting periods in the fiscal year 2019/20, also due to the impact of COVID-19.

- CCD Ratio: Credit to core capital and domestic deposits (CCD) ratio of commercial banks (CBs) improved from 76.27% in July 2019 to 71.42% in July 2020. In the context of COVID-19, NRB increased the maximum CCD ratio requirement of 80% to 85% to improve the credit lending capacity during the COVID-19 pandemic. There is adequate space to further enhance lending given the low CCD level of CBs in Nepal.

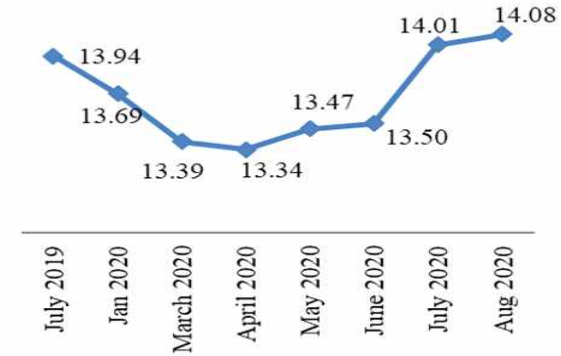
- Interest Rate and Liquidity: Weighted average deposit and lending rates of CBs decreased in a gradual way, particularly starting in February 2020. The net liquid asset ratio of CBs improved from 24.6% in March 2020 to 29.8% in July 2020.

- Leverage Ratio: Banks are required to maintain a minimum Tier-1 leverage ratio of 4%, which restricts banks to build up excessive leverage while still showing strong risk-based capital ratios. The leverage ratio of commercial banks declined from 8.41% in March 2020 to 8.29% in mid-July 2020. However, it is still well above the minimum regulatory requirement.

<Figure 3-32>

Capital Adequacy Ratio

(unit: %)

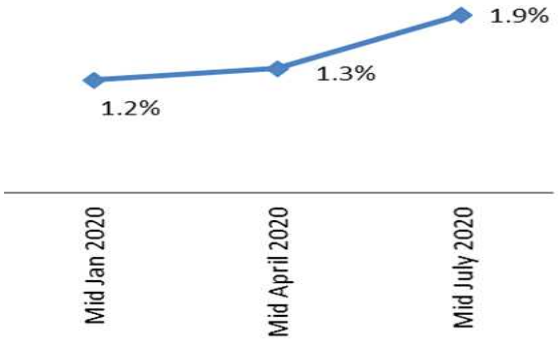


Source: Nepal Rastra Bank

<Figure 3-33>

NPL Ratio

(unit: %)



Source: Nepal Rastra Bank

<Figure 3-34>

CCD Ratio

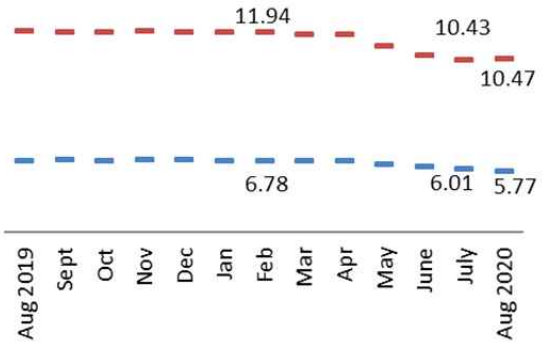
(unit: %)

Source: Nepal Rastra Bank

<Figure 3-35>

Lending and Deposit Rate

(unit: %)

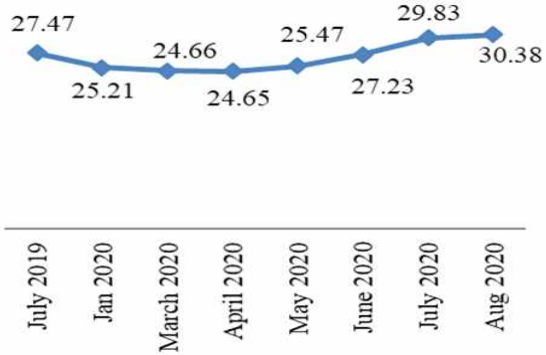


Source: Nepal Rastra Bank

<Figure 3-36>

Net Liquidity Assets Ratio

(unit: %)



Source: Nepal Rastra Bank

<Figure 3-37>

Leverage Ratio

(unit: %)

Source: Nepal Rastra Bank

B. Policy Responses of NRB

In response to the situation posed by COVID-19, NRB introduced a series of macroprudential measures to support economic activity while preserving the financial system's soundness and stability. These measures taken were mainly targeted at ensuring adequate liquidity and supply of credit to the economy as well as maintaining public confidence. Borio and Restoy (2020) suggested basic three principals on which regulatory responses should be guided.

- Principle 1: Adjustments should be effective in supporting economic activity.

- Principle 2: Adjustments should preserve the health of the banking (financial) system.

- Principle 3: Adjustments should not undermine the long-run credibility of financial policies.

NRB's policy/directives on dealing with the COVID-19 crisis may be classified into following broad areas: employee safety and business continuity, availability of liquidity and credit to the economy, minimizing COVID-19's effects on SMEs and individuals, providing regulatory relaxations to BFIs to minimize additional stress and other prudential regulatory measures. The table below broadly summarizes important dates of NRB's policy response to COVID-19. The objectives and associated directives have been discussed thereafter.

<Table 3-18>

Important Dates on COVID -19

Date	Circular
January 24	1st COVID-19 Case in Nepal
March 11	WHO declares COVID-19 as a Pandemic
March 18	Closure of educational institutions, religious gatherings, recreation and international flights from March 22
March 22	Closure of all borders with India and China
March 23	Declaration of nationwide lockdown from March 24 and later extended for three months
March 29	NRB directs BFIs with comprehensive support and prudential measures
April 28	NRB announces additional support measures to help SMEs and other affected business
July 17	NRB announces Monetary Policy for FY 2020/21 with more relief packages
July 27	NRB issues directives to BFIs to accommodate facilities as per the Monetary Policy for FY 2020/21
August 19	Three week lockdown in Kathmandu. Additionally, local lockdowns were implemented in various districts and local levels. due to spike in cases
September 9	Lockdown eased in Kathmandu with constraints in vehicle movement

Source: Nepal Rastra Bank

(1) Safety and Business Continuity

Since the start of the pandemic NRB has directed BFIs to conduct daily business by taking adequate safety measures as recommended by the World Health Organization (WHO) and the GoN. Notices were issued encouraging customers to increase the use of ATMs, electronic banking, and other measures to reduce traffic at branches and the BFIs were directed to make all the electronic transactions/interbank ATM transactions free of charge. Also, charges on large value payments under real-time gross settlement system (RTGS) were waived from March 23, 2020 until further notice. BFIs were mandated to

entertain the requests of customers received via email and telephone to enable their electronic banking services. BFIs were also directed to open the least number of branches in coordination with local authorities. NRB encouraged banks to continue operations of banking services with measures such as work from home, shift-wise work, and job rotations, among others. Some directives issued in regard to Safety and Business Continuity are tabulated below.

<Table 3-19>

Safety and Business Continuity

Date	Circular
May 8	BFIs directed to work with one-third of their employees at office premises
June 14	BFIs to implement flexible shift-wise work, if needed
July 19	No charges for interbank ATM transactions
July 23	BFIs directed for normal operation of banking services after the lockdown was lifted
August 9	Flexibility for shift-wise work, work from home amid an increase in the number of cases
August 13	BFIs directed to form a "COVID-19 safety management team" and other safety protocols
August 19	BFIs directed to offer banking services for only a limited number of hours and provide banking services online as far as possible
May 8/ June 14/ July 23/ August 9/ 13/19	Promote online banking, ease of use of banking services and availability of services.

Source: Nepal Rastra Bank

(2) Liquidity Support

The US financial crisis of 2007/8 taught that in order to maintain confidence in the financial sector, it is vital to preserve short term liquidity in the time of crisis. In the earliest days of lockdown, NRB reduced the compulsory reserve ratio (CRR) and bank rate by 100 basis points while the standing liquidity facility (SLF) rate and deposit collection rate as the upper bound and lower bound of interest rate corridor respectively were also reduced by 100 basis

points. The credit to core capital plus deposit ratio (CCD ratio) was increased to 85% from the existing 80% in the monetary policy statement for 2020/21. NRB took these measures to signal its readiness to bolster for the BFIs liquidity needs and ensure adequacy of liquidity in the economy during the time of the Pandemic as well as the recovery period in the future. Directives related to this genre are presented in <Table 3-20>.

<Table 3-20>

Liquidity Support

Date	Policy/Directive	Objective
March 29	CRR reduced from 4% to 3%	To release funds for any liquidity needs in the banking industry
March 29	Bank rate reduced from 6% to 5%	To maintain banking sector confidence
March 29	SLF rate reduced from 6% to 5%; deposit collection rate reduced from 3% to 2%	To maintain short term interest rates
July 27	CCD ratio increased from 80 percent to 85 till mid-July 2021	To assist credit needs in the recovery cycle

Source: Nepal Rastra Bank

(3) Payment Deferral, Restructuring and Rescheduling

Payment deferral policies for loans could help borrowers who are solvent but facing temporary cash flow shortages due to the COVID-19 crisis. Such deferral policies provide financial breathing space to cash-strapped borrowers. However, deferred payments must be later repaid and it so increases credit risk for banks. Hence policy prudence is vital.

On March 29 2020, NRB directed BFIs to allow a moratorium period and defer the recovery process of all the instalment-based loans whose instalments were due on mid-April 2020 through mid-July 2020 without any penalty charges for such deferral. The tenure of short-term loans due in mid-April 2020 was automatically increased by 60 days. It was an immediate response to COVID-19 by NRB. However, NRB was sure that these relief packages were not sufficient

for addressing the problem, which was growing in the days ahead.

After further analysis of the situation discussion with the stakeholders and realizing the needs of the time, NRB announced the monetary policy for 2020/21 with miscellaneous relief packages and subsequent to this, it issued the related directive. The new directive categorized COVID-19 affected sectors in 3 profiles – the highly affected, moderately affected, and least affected. For projects where commercial operation had not commenced, as per the new directive, a grace period of 1 year, 9 months and 6 months were allowed for highly affected, moderately affected and least affected sectors respectively but up to 2 years for hotels. The interest of the added grace period should be recovered in minimum 3 instalments within the new grace period.

Regarding interest accrued up to mid-July 2020 on loans of highly affected, moderately affected and least affected sectors, such interest can be repaid within mid-July 2021 (4 instalments), mid-April 2021 (3 instalments) and mid-Jan 2021 (2 instalments) respectively.

For projects where commercial operation had begun, one-time special rescheduling or restructuring has been allowed within mid-Jan 2021 only after at least 10% of the due interest recovery upfront. Such loans can also be treated as good loans with 5% provision if good on mid-Jan 2020. In case the of working capital type loans, a time extension has been allowed up to mid-Jan 2021.

Similarly, additional special packages have been announced for highly affected sectors. These packages include the 20% additional working capital facility (of the limit on mid-April 2020), relaxation on the debt to equity ratio, and the single obligor limit. However, these facilities were allowed only for meeting specified expenditures and the repayment period should not exceed one year. Later these facilities were extended to borrowers profiling moderate impact. Similarly, for hydropower projects exporting power, banks and financial institutions have to extend loans with interest rate not more than 1% above the base rate.

Regarding interest capitalization, it has been allowed for those already approved to cover the interest accrued up to mid-Jan 2021. For the hydropower project where commercial production has commenced but not operating fully due to lack of transmission line, partial interest capitalization has been allowed for

such period.

The LTV ratio for personal residential home loan has also been increased up to 60% from the earlier 40% for the Kathmandu valley and to 50% for outside the Kathmandu valley. Directives related to this genre are presented in <Table 3-21>.

<Table 3-21>

Liquidity Support

Date	Policy/Directive	Objective
March 29	Defer the recovery process till mid-July 2020 for all term loans outstanding till mid-March 2020	Develop market confidence and accommodate market needs
March 29	The tenure of short-term loans was automatically increased by 60 days	Minimize the impact of cash flow disruptions
March 29	Interest capitalization period extended till the period of mid-July	Facilitate projects under construction
April 28	Additional 10% working capital limits	To address the working capital needs of the business
July 27	Monetary policy of 2020/21 categorized COVID-19 affected sectors in 3 sectors, highly affected, medium affected and least affected. Highly Affected: ▪ A grace period of 1 year ▪ Rescheduling and restructuring ▪ Additional 20% working capital loan, repayment of instalments can be done up to mid-July 2021 Affected: ▪ Grace period of 9 months ▪ Rescheduling and restructuring ▪ Repayment of instalments up to Chaitra 2077 (mid- April 2021). Least affected: Grace period of 6 months. Repayment of the instalment was postponed till mid-January 2021.	
July 27	Time extension for demand loans, cash credit loans up to mid-January 2021.	Minimize the impact of cash flow disruptions
July 27	Relaxation in LTV, debt to equity and single obligor limit	To stimulate demand in the economy
September 8	Additional 20% working capital for COVID-19 impacted business	The provision was broadened to cover all COVID-19 impacted business

Source: Nepal Rastra Bank

(4) Support to Small and Medium Enterprises (SMEs) and Priority Sector

The refinance facility provided by NRB was redesigned completely in the wake of COVID-19 to focus credit assistance to SMEs and provide liquidity to all facets of the economy. With the issuance of 「the Nepal Rastra Bank, Refinance Working Procedure, 2077」, the scope of the refinance facility and the size of the refinance fund were broadened to include the business and sectors affected by COVID-19.

Also, BFIs were allowed to report the loans under the existing category of "priority sector" if loans were given to the hospitals that were focusing on maintaining facilities for the treatment of COVID-19. Similarly, a policy provision was made in the monetary policy of 2020/21 whereby BFIs had to allocate at least 15% of their total lending to the agricultural sector (an increase from 10%) up to mid-July 2023. Similarly, such a minimum lending requirement was set at 10% for the energy sector and the SME sector each and these must be maintained until mid-July 2024. Similarly, the concept of developmental bonds was introduced in the monetary policy whereby BFIs can issue agricultural bonds and energy bonds. A list of directives related to this genre are presented in <Table 3-22>.

<Table 3-22>

Support to SMEs and Priority Sector

Date	Policy/Directive	Objective
March 29 /April 28	Refinancing raised to Rs 60 billion, refinance rate maintained at 2% while the interest rates a bank charges for such kind of loans cannot exceed 5%.	Increase market confidence while reducing the cost of borrowing
March 29	Reporting allowed under the "priority sector" if lending done to hospitals wanting to enlarge their facilities for the treatment of COVID-19 patients.	Assist the emergency need of the health care system
July 21	"Nepal Rastra Bank, Refinance working procedure,2077" issued	Make the refinancing facility more inclusive and accessible

Source: Nepal Rastra Bank

(5) Asset Quality recognition

As per the new directive, for all loans which were good in mid-January 2020 and disbursed after mid-January 2020 but both are classified as otherwise in mid-July 2020 as per normal provision, such loans can be treated as pass loan with only 5% provision for mid-July 2020. This 5 % provisioning requirement is to maintain an adequate cushion for absorbing losses in the case of loans that potentially degrade in future.

Similarly, for projects with more than one-year grace period, the provisioning requirement can be met on an annual pro-rata basis. For cash crop farming like silk, jute, cotton, mango, orange, kiwi, dragon fruit, lemon, litchi, avocado, etc. provisioning of 0.2%, 0.6% and 1% is required for the first three years, respectively. The following directives were issued to BFIs on asset quality recognition.

<Table 3-23>

Asset Quality Recognition

Date	Policy/Directive	Objective
March 29	Classification of pass category of loans	To assist provision requirements that was unduly affected by lockdown
April 28	Relaxed to classify the pass category of loans as the watch list for not being renewed during this lockdown	To assist provision requirements that were unduly affected by lockdown
July 27	5% provision for loans that would have been downgraded from pass category	To Maintain a cushion for future prospective losses
July 27	Annual pro-rata provisioning in case of projects with more than a one-year grace period, and relaxed provisioning for the first three years for specified agro-farming	To ease project repayment and encourage high value agro-farming

Source: Nepal Rastra Bank

(6) Macro-prudential Regulation

(a) Relaxation of Buffers

Capital and liquidity buffers support credit expansion in times of crisis. Basel III countercyclical capital buffer (CCyB) is best suited to support lending during a downturn and is designed to sustain financing in difficult times. In the context of COVID-19, NRB deactivated CCyB, which was supposed to come into effect in the mid-July 2020.

<Table 3-24>

Macro-prudential Adjustments

Date	Policy/Directive	Objective
March 29	Countercyclical buffers relaxed	Avoid the unwanted build-up of capital during times of stress
March 29	10% discount on interest for those borrowers who want to pay their instalments before mid-April 2020	Provide some relief for borrowers impacted by disruptions in cash flow
March 29	Sanction loan within 5 working days for certain urgent needs in sectors defined	Address the need for healthcare and travel and transport sector promptly
April 28	Directed BFIs to lower their interest rates by 200 basis points for the fourth quarter of FY 2076/77 for a certain defined sector	Provide some relief for borrowers impacted by disruptions in cash flow and lower overall cost of borrowing
July 27	Dividend allowed only up to 30% of the distributable profit, subject to cap of weighted average interest on the deposit	Develop a cushion in the banking system to absorb future losses

Source: Nepal Rastra Bank

(b) Discount on Interest Rate

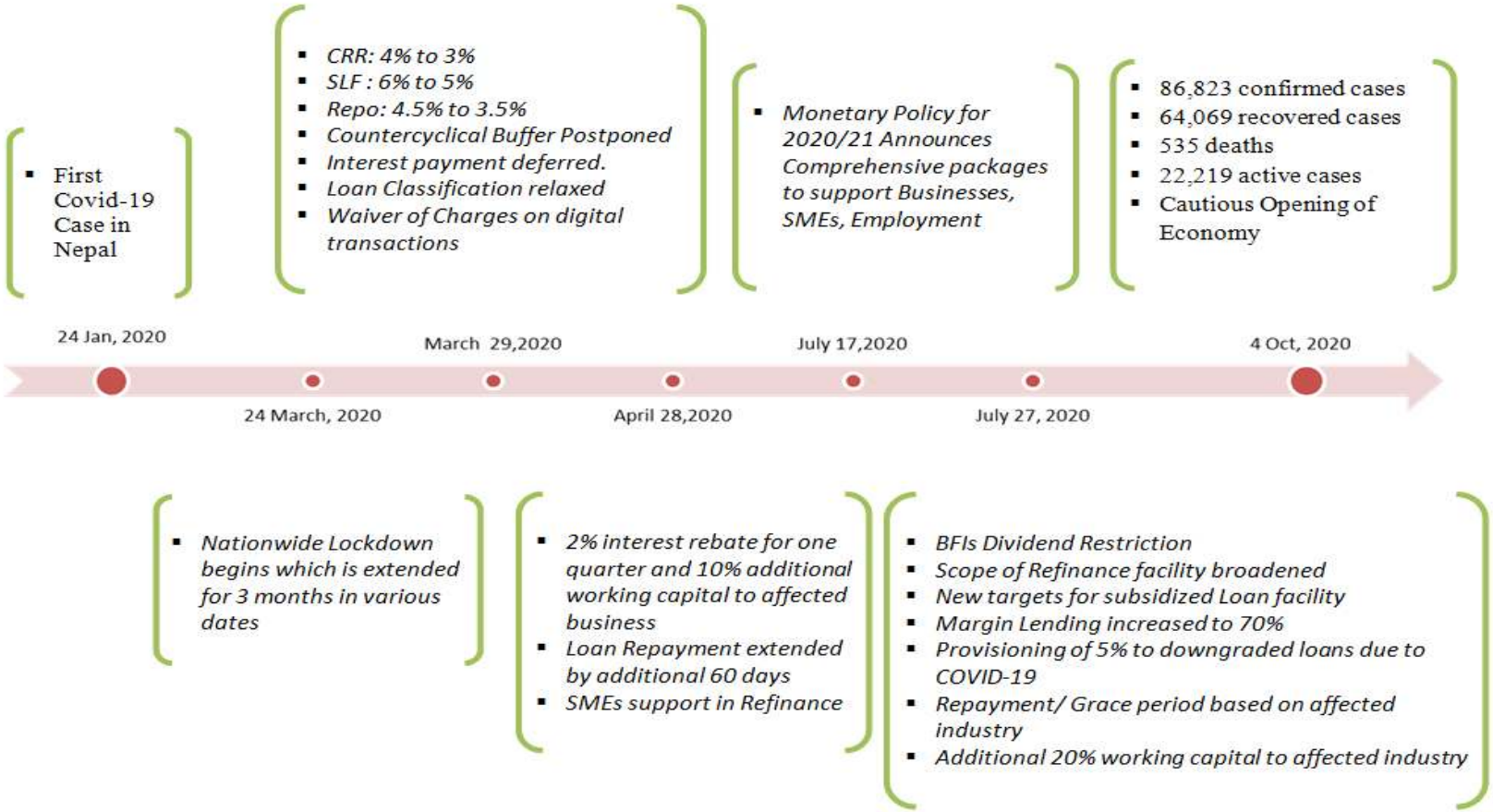
During the initial phases of the lockdown, NRB directed BFI's to provide a 10% discount on interest for those borrowers who wanted to pay their installments before mid-April 2020. Similarly, in the next phase, NRB directed the BFIs to lower their interest rates for COVID-19 impacted business by 200 basis points while calculating the interests for the quarter of mid-April 2020 to mid-July 2020.

(c) Dividend Payout

BCBS recommends that relaxation of capital requirements should go together with constraints on the payment of dividends the as the joint action will simultaneously help expand banks' lending capacity and enhance their ability to absorb losses (FSI Briefs; Banks' dividends in COVID-19 times, May 2020). Under the discretionary supervisory action, the monetary policy of FY 2020/21 put restrictions on BFIs for dividend pay-outs from the profits of the fiscal year ending in June 2020. Dividend for FY 2019/20 is allowed up to 30% of distributable profit subject to a cap of cash dividend not greater than the weighted average interest on the deposit. Following directives were issued to BFIs on Payment Deferral, Restructuring and Rescheduling.

<Figure 3-38>

Timeline of Policies from NRB



Source: Nepal Rastra Bank

<Box 3-5>

Financial Stability after COVID-19

The World Bank defines a stable financial system as one "which is capable of efficiently allocating resources, assessing and managing financial risks, maintaining employment levels close to the economy's natural rate, and eliminating relative price movements of real or financial assets that will affect monetary stability or employment levels."

Financial stability is associated with the ability to facilitate and enhance economic processes, manage risks, and absorb shocks because in stability, the system will absorb shocks primarily via self-corrective mechanisms, preventing adverse events from having a disruptive effect on the real economy or on other financial systems (World Bank).

In the context of COVID-19, it is important to identify key challenges to financial stability in Nepal. The severity of this sudden economic slowdown caused by COVID-19 is still unknown. The challenges brought about by the COVID-19 are unique. The following are a few areas that are crucial for maintaining financial stability in Nepal.

- Provide policy support to households and businesses with an objective of bolstering production and consumption.

- Promote banks and financial institutions to continue lending but be vigilant to avoid moral hazards. Continuous monitoring of risks, rigorous capital planning, and stress testing is required.

- Analyze financial channels and macro financial linkages that could amplify the negative economic/financial impact and spillover of the COVID-19 outbreak.

- Calibrate and cautiously taper relief measures balancing growth and stability.

<Table 3-25>

Summary of Policy Measures

Sector	COVID-19 Effect	Policy Measures	Comments
Financial Sector			
FX rates	Stable	No interventions	Pegged to INR
FDI	Increase	No interventions	Anticipated Growth
Capital Outflows	No	No interventions	Portfolio Investments not allowed
Liquidity	Increase/Adequate	Decreased CRR, SLR, Bank Rate, Refinancing and increase in CCD	Adequate for revival cycle
Equity Prices	Stable	No interventions	Normal fluctuations seen
Operational Risk	Possible	BFIs implement business continuity through various measures	No reported operational risk event
Solvency	No	Constant monitoring	Financial indicators remain strong
Capital Adequacy	Adequate	Limit in dividend pay-out, relaxation in capital buffers	Capital adequacy position comfortable
Lending Capacity	Adequate	Refinancing, lending in specified sectors	Increase in Lending seen since August 2020
Public Finance			
Expenditure	Growth as anticipated	Cautious to minimize current expenditure	Expected to be normal growth

Source: Nepal Rastra Bank

<Table 3-25>

Summary of Policy Measures (Continued)

Sector	COVID-19 Effect	Policy Measures	Comments
Public Finance			
Revenue	Decline particularly April 2020- July 2020	Ease of Lockdowns and border restrictions with cautious measures	Decline due to border closure and decreased trade volume. Expected to increase with ease of lockdowns, opening of border
External Position			
Net Exports	Decline	Ease of Lockdowns and border restrictions with cautious measures	Decline due to border closure and decreased trade volume. Expected to increase with ease of lockdowns, opening of border
Net Imports	Decline	Ease of Lockdowns / Opening of border with cautious measures	Decline due to border closure and decreased trade volume. Expected to increase with ease of lockdowns, opening of border
Domestic Position			
Demand	Decline	Ease of Lockdowns / Opening of border with cautious measures	Decline due to border closure and decreased trade volume. Expected to increase with ease of lockdowns, opening of border
Supply	Overall decline but normal for essential items	Ease of Lockdowns / Opening of border with cautious measures	Decline due to border closure and decreased trade volume. Expected to increase with ease of lockdowns, opening of border

Source: Nepal Rastra Bank

4. Policy Responses to COVID-19 over the World

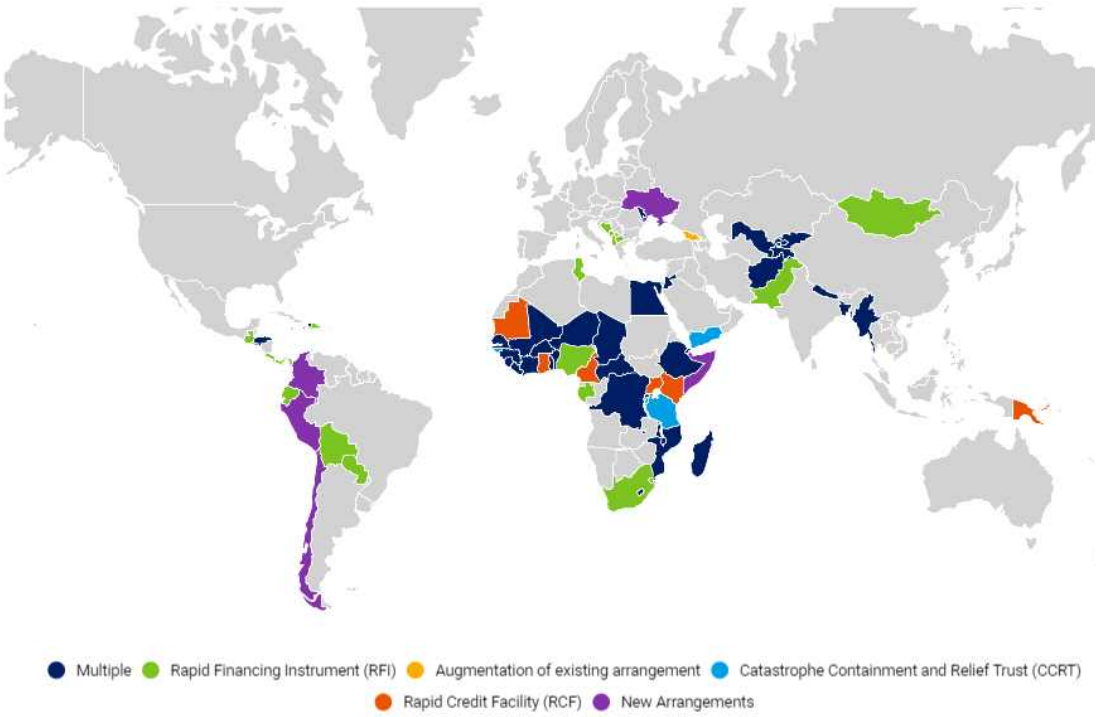
A. IMF Financial Assistance

The IMF actively provides financial assistance to its member countries that underwent a shortage of liquidity due to the COVID-19 pandemic.

Since late March 2020 until August 19, 2020, the IMF has supplied liquidity, under various lending facilities, to 80 countries. The total amount of liquidity the IMF extended is approximately $250 billion (U.S. dollar), which is about 25% of its $1 trillion lending capacity. <Figure 3-46> shows the countries that received financial assistance and debt service relief from the IMF.

<Figure 3-39>

Countries Receiving Assistance and Debt Service Relief



Source: International Monetary Fund

<Table 3-26>

IMF Financial Aid

Type	Details
Rapid Credit Facility	- rapid concessional financial assistance with limited conditionality to low-income countries - address an urgent balance of payments need
Rapid Financing Instrument	- rapid financial assistance available to all member countries - address an urgent balance of payments need
Debt Service Relief from the Catastrophe Containment and Relief Trust	- grants for debt relief for the poorest and most vulnerable countries hit by catastrophic natural disasters or public health disasters

Source: International Monetary Fund Website

B. Other Central Banks' Policy Response to COVID-19

The IMF provides extensive information on 196 member countries' policy responses to the COVID-19 pandemic to effectively address the pandemic by sharing various policy measures taken by central banks and governments. The 「Policy Tracker」 is found on the IMF homepage.[9] For each country, the policy tracker give information on COVID-19 situation, reopening of the economy, fiscal policy, monetary and macro-financial policy and exchange rate and balance of payments.

East Asian countries are actively responding to the pandemic. Taking a look at fiscal policies, almost all countries have implemented cash transfer programs to the poor and the vulnerable, tax relief or exemption, and allowance subsidies for main industries. For instance, Myanmar decided to give 2% tax exemption on exports and Cambodia adopted a new monthly cash transfer program (USD 300 million) for poor and vulnerable households.

Focusing on East Asian countries, central banks in the region cut their benchmark rates and relaxed their supervisory rules.

- Myanmar: The Central Bank of Myanmar cut the policy interest rate three times : 0.5% points on March 12, 1% point on March 24, and 1.5% points on May 1.

9) https://www.imf.org/en/Topics/imf-and-COVID19/Policy-Responses-to-COVID-19

- Cambodia: The National Bank of Cambodia postponed planned increases in the Capital Conservation Buffer and lowered required reserves for domestic and foreign currencies.

- Sri Lanka: The Central Bank of Sri Lanka decreased policy interest rates by 200 basis points since March and lowered required reserves ratio of commercial banks by 3% points.

- India: On March 27, the Reserve Bank of India lowered RP and reserve RP rates by 115 bps and 155 bps, respectively, and temporarily reduced the Liquidity Coverage Ratio (LCR).

- Vietnam: The State Bank of Vietnam lowered its base rates twice: 50～100 bps in March 17 and 50 bps on May 13. Also, the State Bank of Vietnam cut the short-term deposit rates cap by 30～50 bps.

- Thailand: The Bank of Thailand lowered its policy rates by 75 bps (1.25% → 0.50%) in 2020. The Bank also relaxed loan repayment conditions so that SMEs are given suspension of repayment of principal and reduction of interest payment.

<Table 3-27>

IMF Web Sources on COVID-19

	URL
Policy Tracker	https://www.imf.org/en/Topics/imf-and-COVID19/Policy-Responses-to-COVID-19
COVID-19 Financial Assistance and Debt Service Relief	https://www.imf.org/en/Topics/imf-and-COVID19/COVID-Lending-Tracker
IMF COVID-19 HUB	https://www.imf.org/en/Topics/imf-and-COVID19
More Detail on Fiscal Actions	https://www.imf.org/~/media/Files/Publications/fiscal-monitor/2020/April/English/onlineannex11.ashx
Tracker of COVID-19 Responses to Facilitate Financial Access	https://www.imf.org/~/media/Files/Topics/COVID/2020-fas-COVID-19-policy-response-tracker-smes-and-mobile-money-080320.ashx

Source: International Monetary Fund Website

The IMF plays a key role in gathering and sharing member countries' policies and important economic and financial issues related to the pandemic. <Table 3-27> shows useful web sources provided by the IMF.

<Box 3-6>

Potential Labor Market Consequences of Labor Mobility Disruption

One characteristic of the Nepalese economy is the importance of Nepalese workers working abroad (i.e., labor emigration). Since the COVID-19 pandemic brought heavy restrictions on international labor mobility, its economic consequences are likely to extend beyond the reduction of remittances sent by the Nepalese workers working abroad. Here, we postulate its labor market consequences, based on the related economic literature on the European experiences. In the European Union (EU hereinafter), labor mobility largely flows from the newer and less rich member states in central and eastern Europe (e.g., Lithuania and Romania) to the older and richer member states in western Europe (e.g., France and Germany). Studies that analyze the impact of this labor migration on the sending counties' labor market and human capital can offer valuable implications for Nepal.

For instance, Elsner (2013a) analyzes the impact of the increase of labor emigration from Lithuania following the country's accession to the EU in 2004 on domestic wage. Applying the clustering method proposed by Borjas (2003) to the data from 2002 to 2006, he finds that a one percentage-point increase in emigration rate increases actual domestic wage by 0.67%. One natural explanation for this finding is that labor emigration (i) reduces the domestic labor supply, which in turn puts an upward pressure on the domestic wage, while (ii) shifting the domestic distribution of skill levels towards left, because more skilled workers are more likely to emigrate, which in turn lowers domestic productivity and puts a downward pressure on domestic wage. And labor emigration results in a wage increase when the former effect dominates the latter. Based on this idea, Elsner (2013b) extended the theoretical model of Card and Lemieux (2001) and predicted that labor emigration increases the domestic wage for young people because the first

effect is likely to dominate the second effect among young people, while it will have no impact for older people, for whom the two effects cancel each other out. The wage distribution by skill level is also predicted to be not affected.

In a similar vein, Mayr and Peri (2009) built an overlapping generations (OLG) model in which individuals decided on (i) the level of education, (ii) whether to emigrate, and (iii) if they emigrated, whether to come back to the home country. They found that, surprisingly, labor emigration results in a brain gain, rather than a brain drain, in the sending country. This is because (the possibility of) working in a richer country increases the expected return on human capital, which in turn increases the human capital investment in the sending country. If there is a labor market premium in the sending country for those who have emigrated to a richer country and come back, it enhances the aforementioned brain gain effect of labor emigration.

These studies offer a couple of implications for the Nepalese economy in the context of COVID-19. First, the emigration disruption of Nepalese workers can increase the domestic labor supply ceteris paribus, which, combined with the reduction of labor demand due to the economic slowdown, can put heavy downward pressure on the domestic wage. Unless the foreign demand quickly recovers, which is not very likely, this can result in a reduction in the aggregate demand, starting a vicious circle.

If the possibility of working in a richer country was offering a significant incentive for human capital investment in Nepal in the pre-COVID-19 era, as in the case of eastern Europe described above, the sudden cut of that possibility and the uncertainty in its future can seriously reduce the incentive for human capital investment, at least in the short run; and this, combined with the difficulties in learning and training already imposed by the pandemic, can reduce the productivity of people who are in the prime age for human capital accumulation at this moment. These negative outlooks imply the need for the Nepalese government to think seriously of the negative impacts of COVID-19 on the labor market and human capital. When designing policy measures to counter the negative impacts of COVID-19, the Nepalese government needs to take these aspects into consideration.

5. Important Consideration in Policy Making

This section suggests several important factors that NRB must consider in making policies in response to the COVID-19 pandemic. Thus, this section does not include some factors relevant to the government (e.g., fiscal policy).

<Box 3-7>

Granger Causality of COVID-19 between India and Nepal

To minimize the effects of the COVID-19 shock on the Nepalese economy, reducing the newly infected is the most urgent and important thing to be solved. The best way to curb increasing new infection is to restricting immigration from India to Nepal. A simple Granger Causality result using daily new cases support this suggestion. We do not have enough information on what kind of immigration restriction measures are running and how effective the measures taken by Nepal are. However, the Granger Causality results suggest that increasing Indian cases granger causes increasing Nepalese cases.

<Table 3-28>

Granger Causality Results (India → Nepal)

Lags	Prob > chi2
5	0.000
10	0.000
15	0.000

A. Potential Problems

(1) Massive & Non-selective (Less Selective) Liquidity Injection

Since the COVID-19 pandemic, a rare type of economic shock occurred suddenly and simultaneously over the world and the pandemic shock directly affected both real activity and the financial sector, central banks quickly took

several measures injecting massive liquidity in various ways to financial institutions and non-financial firms and relaxing regulation requirements on financial institutions. Overall, this liquidity injection measure is evaluated as an adequate or inevitable policy choice of central banks.

However, policy makers are perfectly uncertain about how long the pandemic will last, while we already know from historical experience that a massive liquidity injection brings several critical side effects. Liquidity is a financial resource and efficient resource reallocation is a crucial factor that guarantees the sustainability of economic growth and the soundness of the banking system. Massive liquidity injection or non-selective financial subsidies might help to avoid a temporary crisis when an adverse shock comes. However, it is likely to hamper the productivity of firms and cause a moral hazard, which brings persistently negative effects or more serious effects on the economy and the banking system. It might hinder rapid recovery from recessions and bring prolonged recessions.

(2) Side effects of Massive liquidity Injection

Massive liquidity injections have an effective and direct policy effects that pacifies financial instability and channels liquidity to businesses. Nonetheless, this policy measure causes several serious problems that have negative long-run effects such as credit misallocation, soaring NPLs, and forming zombie firms

(a) Credit Misallocation

Central banks' emergency measure of credit expansion definitely has several positive effects on keeping the financial stability and boosting the economy. For instance, extending credit to very weak firms keeps them survive and maintain employment. In addition, it is helpful for production by maintaining supply chains.

However, it causes potential problem of credit misallocation. The economic literature documents that credit misallocation has negative effects on the dynamism of the economy and credit markets, reducing potential economic

growth and productivity, forming moral hazard and agency problems. More specifically, credit misallocation means that firms with high productivity or good investment opportunities tend to receive insufficient amounts of credit, while insolvent or less productive firms are likely to get loans that exceed their needs. Then, firms with poor performance spend credit in overinvestment or pursuing managerial profits. On the other hands, firms with high productivity or good investment opportunities tend to invest less than their optimal levels. Consequently, capital misallocation occurs following credit misallocation. This is a phenomenon that Korea experienced before the 1997 financial crisis.

- Schivardi et al. (2017) : The paper investigates credit misallocation occurred in Italy during the European financial crisis and finds interesting evidence on it. First, unhealthy banks are less likely to reduce credit to non-viable firms. Second, credit misallocation results in an increase in the failure rate of healthy firms and a reduction in the default rate of non-viable firms. Third, banks with low capital play a key role in bringing aggregate inefficiency in the long run.

- Borio et al. (2016) : They use 20 advanced countries' data to investigate how credit expansion eventually causes serious impacts on productivity. They find evidence that credit expansion is likely to undermine productivity growth with a channel that more labor is allocated to less productive sectors. Also, they show that a misallocation generates another misallocation, which is hysteresis effects of misallocation.

- Gopinath et al. (2015) : Using the data on European countries, the paper reveals that credit misallocation leads to capital misallocation from which productivity losses stem.

(b) Soaring NPLs and Under-capitalization at the mid-term horizon

It is a stylized fact that fast and massive loan expansion results in growing NPLs and eventually the under-capitalization of banks with a time lag (usually 2

or 3 years). During the loan expansion period, loan default rates are marginal and borrowers seem to have repayment abilities. However, massive lending means that lenders neglect borrowers' repayment abilities and do not allocate credit in terms of firms' profitability and investment opportunities. These moral hazard and adverse selection problems are realized two or three years after loan expansion. A growing number of firms turn out being insolvent and cannot afford to pay back their debt. Then, the NPLs grow to the extent that lenders are undercapitalized. This is a common process for how massive loan expansion undermines the stability of individual banks and the whole banking system.

- **Foos et al. (2010)** : They investigate how rapid expansion of loans affect banks' performance using data from individual banks in 16 countries from 1996 to 2007. They show several important findings. First, abnormally fast loan growth resulted in significant loan losses for individual banks. Second, if new loans are extended at low lending rates, banks receive relatively lower interest income. So rapid expansion of loans with low interest rates does not enhance the profitability of individual banks. Third, fast loan growth has a negative influence on bank solvency.

- **Keeton (1999)** : This paper is an earlier work that examined how loan growth leads to higher NPLs and lower stability of banks. When lenders increase the supply of loans, they cut the lending rate charged on new loans and relax their lending standards for new loans. For instance, they reduce the amount of required collateral the borrower has to pay or extend loans to borrowers with weaker credit histories. These behaviors can be regarded as behaviors driven by moral hazard and increase the possibility that borrowers will eventually default on their loans. Thus, increases in lending are likely to lead to higher loan losses in the future.

- **Salas and Saurina (2002)** : The paper uses data from Spanish banks from 1985 to 1997 to investigate how faster loan growth affects banks' soundness and future growth. It concludes that steady growth is the best strategy to keep problem loans at a low level.

- **Soedarmono et al. (2017)** : They investigate 161 banks in Asian countries (China, Japan, Hong Kong, South Korea, Indonesia, Malaysia, Philippines, Singapore, and Thailand) for the 1998-2012 period finding very similar results to prior studies.

If the economy recovers from recession in two or three years when the NPL problem is realized, then the bad effects might be mitigated. However, if the recession is prolonged and the NPL problems occur before the economy rebounds, then the recovery of the economy is likely to be delayed, which is one of the worst cases.

(c) Evergreening and zombie firms

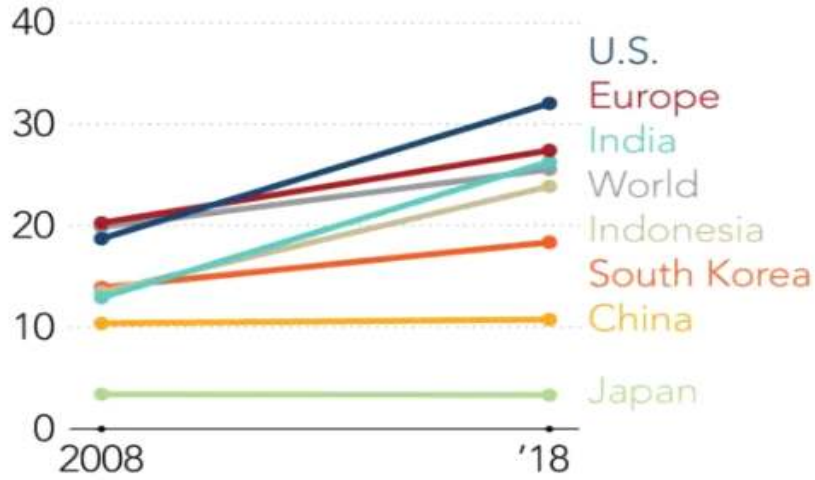
Misallocation of credit and zombie firms are extremely serious economic problems in Japan. This was mostly a problem for Japan in the early 2000s. However, many countries experience zombie firm problems after the global financial crisis. Zombie firms can be defined in various ways.

A simple definition of a zombie firm is a firm that is highly indebted and poor performing so that it cannot generate sufficient revenues to pay back its interest expenses and repeatedly refinance its loans to survive. <Figure 3-47> demonstrates that the portion of zombie firms is increasing around the world, although rates of increase differ across countries.

<Figure 3-40>

The Trend of Zombie Firms

(unit: %)



Source: Nikkei Asian Review (2019)

Extending loans to zombie firms makes lenders vulnerable to economic shocks while also undermining financial stability.[10] One important thing to note is that the zombie firm problem also occurs in developing countries. In particular, financial friction or credit market intervention by governments are more severe in developing countries, and consequently, these countries have an environment conducive to nurturing zombie firms, which eventually leads to the low productivity of such businesses and financial vulnerability. As the proportion of zombie firms increases, economic growth naturally lowers, and the economy is more likely to be vulnerable to external shocks. In addition, channeling credit to zombie firms might suggest that normal firms with superior capabilities receive insufficient liquidity to invest and hire, which deals a blow to the functioning industrial sector of the economy.

10) Extending loans to zombie firms to make them survive is called evergreening. Evergreen lending to zombie firms distorts market discipline of credit markets (Peek and Rosengren, 2005).

<Box 3-8>

Zombie Firms in Korea and COVID-19

A news media, Korea Herald, reported on July 20, 2020 that Korea is experiencing an increase in zombie firms, especially after the COVID-19 pandemic. This leads to the increasing problem of zombie firms ruining the manufacturing sector's labor productivity, which negatively affects the aggregate economic activity of the economy. According to the Bank of Korea, 9.5% of

76,753 Korean manufacturing firms are a zombie state. This portion has increased from 7.4% to 9.5% in the last 8 years. Such firms can be a serious burden to lenders. Furthermore, due to demand shocks caused by COVID-19, coupled with credit injection, there is a pronounced possibility that more firms will enter into the zombie state.

- **Peek and Rosengren (2005)** : This is a seminal paper examining zombie firms in Japan during the last decade. When the banking crisis occurred in Japan, almost 50% of credit injection to lenders was allocated to distressed firms to help them survive, causing a serious zombie firm problems and leading to a prolonged recession. The authors point out that one reason that zombie firms formed was government pressure on banks to provide loans to financially vulnerable firms. This finally resulted in high NPLs, making banks under-capitalized.

- **OECD (2017)** : Investment in normal firms is larger than that of zombie firms. Furthermore, when zombie firms dominate in a market, called zombie congestion, new firms are unlikely to enter the market. Interestingly, in this state, only firms with high productivity can enter the market. Because wage is inflated in the market due to zombie firms, new entrants must be highly productive enough to afford labor expenses. However, high current expenses undermine young firms' growth. Firms in an industry with serious zombie firm congestion show quite low firm-level productivity and low employment growth.

- **Tan et al. (2015)** : They investigate the phenomenon of zombie firms in China. First, as zombie firms exit, industrial output grows at a higher level and capital accumulation rises. The more dominant that state-owned banks are in credit markets, the more likely it is that zombie firms will increase, suggesting that government intervention in credit allocation hampers market discipline and increases misallocation of credit. Credit injection to zombie firms increases capital investment in those firms resulting in a crowding out effect on investment in normal firms.

- **Fukuda and Nakamura (2011)** : This paper examines how Japanese zombie firms recovered in the mid 2000s. It suggests that reducing the number of employees and selling fixed assets mitigated the financial burdens of zombie firms and facilitated liberation from the zombie state.

B. Policy Recommendations

(a) Selective Liquidity Allocation (Using Supply Chains)

Shortly after the outbreak of the COVID-19 pandemic, many central banks started to provide emergency liquidity to businesses and purchase eligible corporate bonds. In particular, NRB took measures to provide working capital loans and priority lending to SMEs.

It is a dilemma for banks to choose target firms to receive emergency liquidity. Based on liquidity demand, less productive or profitable firms should receive funds. On the other hand, considering the aftermath of ad hoc credit injection, it should be important to channel emergency liquidity to productive and profitable businesses or those with low debt. However, the effect of supporting such businesses may be weaker compared to the former.

An alternative strategy to rescue businesses and maintain the real economy is to focus on allocating credit to supplier firms in supply chains. In the supply chain, supplier firms sell their products or raw materials to client firms. Usually, client firms delay their payment to suppliers. In other words, suppliers provide

informal credit to client firms.

This type of credit is called trade credit. Trade credit is short-term, informal credit between suppliers and client firms. As Boissay et al. (2020) and Garcia-Appendini and Montoriol-Garriga (2013) emphasize, trade credit is an important source of external financing for both large firms and SMEs. Furthermore, problems between lenders and borrowers, such as financial friction and informational asymmetry, is less severe in supplier-client relationships, as the literature documents, because they share soft and confidential information. Boissay et al. (2020) point out that the amount of trade credit accounts for around 20% of GDP over the past 25 years.

Since a supplier-client relationship is exceedingly important to all firms in the supply chain, supplier firms have various incentives to provide financial support to financially constrained client firms. A lot of evidence demonstrates that financially vulnerable firms are more likely to receive more trade credit during a credit crunch than they received before a credit crunch. In the literature, the former is called “redistribution theory”, while the latter is called “substitution theory”.

Hence, by injecting more liquidity to key players in the supply chain, we can achieve the policy goal as much as possible. When the key player is in a client position, it can provide financial support to their suppliers by paying their suppliers without delay or up front. Meanwhile, when the firm is in a supplier position, it can provide longer-term and larger trade credit to their client firms. In that way, policy makers can maximize the policy impacts on businesses.

(b) Recognization of cognitive bias

The current policymaking situation is characterized as future uncertainty and asymmetric information. In such a situation, central banks’ rationality is more likely to be bounded. Namely, they have to assume bounded rationality, not perfect rationality when they make policy decisions regarding COVID-19. Thus, NRB has to recognize whether it suffers from cognitive biases, such as illusion of control, confirmation bias, selective perception, loss aversion, or sunk cost fallacy and figures out a way to avoid them (Lee, 2016).

<Box 3-9>

Trade Credit and Unconventional Monetary Policy

Adelino et al. (2020) report very brand new and interesting findings on trade credit financing. Firms with bonds eligible for purchase programs implemented by European Central Bank increase their provision of trade credit to their client firms, especially financially constrained customers. Furthermore, customer firms who receive trade credit from their suppliers increase both investment and employment. This NBER working paper confirms that by considering the supply chain and trade credit, central banks can maximize their policy goals and minimize the side effects of liquidity injection.

(c) Monitoring the Efficiency or Stability of Credit Allocation

Credit easing usually leads to misallocation of credit. Hence, NRB needs to assess how efficiently its credit is allocated. Efficiency of credit allocation from the perspective of the entire credit market is totally different from bank-level or firm-level efficiency of credit usage.

After the global financial crisis, efficiency of credit allocation became an increasingly important issue for academic researchers and policy makers. Recently, a simple way to measure the efficiency of credit allocation was suggested by Hyun and Minetti (2019) and Mead and Roland (2020). Using this index, NRB can monitor the market-level efficiency of credit allocation and investigate how credit is allocated in terms of financial stability.

(d) Monitoring Liquidity Buffers

To prevent lenders (BFIs) from being insolvent or under-capitalized at a mid-term horizon, it is critically important to induce lenders to maintain a sufficient capital buffer. In this regard, the relaxation of capital buffers assumed by NRB has the possibility of bringing about negative effects on banks' stability. Although this measure has a legitimacy to ease credit market conditions, it is recommended as only a temporary measure. In line with this recommendation,

the governor of the FSS, the Korean financial watchdog, requested lenders to build up sufficient capital buffers to prepare for a possibility that COVID-19 would be more prolonged than expected. If COVID-19 is ongoing into 2021, it is obvious that business loan defaults will increase and, consequently NPLs will also increase. This is the time for central banks to prepare for the worst scenario.

<Box 3-10>

Import Prices and Nepalese Domestic Inflation

This short article attempts to understand the linkage between Nepal's import prices and inflation slowdown during the COVID-19 period. Nepal experienced a considerable decline in import sectors after the COVID-19 outbreak. Since Nepal's import dependence is high, the reduction in imports was likely to affect Nepal's real economy and its price levels. In Nepal, import growth (year-on-year) began to decrease to -7.5% in April 2020. In July 2020, the import growth was -15.6%, while export growth was 0.6%, contributing to the current account improvement. Note that Nepal had suffered substantial current account deficits. Nepal's major trading partners in 2017 were India (66% of total imports) and China (13%). Her main import products are machinery, nuclear reactors, boilers, vehicles other than railway, tramway and electrical, electronic equipment (25.5% of total imports), mineral fuels, oil, distillation products, and iron and steel (24.4%).[11] Interestingly, Nepal's inflation had been slowing down since March 2020 (the COVID-19 outbreak), while Nepal Rastra Bank (NRB) achieved a target growth of broad money (M2). It was also found that the three month Treasury bill rate decreased to about 2% in April 2020. Note that the T-bill rate increased to 3.5% in May 2020 but fell to 1.3% in July 2020. Nepalese Rupee (NRP) also depreciated from March, as the Nepalese exchange rate (NRP/USD) increased from 116 to 122 during March.

Currency depreciation raised import prices, thereby increasing the domestic price level. However, a positive link between depreciation and domestic inflation was not observed in Nepal during the COVID-19 period. One might argue that adverse demand shocks driven by COVID-19 hit the Nepalese

economy, thereby reducing the price level. Conversely, at the same time, adverse supply shocks during the COVID-19 period would lead to cost-push type of inflation and stagnation, which contradicts our observation on the inflation slowdown. More interestingly, NRB's domestic monetary expansion would contribute to boosting aggregate demand. However, it was not likely to effectively put upward pressure on the domestic price level. Hence, this article discusses how to explain Nepal's inflation slowdown and takes a hint from the import price pass-through literature as follows.

Previous work, such as Goldberg and Campa (2006), revealed that the exchange rate pass-through into domestic prices is incomplete and delayed. McCarthy (2007) argued that the extent to which exchange rates and import prices affect domestic inflation is of significant concern for central banks. He also showed that import prices have a greater effect on domestic inflation than exchange rates. This pass-through is more remarkable in countries with a larger import share and more persistent exchange rates and import prices. The following studies focused on commodity prices and examined how world prices affect local prices. Bekkers et al. (2017) showed that the transmission of import food price shocks to final consumers is greater in low-income countries than in high-income countries. Ferrucci et al. (2012) analyzed the pass-through of a commodity price shock along the euro area's food price chain, particularly during the 2007–08 food price shock period. Hamilton (2012) reviewed Ferrucci et al. (2012)'s work and derived quantitative prediction on the effect of import price on domestic inflation; if the price of imported commodities increases by 10% and imported commodities account for 20% of the value of final spending, it will push domestic inflation up by two percentage points.

According to these previous works, we conjecture that an emerging country such as Nepal, with larger import shares and relatively lower development levels, would face a greater import price pass-through. We also find that oil and commodity prices had reduced abruptly around March and April 2020 when COVID-19 began to spread, and gradually restored afterward. Thus, a decrease in oil and commodity prices would exert downward pressure on Nepal's domestic inflation, considering Nepal's large import shares of oil and other commodities.[12)]

<Box 3-11>

Nepal's Economy after COVID-19 Outbreak

Nepal's economy largely depends on three major sectors, which are agriculture, tourism, and remittance. The agricultural sector accounts for around 30% of Nepal's GDP, and is the main source of the country's household income and employment. Remittance contributes significantly to Nepal's economy, accounting for 25% of its GDP. This is because Nepal's domestic industry does not absorb local labor supply and 40% of Nepalese workers are lifetime migrants. Tourism is also one of the largest and fast-growing industries in Nepal, taking about 8% of GDP. Due to the spread of COVID-19, Nepal's major industries are undergoing a severe crisis, driving the national economy into a slump. This article will explore predictions and concerns about the economy.

(Nepal's Economy after COVID-19 Outbreak)

Since the first COVID-19 case appeared on 23 January, the virus has been hitting the country severely. As of 4 October 2020, there are 86,823 confirmed COVID-19 cases, and more than 1,000 new cases have appeared in the country since September (see Figures 3-49 and 3-50). A nationwide lockdown came to effect from March to July this year, but the increase in the number of infected people has not subdued even now. As the pandemic's growth persists, Nepal's economy will be dampened in multiple ways.

First, the cross-border lockdown hinders international tourists from visiting the country, and Nepal's tourism sector has been declining since this March as a result. Many employees in the sector, such as trekking guides, have lost their jobs, and the employees in the related sectors, such as restaurants and hotels, have been laid off due to the direct impact of COVID-19.

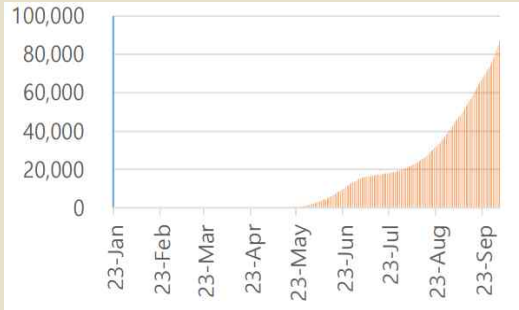
Second, COVID-19 prevents Nepalese migrants from working abroad, and the amount of remittance has been significantly reduced. Due to the restriction of overseas travel, and for safety reasons, many international migrants have been returning back to Nepal. This has resulted in a decrease in international

remittance, which supports Nepal's economy. Also, the downsized domestic economy is unable to support most Nepalese migrants, which will cause a surge in the unemployment rate in the near future.

<Figure 3-41>
GDP Growth Rate, Annual
(unit: %)

Source: Nepal Rastra Bank and Wikipedia

<Figure 3-42>
COVID-19 New Daily Cases
(unit: person)



Source: Nepal Rastra Bank and Wikipedia

(Potential External Factor to Nepal's Economy: India's COVID-19 Outbreak)

Nepal's economy is highly dependent on the Indian economy, as Nepal's largest trade partner and FDI source. For example, most petroleum in Nepal is imported from India, and many Nepalese people work in India. Due to these strong economic ties between the two countries, Nepal's exchange rate was pegged to Indian currency in 1956. As Nepal's economy is largely associated with the Indian economy, maintaining the peg relationship appears to be an appropriate choice for both countries. However, the recent spread of COVID-19 in India has negatively affected Nepal's economy in many ways.

As of 5 October, India has more than 6 million confirmed cases, making it the country with the second-largest number of COVID-19 cases in the world. More than 70,000 new cases have been reported from September. Due to the rapid spread of virus, the Indian economy has been significantly dampened in 2020. In the second quarter of 2020, India's GDP growth decreased by more than 10%. The deteriorated economy in India may depreciate the Indian rupee in the near future, which will indirectly affect the Nepalese economy as well.

First, Nepal's inflation rate may increase. Nepal imports many of its daily necessities from abroad due to its limited manufacturing infrastructure. The depreciation of Indian currency will also lower Nepal's currency value, which will lead to higher import prices. COVID-19 is suppressing the country's gross demand, and given the external sourcing structure of Nepal's economy, inflation from imports may cause more problems in the near future.

Additionally, as Nepal and India's economies are closely intertwined with one another, economic hardship in India will transfer to Nepal. Many Nepalese migrants in India will lose their jobs, and thus the amount of remittance from India to Nepal will decrease. Also, global as well as India's FDI flow into Nepal could shrink since India, a major country in South Asia, is experiencing a severe economic downturn.

(Conclusion)

Prior to the COVID-19 outbreak, Nepal's economy was sound and promising. Its GDP had increased by more than 6% from 2016 and the growth rate reached 7.1% in 2019. However, the outbreak of COVID-19 deeply affected Nepal's economy. To recuperate its economy, many countries and international agencies are providing aid, such as medical supplies or financial support through ODA. The Nepalese government has also introduced a relief package to revive the economy. These supporting measures are helpful in boosting Nepal's economy, but its recovery largely depends on the global economic situation, as Nepal is a small open economy.

11) UNCOMTRADE database 2017.
12) A decrease in Nepalese import growth may lessen the impact of import prices on domestic inflation.

<Box 3-12>

Nepal's Stock Market after COVID-19 Outbreak

After COVID-19 outbreaks spread, stock markets around the globe briefly crashed and then very quickly recovered to pre COVID-19 level. It seems that stock markets were not concerned with the economic downturn of this outbreak. The real asset market has not yet recovered; nonetheless, stock markets have performed well. This article examines how Nepal's stock market has behaved after COVID-19 and shares some thoughts on this.

(Brief Overview of Nepal's Stock Market)

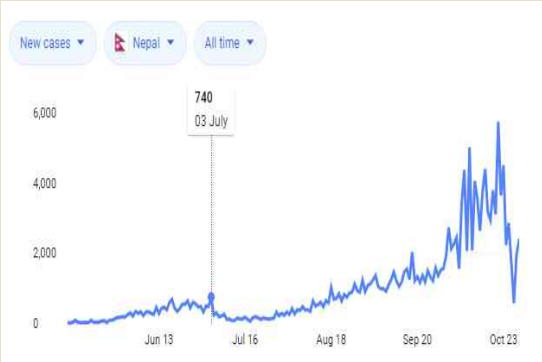
Financial securities in Nepal are mainly traded on the Nepal Stock Exchange (NEPSE, hereafter), which has been in operation since 1994. As of October, 2020, about 270 firms are listed on the exchange and total market capitalization (floated market capitalization) amounts to Rs. 2.1 trillion. Even though dual listing of shares is common in most stock markets, NEPSE's dual listing is a bit different from others. On NEPSE, there two kinds of shares: promoter shares and ordinary shares. Promoter shares are shares owned by government (central banks) mainly invested in financial service firms, and are not liquid because of restrictions in trading, though it has the same voting rights as ordinary shares. There are four major indexes (NEPSE, Sensitive, Float, Sensitive Float indexes) and 12 sub indexes on NEPSE. NEPSE's index is a value-weighted index of firms listed on NEPSE, the Sensitive index consists of big firms (firms that pass certain criteria, such as profitability measures) on NEPSE, and the Float index is a value-weighted index for ordinary stocks. To examine Nepal's stock market, we need to look at the NEPSE index as well as the Float index.

(Nepal's Stock Market after the COVID-19 Outbreak)

Nepal's COVID-19 cases have increased significantly since June and transmission has not slowed down yet, as shown in <Figure 3-43>. <Figure

3-44> shows NEPAL's stock index. On March 1st, the NESPE index was at 1620.27 Points and then the stock market was shut down. After the market was reopened, the index was dropped to 1178.15 points on June 30, due to concerns of an economic downturn. Then, NEPSE index points were gradually increased and recovered to 1,600 points, which was the pre-COVID-19 level.

<Figure 3-43>
COVID-19 New Cases



Source: Google

<Figure 3-44>
NEPSE Index Points

Source: NEPSE.COM

The Sensitive Float index, which is a value-weighted index comprised of the largest ordinary shares, showed a very similar pattern to the NEPSE index. Among 12 sub-indexes, only the hotel index is not fully recovered yet, as shown in <Figure 3-45> and <Figure 3-46>.

<Figure 3-45>
Sensitive Float Index Points

Source: NEPSE.COM

<Figure 3-46>
Hotel Index Points

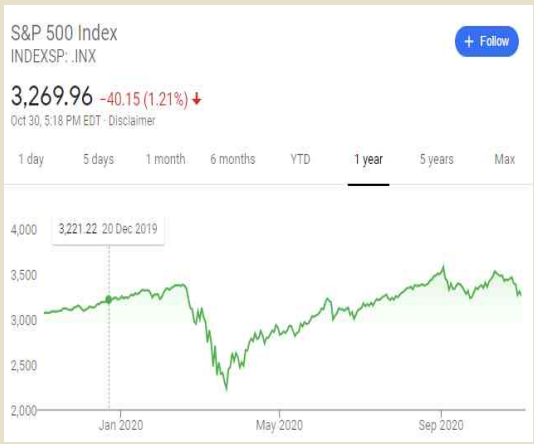
Source: NEPSE.COM

In summary, despite increasing COVID-19 cases and fears of recession, Nepal's stock market briefly dropped and then recovered to its pre-COVID-19 level in a short time. To check whether this pattern is unique in Nepal, we look at India's stock market, as well as the S&P 500. Nepal's economy has close ties with India, so it is ideal to examine India's stock market response to COVID-19.

<Figure 3-47> SENSEX Index Points

Source: Google

<Figure 3-48> S&P 500 Index Points



Source: Google

India has two main stock indexes. One is SENSEX, as shown in <Figure 3-47>. The other is the NIFTY 50. It is not surprising to see India's stock market behave just as that of Nepal. In March, Sensex index points dropped to 26,000 points and then recovered to pre-COVID-19 level in October. The NIFTY 50 shows an almost identical pattern. The S&P 500 index is shown in <Figure 3-48>. The index is dropped to 2,240 points in March and then reached 3,500 points in September. Thus, we found that stock market behavior in Nepal after COVID-19 was not unique and showed a very similar pattern to other markets.

(Non-synchronization with the Real Asset Market)

It is somewhat puzzling that real economy, as indicated by (expected) GDP growth rate, has been slowed down by this pandemic and is not expected to

be fully recovered anytime soon; nonetheless, stock markets are quickly and fully recovered. It cannot be explained always as simply investors' irrationality. It can be explained that investors are expecting that this pandemic will end soon and the world will return to the pre-COVID-19 era. They think that, unlike previous crises (dotcom bubble, subprime mortgage crisis), COVID-19 is short and temporary and thus will not have systematic impacts on the stock market. The expectation that this pandemic is temporary, in addition to improved liquidity provided by governments and central banks, could be the reason why stock markets behave differently from the real asset market.

(Nepal's Policy Response)

The government of Nepal enforced a nationwide lockdown on March 24 to prevent the spread of the COVID-19 pandemic. Before that, the NEPSE closed its transactions (both online and physical) on March 22.

Though the NEPSE was earlier reopened on May 12 amid a relaxation of the lockdown, the stock market was again shut after two trading days. When the market was opened for two trading days in May, the NEPSE index was down to 1,201.57 points. As the economic lockdown relaxed, the stock market was reopened on June 29.

The biggest concern for policy makers in dealing with the financial market is that no one knows when this pandemic will end. If this pandemic does not end soon, and if the real economy is not recovered, then the stock market could bust and crash, which spill over into bond and loan markets, and get into whole financial systems, further making the situation worse. In the case of Nepal, trading halt and shutting down the market could be a (temporary) solution, even though the measure is extreme. Another solution would be, with the market opened, government and central banks may buy ordinary shares and convert them to promoter shares to stabilize the financial market. Either way, it is important to be ready to provide liquidity in financial markets in case of a prolonged COVID-19 situation. In the long run, of course, the development of financial systems is needed for Nepal.

IV. Step-by-Step Plan to Develop a Macro Stress Testing Framework for Nepal

1. General Characteristics of Macro Stress Testing

A. What is Macro Stress Testing?

A macro stress test is a methodology to assess financial vulnerabilities that can trigger systemic risk[13] and the need of systemwide mitigation measures (IMF, 2020). After measuring the resilience of the financial system under a hypothetical scenario, it is used as a basis for providing policy advice to ultimately maintain/recover financial stability. In order to measure its resilience under the unfavorable scenario that can happen in the financial market, macro stress testing takes macro-financial variables into account, along with the health of financial institutions. In terms of being able to reflect multiple risk factors within the macroeconomics, macro stress testing is distinguished from sensitivity analysis, which is conducted separately from the other parts of financial system and focuses on individual financial institutions. A macro stress test is a methodology applied to the financial system as a whole.

To understand macro stress testing, it is necessary to compare it with micro stress testing. A micro stress testing is a forward-looking supervisory tool that assesses the adequacy of individual banks' capital or liquidity conditional on their portfolio risks. Key to the supervisory purpose is the ability of the bank “to pass or not to pass the test” as well as the to identify subsequent supervisory measures that may be needed to strengthen cushions when the bank does not pass the test (IMF, 2020). A macroprudential stress test, instead, focuses on financial vulnerabilities that can trigger systemic risk. Financial vulnerabilities are imbalances and other financial characteristics in the financial environment[14] that amplify adverse shocks. The final objective is not to determine whether

13) IMF, FSB, and BIS (2009) defines systemic risk at the onset of the global financial crisis as the risk of disruptions to the provision of financial services caused by an impairment of all or parts of the financial system, that had the potential to cause serious negative consequences for the real economy.

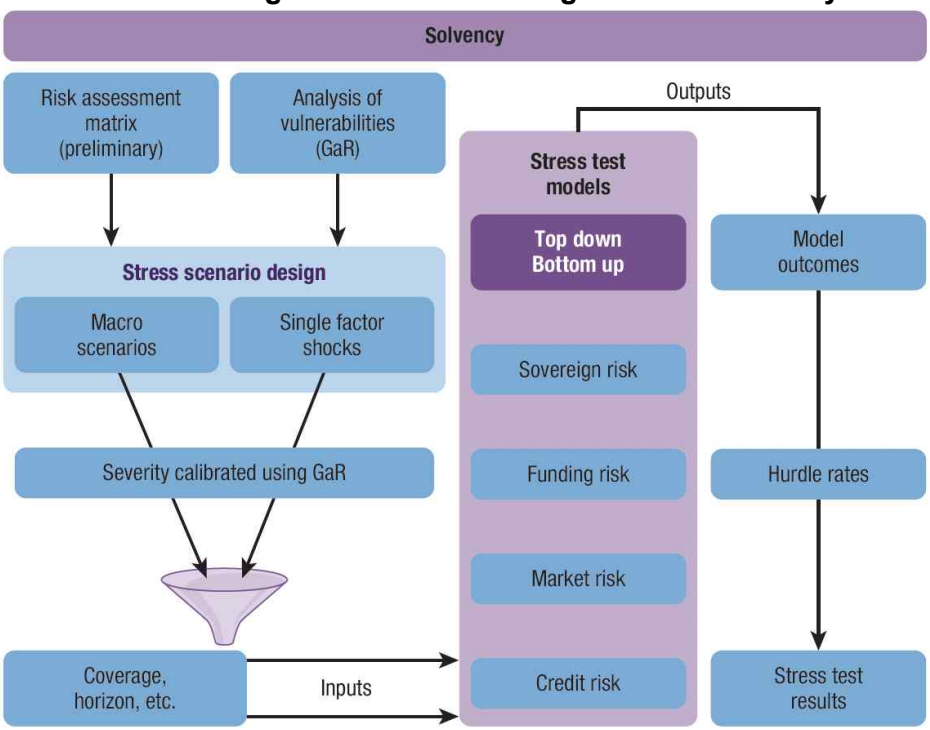
14) High leverage, mispricing, concentration of risk, liquidity mismanagement, and others

individual banks are adequately capitalized based on a hurdle rate, but to assess whether the identified vulnerabilities could potentially compromise financial stability for the whole economy.

System-wide stress tests have emerged as a key risk management tool to guide bank recapitalization, especially since the 2008 Global Financial Crisis (GFC). The emphasis on stress tests to assess and replenish bank solvency was justified by the fact that capital is at the core of a banks' ability to absorb losses and continue to lend (<Figure 4-1>). Macro stress tests help to assess banks' capital planning as well as their capital adequacy, thereby reducing the likelihood of failure. Stress tests could also focus on liquidity, by examining whether a bank has enough cash inflows to withstand cash outflows in a stressed scenario.[15)]

<Figure 4-1>

Stress Testing Framework Focusing on Bank Solvency



Source: IMF (2020)

Macro stress tests measure institutions' resilience to adverse scenarios and

15) Solvency and liquidity risks are often connected, as suggested in BCBS (2015) and other related studies.

identify those vulnerabilities that may be responsible for weaknesses. Resilience is assessed by the adequacy of bank capital under stress. Adequacy depends on a comparison between actual capital under stress[16] and required capital under stress.[17] In the macro stress test, the amount of capital required under stress can be calculated by considering losses[18] due to various sources of risk. Satellite models are used to measure how changes in the macro-financial variables would impact the different components of the income statement. The final stress test results consist of projections of complete income statements, balance sheets, and capital ratios under the adverse scenario for all years included in the risk horizon.

Any macro stress test has four elements. The first is the scenario that defines the exogenous shocks. The policy authority assumes a possible recession and considers how macro-financial variables change. The second is the set of risk exposures subjected to stress. In the typical macro stress test, risk exposures are financial institutions' balance sheets and income statements. The third is the model that maps those shocks onto an outcome (or impact), tracing their propagation through the system. The fourth is a measure of the outcome (<Figure 4-2>).

Any macro stress test starts with the set of exogenous shocks that capture the scenario. The best practice calls for "severe yet plausible" scenarios: severe enough to be meaningful yet plausible enough to be taken seriously. Various scenarios can be assumed according to the purpose of the macro stress test. When the objective is to support crisis management or resolution, the key risks are often apparent. When the objective is to uncover vulnerabilities in tranquil times, scenario design becomes more difficult.

There are two types of approach to building scenarios. The first type is to rely directly on history. One may replicate specific historical episodes (for

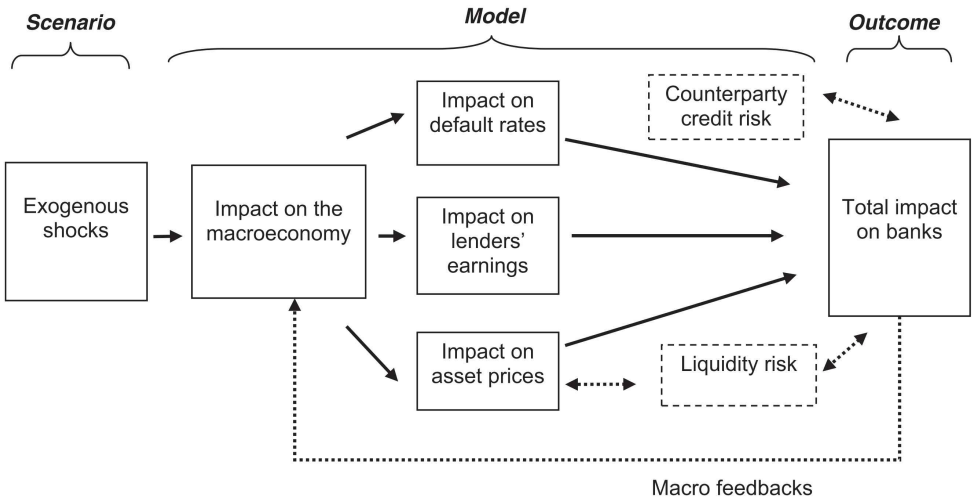
16) Actual capital under stress is the sum of the initial capital and net losses that are expected to materialize under the adverse scenario.

17) Stress tests also estimate capital requirements under the adverse scenario. For example, for credit risk, the calculation of capital required under stress would reflect the evolution of the portfolio size as well as changes in the credit risk parameters under the scenario.

18) All elements of the income statement need to be forecasted in the adverse scenario to arrive at a new measure of actual capital under stress. This is comprised of the net interest income (including the impact of interest rate risk and funding shocks), provisions for credit risk, trading losses, fee income, operational expenses, and taxes.

<Figure 4-2>

The Structure of Macro Stress Tests



Note: Bold lines represent the components captured by the majority of stress tests; dotted lines indicate the feedback effects that only the more sophisticated versions are able to capture, and even then, only partially.

Source: Borio et al. (2014)

example, the 1997 Asian Financial Crisis and the 2008 GFC). Alternatively, one may draw shocks from the tail of the historical distribution of specific risk factors. The second type of approach is to use judgement to avoid the risk of relying excessively on the past. In this case, one may run hypothetical scenarios or else try to identify the shocks that would cause the most damage to the system. That said, in the end, plausibility is often judged according to historical experience. Given their focus, macro stress test scenarios generally consider weak macroeconomic conditions. Typical scenarios that were run ahead of the crisis included severe drops in property prices, sharp adjustments to exchange rates or severe and sustained recessions (IMF, 2005; CGFS, 2005).

Macro stress tests generally rely on more than one model (or module). The initial component is a macro model that provides estimates of how the exogenous shocks affect the economy. Because standard macro models do not include the variables relevant to the assessment of risks on banks' balance sheets, the outputs of the macro model are fed into auxiliary models that do incorporate them. A set of auxiliary models includes models for the default rates of borrowers (for credit risk), for a broader range of asset classes (for market

risk) and for the future earnings of banks (for income risk). These determine the "fundamental" losses in the stress scenario. The analysis often stops here. The more sophisticated stress tests also seek to assess the size of various potential feedback effects (dotted lines in <Figure 4-2>). By now, tools for the treatment of credit risk in the interbank market are reasonably well developed, but, the modelling of liquidity and macro feedbacks is at a much more preliminary stage.

Macro stress tests primarily apply to depository intermediaries, and in particular, systemically important banks. Banks are more prone to engage in behavior that can lead to systemic risk, either through the maturity and liquidity transformation or through the credit risk channel.[19] To understand diverse sources of financial vulnerabilities, it is also required to adapt to different types of threats to financial stability, uneven data availability (see <Box 4-1> and <Box 4-2>), and diverse complexity of financial systems.

There are two types of macro stress tests: top-down and bottom-up approaches. Top-down stress test is performed by national supervisors using its own stress test framework (data, scenarios, assumptions and models). Either bank-level or aggregated data may be used, but always in models with consistent methodology and assumptions, generally developed by the authority. Top-down stress tests have assessed the resilience of the system as a whole against macro-financial adverse developments, primarily by focusing on credit risk, i.e. the link between macro variables, probabilities of defaults (PDs) and loss given defaults (LGDs) in banks' portfolios. Therefore, liquidity risk, funding risk, counterparty risk, vicious fire sales or macro feedback loops were captured only to a limited extent. However, recently more efforts have been made to include such dynamics.[20] To make up for this flaw, top-down macro stress testing is usually combined with the bottom-up stress testing based on agreed-on methodology and

19) In many cases, following the identification of specific sources of systemic risk, stress tests of nonbanks, such as insurance and asset management companies, nonfinancial firms, and estimates of stress for households have been taken into consideration these days.

20) The most prominent examples include Elsinger et al. (2006), who were among the first to develop a stress testing framework that integrates credit, market, interest rate and counterparty risks using credit register and interbank claim data. Similarly, the Bank of England's RAMSI framework (Aikman et al., 2009; Alessandri et al., 2009; Burrows et al., 2012) incorporates, on top of all relevant channels, feedback mechanisms capturing counterparty credit risk in the interbank market and feedback channels arising from market and funding liquidity risk.

scenarios.[21] The bottom-up stress test is performed by a bank using its own stress test framework as part of a system-wide exercise, or as part of a stress test where authorities provide banks with common scenario(s) and assumptions.

<Box 4-1>

Data Required for Conducting Stress Testing (1): General Considerations

Stress test data requirements are generally very demanding. In addition to individual bank data over time and across a number of dimensions, the country-specific macro-financial data that form the baseline and adverse scenarios used in the stress test are an integrant part of the exercise. Banking sector stress tests are typically conducted on individual bank data irrespective of the test modality. For a top-down fashion, harmonised bank-level data is particularly important for comparability and the overall quality of results. Data quality is a key determinant of the reliability of any stress test results. The quality and granularity of the data used in stress test exercises crucially depends on data availability, usually banks' financial reporting, and, ideally, proprietary supervisory information. In the case of centralised exercises run with supervisory data, the granularity of the data needs could depend on the ultimate purpose of the exercise. This can range from an assessment of overall soundness of individual banks or the banking sector to the estimation of provisioning or capital targets to back supervisory actions and requests imposed on banks, where rigour in the data input is crucial.

Source: ECB (2013)

The last component of a macro stress test is a measure of the outcome, which captures the final impact of the shocks on banks' balance sheets and income statements. The most common metrics are portfolio losses or capital, and less frequently, liquidity adequacy. Other metrics include the number of defaults or

21) In practice, many IMF and national stress tests have combined both processes, as was the case for the Supervisory Capital Assessment Program (SCAP) in the United States (Board of Governors of the Federal Reserve System, 2009).

the size of capital injections needed to recapitalize the system. If stress tests are used as tools for crisis resolution, the outcomes are typically set in terms of the amount of capital required to restore adequate strength.

Stress tests can fulfill a variety of policy objectives. Stress tests are more than just numerical calculations of the impact of a scenario. They can help policymakers to set microprudential measures to ensure that individual banks are adequately resilient. By subjecting banks to the same adverse scenario, stress tests can also be used to inform macroprudential policy settings. For example, stress tests can be used to determine the resilience of the banking system to some common economic or financial risks, or to support the calibration of macroprudential instruments.

<Box 4-2>

Data Required for Conducting Stress Testing (2): Key Variables

The bulk of variables used in stress testing exercises are bank-specific as reported in the bank balance sheet, asset quality and profit and loss data. Individual bank level data are typically employed to evaluate the output from the credit risk, market risk and profitability models in terms of impact on the banks' profit and loss accounts and on their balance sheets. Furthermore, data input is also needed to model feedback effects, going beyond the direct impact of shocks on an individual bank. In this context, the availability of sufficiently granular data particularly relates to interbank exposures to model contagion in the banking sector.

While stress tests are typically conducted on banks' consolidated data, the specific purpose of the test (e.g., assess the solvency of foreign subsidiaries) may require the use of sub-consolidated levels of a banking group's data. Key to the quality of the stress test results is not so much about the core balance sheet, profit and loss variables, as published in banks' financial statements, but their breakdowns across a number of dimensions. On the asset side, critical to the assessment of loan losses is the simultaneous breakdown of loans and receivables by portfolio (e.g. large corporates, small and medium-sized enterprises (SMEs), commercial real estate, housing, consumer

retail, sovereigns and financial institutions) and geographical dimensions (by individual country), where applicable. Moreover, information on PDs and LGDs (or related measures of credit risk, such as NPLs, loan-loss provisions or write-off rates), provided by the same breakdowns is essential for conducting top-down stress tests. The information on risk-weighted assets for these credit exposures is also needed for a consistent analysis of credit risk.

Beyond the asset quality information for the relevant quarter, there is the need for sufficiently long historical time series to allow for the projection of asset quality indicators for the test horizon. Profitability modelling requires detailed breakdowns of income and expense items along its subcomponents, broken down across countries in the case of cross-border banks. Information on the type of interest rate contract, average maturity and interest rate on key assets (loans and receivables) and liabilities (categories of deposits and other main financial liabilities) are also important data inputs to assess effects on profitability and overall balance-sheet adjustment to shocks. Concerning market risk data, trading book data – as well as by accounting portfolio (available-for-sale, held-to-maturity positions) and by type of security (bonds, equities, structured) – are essential to understand the sensitivity of banks' balance sheets to market risk. Further information about the nature of the underlying assets (counterparty type, instrument type, underlying risk, maturity, etc.) as well as hedging positions is crucial to be able to precisely assess and stress banks' market risk. Where data are not available, country-specific parameters or assumptions on the basis of other banks with similar size and business model are generally used, implying caveats and the need to exercise appropriate caution in the interpretation of results.

Source: ECB (2013)

B. Brief History of Macro Stress Testing

Stress testing at the level of individual financial institution has been already applied by the global banks in the early 1990s. Bank regulators had to use stress tests to monitor both market and credit risk. It was in the late 1990s that macro stress testing began to draw attention as a tool to assess financial vulnerability of the entire financial system. It was an important component of the Financial Sector Assessment Program (FSAP) launched by the IMF and the World Bank and was an integral part of the toolbox for financial stability of policymakers.

From its inauguration, stress tests have been a key component of the FSAP and they have been performed for every country participating in the program.[22] The purpose of these tests is to provide a quantitative measure of the vulnerability of a country's financial system to different macro-financial scenarios and to complement the insights gathered from other components of the assessment. These include qualitative vulnerability assessments and a review of the regulatory and crisis management frameworks in place in a country. Although policymakers had been considering the potential impact of adverse events on the financial system for some time, the use of stress tests as a tool for doing so only emerged towards the end of the 1990s. The FSAP, launched in 1999, recognized the significant detrimental effects financial instability can have on economic growth and the workings of financial markets, as evidenced by the financial crises of the 1980s and 1990s.

Nevertheless, until the GFC in 2008, macro stress testing was mostly conducted by the bank itself for internal risk management purposes. Some regulators conducted stress tests before the financial crisis, but at a simple level with little direct impact on policy. Through the GFC, macro stress testing within regulatory toolkits began to play a much more important role. Also, the way these initial stress tests were used varies from bank to bank before the GFC.

22) The use of stress tests within FSAPs helped encourage national central banks to develop their own, independent stress tests. These often began as updates of previous FSAP scenarios with central banks developing models that considered the banking system as a single entity. Over time, these approaches started to evolve into the concurrent stress-testing frameworks widely used today.

Some banks aim to quantify the maximum losses a bank may have in a trading portfolio,[23] while others aim to quantify the appropriate amount of capital to determine transaction limits or fund a specific portfolio (Committee on the Global Financial System (CGFS), 2000).

While firm-wide stress testing for market risk went on to become standard practice at large international banks, the development of stress tests for credit risk[24] significantly lagged those of market risk. In 1999 the Basel Committee on Banking Supervision (BCBS) found that little progress had been made to develop techniques to implement credit risk stress tests (BCBS, 1999). This was despite the fact that credit risk was the most significant risk facing most banks. In 2005, the CGFS reported that this was still the case, and highlighted the need to develop better stress tests incorporating loan portfolios, as well as instituting bank-wide stress tests aimed at capturing all of the risks banks faced.

The first steps towards addressing the lag between credit and market risk stress tests were taken in a revision to the international regulatory capital regime published in 2004, known as Basel II.[25] This sought to make it a requirement for banks using their own internal models to determine credit risk for regulatory capital purposes to have in place a program of stress testing. Under these stress-testing programs, banks would review the robustness of their model-based assessments and the adequacy of capital buffers above the regulatory minimum. Upon implementation, all banks would be additionally required to subject their loan portfolios to stress tests regardless of whether or not they were using their own models to determine credit risk capital.

Unlike the stress tests conducted by banks, which focused on the risks faced at the portfolio or individual institutional level, the stress tests conducted by policymakers prior to the GFC sought to capture the impact of severe, but

---

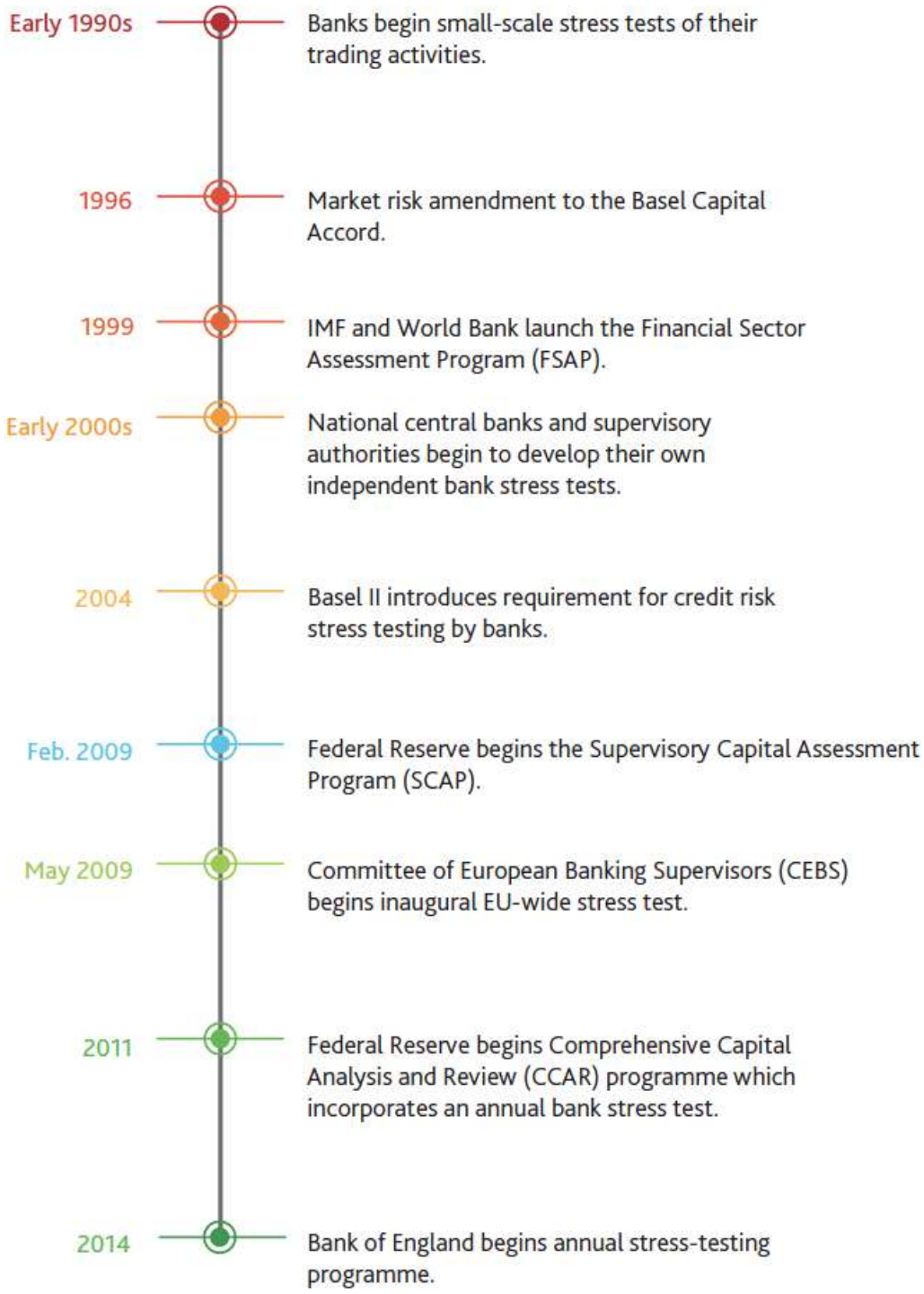
23) The practice of using stress tests to evaluate trading portfolios was formalised in 1996 with an amendment to the international regulatory capital regime for market risk (the risk of losses on positions associated with changes in market prices). Following this amendment, banks seeking to use their own internal models to quantify market risk for regulatory capital purposes were required to implement a bank-wide stress-testing program for market risk.

24) The risk associated with a bank's counterparties or borrowers failing to make payments

25) Basel II had not been universally implemented by advanced economies prior to the onset of the financial crisis. And even where it had, banks' stress-testing models for credit risk and for capturing both credit and market risk were still at a developmental stage (BCBS, 2009; Schuermann, 2013).

<Figure 4-3>

Timeline of Key Events in the Development of Macro Stress Testing



Source: Dent et al. (2016)

plausible, shocks on the entire financial system or even the wider economy. Prior to the financial crisis, the concurrent stress tests conducted by policymakers rarely had a direct impact on regulatory or broader financial policy. But their outputs were often incorporated into broader financial stability assessments, with the results sometimes published in central bank publications such as Financial Stability Reports.

The GFC highlighted substantial deficiencies in risk measurement and management across the financial sector. With respect to stress testing by banks, the scenarios used prior to the financial crisis were revealed to be significantly more benign than the crisis itself, while the loss estimates these exercises generated were well below banks' actual loss experience (BCBS, 2009).

As well as exposing the shortcomings of stress-testing practices at banks, the financial crisis also brought with it a step change in the use of stress testing within the regulatory sphere. Regulatory stress tests moved from being small-scale, isolated exercises within the broader risk assessment program, to large-scale, comprehensive risk-assessment programs in their own right leading directly to policy responses.

The first prominent example of this new wave of stress tests was the US Supervisory Capital Assessment Program (SCAP) conducted by the Federal Reserve in early 2009. The SCAP stress test assessed whether the largest US banks had sufficient capital resources to absorb losses and continue to operate under a common stress scenario (see <Box 4-3>). By design, the scenario was significantly more severe than the expected trajectory for the economy at the time (Bernanke, 2010).

In a marked departure from the past, the results of the SCAP were publicly disclosed on a bank-by-bank basis. Those banks judged to need additional capital resources were given six months to raise that capital, with the US Treasury Department providing a backstop in the event that any bank was unable to do so in private markets. In the event, almost all of the banks were able to raise sufficient equity privately so as not to need Treasury support. The SCAP is widely regarded to have made a significant contribution to stabilizing the US financial system, and restoring broader market confidence with the Treasury backstop recognized as an important driver of its success (Krugman, 2014;

Schuermann, 2013; Zhang, 2013).

<Box 4-3>

Supervisory Capital Assessment Program (SCAP)

In the midst of the 2008 financial panic caused by the collapse of the subprime housing market, the U.S. government responded with unprecedented measures, including liquidity provision through various funding programs, debt and deposit guarantees and large-scale asset purchases. In February 2009, the U.S. banking supervisors conducted the first-ever system-wide stress test on 19 of the largest U.S. bank holding companies (BHCs), known as the Supervisory Capital Assessment Program (SCAP). The stress test required these 19 BHCs to undergo simultaneous, forward-looking exercises designed to determine whether they would have adequate capital to sustain lending to the economy in the event of an unexpectedly adverse scenario. By conducting this SCAP exercise, the supervisors hoped that it would reduce uncertainty and restore confidence in the U.S. financial institutions. In their 2010 staff reports, Peristian, Morgan and Savino (2010), of the Federal Reserve Bank of New York, concluded that the SCAP might have helped to quell the financial panic by releasing vital information about the BHCs. They claimed, "While investors did not need supervisors to tell them which banks had capital deficiencies, they were surprised by the size of the capital gaps and they used that information to revalue banks."

Source: Yuen (2015)

The success of the SCAP was followed by a proliferation of frameworks for regular concurrent stress testing across central banks and supervisory authorities. The first EU-wide concurrent stress test was conducted in late 2009 under the direction of the Committee of European Banking Supervisors (CEBS). This was followed by another exercise conducted under the direction of the CEBS in 2010, and a series of exercises conducted under the direction of the European Banking Authority (EBA) starting in 2011. In the United Kingdom, these

EU-wide exercises initially served to complement the stress-test scenarios that were being provided to banks to run on a non-concurrent basis by the former Financial Services Authority (FSA), before the Bank of England launched its own concurrent stress-testing program in 2014.

This greater regulatory focus on stress testing has helped to drive improvements in banks' own stress-testing capabilities and risk management practices, with sophisticated, bank-wide stress testing now common practice at systemically important banks. And as the immediate turmoil that followed the crisis has abated, the focus of regulatory stress-testing frameworks has shifted away from the immediate need to recapitalize the banking system towards an ongoing assessment of the adequacy of banks' capital resources and to informing broader micro and macroprudential policy.

Stress testing has become increasingly mainstream, but its limitations should be kept in mind. Stress test results are susceptible to a number of factors, including the quality and granularity of the data, the severity or extent of the scenario, and limitations on the risk of the model, especially with regard to complex methodologies and assumptions. The macro stress test is not intended to predict future bank performance, but to analyze the impact of a specific stress scenario on the bank based on a number of assumptions given, and to identify financial vulnerabilities.

2. The BOK's Macro Stress Testing

In this section, we examine the history of the macro stress testing in Korea briefly, and then investigate the features of the early version of Korean macro stress testing, BOKST-07 model. The recent version of Korean macro stress testing, SAMP and NBFI ST model will be followed after BOKST-07 model.

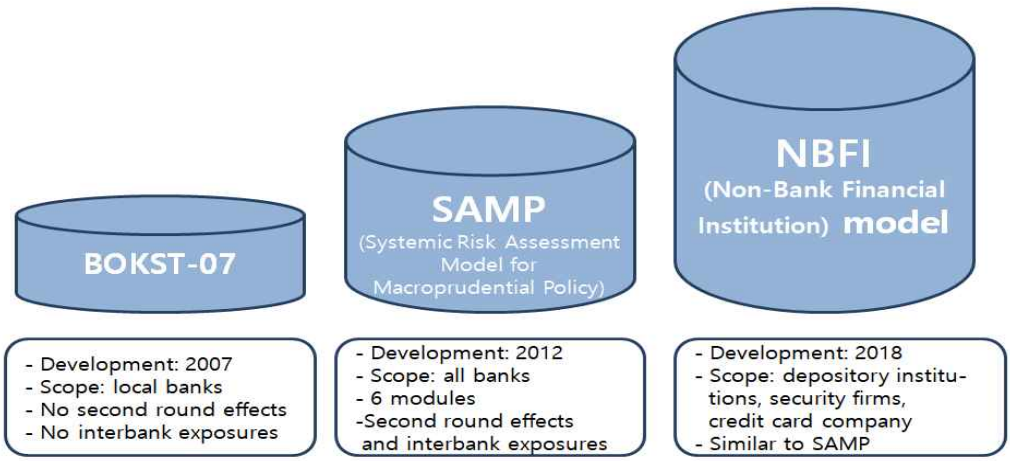
A. History of Macro Stress Testing in Korea

The Bank of Korea (BOK) had implemented stress tests without a unified framework and with micro approach until the mid 2000s. As central banks and financial regulators in several advanced countries developed a macro stress test

under a unified framework, the BOK started developing a unified macro stress testing framework in the late 2006 and finished the development project in December 2007. Namely, the first macro stress testing model, the BOKST-07 model was launched.

After experiencing the global financial crisis, the BOK recognized that a more sophisticated and comprehensive model is necessary to adequately assess systemic risk in the financial system in Korea. A brand-new macro stress testing model, Systemic Risk Assessment Model for Macroprudential Policy (SAMP), was developed in 2012. The SAMP solves some problems that BOKST-07 had. For instance, the SAMP considers second-round effects and interbank exposures in the analysis. As the SAMP model only covers the banking system, the separate macro stress testing model for the non-banking financial sectors was developed in 2018 (<Figure 4-4>).

<Figure 4-4>
Transition History of Macro Stress Testing Model in Korea



Source: Bank of Korea

Now the BOK is continuously putting efforts in enhancing the ability and of the current models and is planning to combine the two models into one model. Given the current status of NRB's stress test models, BOKST-07 sheds light on how the BOK's macro stress testing model evolve from a pre-version to a more sophisticated model. Therefore, we first introduce BOKST-07 model here and then move onto SAMP.

<Table 4-1>

The Development Process of BOKST-07 Model

Time	Action
2006 Q3	- Set up the plan to develop the BOKST-07 model
2006 Q4	- Hold meetings to determine an action plan with testee banks
2007 Q1	- Investigate banks' actual conditions for the macro stress testing
2007 Q2	- Define requirements of the model - Gather opinions and ideas from banks under the testee banks - Set up initial shocks and scenarios
2007 Q3	- Collect data and establish database - Develop a stress testing model with a top-down approach - Seek feedback from in-house experts
2007 Q4	- Complete developing a pilot model - Do a pilot test and fine-tune the model - Seek opinions from foreign experts - Seek opinions about the test results from testee banks - Complete the development

Source: Bank of Korea

B. BOKST-07 Model

To examine details about the BOKST-07 model, we go over credit risk, market risk, and interest rate risk stress testing model, which together compose the BOKST-07 model. Then, we investigate the practical issues in conducting the BOKST-07 model. First of all, we start with the overview of the BOKST-07 model.

(1) Overview

The formal name of BOKST-07 model is the Bank of Korea's financial system stress test model. BOK planned to establish the model in the third quarter of 2006. Under the development process, BOK investigated how banks were prepared for stress tests, gathered opinions and ideas regarding the plan, collected data necessary to the testing, and got a consulting from the Bank of England. Eventually, the BOK did a pilot test in the fourth quarter of 2007 and completed the development in December 2007.

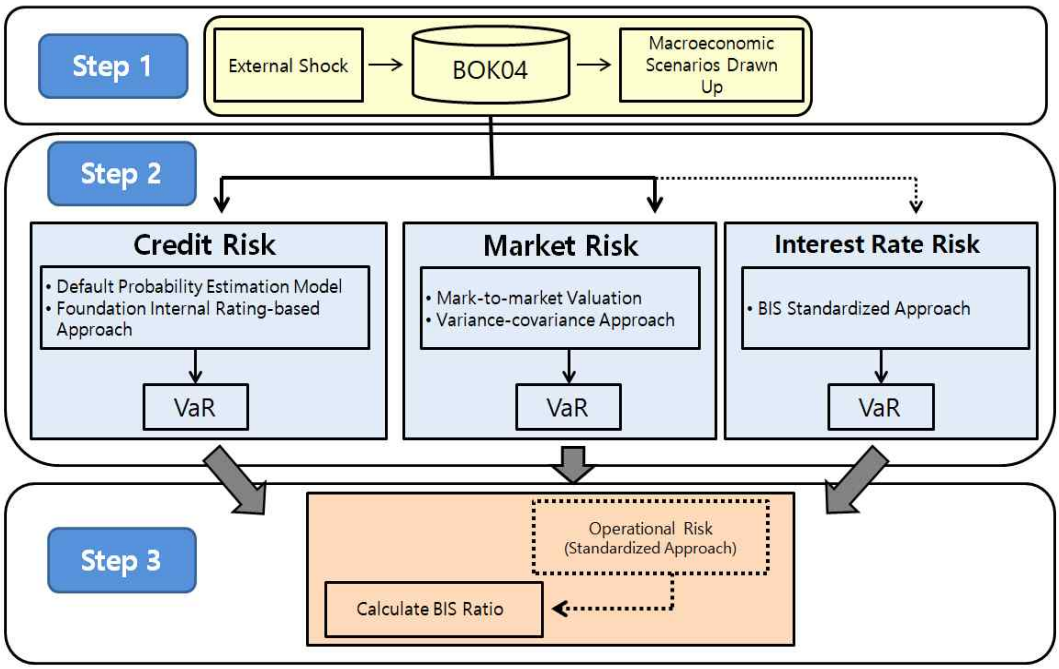
The model evaluates the stability and resilience of the Korean financial system. Namely, it compares changes in the degree of risk exposed to financial

institutions (seven nationwide banks, two state-owned banks, three regional banks) in responding to a macroeconomic shock. To do so, it estimates financial risks such as credit risk, interest rate risk, and market risk by adopting specific quantitative measurement models, as shown in <Figure 4-5>. Bonds in banking book are categorized into market risk and those in trading book are into interest rate risk. Operational risk is only used for calculating risk weighted assets. The BOK-04 macroeconomic forecasting model is employed in making up scenarios.

<Figure 4-5> illustrates the process of macro stress testing of the BOKST-07 model. The process can be summarized as 3 steps. The first step is generating scenarios, the second step is about estimating credit risk, market risk, and interest rate risk. The last step is calculating changes in BIS ratios as a result of initial shocks.

<Figure 4-5>

Basic Structure of the BOKST-07 Model



Source: Bank of Korea

(2) Credit Risk

Credit risk stress testing model is the crux of BOKST-07 model because credit risk is the main financial risk that triggers systemic risk. This model comprises ⅰ) a probability of default (PD) estimation model and ⅱ) a credit risk estimation model. The former is employed to form the link between the PD and macroeconomic variables, while the latter utilizes the estimated PDs as variables to estimate credit risk inherent in the financial system.

(a) Probability of Default (PD) Estimation Model

PD estimation models were estimated separately for each segment (corporate, small and medium-sized businesses, and retail businesses). This is because each segment has its own unique feature and therefore segments have heterogeneous responses to macroeconomic shocks. The period to observe PD is 1 year. PD is calculated as a ratio of the number of defaulted borrowers at time t to the number of non-defaulted (normal) borrowers at time $t-4$ (a year ago). The data used is the quarterly frequency and the estimation period is from 2000:Q4 to 2006:Q4.

The model prescribes the relationship between the PD and macroeconomic variables (e.g., interest rate, price level, production). Macroeconomic variables that are considered to be closely related to PD are chosen as candidate explanatory variables. The candidate variables are presented in <Table 4-2>. Then, varying regression models, model with the best statistical features (statistical significance, fitness, whether coefficient signs are consistent with expectations) are selected. The PD estimation model employs fixed-effects panel approach and tests the stationarity of the empirical panel estimation model using panel unit root tests and panel cointegration tests.

<Table 4-2>

Macroeconomic Variable List

	Macroeconomic Variable
Real Economy/Business Cycle	GDP, GNI, Government Expenditure, Private Consumption, Domestic Expenditure, Product Export
Price	GDP Deflator, CPI, PPI, Core Inflation, Lf
Corporate	Plant and Equipment Investment (PEI), Construction Investment, Gross Fixed Capital Formation, Capital Productivity, Labor Productivity, Unit Cost of Labor, Hourly Wage, Working Hours
Household	Household Total Asset, Household Housing Asset, Household Stock Asset, Housing Price Index, Rent Price Index, Unemployment Rate, Number of the Employed, Number of the Unemployed, Monthly Wage
Financial Market	Real Interest Rate, Corporate Bond Rate, Market Capitalization
External Economy	Terms of Trade, Won/Dollar Exchange Rate

Source: Bank of Korea

<Box 4-4>

Interview Finding: Technical Point of Assessing Stationarity of Data and Regression Models

Empirically, it is particularly important to assess whether a regression model is well specified so that the model is stable and whether time-series variables suffer from unit root problems that make the variables non-stationary. Before regressions, researchers should check these points before regression.

What follows below is the experience of the BOK when it developed the model in 2007. For instance, the null hypothesis that the variable of default rates of SMEs has panel unit roots was not rejected in the unit root test. In other words, the variable (default rates of SMEs) had a unit root. Then, the BOK used a differenced variable. However, they found that statistical significance of estimated coefficients using the differenced variable was trivial and the fitness of the regression model (R^2) decreased considerably. Alternatively, the BOK included lagged variables of default rates of SMEs as explanatory variables in the regression model, but this trial failed to improve the model. Finally, they estimated long-term equilibrium equations using level variables (not differenced variables).

When researchers check whether a model is specified appropriately, it is important to check whether the signs of coefficients are consistent with theoretical or practical expectations. Another way to check is comparing coefficients of SMEs and large firms, given that SMEs are more affected by economic shocks. Hence, a model with $\beta_{SMEs} > \beta_{large\,firms}$ is likely to be more adequate than a model with $\beta_{large\,firms} > \beta_{SMEs}$. Note that these models cannot be applied to the Nepal's macro stress testing. When NRB develops its model, it has to incorporate the economy's unique features into the regression model specification.

Source: Bank of Korea

In the final models, a GDP growth rate and a corporate bond rate are used as common explanatory variables. For more details, refer to <Box 4-5>.

<Box 4-5>

PD Estimation Model by Segments

There are specific forms of PD estimation model by three segments (corporate, SMEs, retail). Variable list includes PD (probability of default), GDP(gross domestic product growth rate), RCB (rate of return on corporate bonds), ULC (unit labor cost), NBTT (net barter terms of trade), UR (unemployment rate), CPI (consumer price index), WE (total household assets), LF (liquidity of financial institutions). A GDP growth rate (GDP) and a rate of return on corporate bonds (RCB) are used as common explanatory variables.

- Corporate model

$$\ln\left(\frac{DR_{i,t}}{1-DR_{i,t}}\right) = \beta_0 + \beta_1 GDP_{t-2} + \beta_2 RCB_{t-1} + \beta_3 ULC_t + \beta_4 NBTT_{t-1}$$

<Table 4-3>

Estimation Result for the Corporation Segment

β_0	β_1	β_2	β_3	β_4	R^2
-4.71***	-6.95**	6.79*	3.25**	-1.89**	
(-23.70)	(-2.50)	(1.89)	(2.25)	(2.11)	0.69

***, **, and * denote 99%, 95%, and 90% confidence levels, respectively. The numbers in parentheses indicate t-statistics.

- SMEs model

$$\ln\left(\frac{PD_{i,t}}{1-PD_{i,t}}\right) = \beta_0 + \beta_1 GDP_{t-3} + \beta_2 RCB_{t-2} + \beta_3 ULC_t - \beta_4 Lf_t$$

<Table 4-4>

Estimation Result for the SMEs Segment

β_0	β_1	β_2	β_3	β_4	R^2
-3.45***	-4.18***	9.78***	5.91***	-7.77***	
(-34.29)	(-2.97)	(3.97)	(6.17)	(-6.46)	0.93

***, **, and * denote 99%, 95%, and 90% confidence levels, respectively. The numbers in parentheses indicate t-statistics.

- Retail model

$$\ln\left(\frac{PD_{i,t}}{1-PD_{i,t}}\right) = \beta_0 + \beta_1 (UR + CPI + GDP)_{t-3} + \beta_2 RCB_{t-3} + \beta_3 WE_{t-2}$$

<Table 4-5>

Estimation Result for the Retail Segment

β_0	β_1	β_2	β_3	R^2
-3.68***	5.09*	13.72**	-3.30***	
(-7.22)	(1.94)	(2.10)	(-2.71)	0.75

***, **, and * denote 99%, 95%, and 90% confidence levels, respectively. The numbers in parentheses indicate t-statistics.

Source: Bank of Korea

(b) Credit Risk Estimation Model

Changes in credit risk that this model estimates are gauged by utilizing the risk weight functions. It employs the risk weight functions proposed by Fundamental Internal Ratings-Based (FIRB) approach in BASEL Ⅱ. The risk weight functions consider several important factors, such as type of transaction, obligor and maturity, to reflect BASEL Ⅱ regulatory rules and also utilize default probabilities (PDs) computed in the PD estimation models.

Before estimating credit risk, the BOK first standardizes credit ratings of banks' exposures because banks use different credit rating frameworks. The BOK map individual banks credit ratings on exposures into a 15-grade rating using the following formula. If a bank has the 15-grade rating, no adjustment in ratings occurs. When a bank has a 5-grade rating (NR_k=5), the 5-grade rated exposures ($R_{k,i}$) are mapped into the 15-graded exposures ($R_{k,15}$).

$$R_{k,15} = \frac{15}{NR_k} R_{k,i}$$

<Table 4-6>

Exposure Classification

Exposure	Credit Ratings	Effective Maturity		LGD	
		RP (0.5 year)	others (2.5 year)	Priority (0.45)	Subordinate (0.75)
Government	1 (0.03%)	×××	×××	×××	×××
Bank	2 (0.05%)	×××	×××	×××	×××
Corporate	3 (0.10%)	×××	×××	×××	×××
SMEs	4 (0.30%) 5 (0.50%)	×××	×××	×××	×××
Retail	6 (1.25%)	×××	×××	×××	×××
(Housing)	7 (1.50%)	×××	×××	×××	×××
(Revolving)	8 (2.00%) 9 (3.00%)	×××	×××	×××	×××
(Others)	10 (5.00%)	×××	×××	×××	×××
Stocks	11 (7.00%)	×××	×××	×××	×××
Accounts Receivable	12 (10.00%)	×××	×××	×××	×××
ABS	13 (30.00%)	×××	×××	×××	×××
Others	14 (50.00%) 15 (99.99%)	×××	×××	×××	×××

Source: Bank of Korea

Then, credit losses are calculated using DR (default rate), DR in normal times (DR_N) and DR in stressed times (DR_S). A representative PD in stressed times ($PD_{R,S}$) is calculated as shown in the following formula.

$$PD_{R,S} = PD_{R,N} \times \left(1 + \frac{DR_S - DR_N}{DR_N}\right)$$

where $PD_{R,N}$ denotes a representative PD in normal times. This $PD_{R,S}$ is calculated for every 15 ratings. As the formula shows, $PD_{R,S}$ is the combination of default rates in both stressed and normal times, weighted by $PD_{R,N}$.

(3) Market Risk

This model is utilized to estimate changes in asset value, caused by macroeconomic shocks(practically, various scenarios designed by the BOK) for each asset type on a mark-to-market basis. Meanwhile, for every stress scenario, corresponding market VaRs (values at risk) are calculated in order to evaluate capital requirements to meet the regulatory criterion using the following formula.

$$Market\ VaR = W\Gamma\sigma\sqrt{\tau}$$

where W, Γ, σ and τ indicate exposure, 99% confidence level, volatility, and 10 day holding period, respectively.

In addition, equity capital affected by market risk is calculated using the following formula.

$$Capital\ Loss = Max\left[VaR_{t-1}, \left(60^{-1}\sum_{i=1}^{60} VaR_{t-i}\right) \times (3+\alpha)\right]$$

α, additional multiplier for fitness of VaR models, is set zero here. Basically, the estimation of market risk assumes that correlations between asset return rates

and assets are fixed and that losses are incurred only through changes in asset prices.

(4) Interest Rate Risk

Interest rate risk is calculated for asset and liability items, which are sensitive to changes in interest rates, in bank book. The specific formula is presented below.

$$InterestRate\,VaR = \sum_{i} \left[GAP_i \times D_i \times \triangle R_i \right]$$

where GAP_i is interest rate gap of the i th maturity term. D_i is a modified duration of the i th maturity term. $\triangle R_i$ is an interest rate shock.

<Table 4-7>

Modified Duration

Left Maturity	Modified Duration (year)	Left Maturity	Modified Duration (year)
0～1 Month	0.04	4～5 year	3.85
1～3 Month	0.16	5～7 year	5.08
3～6 Month	0.36	7～10 year	6.63
6～12 Month	0.71	10～15 year	8.92
1～2 year	1.38	15～20 year	11.21
2～3 year	2.25	over 20 year	13.01
3～4 year	3.07	—	—

Source: Bank of Korea

(5) Operational Risk

Operational risk is the hardest risk to be incorporated into a macro stress testing framework. Hence, the risk is used to calculate risk-weighted assets. No stress tests are implemented for operational risk.

<Table 4-8>

Measurement on Operational Risk by Businesses

Business	β% of Total Operational Profit	Business	β% of Total Operational Profit
Investment Finance	18%	Corporate Finance	15%
Trading	18%	Asset Management	12%
Retail Finance	12%	Retail Brokage	12%
Payment & Settlement	18%	Correspondent Service	18%

Source: Bank of Korea

(6) BIS Capital Ratio Calculation

BIS capital ratio in distressed times is calculated as the following formula.

$$BIS\ Ratio = \frac{BIS\ Capital - (EL_S - EL_N) - (TR_N - TR_S)}{CRA + MRA + ORA}$$

where EL_N is expected credit loss in normal times and EL_S is expected credit loss in stressed times. TR_N and TR_S are trading asset values in normal and stressed times, respectively. Risk weighted assets are the sum of credit risk assets (CRA), market risk assets (MRA) and operational risk assets (ORA).

(7) Practical Issues for Testing

(a) Estimation Time Horizon: One year

Using the BOKST-07 model, the first macro stress test was conducted on a domestic bank's portfolio at the end of 2006. The estimation time horizon of loss due to external shock was set to one year. And, during the test period, it was assumed that individual banks do not adjust their portfolios in response to external shocks and financial authorities do not implement a policy intervention. In general, a macroeconomic shock affects the individual borrower's repayment

ability with a certain time lag, so it is necessary to set an estimation horizon in which banks' losses due to the shock are estimated in the analysis. In the BOKST-07 model, the estimation horizon is set one year, which is a relatively short. The reason for setting the estimation horizon to a relatively short one-year period in this test is that if you set it too long, the assumption that there is no portfolio adjustment of individual banks due to the impact and the intervention of policy authorities can be too unrealistic.

(b) Hybrid Approach: Mix of Bottom-up and Top-down Approaches

The financial system stress test is conducted using both bottom-up and top-down methods. The bottom-up test is used to increase the interest of the participating banks in the stress test, and to verify the suitability and fitness of the BOKST-07 model by comparing the bottom-up test results performed by individual banks with the top-down test results using the BOKST-07 model. In particular, the BOK acquires the raw data that individual banks use in the bottom-up test so that the BOK can maintain the consistency of raw data used in the top-down approach.[26)]

(c) Scenario and Sensitivity Analysis

Both scenario analysis and sensitivity analysis are implemented to estimate changes in financial institutions' losses due to external shocks. Scenario analysis sets an extreme shock and generates scenarios of the impacts on macroeconomic variables using the macroeconomic model (BOK04). Then, the analysis uses the stress test model to determine the change in losses due to each shock.

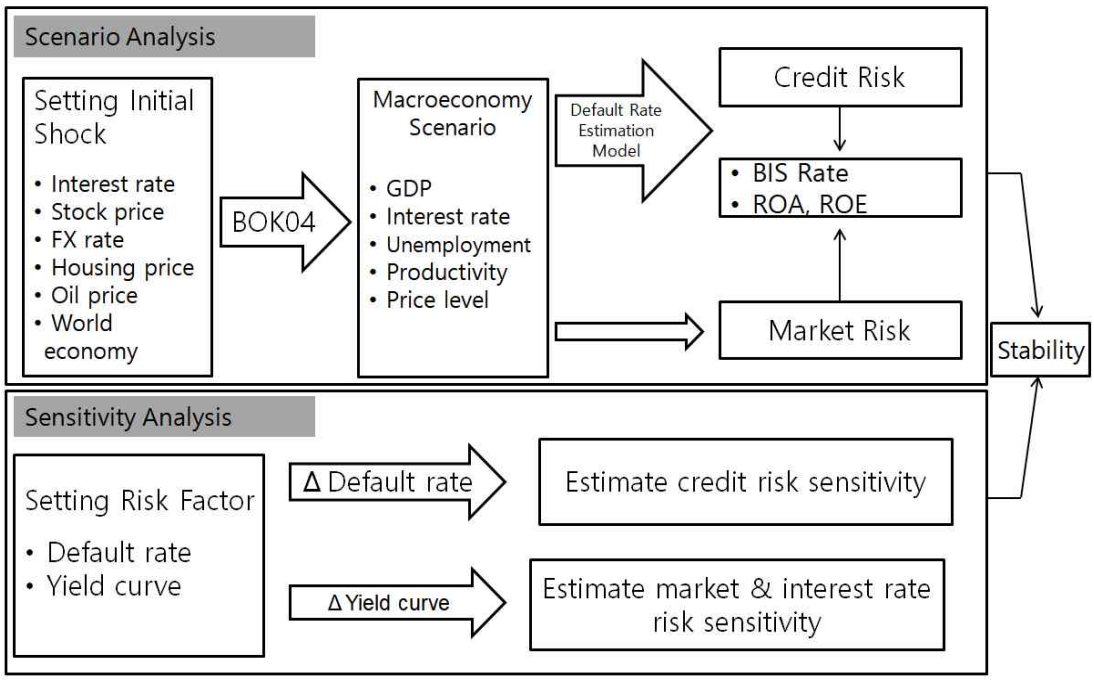
Sensitivity analysis is a method of setting default rates and yield curves as a single risk factor for credit risk, market risk and interest rate risk, and the analysis estimates changes in losses according to the level change of the factors.

---

26) The raw data include observed default rates and items of assets and liabilities (sorted by credit ratings, transaction tpe, and exposures).

<Figure 4-6>

Framework of the BOKST-07 Model



Source: Bank of Korea

(d) 12 Initial Shocks

Based on the current (year 2007) macroeconomic situation, risk factors that could threaten the stability of the financial system in the future were selected across 3 categories (financial, foreign, and asset). For every category, the magnitude of the impact is divided into two stages. Specifically, initial shocks include interest rate, exchange rate, equity price, oil price, property price, and global economy-related shocks. And for each shock, the size of initial shock is set into two levels (severe and moderate). The magnitude of the impact is set by considering historical observations and stress test cases of foreign central and domestic banks. Consequently, the total number of initial shocks is 12, as shown in <Table 4-9>. From today's perspective, the level of severity seems mild because we have not experienced the GFC and COVID-19 pandemic yet in the test time point of 2007.

<Table 4-9>

Types of Initial Shocks

Type	Size		Historical Extreme[1)]
	Moderate	Severe	
1. Financial Shock			
- Interest Rate Rise	300bp	500bp	1,487bp (1997)
- Equity Price Fall	-30%	-50%	-62% (1998)
- Exchange Rate Fall	-20%	-40%	-33% (1998)
2. Foreign Shock			
- Oil Price Spike	100%	150%	116% (2000)
- Global Recession	3.5% growth (half of the long-term global trade growth)	0% growth	
3. Asset Shock			
- Property Price Fall	-30%	-50%	-12.2% (1998)

Note: The numbers in parentheses indicate the year when historical extreme cases occurred
Source: Bank of Korea

(e) Generating Scenarios

By inputting the initial shock to the current macroeconomic model (BOK04), 12 stress scenarios representing a hypothetical economic situation are generated. For the scenario of exchange rate shock, given that exchange rate is set as an exogenous variable in the BOK04 model, the scenario is generated based on the long-term purchasing power parity hypothesis. In addition, given that the BOK04 model does not properly reflect the price change of household housing assets due to the real estate price shock, the impact of the asset shock is directly reflected in the household housing assets.[27)]

The baseline scenario, which is the basis for comparing loss changes according to the crisis scenario, is established based on the assumption that the macroeconomic situation in 2007 is the same as in 2006. This means that the rate of change in macroeconomic variables such as the rate of economic growth in 2007 is the same as those in 2006.

The baseline scenario reflecting a normal situation without a shock generally reflects the recent macroeconomic situation. Or estimation using an economic

27) Households' housing asset values in distressed times = households' housing holdings in normal times × housing prices in distressed times

forecasting model or Monte Carlo simulation is employed to estimate the most likely economic situation as the baseline scenario.

Each initial shock affects the macroeconomic variables through the following channels, weakening the borrower's ability to repay and negatively impacting the bank's assets.

- **Call Rates** : A rise in call rates pushes up market rates, shrinking investment and production activities of companies and reducing consumption, especially in households with excessive borrowings.

- **Stock Prices** : A decline in stock prices not only negatively affects corporate investment, but also reduces households' assets, thereby reducing consumption through the negative effect.

- **Exchange Rates** : Falling exchange rates (appreciation in domestic currency value) weaken price competitiveness, slowing exports while lowering inflation or price levels.

- **Oil Prices** : Rising oil prices deteriorate profitability of companies, which not only negatively affects facility investment and employment, but also acts as pressure for inflation and interest rate hikes.

- **Global Economy** : The global economic slowdown reduces the exports of enterprises, negatively affecting facility investment and employment.

- **Housing Prices** : A decrease in real estate (housing) prices decreases households' assets, reducing private consumption, while it also reduces corporate investment in equipment and construction due to a decrease in the borrowing capacity of the company.

<Table 4-10>

Macroeconomic Scenarios

Initial Shock	CB Rate	Stock Price	FX Rate	GDP	LF	CPI	Household Assets
Call Rate 300bp↑	2.15%p	-0.09%	-1.42%	-0.91%	-1.71%	-0.72%	-0.39%
Call Rate 500bp↑	2.34%p	-0.14%	-1.72%	-1.32%	-2.48%	-1.03%	-0.58%
Stock Price 30%↓	-0.09%p	-30.00%	-0.84%	-0.49%	-0.30%	-0.12%	-4.60%
Stock Price 50%↓	-0.15%p	-50.00%	-0.93%	-0.86%	-0.54%	-0.22%	-7.62%
FX Rate 20%↓	-0.59%p	0.13%	-20.00%	-1.41%	-1.64%	-1.73%	-0.03%
FX Rate 40%↓	-1.29%p	0.33%	-40.00%	-3.45%	-3.86%	-3.92%	-0.10%
Housing Price 30%↓	-0.07%p	0.09%	-1.42%	-1.09%	-0.22%	-0.72%	-22.48%
Housing Price 30%↓	-0.12%p	0.16%	-2.01%	-1.90%	-0.40%	-1.33%	-37.46%
Oil Price 100%↑	-0.17%p	0.22%	1.23%	-1.90%	-0.54%	2.00%	-0.37%
Oil Price 150%↑	-0.24%p	0.31%	2.09%	-2.70%	-0.78%	2.89%	-0.52%
World Economy Growth 1/2	-0.13%p	0.06%	-1.26%	-1.84%	-0.55%	-0.56%	-0.25%
World Economy Growth 0%	-0.25%p	0.10%	-1.81%	-3.60%	-1.11%	-1.12%	-0.50%

Note: CB rate denotes the return rate of corporate bonds, and LF denotes liquidity of financial institutions
Source: Bank of Korea

(8) Test Results of BOKST-07 Model[28)]

The financial stability report, published in Spring 2008 reports the results of stress test using BOKST-07 model, which enable us to evaluate the usefulness of the model. The stress test covers 12 local banks operating in Korea and was conducted in the late 2007.[29)] It considers account three types of financial risk,

28) This is the first test results presented in the Financial Stability Report published in Spring 2008.

29) It excludes two state-owned banks (the Korea Development Bank and Export-Import Bank of Korea) and foreign banks.

namely credit risk, market risk, and interest rate risk. Operational risk is excluded because there is no standard methodology to measure changes in operational risk due to macroeconomic shocks despite its importance. Also, the test is sorted into the top-down approach.

(a) Results of Scenario Analysis

<Table 4-11> shows a summary of the results. In severe scenarios, the BIS ratio for the entire banking sector is estimated to fall (0.53%p～2.22%p) from the baseline value. Overall, the BIS ratio turns out to be above 8% in spite of severe shocks.

<Table 4-11>

Result : BIS Ratios under Various Scenarios

Scenario	BIS Ratio	
	Result under Severe Shock Scenario	Difference from Baseline Value
Baseline	10.93%	—
Interest Rate Shock	8.71%	-2.22%p
Stock Price Shock	10.24%	-0.69%p
Exchange Rate Shock	10.40%	-0.53%p
Property Price Shock	9.00%	-1.93%p
Oil Price Shock	9.52%	-1.41%p
Global Economic Shock	9.78%	-1.15%p

Source: Bank of Korea (2008)

Furthermore, <Table 4-12> shows that interest rate shock has the most adverse impact on BIS ratio, followed by property price shock and oil price shock. This result has an implication that stress test results could be changing over time since these days property price shock, rather than interest rate shock, could be the most significant potential effects on the banking system. According to the BOK, banks' profitability measured by ROA (return on asset) and ROE (return on equity) would remain positive in the event of external shocks, implying that the banking system is resilient enough to absorb losses owing to unanticipated macroeconomic shocks.

<Table 4-12>

Result : Changes in Potential Loss by Exposure

Scenario	Corporate	SMEs	Retail
Interest Rate Shock	15.5%	25.6%	32.0%
Stock Price Shock	2.0%	1.8%	20.6%
Exchange Rate Shock	3.4%	11.8%	-3.8%
Property Price Shock	6.4%	4.6%	64.3%
Oil Price Shock	15.9%	9.7%	22.5%
Global Economic Shock	12.9%	11.2%	12.7%

Source: BOK Financial Stability Report (2008)

Next, <Table 4-13> reports more detailed results about changes in potential loss by segment. First of all, corporate sector is likely to be vulnerable to an oil price shock the most, while retail and SMEs are the most sensitive to an interest rate shock. This implies that the test gives valuable information on sources of financial risks from various angles.

<Table 4-13>

Result : Changes in Potential Loss due to PD Increase

Scenario	Rate of Potential Loss		
	Corporate	SMEs	Retail
Baseline	6.1%	11.1%	4.2%
10% Increase in Default Rate	6.4%	11.5%	4.5%

Source: BOK Financial Stability Report (2008)

(b) Results of Sensitivity Test

A credit risk sensitivity analysis is conducted by assuming a 10% rise in the default rate for all exposures. The results show that potential loss rates tend to pick up the most for SMEs.

Turning to the interest rate sensitivity analysis, it measures the sensitivity by utilizing interest rate VaRs, testing that assets and liabilities respond to changes in the yield curve. The interest rate VaRs used in the analysis is as follows:

$$interest\ rate\ VaR = \sum_i [\, GAP_i \times D_i \times \triangle R_i]$$

where GAP_i is an interest rate gap in the *i*th maturity. D_i is a modified duration for the *i*th maturity and $\triangle R_i$ is the size of interest rate shock. This method is a standard method proposed by the Basel committee. Three type of changes in the yield curve (upward sloping, downward sloping and humped) are considered in the analysis and <Table 4-14> reports the results.

<Table 4-14>
Result : Hypothetical Shock for Interest Rate Sensitivity Analysis

Type of Shock	Upward	Downward	Humped
Short-term (shorter than 1 year)	200bp↑	500bp↑	200bp↑
Medium-term (1~3 year)	300bp↑	300bp↑	400bp↑
Long-term (longer than 3 year)	500bp↑	200bp↑	200bp↑

Source: BOK Financial Stability Report (2008)

C. Systemic Risk Assessment Model for Macroprudential Policy (SAMP)

This subsection introduces the modules in detail to deliver NRB the main concepts of SAMP. As SAMP adopts a modular approach, its key components are six modules: macro-risk factor module, bank profit and loss module, default contagion module, funding liquidity contagion module, multi-period module, and systemic risk measurement module. First of all, we start with the overview of the SAMP model.

(1) Overview

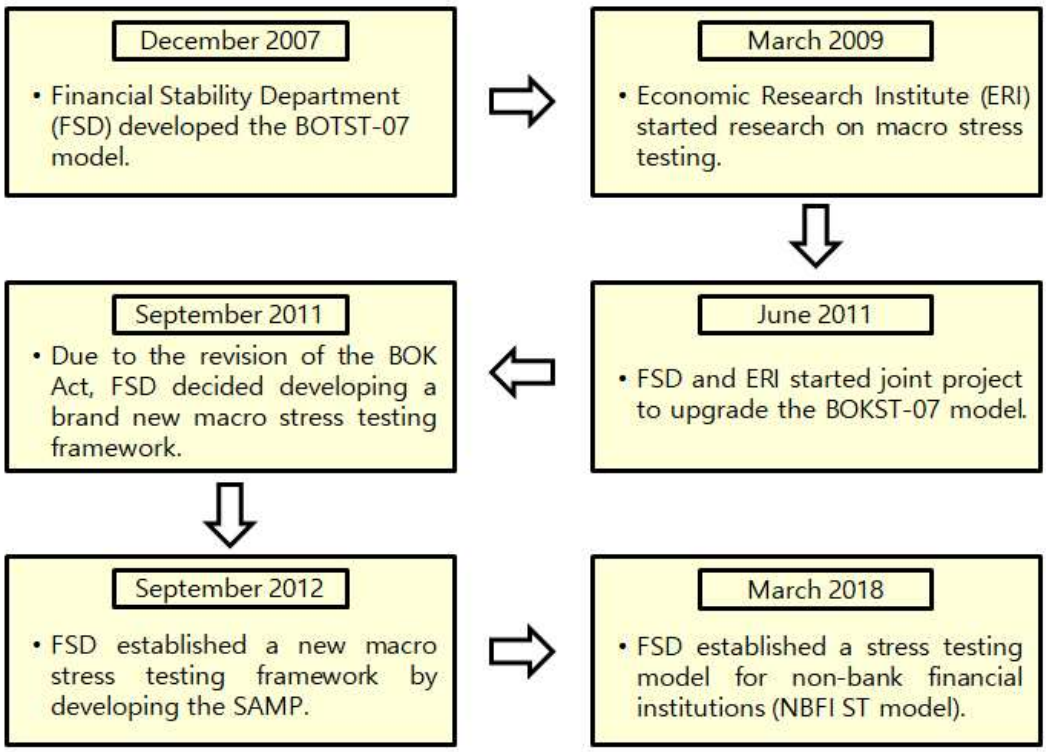
(a) Background and History of Development

In March 2009, Economic Research Institute (ERI), the research-oriented department of the BOK had engaged in several academic and policy research on sophisticating the model.[30] After the global financial crisis, the BOK realized

that the BOKST-07 model should be upgraded to incorporate second-round effects and multiple shocks into the macro stress test.

<Figure 4-7>

Development History of SAMP



Source: Bank of Korea

In June 2011, the Financial Stability Department, which is in charge of macro stress testing, and ERI started a joint research project that plans to upgrade the BOKST-07 model into a more sophisticated and comprehensive model.

In September 2011, the Bank of Korea Act was revised to explicitly assign a mandate for maintaining and enhancing financial system stability. It was motivated by the experience that macroeconomic stability (including price stability) cannot be achieved without financial stability (BOK, 2012). And the BOK realized that comprehensive macro stress testing framework is essential as

30) The BOK has two research department. One is the Research Department in charge of current or routine research supporting monetary policy and the other is the ERI in charge of mid- or long-term research.

a key macroprudential policy tool to assess systemic risk factors and to maintain financial stability. With strengthened role in financial stability, the BOK changed its plan, rather than simply upgrading the BOKST-07 model, to establish a macro stress testing framework that includes a comprehensive macro stress testing model.

As the BOK decided to adopt a modular approach to create the model, the Financial Stability Department at the BOK sequentially developed six modules, the main components of the model. In the first half of 2012, the BOK had a pilot test on SAMP using historical data and finally, in September 2012, SAMP was developed as a brand-new macro stress testing model.

SAMP solves several critical shortcomings that the BOKST-07 model has. For instance, it considers non-linearity of turbulent amplification process of economic shocks and an interlink between financial institutions. SAMP which is the first macro stress testing framework developed in Asia becomes a pillar of the BOK's policy tools.[31)]

During the last decade, non-bank financial institutions (NBFIs) is continuously expanding.[32)] Due to this tendency, the interlink between banks and NBFIs is increasing and complicated, resulting in an increase in systemic risk sourced by NBFIs. Hence, in 2018 the BOK developed a stress testing model specific to NBFIs (NBFI ST model). This model is able to assess systemic risk and resilience of each NBFI sector as well as those of each NBFI.

(b) Features of SAMP

SAMP performs stress tests in an integrated way under a unified framework, as shown in <Figure 4-8>. It has several enhanced features that traditional stress testing models such as BOKST-07 model do not have.

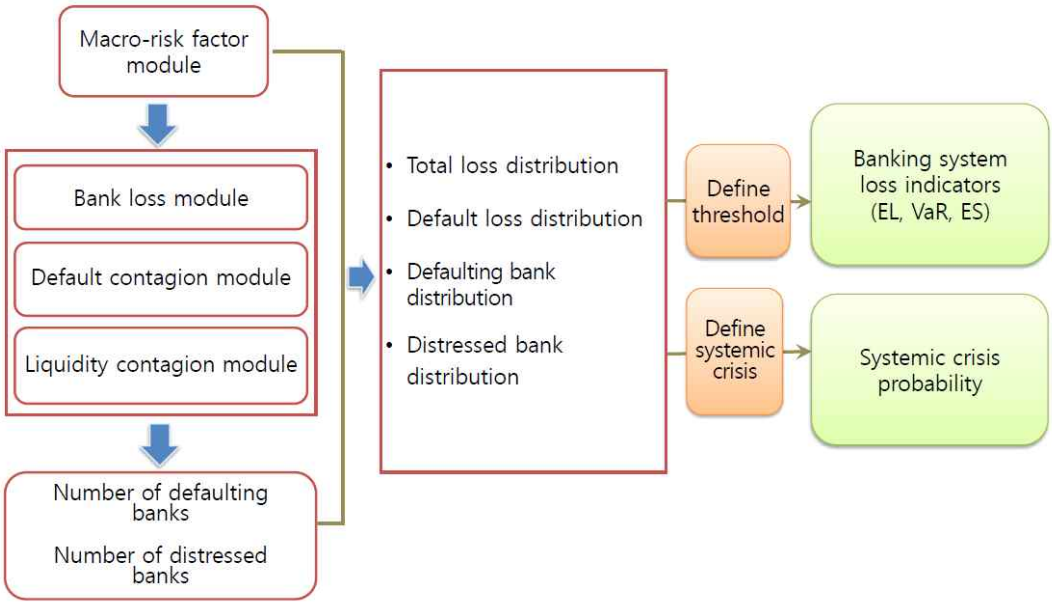
---

31) The BOK has two pillars of econometric policy tools. One is BOK Dynamic Projection Model (BOKDPM) that projects the economic growth of the Korean economy, which is developed as a tool for monetary policy. The other is SAMP for macroprudential policy.

32) Non-bank financial institutions include mutual savings banks, credit unions, security firms, and credit card companies.

<Figure 4-8>

Simple Framework of SAMP



Source: Introduction to Macro Stress Testing: BOK's Experience (2014)

First, it is a disequilibrium model that allows us to measure tail risks usually occurred by disequilibrium phenomena such as imbalances in the macroeconomy and asset price falls (during a financial crisis). The test is more realistic, therefore the results are more reliable. Second, it is a non-linear model that takes into account the amplification and propagation process of macroeconomic shocks, as it is designed to estimate losses when an effect of a shock is above a certain level. It can reflect fire sales, deleveraging, spillover effects, interbank contagion as well as feedback effects.

Next, it is an integrated model that allows to measure diverse financial risks under a unified framework by employing several modules. In addition, it is a sophisticated policy tools that assess effects of financial regulations and policy measures on the financial system. For instance, it can measure the impacts of capital injections by the BOK on financial institutions and the whole financial system. Last, it assesses systemic risk at the bank-level so that policymakers can identify which financial institutions are the most vulnerable to macroeconomic shocks. Therefore, the test results deliver the BOK policymakers valuable information on setting up macroprudential policy.

(2) Macro-Risk Factor Module

This module is used in the first process of SAMP. In this module, the policymakers choose macro risk factors that have a serious or significant impact on financial institutions' profits and losses. Because those risk factors differ from country to country, this step is important because it identifies risk factors relevant to the Korean economy. Based on the characteristics of the economy, the BOK chooses 12 key risk factors, as shown in <Table 4-15>.

<Table 4-15>

12 Macro Risk Factors

Classification	Macroeconomic Variables
Real Economy (4 factors)	- GDP growth rate - Unemployment rate - Inflation rate - Housing price
Financial Market (4 factors)	- FX rate - Equity price - Corporate bond spread - Government bond yield
External Sector (4 factors)	- Global GDP growth rate - Global equity price - US treasury bond yield - Oil price

Source: BOK Financial Stability Report (2008)

Then, the module employs several econometric models to estimate a marginal distribution of each macro risk factor that significantly affects financial institutions' profits and losses. The marginal distribution is allowed to have a time-varying and fat-tailed feature by employing sophisticated macro-econometric tools such as Bayesian vector autoregressive models (Bayesian VAR), generalized auto regressive conditional heteroskedasticity (GARCH) models, and extreme value theory (EVT).[33] As of July 2020, 12 quarterly variables from 1997Q4 to 2019Q4 are used in the VAR model. The upshot of this step is forecasting how these variables are evolving in the upcoming two years. Next, it forms a joint distribution of macro risk factors using estimated marginal distributions. This step

33) GARCH and EVT are used to reflect time-varying and fat-tailed features and these features are incorporated into Bayesian VAR model.

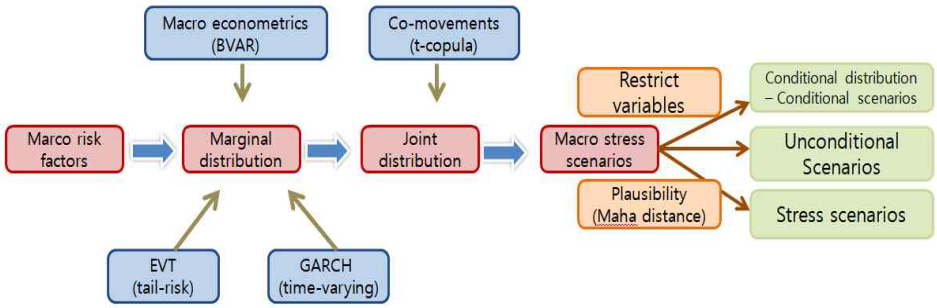
utilizes a Copula method, a statistical method that transforms marginal probability distributions into a multi-variate joint distribution, proposed by Daul et al. (2003).[34)]

Finally, based on the joint distribution, scenarios used for assessing systemic risk are developed by reflecting the inter-dependence among the 12 risk factors. The scenarios can be either unconditional or conditional. An example of conditional scenario is a hike in global oil prices which also lead to changes in other risk factors (e.g., low GDP growth rates and higher inflation). Usually, some parameter constraints are imposed when constructing conditional scenarios. The BOK creates several probable scenarios during the process.

<Figure 4-9> briefly summarizes the flow of macro-risk factor module. In practice, the BOK regularly check if the macro risk factors are adequate over time considering changing economic and financial environment.

<Figure 4-9>

Flow of the Macro-Risk Factor Module



Source: Introduction to Macro Stress Testing: BOK's Experience (2014)

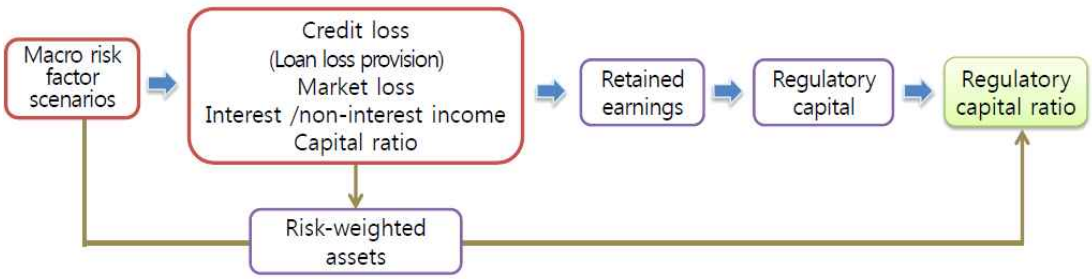
(3) Bank Profit and Loss Module

The bank profit and loss module is the heart of a stress testing model. The Module is mainly utilized to estimate the impacts of macro risk factors on each banks' profits and losses following scenarios set by the macro-risk factor module. The changes in profits and losses of banks are categorized into credit loss, market loss, interest income and non-interest income.

34) See Bank of Korea (2008).

<Figure 4-10>

Flow of the Bank Profit and Loss Module



Source: Introduction to Macro Stress Testing: BOK's Experience (2014)

(a) Credit Loss

Among them, credit losses are the main source of financial risk. Following Schmieder et al. (2011), the credit losses are estimated as direct losses of loan portfolios caused by macroeconomic shocks. To do so, it estimates the changes in the probability of default (PD) and the changes in loss given default (LGD) of loan portfolios, as shown below.

$$\triangle \text{Credit Loss} = \triangle \text{PD} \times \triangle \text{LGD} \times \text{exposure at default (EAD)}$$

- PD: following the Basel Ⅲ, it is estimated according to 5 borrower types (large enterprises, SMEs, housing mortgages, household, and credit card loans). In detail, the BOK gathers "Credit Risk Report" from all testee banks on a quarterly basis. This report includes detailed information on PDs by five borrower types. To estimate PDs, reported (or observed) PDs are regressed on some of the 12 macro-variables.

- LGD: due to the lack of time series data, models suggested by Altman et al. (2003) and S&P (2010) are modified to reflect the Korean financial system. Bank-level LGDs are collected from "Credit Risk Report."

The regression specification to estimate LGD is presented below.

$$LGD_s = LGD_t + 2.1535 \times (PD_s - PD_t)$$

where the subscript s and t denote scenario and time, respectively. The parameter 2.1535 is the sensitivity coefficient of LGD to PD, proposed by S&P model.

<Box 4-6>

Technical Point of Estimating Lending/Borrowing Rates

Bank-level lending and borrowing rates are necessary to estimate market losses, interest income and interest expense. However, in reality, it is a very tricky job to estimate the rates for each bank. Therefore, lending and borrowing rates are computed by adding the CD rates, estimated in the Bayesian VAR model, and a certain spread. This spread is based on financial market conditions and credit ratings of individual banks.

Source: Bank of Korea

(b) Market Loss

Market losses cover those caused by changes in market prices such as interest rates, stock prices, foreign exchange rates on the trading book of banks. And they are estimated by applying a mark-to-market approach. Market losses are simply calculated by the formula presented below. One exception is losses on available-for-sale securities. They are categorized not into market loss, but capital adjustment. Hence, losses on available-for-sale securities directly affect equity capital.

$$\text{Market Loss} = \text{trading position} \times \triangle\text{price}$$

(c) Interest and Non-interest Income

Interest income is calculated as estimated interest revenues less estimated

interest expenses for each repricing period, as BOK (2008) describes, while non-interest income is defined as estimated non-interest revenues minus estimated interest expenses. In the estimation, a simple regression model is used.

(4) Default Contagion Module

This module is used to incorporate possible second round effects of bank defaults caused by macroeconomic shocks. In order to reflect an interbank contagion triggered by bank defaults, the module utilizes network structure analysis on the banking system. Furthermore, this module assesses fire sale losses and losses due to a sharp credit contraction feedback through macro-financial linkages during the time when a bank or banks go bankrupt.

(a) Procedure of the Module

Detailed procedure of the module is as follows. First, the module identifies a defaulted bank (called “fundamental default”) if a bank’s net worth goes down below the default threshold point that is calculated as equity capital minus estimated losses (computed by the bank profit and loss module).

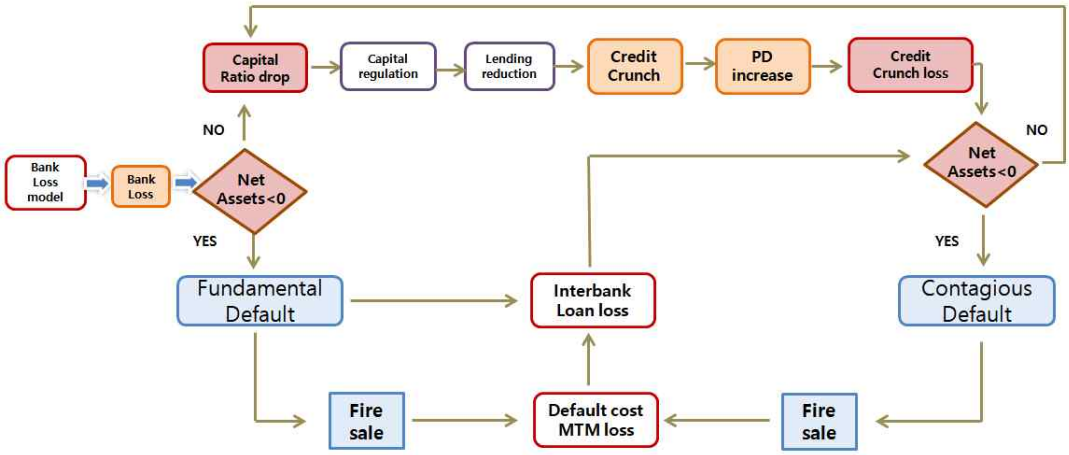
Second, any losses generated from loans extended to defaulted banks are estimated using a network structure analysis suggested by Eisenberg and Noe (2001). Meanwhile, default costs resulting from bank default occur if defaulted banks’ liquidation values are less than book values of the banks (Elsinger et al., 2006). Additionally, when a bank goes bankrupt, liquidity assets held by the bank become under fire sales. Hence, the module estimates additional losses caused by such fire sales separately by a type of loss (mark-to-market losses and disposal losses).

Two common repercussions of bank default are a fall in capital ratios of surviving banks and a subsequent credit crunch that usually leads to additional losses. These credit crunch losses are estimated by a simple reduced form model of macro-financial linkages. The model estimates the impact of changes in the aggregate loan size on probability of default (PD). The changes in aggregate loan size affects banks’ losses through the sequential macro-financial linkage

(macro shock → risk aversion ↑ → loan reduction → credit crunch → economic recession → loan defaults ↑ → bank losses).

<Figure 4-11>

Flow of the Default Contagion Module



Source: Introduction to Macro Stress Testing: BOK's Experience (2014)

If a surviving bank's net worth decreases below the threshold point after considering interbank loan losses, fire sale losses, and credit crunch feedback losses, the bank becomes under default (called "loss contagious default").

Next, when a loss contagious default occurs, the module repeats the process until when no additional loss contagious default occurs.

(b) Network Structure of the Banking System

Network structure is a key factor that makes the model accurate to estimate systemic risk. An interbank exposure matrix is used for analyzing the network structure across banks. For bank i (i= 1, 2,⋯, N), the B/S identity, presented below, holds.[35)]

$$\sum_{j \in N} b_{ji} + a_i^q + a_i^z = \sum_{j \in N} b_{ij} + d_i^q + d_i^z + e_i$$

35) The matrix is collected as part of flow-of-funds statistics not from the financial stability department but from statistical department.

where b_{ij} is bank i's borrowing from bank j. a_i^q and a_i^z are respectively liquid and illiquid assets operated by bank i outside the banking system. d_i^q and d_i^z are respectively liquid and illiquid liabilities financed by bank i outside the banking system. And e_i is the equity capital of bank i.

Using each bank's B/S identity, the network model of the N number of banks, as depicted in Figure <4-12>. The summation of the numbers along the columns (e.g., $\sum_{j \in N} b_{ij}$ for bank i) comes to the assets of the banks, while the summation of the numbers along the rows (e.g., $\sum_{j \in N} b_{ji}$ for bank i) are liabilities of the banks. Since a bank does not lend to itself, every diagonal element of the matrix is equal to zero. If bank i is defaulted, it would affect the other banks through a lending relationship. That is, the i_{th} row (b_{i1}, b_{i2}, ⋯, b_{iN}) is deteriorated. In calculating second round effects, the fixed point method is used and it is iterated until additional defaults do not occur.

<Figure 4-12>

Matrix Structure of Banking System

		Bank					Liquid Liabilities	Illiquid Liabilities	Equity Capital
		1	⋯	i	⋯	N			
Bank	1	0	⋯	b_{1i}	⋯	b_{1N}	d_1^q	d_1^z	e_1
	⋮	⋮	⋱		⋱	⋮	⋮	⋮	⋮
	i	b_{i1}	⋯	0	⋯	b_{iN}	d_i^q	d_i^z	e_i
	⋮	⋮	⋱		⋱	⋮	⋮	⋮	⋮
	N	b_{N1}	⋯	b_{Ni}	⋯	0	d_N^q	d_N^z	e_N
Liquid Assets		a_1^q	⋯	a_i^q	⋯	a_N^q			
Illiquid Assets		a_1^z	⋯	a_i^z	⋯	a_N^z			

Source: Bank of Korea, Financial Stability Report (October 2012)

<Box 4-7>

The Focused Interview with the BOK Officials

We had a focused interview with the BOK officials, in charge of collecting interbank exposures, in the Statistics Department on July 27. The data on interbank exposures are collected by the flow of funds team in the Statistics Department, not by the Financial Stability Department.

In short, the data comes from “From-Whom-To-Whom Table”, which is a detailed flow of funds table. After experiencing the global financial crisis, advanced countries realized lack of data on interbank exposures (data gap) necessary to measure contagion risk that is crucial for maintaining financial stability. Hence, OECD adopted one topic of Data Gap Initiatives to develop “From-Whom-To-Whom Table”, which informs financial linkages across banks. The data collection keeps track of the counterparty to each transaction between a lender and a borrower (Schubert, 2015). As Schubert (2015) points out, the table is now mainly used for macro stress testing in advanced countries.

Participant list

Name	Affiliation
Hyun, Junghwan	Dongguk Univ.
Lee, Min-Syup	Bank of Korea
Lee, Youngsun	Bank of Korea

The BOK started in 2011 to generate the table and now internally use the table to examine interconnectedness of the banking system and to assess contagion risks with the SAMP model.

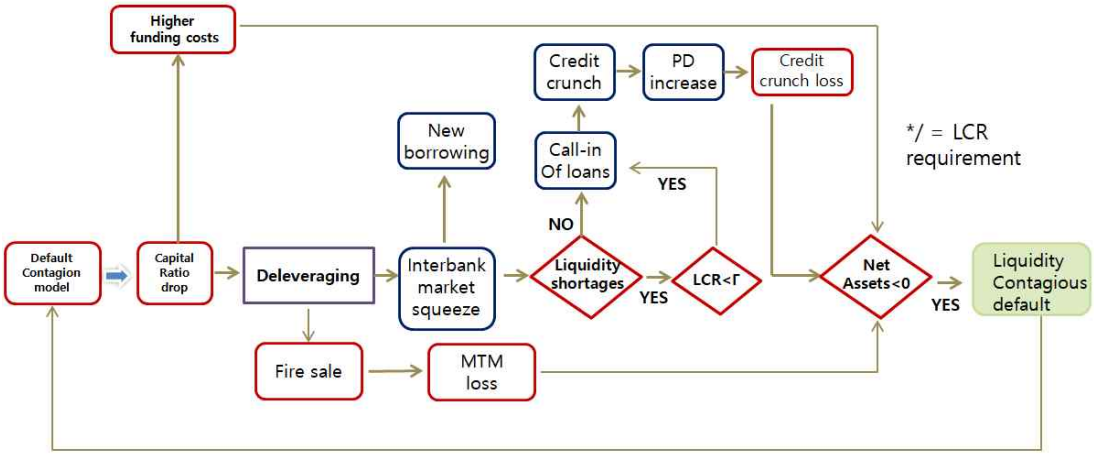
(5) Funding Liquidity Contagion Module

This module incorporates a detailed amplification process of contagion effects into the macro tests, focusing on how liquidity shortage make banks distressed via interbank linkages.

Overall flow of this module is presented <Figure 4-13>, which looks complex. From now on, we explain the several steps in detail.

<Figure 4-13>

Flow of Funding Liquidity Contagion Module



Source: Introduction to Macro Stress Testing: BOK's Experience (2014)

(a) Estimate the Amounts of Withdrawals

The module first measures the amounts that banks withdraw interbank loans and deposits. When a bank whose capital ratio falls, the bank starts withdrawing deposits (deposit run-off). Specifically, the withdrawals are estimated based on a rule that withdrawal rate is proportional to the square of the decline in equity capital and inversely proportional to the initial equity capital ratio (Lee, 2011; De Haan and Van den End, 2011).

<Box 4-8>

Deposit Run-off Rate

$$\text{Deposit run-off rate} = \begin{cases} \beta \dfrac{\left(r_{i,0} - \tilde{r}_i\right)^2}{r_{i,0}} & \text{if } \tilde{r}_i > r_{i,0} \\ 0 \quad otherwise \end{cases}$$

Variable	Meaning
β	sensitivity of run-off to the capital ratio
$\widetilde{r_i}$	initial capital ratio
$r_{i,0}$	capital ratio after default contagion

Source: Bank of Korea, Financial Stability Report (October 2012)

(b) Estimate Losses by Fire Sales

If there is a bank for which the capital ratio falls below the threshold, the liquidity contagion stage begins. In this stage, the module estimates losses generated from banks' fire sales of assets. Since the losses have two components (mark-to-market losses and fire sale losses), the module respectively estimates them. The specific formula is presented in the box.

<Box 4-9>

Fire Sale Losses

(1) Mark-to-market losses : $(\bar{p}_{i,t+h}^{q(2)} - \bar{p}_{i,t+h}^{q(3)})\left(a_{i,t+h}^{q} - l_{i,t+h}^{q} - s_{i,t+h}^{q(2)} - s_{i,t+h}^{q(3)}\right)$

(2) Fire sale losses : $(p_{i,t+h}^{q(2)} - p_{i,t+h}^{q(3)})s_{i,t+h}^{q(3)}$

Variable	Meaning
p_i^q	market price of liquid assets
$\overline{p_i^q}$	average price of liquid assets
l_i^q	1st round liquid asset losses
s_i^q	volume of liquid assets to be sold
(3)	3rd step of contagion

Source: Bank of Korea, Financial Stability Report (October 2012)

(c) Liquidity Shortages and Credit Crunch Losses

The module estimates both liquidity shortages of illiquid banks and subsequent credit crunch feedback losses simultaneously. Liquidity shortages occur if a bank's liquidity holding cannot meet its liquidity needs. If so, the liquidity needs are calculated as the sum of interbank loan withdrawals of other banks minus the sum of liquidity holdings (including deposits to other banks). The formula of liquidity shortages is presented below. u_i^n is liquidity needs. $\triangle b_{ij}$ is an interbank loan withdrawal of bank j from bank i. $\triangle d_i^n$ is an initial liquidity withdrawal and $\triangle x_i^q$ are liquidity holdings.

$$Liquidity\ shortage = 1_{[u_i^n > x_i^q]}\left(\sum_{j \in S} \triangle b_{ij} + \triangle d_i^n - x_i^q\right)$$

The subsequent credit crunch feedback losses are estimated using the first round illiquid asset losses and the feedback probability of default (PD) of the second and third step of contagion, as shown below.

$$Credit\ crunch\ losses = \left(q_i^{z(3)} - q_i^{z(2)}\right)\left(a_i^z - l_i^z - s_i^{z(2)} - s_i^{z(3)}\right)$$

where q_i^z is a feedback PD of bank i. l_i^z is the 1st round illiquid asset losses and s_i^z is a volume of illiquid assets to be called in. The superscripts (2) and (3) respectively denote the 2nd and 3rd step of contagion. Credit crunch losses basically indicate losses in illiquid assets in demand during a corresponding period.

(d) Additional Funding Costs

These costs to which distressed banks are exposed are estimated using the below formula.

$$Additional\ funding\ costs = \triangle f_i \times \left[1 - \delta_i(1-\theta)\right] d_i^{l(3)}$$

where $\triangle f_i$ denotes a change of funding rate applied to bank i. δ_i is a liquid debt run-off rate. And θ and d_i^l are respectively a LLR ratio and total liquid debts of bank i. As additional funding costs increase, the liquidity burden imposed on bank i rises up.

(e) Liquidity Contagious Default

This stage, the final stage of a loop procedure of the module, identifies if a bank fall under liquidity contagious default. The criteria is: a liquidity contagious default occurs if $v_i^{2nd} > v_i^d$ and $v_i^{3rd} < v_i^d$. v_i^{2nd} is a net wealth after default contagion and v_i^{3rd} is a net wealth after liquidity default contagion. v_i^d denotes a default threshold point. Note that a bank whose net worth is not under a fundamental or loss contagious default is only considered in identifying whether to be defaulted due to liquidity contagion.

If any bank turns out to be subject to liquidity contagious default, the module iterates the loop until no bank further goes defaulted due to the liquidity contagion.

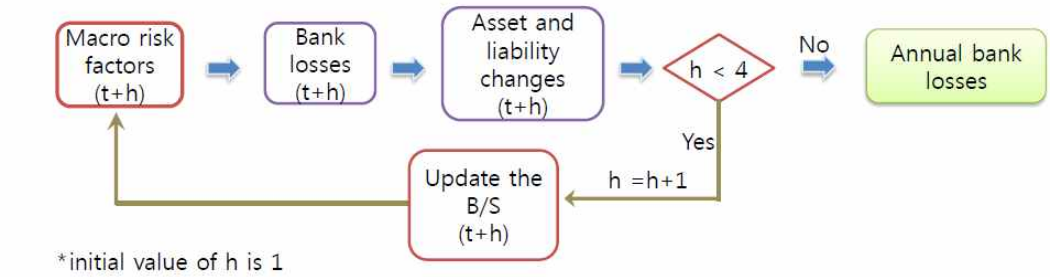
(6) Multi-period Module

This module makes the stress testing model more realistic to reflect dynamic consequences of macroeconomic shocks. A period is a quarter, and the maximum time horizon is a year. In order to take into account quarterly changes in profits and losses of banks, it iterates the procedures of four modules, from (a) to (d) in <Figure 4-14>, and then sum of annual profits and losses caused by macroeconomic shocks are estimated.

One might think that rather than using quarterly data and the iteration procedure, researchers can use annual data. However, if the macroeconomic shock occurs in the middle of a year, the annual data is entangled with the data of the pre-shock period (the first half before the shock) and those of the post-shock period (the second half after the shock). Hence, using the annual data cannot identify the effects of macroeconomic shocks.[36)]

<Figure 4-14>

Flow of Multi-period Module



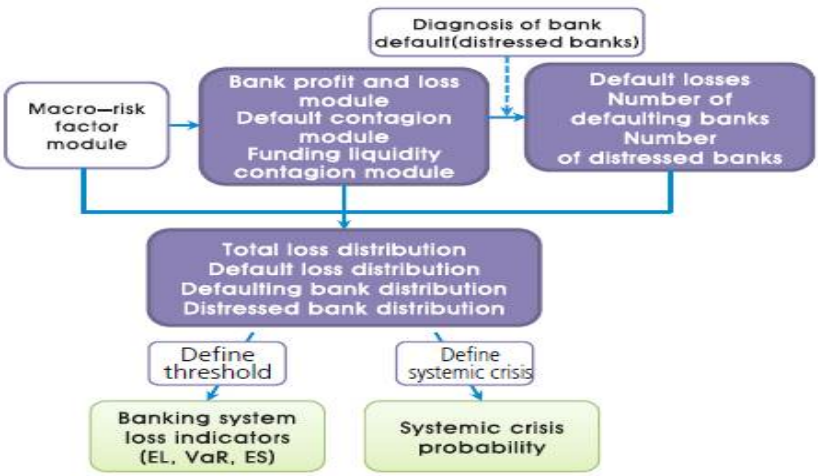
Source: Introduction to Macro Stress Testing: BOK's Experience (2014)

(7) Systemic Risk Measurement Module

This module creates systemic risk indicators whose role is to assess the probabilities of systemic crisis. The module employs the aggregate loss distribution of the banking system (the scope of testing) and follows several steps.

<Figure 4-15>

Flow of Systemic Risk Measurement Module



Source: Introduction to Macro Stress Testing: BOK's Experience (2014)

---

36) All input data are equipped in a quarterly basis, which would be a prerequisite for developing a fully-fledged macro stress testing model.

(a) Measuring the Total Losses of Individual Banks

The total losses of a bank are calculated as summing its fundamental losses, interbank loan losses, fire sale losses, credit crunch losses and additional funding costs.

(b) Detecting the Number of Defaulted Banks

This step uses the total losses of each bank to decide if the bank is bankrupt or distressed and finally calculates the number of defaulting and distressed banks.

(c) Generating Aggregate Loss Distribution of the Banking System

In this step, an aggregate loss distribution of the banking system is generated by using Monte-Carlo simulation. In order to generate the aggregate loss distribution, the simulation is iterated for 100,000 scenarios which is randomly drawn from the assumed joint probability distribution of the macro risk factors. The basic formula of probability distribution of system-wide losses is presented below. F_K denotes a cumulative distribution function of system-wide losses and m is the number of simulations.

$$F_K(z_i) = \Pr(Z_i < z_i) = \frac{\sum_{j=1}^{m} 1\left[y_k(x_j) < Z_i\right]}{m}$$

(d) Calculating the Systemic Risk Indicators

This step eventually calculates several systemic risk indicators of the entire banking system that include the expected losses, value at risk (VaR), expected shortfall (ES), the number of distressed banks.[37] <Box 4-10> presents some Probabilities of Systemic Crisis.

37) For details in calculation, refer to Lehar (2005), Adrian and Brunnermeier (2009), White et al. (2010) and Acharya et al. (2010).

<Box 4-10>

Systemic Risk Indicators

(1) Expectation Indicator : $\int_{-\infty}^{\infty} y_k f_k(y_k) dy_k$

(2) VaR Indicator : $inf\{y_k | F_k(y_k) \geq \alpha\}$

(3) ES Indicator : $E[y_k | F_k(y_k) \geq \alpha]$

where F_K denotes a cumulative distribution function and f_k is the a probability density function of system-wide losses. α is a significance level.

Source: Bank of Korea, Financial Stability Report (October 2012)

(e) Calculating the Probability of Systemic Crisis

Together with the step (d), the module defines 4 definitions of systemic risk and estimates the resulting probability of systemic crisis by using the aggregate loss distribution.

<Box 4-11>

Probability of Systemic Crisis

① Definition Ⅰ : Asset loss rate exceeds critical value(ϵ_1)

$$\Pr[y_1 \geq \epsilon_{1]} = \int_{\epsilon_1}^{\infty} f_1(y_1) dy_1$$

where $f_1(\bullet)$: Banking system probability distribution of asset loss rate.

② Definition Ⅱ : Default loss rate exceeds critical value(ϵ_2)

$$\Pr[y_2 \geq \epsilon_{2]} = \int_{\epsilon_2}^{\infty} f_2(y_2) dy_2$$

where $f_2(\cdot)$: Banking system probability distribution of default loss rate.

③ Definition Ⅲ : Simultaneous defaults more than k number of banks

$$\Pr[N_d \geq k] = \int_{k/N}^{1} f_3(y_3)dy_3$$

where $f_3(\cdot)$: Probability distribution of ratio of defaulting banks(N_d/N) in banking system.

④ Definition Ⅳ:Simultaneous distresses more than k number of banks

$$\Pr[N_b \geq k] = \int_{k/N}^{1} f_4(y_4)dy_4$$

where $f_4(\cdot)$: Probability Distribution of ratio of distressed banks (N_d/N) in banking system.

Source: Bank of Korea, Financial Stability Report (October 2012)

<Box 4-12>

The Focused Interview with the BOK Officials

We had a focused interview with the BOK officials in charge of the macro stress testing in the headquarter of the Bank of Korea on July 14. The participants discuss how to establish and implement an advanced macro stress testing model and some requirements for development of the model.

Participant list

Name	Affiliation
Hyun, Junghwan	Dongguk Univ.
Kim, Kyunghun	Hongik Univ.
Yang, Jungu	Bank of Korea
Lee, Hyeona	Bank of Korea

The main results of the interview are below.

- Importance of data availability: Unless essential data is unavailable, developing a macro stress test model is impossible. There are two important points. The first is frequency (the higher, the better). The other is bank-level data is more important than macroeconomic variables. In fact, macroeconomic variables are employed in generating scenarios. Scenarios can be generated in an arbitrary way that is not always inferior.

- Research ability: A team that takes responsibility to develop a model is formed to focus on the development. It should include several experts with affluent knowledge of financial systems and econometric tools.

- Scope: When the BOK first developed the BOKST-07 model, it covered only 14 domestic banks and excluded foreign banks and regional banks. The criterion about the scope is how a bank is systemically important enough to trigger systemic risk. Ideally, extensive coverage is the best.

D. Upgrade of SAMP: NBFI ST Model

Like SAMP, the NBFI ST model has 7 modules that are key components of the model. Here, we provide brief explanation on these modules. Before examining the details about the model, we will begin by the overview of this model first.

(1) Overview

(a) Background and History of Development

As non-bank financial institutions (NBFIs) are growing fast and continuously during the last decade, they become to play an important role in the financial system in Korea and therefore they have come to be deeply interconnected each other and with banks. Consequently, systemic risk potentially originated from NBFIs is also increasing so that regulators and the BOK recently pay more attention to stability and resilience of NBFIs.

Since usually regulations on banks are stricter than those on NBFIs, stability of NBFIs is quite important to maintain stability of the banking system given the increasing interconnectedness between NBFIs and banks. This is the main reason why the BOK established the NBFI ST model that is a stress testing model especially for NBFIs. Specifically, NBFIs, considered in the NBFI ST model, include credit unions, mutual savings banks, security firms, credit card company.

(b) Features of NBFI ST Model

As the model is aimed at assessing how macroeconomic and financial shocks affect the resilience of NBFIs, it has some noteworthy features.

First, it is intentionally developed to be interoperable with SAMP. While the NBFI ST model adopts a top-down approach for the stress testing, it utilizes the scenarios modules employed in SAMP. This feature, like SAMP, allows it to

capture the tail risks caused by disequilibrium phenomena such as imbalances in the macroeconomic and financial system. Consistent with SAMP, it adopts a modular approach the enables it to analyze various risk types in an integrated way. Thanks to high interoperability with SAMP, in the near future SAMP and the NBFI ST model are integrated into a model whose scope covers the entire financial system.

Second, to reflect the fact that each NBFI sector has a unique business models, regulations and risk factors, a separate model is constructed for each sector. By doing so, it ensures that the BOK are able to estimate profits, losses and capital ratios more accurately.

Next, the model, the same as the SAMP, can estimate the resilience both at the financial institution level and at the sector level. Owing to this feature, the BOK, the BOK can identify which financial institution is the most vulnerable to an adverse shock and the characteristics of financial institutions with high financial weakness.

Last, the model is designed to capture the second round effects, including contagion of risk through the interconnectedness between financial institutions, which is also consistent with SAMP.

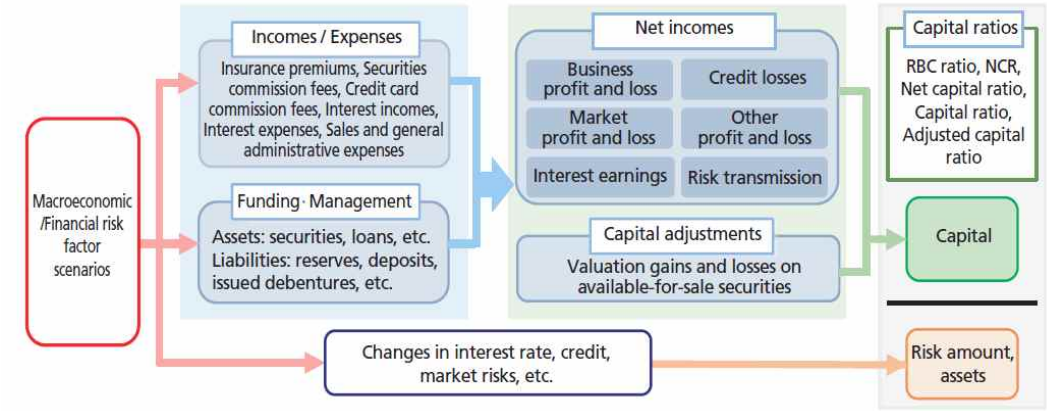
(2) Business Profit and Loss Module

The module utilizes a regression model that has changes in business profits and losses as dependent variables, controlling for macroeconomic and risk factors as explanatory variables as shown below. In details, business profits and losses include insurance premiums, securities commission fees, credit card commission fees. In the below regression specification, I is growth rate of business profits and losses and x_n is macroeconomic and financial risk factors.

$$I_{i,t} = \beta_0 + \beta_i I_{i,t-1} + \beta_1 x_{1,t-k_1} + \cdots + \beta_n x_{n,t-k_n}$$

<Figure 4-16>

Structure of Non-bank Financial Institution Stress Testing Model



Source: Introduction to Macro Stress Testing: BOK's Experience (2014)

(3) Credit Loss Module

It estimates the impacts of changing risk factors on the default rate (DR) and loss given default (LGD). In detail, either the non-performing loan (NPL) ratio or the delinquency rate is used as a proxy variable to estimate DR. The regression model is presented below. x_n is risk factors (macroeconomic or financial). Note that the model converts NPL or delinquency ratios ranging from 0 to 1 into logit forms.

$$\ln\left(\frac{NPL_t}{1-NPL_t}\right) = \beta_0 + \beta_{NPL}\ln\left(\frac{NPL_{t-1}}{1-NPL_{t-1}}\right) + \beta_0 x_{1,t-k_1} + \cdots + \beta_n x_{n,t-k_n}$$

Then using estimated DR and LGD, credit losses(L_s^C) is calculated as presented below.

$$L_s^C = \sum_i DR_{i,s} \times LGD_{i,s} \times EAD_{i,c}$$

where $DR_{i,s}$ is a scenario default rate based on different exposures and $LGD_{i,s}$ is a scenarios loss given default rate. $EAD_{i,c}$ is the current exposures.

(4) Market Profit and Loss Module

This module evaluates, on a mark-to-market basis, the changes in values of securities held by financial institutions due to changes in asset prices (interest rates, stock prices, and exchange rates). For example, bond valuation gains and losses (L_s^B) is defined as the bond exposures times the durations. L_s^B measures the extent of bond price sensitivity to changes in interest rates. Stock valuation gains and losses (L_s^S) is calculated by multiplying the exposures concerned by the growth rates of the stock price index. Similarly, foreign exchange (L_s^F) is gained by multiplying the exposures by the rates of changes in exchange rates.

$$L_s^B = -\triangle r \cdot D \cdot B_c$$

$$L_s^S = -\triangle k \cdot S_c$$

$$L_s^F = -\triangle z \cdot F_c$$

where $\triangle r$ is the change in interest rates, D is the duration, B_c is the bond exposure, $\triangle k$ is the rate of stock price change, S_c is the stock exposure, $\triangle z$ is the rates of change in the exchange rates, and F_c is the foreign exchange exposure.

(5) Interest Earnings Module

In the module, the interest earnings (P_s^R) is calculated by subtracting the interest expenses from the interest income. For non-bank depository institutions, since lending and deposit rates vary depending on maturities, a lending (deposit) rate with a certain maturity is applied to interest-earning assets (interest-bearing liabilities) with the same maturity. Given that the extents of change in lending (deposit) rates of this type of financial institutions are different depending on changes in market interest rates, the module separately estimates risk transmission coefficients reflecting whether market rates increase or decrease.

$$P_s^R = (r^A + \triangle_s^A) \cdot A^R - (r^L + \triangle r_s^L) \cdot L^R$$

where A^R and L^R are interest-earning assets and liabilities respectively, r^A and r^L the lending and deposit interest rates, and $\triangle r_s^A$ and $\triangle r_s^L$ the changes in lending and deposit interest rates.

(6) Risk Transmission Module

This module estimates the overall size of risk transmission for each sector, by using the mutual exposures within the non-bank sector. Then the module allocates the estimated extent of risk transmission among individual financial institutions to calculate amounts of loss for each financial institution. In practice, these amounts are estimated separately for those through the liquidity risk channel and those through the credit risk channel. The loss by liquidity risk is defined as liquid product mutual transaction amount (EAD) × by-product recovery rate × asset disposal loss rate × sectoral default rate (DR). The loss by credit risk is computed as credit product mutual transaction amount (EAD) × by-product loss given default (LGD) × sectoral default rate (DR).

(7) Risk/Asset Amount Adjustment Module

In the module, the risk amount or assets, necessary to calculate each sector's capital ratio, are estimated under various risk factor scenarios. The procedure differs from sector to sector. For instance, for non-bank depository institutions, the changes in provision coverage ratios are used to calculate risk-weighted assets (or total assets). For securities firms, the total risk amount is calculated as the sum of market risk amount, credit risk amount, and operational risk amount. When it comes to credit card companies, adjusted total assets are calculated using the changes in their exposures due to changes in default rates (BOK 2018).

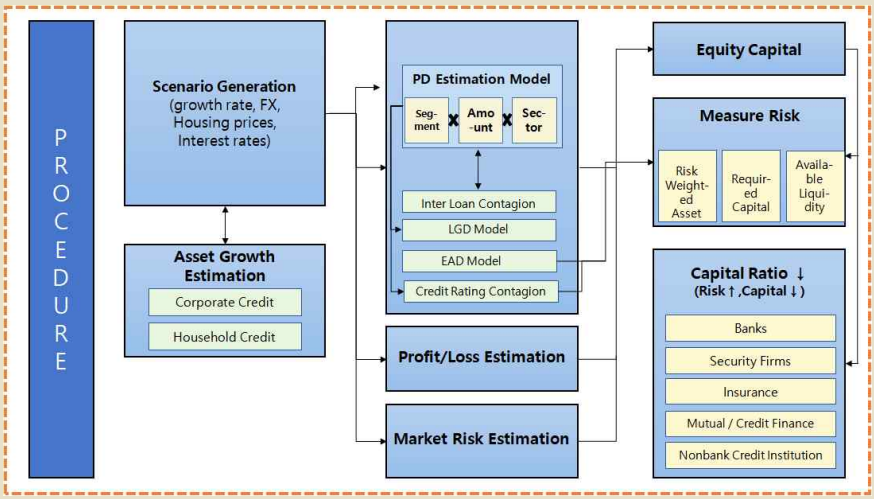
<Box 4-13>

Macro Stress Testing Model of the Financial Supervisory Service (FSS)

In 2017, the financial supervisory service (FSS), a financial watchdog in Korea, developed a macro stress testing model that covers all financial institutions (depository institutions, security firms, insurance companies, credit card companies, credit finance companies and so on). The model is called STAR-Ⅰ, short for 「Stress Test for Assessing Resilience and Stability of Financial System (version Ⅰ)」. The figure presented below shows the overall structure of STAR-Ⅰ.

<Figure 4-17>

Structure of STAR-Ⅰ



Source: Development of Stress Test for Assessing Resilience and Stability of Financial System (STAR-Ⅰ) (2017)

Because this model covers all financial sectors, it enables the FSS to identify a sector or a group of financial institutions that are highly vulnerable to a macroeconomic shock. And by covering all financial sectors, it significantly promotes the reliability and an ability to assess systemic risk. It lays a foundation for comprehensively evaluating systemic risks incurred from financial institutions' connection across financial sectors.

The model has two main features that it adopts modular and top-down approaches. It comprises a credit loss model, a market loss model, and operating profit/loss model, each of which is developed as a module. Since

the model is performed by the FSS without the participation of individual financial companies, the FSS can conduct stress tests and analyze the test results as soon as possible.

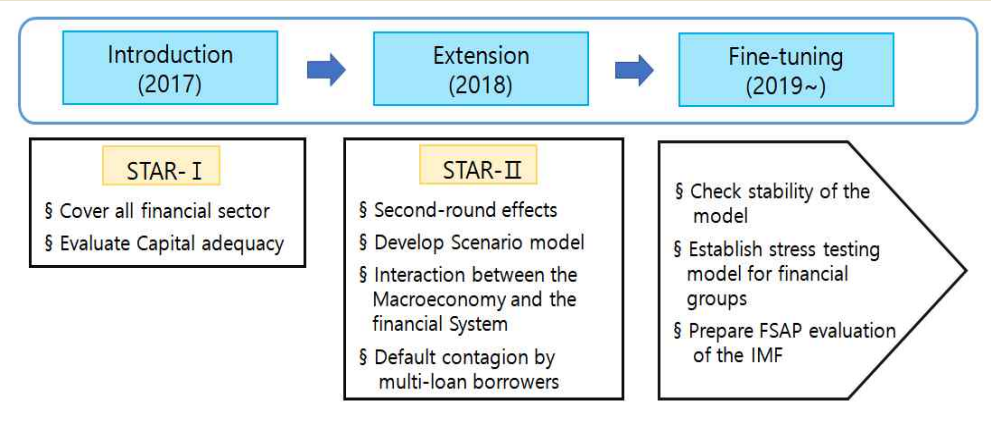
In order to enhance the accuracy of the model, the FSS includes the past data during the crisis times (e.g., 1997 financial crisis, 2003 credit card crisis) and employs long-term time series data with quarterly frequency (longer than 20 years).

The FSS utilizes the test results to evaluate the stability of the financial system in Korea as well as to supervise individual financial institutions and financial groups.

In fact, the FSS had a step-by-step plan to develop a comprehensive and sophisticated macro stress testing framework, as shown in Figure 4-18. The FSS upgraded the STAR-Ⅰ to reflect second-round effects of macroeconomic shocks and STAR-Ⅱ was launched in July 2018.

<Figure 4-18>

Road Map to Develop a Macro Stress Testing Framework



Source: Development of Second-round Effect Stress Test for Assessing Resilience and Stability of Financial System (STAR-Ⅱ) (2018)

STAR-Ⅱ has several features. First, it tracks the transmission process of insolvency across financial institutions, based on the interconnectedness between financial institutions. Namely, it enables the FSS to identify the key linkage across financial institutions by tracking how insolvency of a certain financial firm spreads to others.

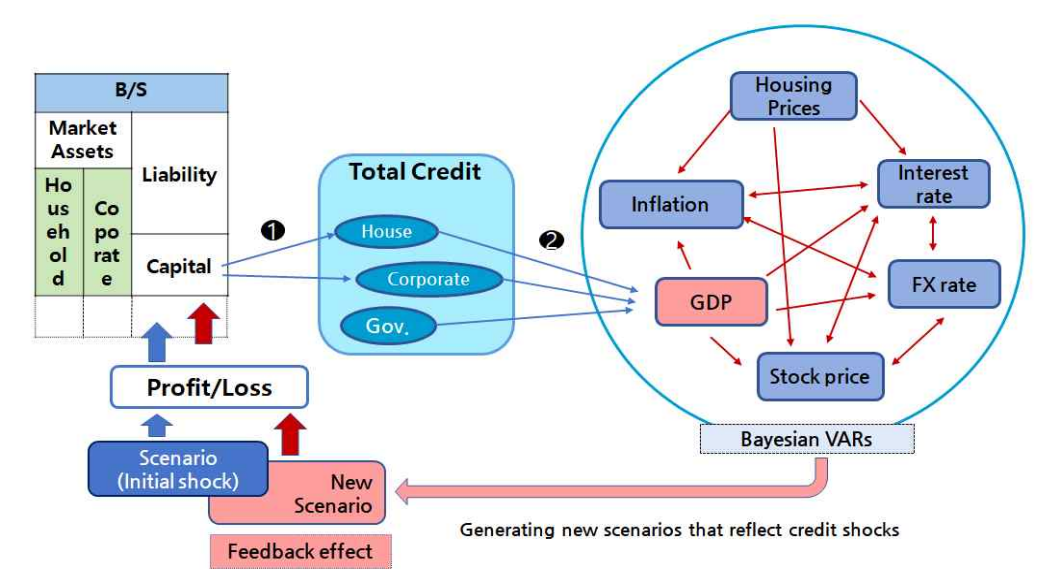
Second, it can assess the contagious effects that multiple debtors'

bankruptcies in a certain financial sector (mainly, non-bank sectors) simultaneously lead multiple financial sectors to become insolvent and reflect these effects to calculate the losses of financial firms.

Third, it incorporates the feedback effects to the real economy. In reality, worsening soundness of the financial system definitely affects the real economy. Hence, the model reflects the mutual feedback between the macro-economy and the financial system, as presented in Figure 4-19. Namely, it captures a vicious cycle aspect of economic shocks.

<Figure 4-19>

Mutual Linkages between the Macroeconomy and the Financial System



Source: Development of Second-round Effect Stress Test for Assessing Resilience and Stability of Financial System (STAR-Ⅱ) (2018)

An initial shock occurs in the real economy and affects the financial system. Then, the shock deteriorates capital adequacy of financial firms and has adverse effects on the real economy, which is the feedback from the financial sector to the real economy. Then, the second economic downturn affects the financial system, again.

The FSS combine the STAR-Ⅰ and STAR-Ⅱ and rename it K-STARS. When it generates scenarios, it uses a three year horizon and assume the macro-economic situations (GDP, stock prices, housing prices, interest rates,

inflation and FX rates). When it analyzes contagion across financial institutions, similar to the BOK's SAMP model, it employs network analysis approaches using data on lending relationships between financial institutions.

3. The Current Status of Macro Stress Testing of NRB

A. Background and History of Development

In Nepal, the finance sector reform program, which started in 1984 and continued till 2004 in three different phases, made tangible developments in setting up legal/regulatory frameworks and establishing financial sector supportive institutions. The reforms enhanced the role of the private sector thereby reducing the dominance of state-owned banks and promoting competitive growth of the financial sector. Many policies, bylaws, guidelines and frameworks were issued by NRB for building a resilient financial sector. Over the period, significant achievements have been made over the issues of financial stability and risk mitigation.

<Table 4-16>

Glimpse of Financial Sector Reform Program in Nepal

Reform Phase	Reform Initiatives
First (1984-1990)	Opened up the banking sector to foreign investors
	Allowed to accept current and fixed deposits on foreign currencies
	Deregulation of Interest rate regime
	Emphasis on increasing accessibility of financial services and market intermediation
	Introduced auction mechanism to sell treasury bills
	Debentures and bonds were issued as new financial instruments
Second (1991-1998)	Emphasis on the liberalization of the financial sector
	Current account convertibility
	Increment in number of BFIs
	Operation of Non -Banking financial institutions started to gain momentum
Third (1999-2004)	Privatizing of government owned banks.
	Enactment of several acts (NRB act 2002, Debt Recovery Act 2002 and the Banking and Financial Institution Ordinance, 2004)
	Establishment of National banking training institute
	Improving accounting and auditing standards

Source: Shrestha (2004)

The Global Financial Crisis of 2008 has shown insights into the financial system's vulnerabilities and highlighted the importance of governance and risk management in the financial system. The focus of regulation has turned to macroprudential from micro-prudential with concern for systemic risks and contagion of the crisis. The global financial crisis brought renewed attention to the importance of stress testing of financial institutions both in normal times as well as in times of crisis for formulating prudential policies for financial stability. Thus, stress testing has become a prominent tool of analyzing risks in banking system. International Monetary Fund (IMF) and Basel Committee on Banking Supervision (BCBS) have issued several guidelines of stress tests for the banks/financial sector. For many authorities, stress testing was introduced as part of the Financial Sector Assessment Program (FSAP) of the IMF and the World Bank (WB).

The IMF defines stress testing as "... a range of techniques used to assess a vulnerability of a portfolio to major changes in the macroeconomic environment or to exceptional, but plausible events" (Blaschke et al., 2001). Stress testing has also been defined as a technique that measures the vulnerability of a portfolio, an institution, or an entire financial system under different hypothetical events or scenarios. It is a quantitative "what if" exercise, estimating what would happen to capital, profits, cash flows, of individual financial firms or the system as a whole if certain risks were to materialize (IMF, 2020).

In Nepal, Risk Management Guidelines (2010) was issued by NRB to banks and financial institutions which forms the basis for overall risk management policy. The guidelines do not replace but rather supplements the existing regulations and guidelines and provides minimum standard for the risk management practice to be exercised in the banks and financial institutions. A bank may establish a more comprehensive and sophisticated framework than the outlines in the guideline.

NRB's Stress Testing Guidelines (2012) was the first step in guiding banks to test the severity of stress scenarios on their solvency, liquidity and profitability. So, it covers sensitivity tests in different risk areas. Banks are encouraged to introduce more complex and advanced techniques of stress testing to improve their own internal risk management practices based on the nature, size and

complexities of the business activities. The monetary policy for 2020/21 has explicitly mentioned about amending the current stress test guidelines following international standard.

B. Main Features of the Current Testing

At present, Nepalese Banks are required to submit quarterly stress test results to NRB and stress tests are critical component of a Bank's Internal Capital Adequacy Assessment Process (ICAAP) which is submitted within 1st quarter of every fiscal year. Stress tests are micro-prudential in nature analyzing the effect of stress at individual bank level and the results do not analyze systemic effect on the financial system. Also, the major risks analyzed are limited to credit, market, and liquidity risks. The following table outlines the key features of stress testing in Nepal.

<Table 4-17>

Key Features of Stress Testing in Nepal

Features	Coverage/Comment
Nature of Stress Testing	Micro-prudential (Supervisory), access health of an individual institution (non-systemic in analysis, scenario-testing without contagion effect).
Reporting Requirement	Quarterly reported to supervision department
Key Risks Analyzed	Pillar 1 risks as required by Basel II and includes credit risk (level of NPL and loan default including real estate risks), market risk (interest rate risk/exchange rate risk) and liquidity risk, focused on balance sheet exposure.
a. Credit Risk Scenarios	Capital Adequacy Ratio (CAR) position on - Performing loans deteriorated to substandard and Loss - Substandard loans deteriorated to doubtful and Loss - Doubtful loans deteriorated to loss loans. - Real estate & housing sector loan directly downgraded to substandard doubtful and loss category - Large exposure downgraded to substandard doubtful and loss category
b. Market Risk Scenarios	Capital Adequacy Ratio (CAR) position on - Change (+ & -) in deposit interest rate by 1 percent, 1.5 percent and 2 percent - Change (+ & -) in loan interest rate by 1 percent, 1.5 percent and 2 percent. - Appreciation and of currency exchange rate by different percentages. - Fall in equity prices by certain percentage.

c. Liquidity Risk Scenarios	Capital Adequacy Ratio (CAR) position on: - Withdrawal of deposits by various percentages in 1st, 2nd, 3rd, 4th, 5th day, respectively. - Deposits withdrawal by top institutional and individual depositors. - Default on interbank transactions by top counterparties
Risks not Analyzed	- Operation risks, legal risks and non-Pillar 1 risks (only few banks conduct non-pillar 1 risks as a part of ICAAP) - Macro risk Factors such as economic growth rate, inflation, unemployment, rate of credit growth, corporate and treasury bond yields, global economic growth and global spillovers - Inter-institution/inter-sector/system-wide risk transmission - Multi period macro risk factors
Output of Test	Bank's solvency and liquidity measurement under different stress scenarios as measured by CAR and liquidity ratio.
Platform of Analysis	MS Excel

Source: Nepal Rastra Bank

The following may be summarized as the current features of stress testing by Banks in Nepal:

- Stress testing is primarily micro-prudential of nature. NRB's stress testing also focuses on stress test results of individual banks and it does not capture systemic risks.

- Stress test is conducted on few risks namely credit, market and liquidity risks.

- Interconnectedness among financial institutions is not analyzed. So, transmission risk/contagion effect of stressed situation has not been covered. Multi-period chain effect of contagion losses is not evaluated in stress test model.

- Most of the banks conduct stress test on excel sheet model currently provided by NRB. NRB conducts stress test on excel sheet model that combines the financial results of all banks to get the stress test result of the system as a whole.

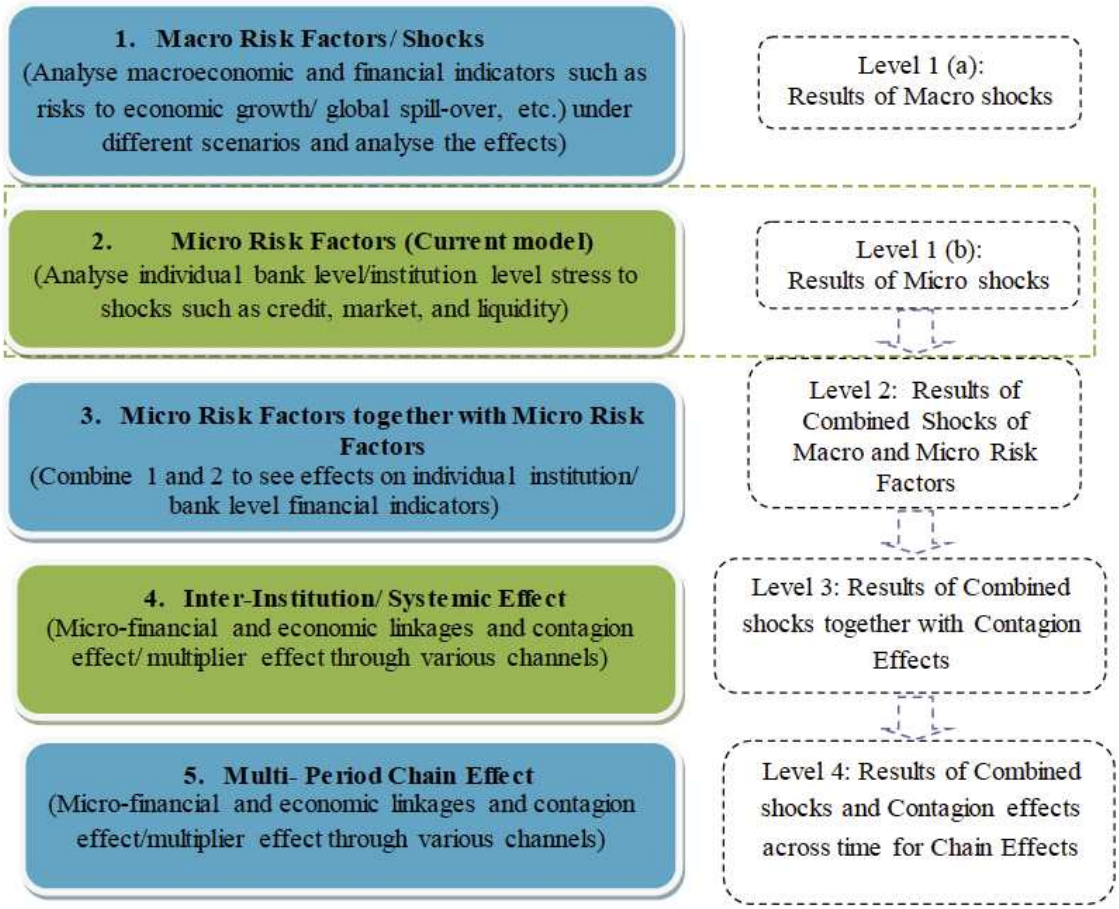
- There are constraints in human, technical, and data capabilities on the institutions undertaking stress testing. Stress testing of non-banking financial institution is lacking.

C. Structure and Procedure of the Current Testing

The following schematic diagram illustrates a conceptual extensive macro stress model in order to have comprehensive risk analysis of the financial system.

<Figure 4-20>

Elements of Extensive Macro-Stress Test Model



Source: Nepal Rastra Bank

The existing stress testing practice is based on analysis of micro risk factors pertaining to individual banks (two in the figure above) which is a part of extensive stress testing module. Given the current status of stress testing practice in Nepal, the following are few prospects for developing stress testing framework in Nepal.

- Stress testing as an internal risk management tool: Financial institutions should make stress testing an integral part of risk management function and not take it as a regulatory requirement.

- Macroprudential focus: Stress test scenarios should reflect bank specific risks and consider system-wide interactions. Stress test should move towards macroprudential focus from individual bank level analysis.

- Coverage of risk factors: At the bank level, the risks covered should include both Pillar 1 risks and non-Pillar 1 risks, risks arising from off-balance sheet exposures, and the feedback between risk factors such as liquidity and solvency risks should be a part of risk assessment process.

- Incorporating systemic part in the stress test model: The global financial crisis and the current COVID-19 provides us the importance of integrating systemic effects, spill-overs and contagion as an integral part of stress testing. In the context of Basel III implementation, the new stress test model should take systemic analysis in account.

- Use of econometric tools and network models: Turning to macroprudential focus from micro-prudential focus and incorporating systemic effect/contagion effect and possible spill-over effect requires use of sophisticated tools and network models. Econometric and network models in financial stability analysis and stress testing help measure inter-connectedness, among financial institutions, systems, or entire countries (claims held against each other or other channels)and analysis of spill-over effects.

- Stress test to identify policy reactions: NRB does not use stress test as an integral part of policy formulation. The monetary policy of 2020-2021 has outlined the need to redesign the stress testing framework in Nepal. Moving forward, stress testing will be used as a tool in implementing appropriate and calibrated macroprudential policies and have feedback of

such policies.

- Stress testing of non-banking financial institutions (NBFI): The NBFIs occupy a major share in the financial system of Nepal, hence risks arising out of such sector need to be identified beforehand to contain the spill-over into financial sector.

However, designing and implementing an effective extensive stress testing practice requires extensive homework and defined methodological approach for implementation and following few challenges are critical in implementing effective extensive stress testing practice.

- Stress tests can give erroneous and misleading results if they are based on wrong or incomplete data and if analysis does not cover crucial risk. Data is an important aspect of a good stress testing module and assessment of availability of data is a critical factor for implementing a good model. In Nepal, banks are rapidly implementing Management Information System (MIS), and NRB has is also developing Supervisory Information System (SIS) platform where banks report extensive financial data and indicators directly through their system. This forms the source of a good data required for extensive stress testing. So, although data remains a challenge today, moving forward we can implement extensive stress testing practice in various stages.

- Shadow banking plays a key role in originating and transmitting shocks in times of stress. Stress tests generally do not cover "shadow banking" and analyzing the shadow banking component in extensive stress testing design is a challenge. Also, it is important to put non-bank financial institutions and financial market infrastructures as a part of macroprudential stress testing which will pose challenge for effective implementation of stress test.

- There is a human resource skill component while implementing an extensive stress testing because it requires understanding, interpreting and decoding of different macro and financial factors that play together in times of stress. Building skill sets at individual banks and institutions and NRB to prepare human resource is a long-term process and will pose a key challenge to implement macroprudential stress testing module.

4. Step-by-step Plan for Nepalese Macro Stress Testing

In conclusion, we would like to summarize the main features of the macro stress test in Korea and Nepal discussed so far. Based on this, we will discuss ways to develop the macro stress test in Nepal in the future. To this end, short-term and mid and long-term plans are presented separately. The short-term plan presents the preliminary steps for the development of the basic macro stress test and the initial form of the model. And in the mid- and long-term plan, we will discuss the direction of future model development based on the initial model suggested in the short-term plan.

A. Short-term Plan

(1) Building an Efficient Database System

In order to build a macro stress test, it must be able to meet demanding data requirements (see <Box 4-1> and <Box 4-2>). In order to gradually expand the capacity of data collection by bank, it is necessary to first focus on the systemically important banks (SIBs) and establish a system that can collect related data first. In addition, it is necessary to systematically collect quarterly data in a uniform format for each bank to perform NRB's top-down macro stress test. The necessary information for each bank basically includes information on the balance sheet, asset type and profit and loss data. This improves the possibility of comparison between banks and by period, thereby improving policy effect.

In addition, NRB needs to actively utilize the bottom-up macro stress test. This will increase the interest of banks participating in the stress test, and it helps to improve the suitability of the Nepal macro stress test to be built in the future by comparing the bottom-up test results performed by individual banks with the top-down. By inducing bank-specific bottom-up testing, NRB acquires raw data for each bank in this process, which can be used by NRB when applying a top-down approach to improve the consistency of the analysis.

(2) Construction of the Early Version of Macro Stress Test Model

The current stress test in Nepal focuses on the soundness of individual banks rather than the entire banking system, and in that only some risk factors can be considered in the current stress test. It can be said to be a form closer to a micro stress test than a macro stress test. Therefore, it is important to first introduce an early version of the macro stress test that can capture systemic risk. This model needs work to make the separately existing NRB's credit risk model, market risk model, and liquidity risk model interconnected into a single integrated system.

The usefulness of the BOKST-07 model can be summarized as follows.

- assess the overall response of BIS capital ratio to macroeconomic shocks (scenarios), namely measure systemic risk.

- evaluate the stability and soundness of a current banking system and the past macro- and micro-regulation policies in order to give valuable information on policymaking decisions.

- assess potential impacts of various macroeconomic shocks to banks' performance (e.g., BIS ratio, ROE, ROA).

- identify vulnerable segment (risk sources) by evaluating potential losses caused by loan defaults.

It is necessary to refer to BOKST-07 model for the development of the early version of the macro stress test model. However, it is necessary to reflect the peculiarities of Nepal's economy (for example, the fact that the Indian economy occupies a high proportion as an external sector and that remittance occupies a high proportion of GDP in Nepal, etc.). This is because Nepal's macro-financial peculiarity has the potential to cause systemic risks that are distinct from other economies. This particularity can be said to make a relatively large difference from country to country in scenario generation as well as in PD or LGD estimation of credit risk models.

B. Mid- to Long-Term Plan

(1) Build Granular Database

In order to further increase the usability of macro stress tests in the long term, it is necessary to build a system that can collect granular data. Through such granular data collection, it is possible to model the effect of feedback beyond the direct impact of the impact on individual banks, and to estimate the effect of crisis transfer between banks.

(2) Improvement of the Macro Stress Test Model

The BOKST-07 model has several limitations, as an earlier version of a macro stress test model. First, it is based on single stress scenario, we can apply a scenario to assess systemic risk one by one, although we can set up several scenarios. In other words, The BOKST-07 model rules out a case in which multiple shocks occur simultaneously and a case in which an initial shock has non-trivial second-round effects.[38] Second, the model does not consider risk sources such as derivatives and inter-bank contagion.

Thinking it the other way around, it is much easier and simpler to set up the model. Rather than trying to directly set up a sophisticated model, it is good

38) Hence there is possibility to underestimate potential systemic risk when a single scenario model is applied. In fact, the model cannot apply to a compounding crisis such as the global financial crisis or the COVID-19 pandemic.

strategy for NRB to set up a simple one like the BOKST-07 model as a steppingstone. Given that derivative and security markets are under-developed in Nepal, the BOKST-07 model would be suitable for Nepal if it considers inter-bank exposures.

In the future, based on this initial model, it is necessary to develop a more complex macro stress test model that can consider the effects of crisis transfer and feedback. The problem you will face to proceed to this stage is more likely to lie in data collection rather than methodological problems. Of course, the challenge is not a methodological issue but data collection.

<Box 4-14>

Key Considerations for Developing & Operating a Stress Test Model

(Developing a Stress Test Model)

① Step-by-step Approach

Korea took a step-by-step approach in developing a macro stress test model. Because there was no pre-existing model in 2007, the BOK developed BOKST-07 model as a first stress test model. After establishing the foundation for the macro stress test model, the BOK then developed the SAMP model by upgrading the BOKST-07 model to reflect Korean specific macroeconomic dynamics such as the linkage effect between the financial and real sectors. Similar to BOK's experience, it is also suitable for the NRB to take a step-by-step approach.

② Need for Country-specific Customization

Research & Data: For optimal results, a stress test model must be programmed to reflect various country-specific macroeconomic dynamics. For example, it must account for:

- Commercial structures and behavior of the country's financial institutions

- Idiosyncratic behaviors of individual economic players

- Overall structure and current situation of the country's capital and financial markets, etc.

Therefore, it is implausible to develop a model that does not reflect a country's specific financial and economic characteristics. To develop a valid stress test model, there must be sufficient research conducted on the current situation of the country's financial industry and the various risk factors involved. For instance, it is crucial to understand how certain events in the real and financial sectors can impact the credit volume and default rates of financial institutions. Only with robust research findings enable a country to establish valid model equation and accurately estimate the coefficients for each input variable.

Moreover, the relevant data is also required to support the model development. Even in the case where a country implements a stress test model that benchmarks more advanced models from different countries, the input data must be stable in quality and sufficient in size to ensure reliable results. Otherwise, the model will not operate properly and fail to provide accurate test results.

To secure sufficient and stable data for the various input variables of the model, the BOK collaborated closely with the risk managers of Korea's commercial banks. This involved explaining the detailed requirements for data collection and continuously communicating to maintain and improve the data collection process through regular meetings.

In addition to research and data collection, BOK also actively consulted other countries with more advanced stress test models, such as the United Kingdom with its RAMSI (Risk Assessment Model for Systemic Institutions). Through conversations with other central banks such as the Bank of England and the Bundesbank of Germany, it was able to introduce appropriate

refinements to further improve the BOKST-07 model.

In Nepal's case, NRB has already been operating a basic stress test model that evaluates major risks for Nepal and the capital adequacy of major Nepalese banks. Although the model is still in its early stage of development, it is clear that NRB recognizes the need to continuously invest in upgrading the existing model.

By applying relevant elements of BOKST-07 and SAMP models, the NRB will be able to improve its existing stress test model while customizing the model to Nepal's unique macroeconomic and financial situations. Then, the initial version should be reviewed and appropriately modified through continuous collaboration and consultation with BOK counterparts, who can provide both strategic and technical assistance throughout the development process.

As mentioned previously, the Nepal's model must be adequately customized to reflect Nepal's unique macroeconomic conditions, such as:

- High dependence on the Indian economy for Nepal's external sector
- High contribution of remittances to Nepal's GDP, etc.

This is because the macroeconomic and financial conditions that are specific to Nepal may lead to systemic risks that cannot be found in other economies. Reflection of such country-specific conditions will be crucial not only when estimating PD and LGD of the credit risk model, but also when developing test scenarios.

(Operating a Stress Test Model)

① Ongoing Model Review & Maintenance

As with all econometrics models, a stress test model requires regular reviews to ensure the consistency of its test results. In order to accurately reflect the changes in the financial sector in a timely manner, there must be consistent efforts to refine and improve the stress test model. Such efforts will

enable multi-dimensional refinement of the model, especially given the growing importance of understanding potential ripple effects in an increasingly interconnected economy with strong linkages between the real and financial sectors.

② Need for Ongoing Data Collection

Ultimately, this brings back the discussion to the importance of data, which is crucial for conducting regular reviews of the model. Again, it is important to maintain ongoing data collection process for relevant risk metrics (e.g., PD, LGD and EAD) and micro-level data points based on appropriate financial regulations (e.g., BASEL III).

③ Need for Various Scenarios

In addition to data collection, revisions of model are also required for developing scenarios that are both exceptional and plausible. Developed scenarios must reflect not only historical risks from previous crises, but also hypothetical risks based on Nepal's specific financial and economic situations. For example, it may be worthwhile to consider scenarios to account for unprecedented external shocks, such as the recent financial impact caused by COVID-19. On the other hand, in order to account for Nepal's unique economic situations, a hypothetical scenario in which there is a drastic decline in remittance level may also be developed.

(Effective Application of Stress Test Results)

In the case of Korea, the test results from BOK's models have been utilized in various fronts of policy-making. Key use cases include:

- Provide important insights for the Monetary Policy Committee of BOK when assessing financial stability and determining monetary policy

- Support the Office of President and economic ministers' meetings for major policy decisions

- Serve as key data point to assess policy measures for various macroeconomic phenomena, such as instability in the real estate market, increasing household debt, and foreign exchange shocks, etc.

In particular, the BOK actively utilizes the test results in the biannual Financial Stability Report, which is published twice a year to monitor major risk factors in the Korean financial system. As one of the BOK's major macroprudential policy tools, the Financial Stability Report is crucial in identifying and analyzing risk factors embedded within the financial system. It enables the BOK to discover risk factors that may not have been apparent previously. In order to identify new systemic risks from multiple perspectives, the BOK has continuously refreshed and improved the underlying methodology for the Financial Stability Report.

In parallel, the newly identified risk factors are then reflected back into the stress test model. In other words, there exists a constant feedback loop between the stress test model and the Financial Stability Report, as they continuously improve and supplement each other. As a result, we highly recommend that the NRB include a variety of scenarios and corresponding test results in Nepal's Financial Stability Report. This will allow the NRB to develop a comprehensive and robust set of policy measures.

The test results can also be used for the purpose of presenting policy countermeasures. For example, consider a case where a bank's capital expansion is proposed as a policy measure. In this case, the stress test model can verify the optimal magnitude of the proposed capital expansion and how to achieve it.

V. Macroprudential Policy Measures in Emerging Countries and Their Impact on Financial Stability

1. Introduction

In the previous chapter, we examine the characteristics of the macro stress testing and the BOK's early model, which Nepal Rastra Bank (NRB) can refer to in the current financial market development stage. The macro stress test is not only used as a means of assessing financial vulnerabilities that potentially cause systemic risks, but also provides a basis for introducing and using macroprudential policy measures (MPMs) based on the test results. After an accurate diagnosis of the resilience of the financial system through the macro stress test, the MPMs will be implemented, thus those two are closely related to each other.

The financial market integration which has been rapidly progressing over the past 20-30 years in emerging countries, has a positive effect on economic growth in some countries where capital is scarce, but it has also increased the possibility that the financial shock from the financial center can spread to neighboring countries. In particular, there can be a big negative impact on the emerging market economies. A representative example of this is the 2008 Global Financial Crisis (GFC). The subprime mortgage crisis in the U.S. caused a long period of recession in both developed and emerging countries. Through this, we can see how strong and preemptive MPMs are necessary in an open financial market, as not only the domestic financial market conditions but also the financial conditions of neighboring countries can cause domestic financial instability. However, in the case of fast-growing emerging countries such as Nepal, it is necessary to efficiently manage macroprudential policies at a level that does not harm the comprehensive and sustainable growth of the real economy. In addition, further efforts for the financial stability must be accompanied by strengthening financial cooperation with countries with high relevance in terms of the real and financial markets. In the case of Nepal, financial cooperation with India and ASEAN countries should be further strengthened.

Section 2 of this chapter examines a list of MPMs being used in emerging countries. Section 3 examines the use of macroprudential policies in five emerging countries (Cambodia, Myanmar, Vietnam, Mongolia, and Sri Lanka).[39] Section 4 discusses the effectiveness of macroprudential policies verified in related literature. In Section 5, we will conclude with a summary of this chapter.

2. A List of Macroprudential Policy Measures (MPMs)

Lim et al. (2011) classify MPMs into three broad categories according to the targets for improving financial soundness: (ⅰ) credit, (ⅱ) liquidity, and (ⅲ) capital. Detailed MPMs for each management purpose will be described below.

A. MPMs for Credit Management

- Loan to Value (LTV) Ratio – When a household borrow funds from banks using house/store/building as collateral, the regulation on LTV ratio puts a limit on the ratio of the loan amount to the actual value of the collateral. Due to the procyclicality of the collateral value, loans are also highly procyclical. Therefore, it is possible to effectively mitigate the procyclicality of mortgage loans through the regulation of the LTV ratio.

- Debt to Income (DTI) Ratio – It is a policy that regulates the loan limit by evaluating the repayment capacity of financial liabilities as income. When the DTI ratio regulation is applied together with the LTV ratio regulation, the effect of the DTI ratio regulation can more effectively weaken the procyclicality of the secured loan.

- Caps on Foreign Currency Loans – Foreign currency denominated loans have borrowers who do not hedged currency, exposed to a risk of currency fluctuations. This in turn exposes lenders to credit risk. This risk is likely to spread to the systemic risk depending on the forex market

39) See Lee et al. (2017). Depending on the available data for each country, the level of detailed explanation of the use of MPMs differs.

situation, so regulation on foreign currency loans (increase the risk weight or reserve requirements for foreign currency loans) is effective for risk management.

- Ceilings on Credit (or credit growth) – These restrictions are imposed when there is an increase in total bank loans or excessive loans in specific sectors. Regulations aimed at dampening the procyclicality of credit and asset prices, and credit limits for specific sectors*, such as real estate, are used to suppress excessive rise in prices of certain types of assets and to reduce financial vulnerability from certain risk factors.

  * Sectoral Capital Requirement: In order to cope with the systemic risk arising from a specific sector, capital regulations are strengthened on the exposure of the sector. For example, capital regulations can be strengthened for residential or commercial real estate mortgage loans, personal credit loans, foreign currency loans, and loans to non-bank financial institutions. As for the method of capital regulation by sector, the risk weight for specific exposures can be increased or the regulated capital ratio itself can be increased (Bank of Korea, 2015).

B. MPMs for Liquidity Management

- Limits on Exchange Position and Currency Mismatch – This policy limits the exposure of banks to foreign currency risk (in a broader sense). In addition, this regulation is effective in reducing negative externalities (drastic fluctuations in exchange rates caused by shocks in the supply and demand of foreign currency). This externality can be said to be necessary to manage because it additionally increases the credit risk of unhedged foreign currency borrowers. In this regard, Korea is using the foreign exchange derivative position regulation.

  - Foreign Exchange Derivatives Position Regulation: In order to manage the currency fluctuation risks of financial institutions, the risk is

evaluated as a combined position of foreign currency assets, foreign currency liabilities, and foreign currency derivatives contracts. However, in addition to this, in order to stricter management of system risk in the banking sector, Korea has enforced the foreign exchange derivative position ratio regulation, which sets the limit on the position of foreign exchange derivatives of banks at a certain percentage of equity at the end of the previous month from October 2010.

- Limits on Maturity Mismatch – If the maturity structures of assets and liabilities are inconsistent, there is a high likelihood that systemic risk will increase due to fire sale. In the financial crisis, a financial institution's ability to repay short-term debts due to maturity mismatches is impaired. In order to secure liquidity, they are sold at a bargain price. It can cause a systemic risk. Specifically, there are two types of Basel III liquidity regulation as follows:

  - Liquidity Coverage Ratio (LCR): This is a regulation on the ratio of High Quality Liquid Assets (HQLA)[40] divided by the expected Net Cash Outflows (NCO) under a 30-day liquidity stress scenario. The NCO is calculated by subtracting the cash inflow from the cash outflow that is assumed to occur in a 30-day stress scenario.[41]

$$LCR = \frac{HQLA}{(30-day\ stress\ scenario)\ NCO} \times 100$$

40) It consists of cash, debt securities issued by the government and central banks, and reserve requirements. However, at the discretion of policy authorities, some securities with relatively low credit ratings (corporate bonds with a credit rating of BBB- or higher, stocks included in the country's representative stock indices, mortgage-backed securities, and covered bonds) are also recognized as highly liquid assets. But, a certain discount rate (haircuts) is applied.

41) When calculating cash outflow and inflow, the churn rate and inflow rate are taken into consideration. In the case of LCR regulation in the Bank of Korea, deposits of individuals and small and medium-sized enterprises receiving deposit guarantees are applied with a churn rate of 5%, and non-financial companies, the state, central banks, multilateral development banks, and public institutions' security deposits are subject to a churn rate of 20%. For cash inflow, a 100% inflow rate is applied to loans to financial institutions and Repurchase Agreements to central banks, and a 50% inflow rate is applied to loans to retail, SMEs, and non-financial companies (Bank of Korea, 2015).

- Net Stable Funding Ratio (NSFR): It is calculated as the ratio of available stable funding (ASF)[42] to required stable funding (RSF).[43] NSFR was introduced to limit short-term financing and to improve the stability in financing.

$$NSFR = \frac{ASF}{RSF} \times 100$$

▪ Reserve Requirements – The policy mitigates systemic risk through two channels: (ⅰ) It directly affects credit growth. By operating in countercyclical manner, it helps to alleviate excessive procyclicality in the credit and asset price cycle. (ⅱ) Sufficient reserves act as a shock absorber in the phase of the liquidity crunch.

C. MPMs for Capital Adequacy Management

▪ Countercyclical Capital Buffer (CCyB) – This policy prevents excessive credit supply by increasing the regulatory level of capital buffer[44] (capital ratio or risk weight regulation) in the phase of credit expansion. On the other hand, during the credit contraction period, by lowering the regulatory level of capital buffer, the accumulated capital is used as a means of mitigating the shock, preventing a sudden decrease in the credit supply.

▪ Dynamic Provisioning – Under the traditional dynamic loan loss

42) Available Stable Funding (ASF) is calculated by multiplying each item of debt and capital in the statement of financial position of a bank by a weight considering the stability of financing (Bank of Korea, 2015).

43) Required Stable Funding (RSF) is calculated by taking into account the liquidity level of the asset. The more stable funding is required when the liquidity of the asset is low (Bank of Korea, 2015).

44) It means additional capital that exceeds the minimum capital requirement. Unlike the minimum capital requirement regulations, macroprudential policy authorities flexibly implement it according to the economic and credit cycle. Policy authorities generally take into account a number of indicators, including credit/GDP gap (= credit/GDP ratio – its long-term trend), bank loan statement, financial market and supervisory information, and stress test results to determine the level of countercyclical capital buffer.

allowance system, loan losses were calculated based on past losses by bank. However, under these criteria, the provision is determined according to the financial cycle. In other words, in the period of credit expansion, loans increase as net profit and capital increase, and the reserve for bad debts decreases. However, in a recession when credit decreases, the reserves for bad debts increase and the loan capacity decreases. A dynamic provision for bad debt was introduced to alleviate this procyclicality. It is to preserve loan capacity by increasing the reserve for bad debts in boom times, preventing excessive credit supply, and by lowering the reserves during recession. This policy can be operated according to a fixed formula or can be flexibly adjusted at the discretion of the policy authority.

- Restrictions on Profit Distribution – This policy was introduced to ensure the capital adequacy of banks. Since undistributed profits are added to the bank's capital, the lending behavior of the banks that are constrained by the policy during an economic downturn can be affected countercyclically. Basel III's Capital Conservation Buffer (CCB) has similar effects on financial stability.

3. MPMs in the Emerging Countries

According to the IMF (2011), macroprudential policies are being effectively operated in some emerging countries. Section 3 refers to Lee et al. (2017) to analyze how effectively MPMs are being used, focusing on five emerging Asian countries (Cambodia, Mongolia, Myanmar, Sri Lanka, and Vietnam). Since the analysis of these countries is similar to that of Nepal in terms of the degree of financial market development and openness, it is expected to provide useful policy implications for the use of NRB's macroprudential policy in the future.

A. Cambodia

There is no formal legal basis for macroprudential policy in Cambodia. The

National Bank of Cambodia (NBC) has proposed amendments to the Central Bank Law and Law on Banking and Financial Institutions in relation to the role of macroprudential policy, and the proposed amendment is currently being discussed at the council of ministers. When it is completed, the proposal will be transferred to the National Assembly.

There is no formal procedure for monitoring systemic risks, and there is no model for qualitative/quantitative analysis of system risk. The central bank does not use the macro stress test, but regularly checks inflation rate, money supply, and financial deepening indices as important macro indicators. In order to identify the systemic risk of the banking system, the systematically important financial institutions (SIFIs) are closely monitored.

Regarding the macroprudential policy used in Cambodia, the NBC evaluated that it was not being used in a sufficiently comprehensive range. This is partly because there is no effective risk assessment tool. This was diagnosed as the most urgent problem in Cambodia, which is rapidly growing in terms of financial market size (credit has been steadily growing since 2013) and financial function.

Cambodia is making steady efforts to establish a macroprudential policy system for financial stability. The existing policies are being supplemented and new macroprudential regulations are being introduced. The MPMs that have already been introduced are as follows.

① As a means of monetary policy and macroprudential policy, the reserve requirements have been proven to be an effective policy tool to prevent excessive expansion of credit and absorb the impact of liquidity shortages.
② LTV ratio regulations are being used to mitigate credit expansion and excessive risk-taking behavior of banking institutions.
③ Credit limit restrictions for high-risk sectors were introduced in early 2008 (there was a credit and real estate bubble at the time) but abolished in early 2009 to stimulate the economy.
④ In order to mitigate systemic risk, the monitoring currency and maturity mismatch were strengthened.
⑤ Additional capital buffers and provisioning have been adopted in order to

mitigate procyclicality that causes systemic risk (especially in response to the GFC).

As mentioned above, Cambodia introduced five macroprudential policy measures to achieve some of the goals of financial stability, but the legal system is still not complete, and it needs technical development to identify financial weakness from external sources.

B. Myanmar

Myanmar has undertaken massive financial reforms under the new government to secure economic growth engines in the past few years. With the opening of the financial market and the establishment of a market-based economic system, they were exposed to external risks, which resulted in increased financial vulnerability.

Myanmar's banking and non-banking financial sectors are still developing. The banking system, the core of the financial system, serves as a channel through which monetary policy affects the real economy. The Central Bank of Myanmar (CBM) is responsible for monetary and financial stability as mandated under the Central Bank of Myanmar Law of 1990. The CBM is operating the CAMELS system.[45)]

In order to improve the financial vulnerability that has slightly increased in the rapid real and financial market development, monitoring and onsite examinations have been strengthened to regulate the operation of funds that may increase the systemic risk of the banking system. The CBM requires banks to meet the following four requirements:

① 10% of total deposits are held as reserve requirements.
② At least 20% of eligible liabilities are held as highly liquid assets.
③ Holding risk-weighted assets not to exceed 10 times the total amount of

45) CAMELS is an indicator used by bank surveillance/supervisory authorities to assess the soundness of financial institutions, and it consists of the following six elements: (ⅰ) Capital adequacy, (ⅱ) Asset quality, (ⅲ) Management soundness, (ⅳ) Earnings, (ⅴ) Liquidity, (ⅵ) Sensitivity to market risk.

capital and reserves.

④ Do not lend more than 20% of capital and reserve requirements to a single borrower.

In the case of Myanmar, financial stability is expected to be a particularly important central bank policy goal for the growth of the real sector. The government should carry out financial sector reforms in line with the rapidly changing and developing economic structure of Myanmar.

C. Vietnam

Vietnam is gaining strong international influence, mainly in Southeast Asia, based on rapid economic growth. With the growth of the real sector, banking and related business activities expand to the international sector, securing the stability of the financial sector as a priority of policy objectives.

Compared to the two emerging countries mentioned above, Vietnam's macroprudential policy system has made significant progress. The State Bank of Viet Nam (SBV) has extensively reorganized the central bank's structural reform, functions, tasks, and organization (Decree156/2013/ND-CP). In 2014, the Monetary and Financial Stability Department was established within the SBV, and this department is responsible for introducing, implementing, evaluating, and analyzing macroprudential policies.

This department is monitoring the five risks: foreign exchange exposure, credit, leverage, liquidity, and asset prices. The SBV classifies the sources of systemic risk as follows (<Table 5-1>).

In order to alleviate the system risk identified as above, various MPMs have been introduced. Regarding the currency mismatches, restrictions are placed on the foreign exchange position, foreign currency loans, and interest rates on foreign currency-denominated deposits. In addition, the SBV uses a policy to limit the fluctuations of interest rates on Vietnamese currency (dong) denominated deposits to prevent excessive risk-favoring behavior and large fluctuations in interest rates during the phase of economic boom. During periods of rapid credit growth (especially funds flow into real estate and stock markets),

the credit growth rate is managed to slow down. The management of the credit growth rate mainly uses the reserve requirements.

<Table 5-1>

Sources of Systemic Risks in Vietnam

Systemic Risk	Sources
Foreign currency exposure risk	Dollarization, currency mismatch
Credit risk	Dollarization, high credit growth, interest rate volatility
Excessive leverage risk	Bank-dominant financial system, high credit growth
Liquidity risk	Maturity mismatch, lack of confidence
Asset price risk	Real estate loans, stock-related loans

Source: Lee et al. (2017)

Although macroprudential policies have been introduced and managed by type/cause of system risk, there are not many studies on their effects except for Nguyen (2012). This paper argues that Vietnam's macroprudential policy was somewhat effective in slowing down the pace of credit growth, restraining rapid increases in leverage and asset prices, and was effective in managing currency mismatch and other system risks.

In the future, the SBV needs to improve the legal system to clarify the role of macroprudential policy, and the development of a monitoring/alarm system for systemic risk and effective data management is also required.

D. Mongolia

As Mongolia promoted economic reforms related to the financial market integration and international trade, the volatility of the financial market and the possibility of the contagion of the financial crisis increased compared to the past. During the GFC, Mongolia's financial vulnerability increased due to the financial crisis from external sources. As procyclicality in the credit growth, asset prices, and banking's risk preference increases, there is a need for improvement in the macroprudential policy system to manage them in Mongolia.

Currently, under the macroprudential policy system of Mongolia, a cooperation system is established through the Financial Stability Council (FSC) among the Bank of Mongolia, Financial Regulatory Commission, and Ministry of Finance. The FSC is obligated to agree on and take cooperative measures on MPMs that are important for long-term economic growth. The FSC was established on May 9, 2007 as a decision-making committee on risk management with the aim of financial stability in collaboration with the Bank of Mongolia, Financial Regulatory Commission, and Ministry of Finance.

In Sukhee and Byambasuren (2016), Mongolia's macroprudential policy to reduce systemic risk is summarized as follows.

① Increased liquidity ratio (from 18% to 25% in 2011)
② Increased capital adequacy ratio (from 12% to 14% for 5 major banks)
③ Regulation on concentration of exposure (must not exceed 20% of bank capital)
④ Regulation on foreign exchange position (must not exceed 15% of bank's equity capital)
⑤ Restrictions on maturity mismatch
⑥ Apply a reserve requirement on all deposits
⑦ Reduction of provisioning during crisis period

The feature of the MPMs introduced in Mongolia is that it focuses on mitigating the volatility of capital inflows and outflows (See <Box 5-1> about

the effect of capital flow management, which is a part of MPMs). Maino, Imam, and Ojima (2013) argued that in order to increase the effectiveness of the FSC's operation with regard to macroprudential policy decision-making, the legal basis should be improved: (ⅰ) Clarify the department responsible for macroprudential policy, (ⅱ) The FSC has created a permanent secretariat with a fixed number of central bank staff. (ⅲ) The decision-making and recommendation of the FSC do not have the same legal effect as the Central Bank Law due to the unclear structure of responsibility. This needs to be revised.

<Box 5-1>

The Effect of Capital Flow Management in Emerging Countries

Kim (2020) analyzed the effect of capital flow management (CFM), which is a part of macroprudential policy on external sector. The data used for the empirical analysis is "2018 Taxonomy of Capital Flow Management Measures (CFMs)" provided by the IMF, which is related to domestic or global capital flow stabilization measures evaluated by IMF staff. It is a document that encompasses all of the CFM measures.

The propensity score matching (PSM) method was used for empirical analysis. In this methodology, the treatment group and the control group are matched to test whether the difference between the two groups is statistically significant in the effect of the policy after the implementation of the CFM measures. The estimates of the effects of CFM measures were analyzed by dividing into measures to weaken/strengthen capital inflows/outflows. 24 countries, including Korea, were included in the data (all emerging countries except for 8 countries), and the sample period is from January 2009 to August 2018.

As a result of the empirical analysis, the strengthening of capital inflow regulations and the weakening of capital outflow regulations are related to the depreciation of the local currency. Regarding the effect on foreign portfolio investment, the reinforcement of capital inflow regulations has an extremely significant effect in reducing capital inflow. The weakening of capital outflow regulations also proved effective in reducing the accumulated net inflows.

Regarding volatility, weakening measures rather than tightening measures to regulate capital inflows and outflows are effective in easing volatility of portfolio investment.

Through the analysis of the effects on interest rates, it was confirmed that the central bank's monetary policy and the CFM measures are being used complementarily. While strengthening measures against CFM measures brought some negative signals to the stock market, measures to weaken regulations had a positive effect on stock prices. Measures against capital outflows increased exchange rate volatility, but other measures to weaken or strengthen capital inflows were not found to have much to do with exchange rate volatility. Contrary to the intentions of the policy authorities, measures to reinforce capital outflows were found to be highly related to devaluation of the currency value and expansion of exchange rate volatility.

Source: Kim (2020)

E. Sri Lanka

In order to improve the soundness of the financial system, the Central Bank of Sri Lanka (CBSL) monitors and supervises the financial markets and participants to prevent the spread of systemic risks that can lead to the financial crisis. In order to perform these functions effectively, the Financial System Stability Committee was established in 2002, consisting of central bank staff dispatched from other departments under the responsibility of CBSL Deputy Governor. Through regular (monthly) meetings, the soundness, resilience, and risk factors of the financial system are analyzed, and reports are submitted to the Governor and Monetary Board.

Sri Lanka's macroprudential policy framework relies on risk monitoring and management of macroprudential indicators (foreign exchange market, real and financial markets, real estate, commodity markets, banks, financial institutions, companies). Based on this indicator, indicators such as Financial Stability Indicator and Banking Soundness Indicator are constructed and presented.

As the interconnectedness among financial institutions increased, the potential risk factors increased as well. A network analysis is being used to manage these risk factors. The authority is also conducting a stress test to evaluate the resilience of the banking system. It is also looking at risk factors that may derive from the volatility of Sri Lankan rupee.

In the past few years, credit growth management policies, dynamic provisions, capital ratio and margin rate that change according to economic fluctuations, reserve requirements, net foreign exchange position, foreign currency loans, foreign currency exposure regulations, etc. have been introduced. For the MPMs introduced in this way, CBSL generally evaluates that it has helped to improve the soundness of the banking system (CBSL, 2014).

CBSL should be improved in the direction of clarifying the transparency and accountability of the macroprudential policy system through the Financial System Stability Review issued annually in the future. Further efforts are required to inform the public about the evaluation of the entire financial system, find potential risk factors and financial vulnerabilities, and apply appropriate means to improve them (CBSL, 2014).

4. The Effect of MPMs on Financial Stability

In Section 4, we examine how much the macroprudential policies implemented in emerging countries contributed to the stability of financial markets. For this, we refer to the empirical results of Ansari (2017). In this study, the author focuses on the effects of MPMs introduced in emerging countries (SEACEN Economies: India, Mongolia, Malaysia, Nepal, and Vietnam) on credit growth in each country in order to evaluate the effect of macroprudential policies. The specific measures considered as macroprudential policies in this paper are shown in <Table 5-2>.

<Table 5-2>

MPMs Used for Macroprudential Policy Index

Policy Instrument	Definition
Loan-to-Value Ratio	Constrains highly levered mortgage down payments by enforcing or encouraging a limit or by determining regulatory risk weights.
Debt-to-Income Ratio	Constrains household indebtedness by enforcing or encouraging a limit.
Dynamic Provisioning	Requires banks to hold more loan-loss provisions during upturns.
Countercyclical Capital Buffer	Requires banks to hold more capital during upturns.
Leverage Ratio	Limits banks from exceeding a fixed minimum leverage ratio.
Capital Surcharges on SIFIs	Requires Systemically Important Financial Institutions to hold a higher capital level than other financial institutions.
Limits on Interbank Exposures	Limits the fraction of liabilities held by the banking sector or by individual banks.
Bank Levy	Taxes revenues of financial institutions.
Reserve Requirement Ratios	Limits credit growth; can also be targeted to limit foreign-currency credit growth.
Limits on Foreign Currency and Domestic Currency Loans	Limits vulnerability to foreign-currency risks and credit growth directly.
Concentration Limits	Limits the fraction of assets held by a limited number of borrowers.

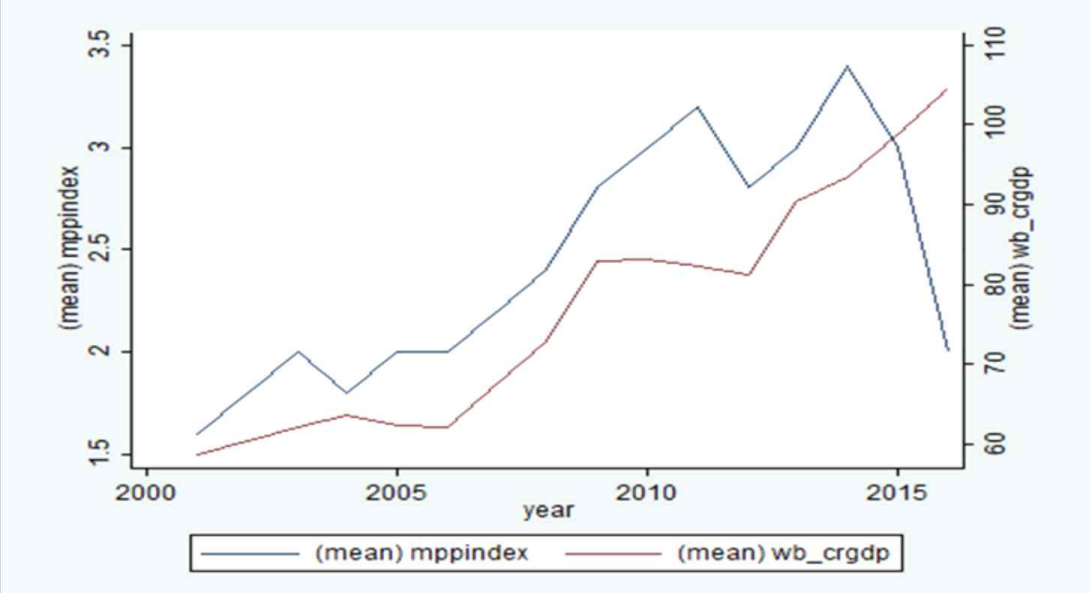
Source: Ansari (2017)

With the specific MPMs listed above, Ansari (2017) established the Macroprudential Policy Index. This index is calculated as a simple sum of dummy variables indicating whether the policy is introduced or not, measured as 0 or 1 for each policy measure. As for the reason for constructing the index with a simple sum, Ansari (2017) pointed out the reason why it is difficult to reflect the constraints of the available data and the strength of the policy.

Immediately after the GFC, the adoption of MPMs increased significantly, leading to a decline in credit in emerging countries. On the other hand, it can be seen that the related MPMs have decreased significantly since 2014, and credit has increased rapidly simultaneously (<Figure 5-1>). Therefore, it can be inferred that these two variables generally have a negative correlation, but a panel analysis needs to be performed for a more rigorous verification.

<Figure 5-1>

Macroprudential Policy Index and Credit Growth: FY2001~2016



Note: This is the average of the five SEACEN countries (India, Malaysia, Mongolia, Nepal, and Vietnam). The red solid line (wb_crgdp) represents credit (% of GDP), and the blue solid line (mppindex) represents the macroprudential policy index

Source: Ansari (2017)

The empirical model is as given below. The subscript i denotes country, and t denotes the year. Y represents the real credit growth (%) which is used as an index to evaluate the effectiveness of MPMs. μ_t and η_i represent time and country fixed effects, respectively. MPI represents the Macroprudential Policy Index constructed by the sum of 11 MPM dummy variables. $Controls$ denotes other control variables which include GDP growth rates (%, henceforth GDP), policy rate (%), financial crisis (Acharya et al., 2013). The interaction between GDP growth rates and MPI ($MPI \bullet GDP$) is also included to examine whether the effect of the macroprudential policy differs according to the GDP growth rates. ϵ is the error term. To alleviate the endogeneity problem, the coefficient is estimated using the Generalized Method of Moments (GMM).

$$Y_{i,t} = \mu_t + \eta_i + \beta \bullet MPI_{i,t} + \gamma \bullet MPI_{i,t} \bullet GDP_{i,t} + \delta \bullet Controls_{i,t} + \epsilon_{i,t}$$

The empirical results are presented in <Table 5-3>. As a result of empirical

analysis, it was found that the *MPI* has a statistically significant and negative correlation with credit growth. This is also robust in the expansion model that includes the interaction of GDP growth rate and *MPI*. Although it is somewhat different between the basic model and the extended model, it was found that an increase in the *MPI* by one unit generally reduces credit by 2.3-2.7%p. The results of this empirical analysis imply that *MPI* has a positive effect on financial stability in emerging countries. As a result of estimating the coefficients of other explanatory variables, it was found that GDP growth rate is positively associated with the credit growth, while the occurrence of the financial crisis and policy rate hike are negatively associated with the credit growth. These are all statistically significant. The coefficient of the interaction term between the GDP growth rate and the *MPI* is estimated to be positive, but it was not statistically significant.

<Table 5-3>

Empirical Result on the Effect of MPMs

Dependent Variable: Real Credit Growth	(1) OLS	(2) marginal effect	(3) OLS	(4) marginal effect
MPI	-0.924*** (0.032)	-0.273*** (0.003)	-0.771*** (0.033)	-0.237*** (0.004)
GDP growth rate	0.869*** (0.030)	0.278*** (0.003)	0.271*** (0.031)	0.403*** (0.004)
Crisis	-0.064*** (0.009)	-0.003*** (0.0004)	-0.102*** (0.011)	-0.011*** (0.001)
Policy rate	-0.049* (0.020)	-0.011* (0.001)	-0.176* (0.073)	-0.431* (0.214)
GDP growth rate X *MPI*			0.976 (1.703)	0.001 (0.0004)
R-squared	0.669		0.786	

Note: Robust standard errors are in the parenthesis. ***, **, and * represent level of statistical significance at 1, 5, and 10 percent, respectively

Source: Ansari (2017)

5. Conclusion

Establishing a strong and effective macroprudential policy system to achieve financial stability goals is essential for the economic development of emerging countries. In line with the changing global financial market environment, policy authorities must develop their ability to find potential factors that may cause new systemic risks, analyze the impact of the financial market, and formulate response policies. For this, it is required to improve the macroprudential policy system as well as the macro stress test model for evaluating resilience.

In this chapter, we evaluated the macroprudential policies of neighboring emerging countries that NRB can refer to. Improvements commonly required in these emerging countries can be summarized as follows.

① An institutional system that can manage stability of the financial market as a whole based on a strong legal basis should be established. This can improve the efficiency of macroprudential policies.

② The means of finding and evaluating potential risk factors should be developed. For this, it is necessary to improve the data management and processing system, which is also the first step to develop the macro stress testing.

③ Cooperation between departments that establish and implement macro-prudential policies should be improved more.

Based on the analysis of the macroprudential policies of the five emerging countries discussed above, a future report will compare/evaluate Nepal's MPMs and conduct in-depth research on areas that need improvement in the future.

References

[References in English]

Adrian, T, Morsink, J, Schumacher, L (2020), “Stress Testing at the IMF”, *Monetary and Capital Markets Departmental*, IMF

Aikman, D., Alessandri, P., Eklund, P., Gai, P., Kapadia, S., Martin, E., Mora, N., Sterne, G. and Willison, M (2009), ”Funding liquidity risk in a quantitative model of systemic stability”, *Bank of England Working Paper* No. 372.

Alessandri, P., Gai, P., Kapadia, S., Mora, N. and Puhr, C (2009), ”Towards a framework for quantifying systemic stability”, *International Journal of Central Banking*, December.

Ansari, J (2017), “Macroprudential policies in SEACEN economies”, *SEACEN Working Paper*, 2015,1–30.

Bank of Korea (2008a), “Financial Stability Report”.

Bank of Korea (2020b), “Bank of Korea announces 50bp base rate cut and measures to stabilize economic and financial conditions”.

Bank of Korea (2020c), “Bank of Korea to expand financial institutions’ collateral capacity by 10.1 trillion won”.

Bank of Korea (2020d), “Ceiling on the Bank intermediated lending support facility raised by 5 trillion won to provide financial supports to SMEs affected by COVID-19”.

Bank of Korea (2020e), “Bank of Korea broadens securities eligible for open market operations”.

Bank of Korea (2020f), “Broadening of eligible collateral for lending facilities”.

Bank of Korea (2020g), “BOK to launch corporate bond-backed lending facility”.

Bank of Korea (2020h), “Monetary Policy Report”.

Bank of Korea (2020i), “Results of competitive US dollar loan facility auctions using the proceeds of swap transactions with the US Federal Reserve”.

Bank of Korea (2020j), “Ease of FX market stability rules”.

Bank of Korea (2020k), “Financial Stability Report”.

Basel Committee on Banking Supervision (BCBS) (2009), “Principles for sound stress testing practices and supervision”.

Basel Committee on Banking Supervision (BCBS) (2015), “Making supervisory stress tests more macroprudential: Considering liquidity and solvency interactions and systemic risk”, *BCBS Working Papers,* NO. 29, November.

Basel Committee on Banking Supervision (BCBS) (2017), “Supervisory and bank stress testing: range of practices”, *Bank for International Settlements*.

Bernanke, B (2010), “The Supervisory Capital Assessment Program － one year later”, www.federalreserve.gov/newsevents/speech/bernanke20100506a.htm.

Board of Governors of the Federal Reserve System, April (2009), “The supervisory capital assessment program: Design and implementation”.

Borio, Claudio EV, Enisse Kharroubi, Christian Upper, and Fabrizio Zampolli

(2016), “Labour reallocation and productivity dynamics: financial causes, real consequences”, *BIS Working Paper*.

Borjas (2003), "The labor demand curve is downward sloping: re-examining the impact of immigration on the labor market", *Quarterly Journal of Economics*, Vol. 118, No. 4.

Burrows, O., Learmonth, D. and McKeown, J (2012), “RAMSI: a top-down stress testing model”, *Bank of England Financial Stability Paper* No. 17.

Card and Lemieux (2001), "Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis", *Quarterly Journal of Economics*, Vol. 116, Issue 2.

Central Bank of Sri Lanka (CBSL) (2014), “Objectives, Functions & Organization. Colombo”.

Committee on the Global Financial System (CGFS) (2005), “Stress testing at major financial institutions: survey results and practice”, *CGFS Paper* No. 24.

Dent, K.,Westwood, B., Segoviano, M. (2016), “Stress Testing of Banks: An Introduction”, *Bank England*. Q. Bull. 56, 130–143.

Elsinger H., A. Lehar and M. Summer. (2006), “Using market information for banking system risk assessment”, *International Journal of Central Banking*, Vol. 2 (1), pp. 137-165.

Elsinger, H., Lehar, A., Summer, M., (2006), “Risk assessment for banking systems”, *Management Science 52* September 9, 1301–1341.

Elsner (2013a), “Does emigration benefit the stayers? Evidence from EU enlargement”, *Journal of Population Economics*, Vol. 26.

Elsner (2013b), "Emigration and wages: The EU enlargement experiment", *Journal of International Economics*, Vol. 91, No. 1.

European Banking Authority (EBA) (2011), "Overview of the EBA", Banking EU-wide Stress Test.

Fabiano Schivardi, Enrico Sette and Guido Tabellini (2017), "Credit misallocation during the European financial crisis", *BIS Working Paper*, No 669.

Financial Services Authority, UK (2009), "The Turner Review: A Regulatory Response to the Global Banking Crisis", (March 2009).

Foos, D., Norden L., and Weber M (2010), "Loan growth and riskiness of banks", *Journal of Banking and Finance,* 34(12), 2929-2940.

Gita Gopinath, Sebnem Kalemli-Ozcan, Loukas Karabarbounis, and Carolina Villegas-Sanchez (2017), "Capital Allocation and Productivity in South Europe", *NBER Working Paper* No. 21453.

Goodhart Charles A.E (1984), "Monetary Theory and Practice", London, *Macmillan Press*.

Hoi, Le Cong, Le Thi Minh Ngoc (2018), "Macroprudential Policy in Vietnam: New Mandate with Many Challenges", *State Bank of Vietnam*.

IMF (2005), "Financial sector assessment: A handbook", Washington DC. Jacobson,

IMF, FSB, and BIS (2009), "Guidance to Assess the Systemic Importance of Financial Institutions, Markets and Instruments: Initial Considerations", Report to the *G-20 Finance Ministers and Central Bank Governors*, Washington, DC, and Basel.

Jacobson, T., Linde, J. and Roszbach, K (2005), “Exploring interactions between real activity and the financial stance”, *Journal of Financial Stability*, Vol. 1 (3), pp. 308-341

Keeton, W (1999), “Does Faster Loan Growth Lead to Higher Loan Losses?”, *Federal Reserve Bank of Kansas City Economic Review*, 84, 57-75.

Kim Kyunghun (2020), “Determinants of Capital Flow Management and Its Impact on Financial Market”, mimeo

Lee, Minsoo, Gaspar, Raymond, and Villaruel, Mai Lin (2017), “Macroprudential Policy Frameworks in Developing Asian Economies”, *Asian Development Bank Economics Working Paper Series*, 510.

Lim, Cheng Hoon, Francesco Columba, Alejo Costa, Piyabha Kongsamut, Akira Otani, Mustafa Saiyid, Torsten Wezel, and Xiaoyong Wu (2011), “Macroprudential Policy: What Instruments and How to Use Them?: Lessons from Country Experiences”, *IMF Working Paper* No. 11/238

Maino, Rodolfo, Patrick Imam, and Yasuhisa Ojima (2013), “Macroprudential Policies for a Resource Rich Economy: The Case of Mongolia”, *IMF Working Paper* No. 13/18.

Mayr and Peri (2009), "Brain Drain and Brain Return: Theory and Application to Eastern-Western Europe", *The B.E. Journal of Economic Analysis & Policy,* Vol. 9, No. 1.

Monetary Financial Stability Department, State Bank of Vietnam (2019), “Vietnam Financial Stability Framework,” presented at the *2019 Bank of korea-KPP Kick-off Meeting*. (July 9)

Nguyen, Do Quoc Tho (2012), “Implementing Macroprudential Policy: The Case of Vietnam”.

Osiński, Jacek, Katharine Seal, and Lex Hoogduin (2013), "Macroprudential and Microprudential Policies: Toward Cohabitation", *International Monetary Fund.*

Quagliarello, M (2009), "Stress Testing the Banking System: Methodologies and Applications", *Cambridge University Press*

Salas, V., Saurina, J (2002), "Credit Risk in Two Institutional Regimes: Spanish Commercial and Savings Banks", *Journal of Financial Services Research*, 22(3), 203-224.

Schubert. A (2015), "Statistics on a who-to-whom basis", *Third IMF Statistics Forum.*

Schuermann, T (2013), "Stress testing banks." *Wharton Financial Institutions Center.*

Shin-ichi Fukuda, Jun-ichi Nakamura (2011), "Why did 'zombie' firms recover in Japan?", *The World Economy*, 1124-1137.

Soedarmono, W., Sitorus, D. and Tarazi, A (2017), "Abnormal loan growth, credit information sharing and systemic risk in Asian banks", Research in *International Business and Finance*, 42, 1208-1218.

Sukhee, Munkhchimeg, and Tsenguunjav Byambasuren (2016), "Living with Volatilities: Capital Flows and their Implications for Central Bank Policies in Mongolia", In Living with Volatilities: Capital Flows and Policy Implications for *SEACEN Central Banks*, by Chris Becker. Kuala Lumpur: SEACEN.

Vinals, Jose and Erlend Nier (2014), "Collective action problems in macroprudential policy and the need for international coordination", *Banque de France Financial Stability Review.*

Yuen, Kapo (2015), “Determining the Severity of Macroeconomic Stress Scenarios”, *Federal Reserve Bank of New York*.

Yuyan Tan, Yiping Huang, Wing Thye Woo (2016), Zombie firms and the crowding-out of private investment in *China, Asian Economic Papers* 15(3), 32-55.

[References in Korean]

Bank of Korea (2015), “Macroprudential Policy in Korea”.

Lee, Namsuk (2016), “Cognitive Bias Dictionary”, Okdang.

Contributing Authors by Chapter

Contents	Authors
I. Introduction	Junghwan Hyun
II. The Economy and The Financial System in Nepal	Danda P Kharel Prithu Sharma Binadi Bibek Koirala Sagar Gautam
III. Policy Responses to the COVID-19	Junghwan Hyun Hong-Youl Ha Bibek Koirala Prithu Sharma Binadi Danda P Kharel Sagar Gautam
IV. Step-by-Step Plan to Develop a Macro Stress Testing Framework for Nepal	Junghwan Hyun Kyunghun Kim Jeonghwan Cho Sagar Gautam Danda P Kharel
Ⅴ. Macroprudential Policy Measures in Emerging Countries and Their Impact on Financial Stability	Kyunghun Kim