

Fiscal Spending and Liquidity: Is Fiscal Monetization Underway?*

Jaechan Sim** · Chul-In Lee***

Given the distinct roles of fiscal and monetary policies in modern economies, no systematic relationship should exist between public debt and liquidity in typical economic settings. However, data from recent two decades show a robust positive relationship without fiscal spending based on large-scale quantitative easing, a finding that is also supported by a thorough econometric analysis. We present rare evidence that excessive fiscal spending shocks partly led to bond acquisitions and open market operations by the central bank in the era of low borrowing rates and price stability, thus generating the observed positive correlation. Fiscal debt is found to boost liquidity substantially over the sample period of 2003–2021.

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I. Introduction

The effects of large-scale fiscal spending as a means to overcome major recessions (e.g., the Great Depression, the 2008 financial crisis, and COVID-19) are drawing significant attention. Unlike monetary policy, fiscal policy remains a subject of controversy among academics and policymakers because of policy lags, ambiguities

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** First Author, Research Fellow, Nonghyup Financial Research Institute, E-mail: jcwjc88@gmail.com

*** Corresponding Author, Professor, Department of Economics, Seoul National University, E-mail: leeci@snu.ac.kr

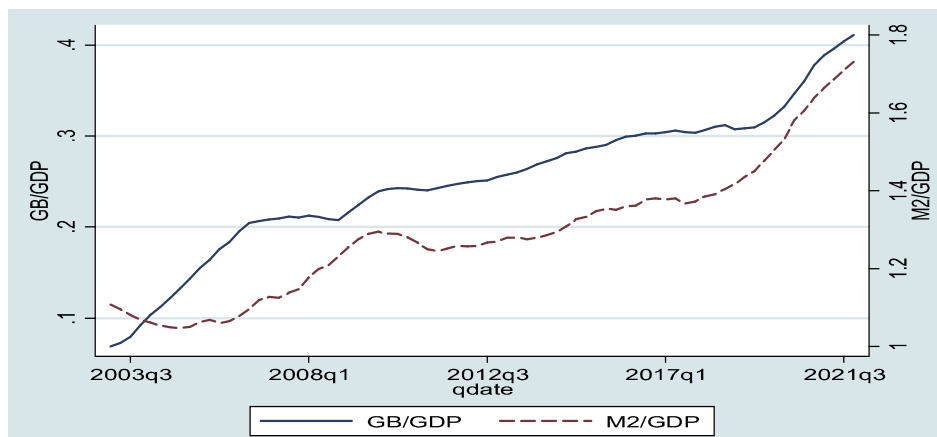
regarding fiscal multipliers, and differences across schools in terms of estimated effects (Feldstein, 2009).¹ Nevertheless, some agreement has at least been reached—particularly in studies using DSGE and (S)VAR models—on the short-term boosting and stabilizing effects of fiscal policy (e.g., Auerbach and Gorodnichenko, 2011; Christiano et al., 2011; Hall, 2009). Fiscal policy is also believed to have a unique operation principle, with channels different from those of monetary policy. For example, the Ricardian equivalence theorem (i.e., a basis of fiscal spending theory) addresses the fundamentally neutral nature of fiscal policy independent of monetary policy and the irrelevance of fiscal policy in the real economy. Similarly, in heterogeneous agent models with idiosyncratic labor productivity and borrowing constraints, fiscal policy has redistributive effects distinct from monetary policy affecting intertemporal price structure (Heathcote, 2005).

Given the distinct roles of fiscal versus monetary policy as modern macro stabilization policies, combined with the well-known central bank independence doctrine, conceptualizing a systematic positive relationship between fiscal debt and liquidity over a decent sample period (see Figure 1 below for motivation) is challenging. As will be shown in the empirical approach section of the paper, the data exhibit a positive relationship with strong statistical significance. In general, an ideal fiscal policy is implemented countercyclically. When market liquidity typically follows a procyclical pattern in the absence of monetary intervention (e.g., borrowing and lending are procyclical), we may expect to see a negative correlation between fiscal spending and liquidity. Although fiscal spending can increase liquidity by boosting GDP, this effect is likely to be negligible during an economic downturn. Moreover, even if this effect exists, it may be temporary, failing to explain the medium- or long-run trend of rising liquidity.

Frequent monetary policy interventions may compound the negative correlation pattern mentioned above. Accordingly, we cannot exclude the possibility of obtaining a weak positive correlation in part of the period of low interest rates. Nevertheless, we recognize the difficulty of observing a positive correlation when the effects of a monetary policy are properly controlled for. One exception may be the so-called debt monetization, that is, fiscal debt financed through quantitative easing.² This strategy has widely been used during recent crises in many countries (e.g., the US and those in Europe) but not in Korea.

¹ For example, the fiscal spending multiplier differs across schools. In one school, fiscal spending stimulates aggregate demand but raises long-term interest rates that crowd out investments with long-term burdens on the economy (Feldstein, 2009). By contrast, Barro and Redlick's (2011) opposing view is also well known. They primarily focus on the Ricardian equivalence theorem, arguing that the effects of fiscal policy are limited in the long run.

² Monetization—also known as “money-financed fiscal program” or “money-printing”—occurs when a government finances itself by issuing currency or other non-interest-bearing liabilities (e.g., bank reserves).

[Figure 1] Government bond balance vs. M2/GDP

Note: Government bonds and M2 are divided by GDP. Source: Bank of Korea. We later present a more reliable partial correlation between the two variables after controlling for the influence of the monetary policy, showing a more robust correlation.

Surprisingly, our analysis shows that data about Korea since 2000 exhibit a strong positive correlation between fiscal debt and liquidity normalized by GDP, even after controlling for monetary policy effects using the policy interest rate data. Fiscal policy has been almost acyclical or slightly procyclical under a balanced budget (Hong, 2011;³ Kang and Woo, 2022), and unlike the US, no official quantitative easing and fiscal monetization have been implemented in Korea. Therefore, a strong positive correlation is difficult to justify, raising an interesting puzzle.⁴

We address this puzzle in this paper. As will be shown later, this positive relationship is found through both intuitive regression and rigorous time-series analysis. We ensure that this correlation does not arise from (i) a coincidental spurious factor of the low-interest rate trend that has strengthened continuously since the 2000s, combined with (ii) the trend of expansionary fiscal policy to deal with major downturns or secular expansion in welfare programs.⁵ This positive

³ In his analysis of data, Hong claims that a pattern of relatively more procyclical fiscal spending is evident from 1970 to 2009. In particular, procyclicality has become stronger since the 1990s, and expansionary fiscal policy has been implemented during both economic downturns and boom times.

⁴ Korea did not officially carry out quantitative easing in the pre-COVID-19 period, and the Bank of Korea (BOK) did not formally purchase government bonds (GBs) by printing money. However, even after controlling for the effect of the interest rate, we see a clear positive correlation between debt and liquidity. Kang and Woo (2022) present evidence that the automatic stabilizers have a marginal stabilization effect.

⁵ As seen from media coverage of the BOK's announcement of the purchase of GBs totaling around 5 trillion won by the end of 2020 and the subsequent liquidity debate, large-scale fiscal spending can increase liquidity (Kim, 2020). Kim points out that the amount required for the fourth supplementary budget—including support for telecommunications expenses worth 1 trillion won—is secured through

correlation is empirically valid even after the part related to the monetary policy (i.e., the part explained by the policy interest rate) is removed from the analysis. We also check the validity of our approach by examining whether the U.S. economy has exhibited such a positive pattern in recent decades. Quantitative easing occurred along with a large-scale fiscal stimulus in the US. Therefore, its economy should exhibit such a positive correlation.

This research pursues two goals. First, we offer a puzzling stylized fact that there has been a positive correlation between fiscal debt and liquidity since the 2000s. Second, we try to account for this stylized fact. We show empirically that excessive fiscal spending leads to liquidity expansion with a large short-run impact. In response to a rapid secular increase in the demand for fiscal spending (active fiscal policy), the central bank partly takes over public bonds and buys back its own bonds (i.e., the so-called monetary stabilization bonds [MSBs]) through open market operations, which help keep the planned target policy rate while raising liquidity. The data show that given the low inflation in the sample period, the central bank has pursued this line of policy without considerable side effect. This view is partially related to the fiscal theory of the price level (FTPL) (Leeper, 1991; Sims, 1994; Woodford, 1995),⁶ but there are clear differences.

While our analysis identifies excessive fiscal spending to be the driving force as in the FTPL, we do not assume that the central bank deliberately induces inflation to lower the real value of debt for sustainability. The rigid tax system in Korea allows fiscal deficits to accumulate quickly, thereby increasing national debt over time. However, there have been virtually no expectations that public debt would exceed the limit leading to bankruptcy; therefore, inflation does not appear in the data.

We also show that liquidity expansion is an outcome of the central bank's intervention motives to reduce market distortions arising from excessive fiscal deficits. As discussed by Blanchard and Perotti (2002),⁷ along with the lack of

simple purchases of about 7 trillion won. In this paper, simple purchase refers to the purchase of GBs that permanently increase liquidity, unlike repurchase agreement (RP) trading with the condition of repurchasing or selling GBs later. The former is consistent with the concept of monetization of fiscal spending in this paper. Sluggish repurchasing can also lead to an increase in liquidity.

⁶ Some studies (e.g., Leeper, 1991; Sims, 1994; Woodford, 1995) argued that inflation could be explained not only as a monetary policy but also as a result of fiscal policy. According to the fiscal theory of the price level, inflation occurs when fiscal debt exceeds the level that can be repaid in the future (or the sum of the present value of the expected fiscal surplus). Given that the government implements an active fiscal policy by issuing GBs beyond the repayment limits, the central bank has to intervene and intentionally create inflation to reduce the real burden of government debt, at least to prevent catastrophe. Specifically, it occurs due to the combination of an active fiscal policy that does not consider future repayment and a passive monetary policy to prevent catastrophe, leading to the endogeneity of the central bank monetary policy. For additional information on fiscal policy being the key to understanding inflation in certain situations, see Sargent and Wallace (1981) and Sargent (1982).

⁷ The government's political motives (e.g., redistribution vs. growth) can trigger fiscal spending.

countercyclicality in fiscal spending, discretionary government spending shocks have become stronger over time, especially in recent periods. Large-scale fiscal deficits usually lead to interest rate hikes,⁸ and therefore, the monetary authority may have no choice but to supply more liquidity to maintain the target policy rate. This policy stance seems to persist since inflation has not been a pressing issue until recently.

Identifying these channels is an important empirical topic. In this research, we first raise this puzzle and then try to present possible explanations. Empirically, we show that the central bank purchases or partially monetizes government bonds (GBs) to maintain the target policy rate in response to rising interest rate pressure from massive fiscal spending. In addition, we present findings even after controlling for a channel through which liquidity goes up by reducing the scale of MSBs issued by the central bank. Various robustness checks, including (i) instrumental variable (IV) estimation, (ii) more extended model specifications, (iii) ARDL model estimation, and (iv) structural vector autoregressive (SVAR) estimation, strongly confirm our conclusion.

Few literature have studied the applicability of the FTPL to Korea. Yoon (2001) theoretically found that the effect of fiscal spending can vary depending on whether the central bank adopts an active or passive interest rate rule when fiscal spending and subsequent inflation pressures occur. However, as the paper was written before the emergence of the stylized fact of the present work, it does not offer empirical evidence or direct implications for this study. Lee (2009) used a vector error correction model with Korean data from 1970 to 2002 and concluded that Korea's inflation resulted from a monetary phenomenon rather than a fiscal one. Using the new Keynesian DSGE model, Sung et al. (2015) showed that the combination of active fiscal spending and passive monetary policy could explain Korean data well, the implication of which seems consistent with our research. Meanwhile, debt monetization captured attention through previous war expenditures and was revived with high public deficits, especially after the COVID-19 pandemic (Protopapadakis and Siegel, 1986; Lawson and Feldberg, 2020). However, either the empirical support found was quite weak or the methodology used seemed outdated.

We show that other competing hypotheses cannot account for the positive correlation observed in Korea. First, the original version of the FTPL is inconsistent with the data: the central bank has never officially financed GBs, and inflation has

Blanchard and Perotti (2002) identify this expenditure as a structural shock in government spending, distinguishing it from the notion of countercyclical fiscal spending.

⁸ During 2023–2024, U.S. monetary policy was contractionary with falling liquidity. Although a large volume issuance of short-term public bonds put upward pressure on interest rates, the federal reserves' RP account supplies liquidity, thereby satisfying the liquidity demand. The resulting M1 balance rose from \$4 trillion before the COVID-19 pandemic to \$18 trillion in 2024, after peaking at \$22.7 trillion.

not been a concern until recently. Second, it is difficult to discuss the specific relationship between fiscal spending and liquidity based on the Ricardian equivalence theorem or the neoclassical crowding-out hypothesis alone. Third, some (e.g., Hong, 2011) argue that the time trends of expansionary fiscal and monetary policies jointly adopted since the 2000s may have generated a spurious positive correlation between debt and liquidity. We show that a strong positive correlation still exists even after controlling for the monetary policy effect on liquidity in analysis.

Against these backdrops, the primary tasks of this paper are to (i) empirically identify the systematic relationship between excessive fiscal spending and liquidity as a stylized fact and (ii) provide possible explanations for the mechanism of how large fiscal deficits lead to liquidity expansion. Drawing on conventional fiscal theories, we present evidence that liquidity has increased through the following channel: when fiscal deficits are financed through public bonds, the central bank takes over the bonds or indirectly reduces MSBs through open market operations.⁹

The rest of this paper is organized as follows. Section II presents the theoretical background and empirical specifications for analyzing the relationship between excessive fiscal spending and liquidity. Section III establishes the stylized fact of a positive correlation based on empirical results. Section IV seeks proper interpretations of these empirical results and attempts a partial understanding through related data. Section V conducts a sensitivity analysis for the robustness of our results. Finally, Section VI concludes.

II. Econometric Framework and Data

1. Econometric framework

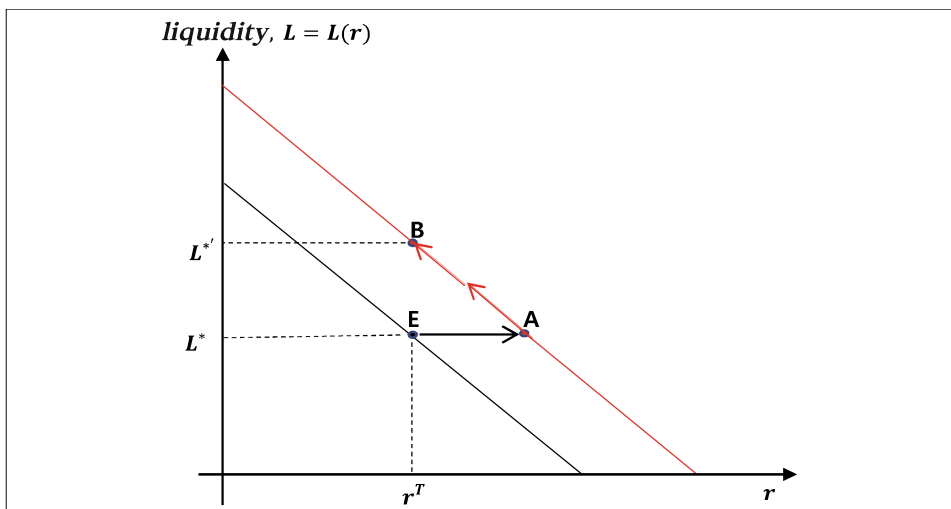
a. Theoretical background

Liquidity side. We propose a two-step regression model to investigate the underlying factors contributing to the sustained expansion of liquidity. According to conventional wisdom, modern monetary policy authorities retain the independent right to set the policy interest rate to stabilize the aggregate price level (and the economy), as exemplified by the Taylor rule. All economic concerns are condensed into setting the policy rate, which requires adjusting the money supply under a given money demand. Therefore, the policy rate works like a sufficient statistic for

⁹ In addition to direct bond purchases, liquidity can rise when the central bank reduces the issuance of monetary stabilization bonds (MSBs), which are issued to absorb market liquidity, as will be shown later.

the money supply. Given this, we hypothesize an intuitive empirical equation that money supply (and hence liquidity) is determined as a result of setting the policy interest rate at a specified target level. If the arrival of shock causes the market rate to deviate from the policy rate, then the central bank has to intervene to maintain the target interest rate by increasing the money supply, as long as the intervention does not hurt price stability. In our context, fiscal deficits financed through public bonds are a shock to the market interest rate, which the monetary authority must neutralize. This view makes sense if monetary and fiscal policies are independent of each other.

[Figure 2] Theoretical basis



Notes: Under the policy rate set according to the Taylor rule, liquidity L^* is defined using the liquidity function $L(r; Z)$, where Z denotes other external factors. Point A represents the situation where debt-financed fiscal spending puts upward pressure on the interest rate. Point B shows the policy rate r^T has been restored through a reaction of the central bank, such as purchasing bonds or increasing money supply, and the resulting market liquidity expands to L^{*} . If the Ricardian equivalence holds, then the economy stays at the original point E, since savings rise in response to the issuance of government bonds.

We describe this idea using Figure 2, where the Y axis measures liquidity L and the X axis measures the target interest rate or policy rate r . A certain negative structural relationship exists between liquidity and the interest rate, holding other things constant. Suppose the government implements debt-financed fiscal spending. The market rate of interest rises as a result. Although the central bank acts based on the Taylor rule, an unexpected upward deviation of the interest rate from the target level r^T happens. This is noted by point A in Figure 2. Then the central bank has to intervene to maintain the target rate by supplying more

money (or liquidity eventually), which is denoted by point B. This mechanism shows that while the target policy rate is restored, liquidity ultimately increases. If inflation does not happen with the additional money supply, point B remains as the equilibrium. In identifying the market liquidity function, this fiscal shock serves as an omitted variable in the empirical specification, which will be discussed later.

The example given above does not hold under the classic Ricardian equivalence theorem. If the Ricardian equivalence holds, then the economy still stays at E since savings rise in response to the issuance of GBs with no impact on the interest rate. Whether or not the Ricardian equivalence theorem holds is an empirical question. However, given that most countries suffer from fiscal deficits and public debt, there is evidence suggesting that fiscal policy can affect the real economy, a conclusion that is also drawn in this research.

Fiscal theory side. Additional theoretical background comes from the debates on Wagner's law versus the displacement effect on the fiscal side. Wagner's law is the first model of public expenditure in the history of public finance. It suggests that during the process of economic development, the share of public spending in national income tends to expand (Wagner, 1883), implying that fiscal spending grows faster than the GDP growth rate even without a theoretical foundation. Nevertheless, Peacock and Scott (2000) argue that the increasing government size reflects the displacement effect,¹⁰ explaining why this apparently outworn Wagner's law is still studied by modern economists. Empirically, most countries have experienced a rapid increase in fiscal spending (e.g., during war) and then do not return to the previous low level after the fiscal upheaval has ended. In a more modern business cycle context, Blanchard and Perotti (2002) take the view that fiscal spending shocks have the most exogenous short-run component, which is driven by external factors. Overall, in both long- and short-run contexts, including the transitional dynamic one, we observe external variations unrelated to the macroeconomy and—especially—the market liquidity in this paper. We take advantage of these variations for our study. Table A1 shows the recent fiscal spending shock that rose almost 50% in a few years.

b. Empirical approach: establishing a stylized fact and testing

To the best of our knowledge, the topic of this paper has not been addressed elsewhere, so we should take a cautious approach to our analysis. To this end, we intentionally begin with a simple OLS regression to provide a stylized fact of a

¹⁰ In times of crisis, formerly unacceptable revenue-raising methods will be tolerated, and (it is claimed) a higher tax tolerance will persist even after the crisis subsides, enabling the government to implement expenditure programs that it previously desired but could not finance. While this hypothesis is well taken in public economics, empirical evidence is rather weak because of difficulties testing the hypothesis.

positive correlation between fiscal debt and liquidity. We also consider IV estimation to deal with possible endogeneity issues. Then, we perform a slightly more formal autoregressive distributed lag (ARDL) model regression that takes advantage of time series properties of data, followed by an SVAR model that identifies structural fiscal policy shocks. Given the conventional view of liquidity that depends critically on the target policy rate (i.e., some sort of sufficient statistics for liquidity), we regress the liquidity measure (e.g., L / GDP) on the interest rate r in the first step. To show there are other factors affecting liquidity, we then regress the resulting residual obtained from the first step on government debt, which is an omitted variable in our context as it is unrelated to the policy rate under conventional wisdom.

Stylized fact: a positive correlation between fiscal debt and liquidity. Econometric issues aside, we try to remove the effect of the ongoing low-interest rate trend in step 1 using the policy rate of interest r , which is generally regarded as a main driver of liquidity expansion. In step 2, we analyze whether expansionary fiscal policy can increase liquidity even after accounting for the long-run trend of monetary policy. Since liquidity measures (e.g., M2) and GB are ratio variables divided by GDP, the natural economic change effects, such as economic fluctuations and growth, are removed. In the second step, the residual in the first regression is used as the dependent variable and regressed on the GB balance (GB / GDP) to check whether there are fiscal policy side effects on liquidity. At least, this regression can test whether a systematic correlation exists between fiscal debt and liquidity,¹¹ establishing a puzzling stylized fact. We write two equations, (1) and (2), for regression analysis as follows:

$$\text{Step 1: } \left(\frac{L}{GDP} \right)_i = \beta_0 + \beta_1 r_i + u_i \quad (1)$$

$$\text{Step 2: } \hat{u}_i = \gamma_0 + \gamma_1 \left(\frac{GB}{GDP} \right)_i + Z_i \gamma_2 + \epsilon_i \quad (2)$$

If there are other factors (demographic or institutional) denoted by Z_i that affect liquidity, we may need to include them in the empirical specification (2) given above.¹² An international factor such as exchange rate movement may also be considered an additional control variable because it is associated with capital mobility, which is a source of liquidity. Our empirical analysis will include

¹¹ Note that this is not a simple correlation but a specific correlation that is derived after controlling for the monetary policy part.

¹² If z_i interacts with the policy rate r_i , then we need to control for z_i in Eq. (1), the first step; otherwise, we do this in Eq. (2), the second step.

international factors in the model specifications, as they may be important. However, they do not exhibit particular changes in trend during the sample period considered, so the primary focus goes to the long-run changes in fiscal and monetary policy stances during the sample period.

c. Autoregressive distributed lag model analysis

Our second analysis uses the ARDL model to more directly estimate the relationship between fiscal policy and liquidity. The model and its bounds test, proposed by Pesaran and Shin (1999) and Pesaran et al. (2001), allow us to analyze the relationship even when a cointegration relationship exists among variables. They have the advantage of being able to use both short-run and long-run information, regardless of whether the variables are $I(0)$ or $I(1)$. In other words, the model is useful unless the integration order exceeds unity.

In the ARDL error correction model, the dependent variable is regressed on (i) its lag variables with length p and (ii) k explanatory variables with each length q_i , that is, $ARDL(p, q_1, \dots, q_k)$. For simplicity, let us assume the $ARDL(1,1)$ model with a dependent variable $y_t = (\frac{L}{GDP})_t$ and an explanatory variable $x_t = (\frac{GB}{GDP})_t$, each with a lag of length 1. In this case, the regression equation is

$$y_t = c + \alpha y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \epsilon_t \quad (3)$$

Eq. (3) is a distributed lag model if $\alpha = 0$, an autoregressive model if $\beta_0 = \beta_1 = 0$, and an ARDL model if $\alpha \neq 0$, $\beta_0 \neq 0$, $\beta_1 \neq 0$. Substituting $x_t = x_{t-1} + \Delta x_t$ and $y_t = y_{t-1} + \Delta y_t$ into x_t and y_t in Eq. (3), respectively, we can derive Eq. (4) as follows:

$$\Delta y_t = (1-\alpha) \left(\frac{c}{1-\alpha} - y_{t-1} + \frac{\beta_0 + \beta_1}{1-\alpha} x_{t-1} \right) + \beta_0 \Delta x_t + \epsilon_t \quad (4)$$

The level variable in the second parentheses on the right side of Eq. (4) is $c^* - y_{t-1} + \beta^* x_{t-1}$, defined as $c^* = \frac{c}{1-\alpha}$ and $\beta^* = \frac{\beta_0 + \beta_1}{1-\alpha}$. Given that $E(\Delta y_t)$, $E(\Delta x_t)$, and $E(\Delta \epsilon_t)$ all have a value of 0, the long-run relationship is established. The coefficient β_0 of Δx estimates the degree of deviation of the dependent variable from this long-run relationship. In this structure, $\frac{\beta_0 + \beta_1}{1-\alpha}$ is the long-run coefficient of x , and $-(1-\alpha)$ is the speed of adjustment. If $\alpha = 1$, it does not return to the original path when there is a shock that deviates from the long-run path. Conversely, if $\alpha = 0$, it returns to the equilibrium path immediately next period. The generalized form of the ARDL error correction model is given as

$$\Delta y_t = c_0 - \phi(y_{t-1} - \theta x_{t-1}) + \sum_{i=1}^{p-1} \psi_{yi} \Delta y_{t-i} + \omega' \Delta x_t + \sum_{i=0}^{q-1} \psi'_{xi} \Delta x_{t-i} + \epsilon_t \tag{5}$$

where $\phi = 1 - \sum_{i=1}^p \alpha_i$, $\theta = \frac{\sum_{j=0}^q \beta_j}{\phi}$, $\psi_{yi} = -\sum_{j=i+1}^p \alpha_j$, $\omega = \beta_0$, and $\psi_{xi} = -\sum_{j=i+1}^q \beta_j$.

After obtaining the optimal lag (p^*, q^*) based on the specific criteria, we perform a bounds test for the analysis. The bounds test is a F-test to verify whether a cointegration relationship is established between each variable ($H_0^F : \phi = 0 \cap \sum_{j=0}^q \beta_j = 0$). If H_0^F is rejected, a t-test ($H_0^t : \phi = 0$) is then implemented. The critical value Pesaran et al. (2001) present based on non-normal distribution is used in the bounds test. The lower and upper limits are calculated at 10%, 5%, and 1% significance levels, assuming that all variables are I(0) and I(1), respectively. If the F value is less than the lower threshold, the null hypothesis cannot be rejected, which suggests that the variables are not cointegrated. Conversely, if the F value exceeds the upper threshold, it can be concluded that the variables are cointegrated. No conclusion about the null hypothesis can be drawn if the F value lies between the upper and lower bounds. If both the F-test and t-test results are statistically significant, then the presence of a cointegration relationship among the variables is confirmed. Once the long-run relationship is established, the long-run effect of variable x_j on y is calculated as $\theta = \frac{\sum_{j=0}^q \beta_j}{\phi}$. Further investigation using an SVAR model will be conducted in the sensitivity analysis section.

2. Data

a. Variables

The analysis is based on data from the first quarter of 2003 to the fourth quarter of 2021, covering the decades of growing public debt while excluding the IMF financial crisis and its aftermath. Our data include the following variables: (i) the quarterly average of the Bank of Korea (BOK)’s adjusted monthly average nominal balance of M2 as a measure of market liquidity L ; (ii) a more broadly defined measure of liquidity L_f , including M2 and other liquid assets to be discussed below; (iii) seasonally adjusted nominal GDP; (iv) average quarterly GB balance; (v) the BOK’s GB holding (balance end of period) and (vi) MSB (balance end of period); and (vii) the target policy rate of interest. GDP is annualized by multiplying four,¹³ and the non-seasonally adjusted GB and MSB variables are seasonally adjusted using X12. The nominal target policy rate of interest serves as

¹³ This is to match the unit with the US data and match the unit of GDP/M2 that generally measures the velocity of money supply. The data are provided quarterly, but the actual values represent annual ones.

the main monetary policy variable and is not seasonally adjusted, as in previous studies.

To ensure comparability, we express the dependent and explanatory variables as a ratio to nominal GDP: specifically, Liquidity/GDP, GB balance (GB / GDP), and GBs held by the Bank of Korea (BOK) ($BOKGB / GDP$). By doing so, we can net out the variations coming from short-run fluctuations and the natural growth of M2 due to GDP variations over time, which might obscure the real liquidity expansion in Korea during the 2000s. After seasonally adjusting the variables, we convert them to log-scale variables to facilitate analysis. In summary, our analysis aims to explain the continuous increase in liquidity in Korea by examining the domestic monetary policy factor (r), fiscal policy factor (GB/GDP), changes in international economic conditions, and the subsequent policy responses, such as exchange rates (won/dollar), not to mention the influence of GDP.

Since this study aims to analyze whether excessive fiscal spending boosts market liquidity, we intentionally use liquidity measures that do *not* include public bonds. Otherwise, a correlation between public debt and liquidity arises automatically with the inclusion of public bonds. For this reason, we limit our liquidity measures to $M2$ and Lf , which will be used as a dependent variable in later analysis. We also consider using a more broadly defined measure of liquidity as the dependent variable. $M2$ is a broadly defined measure of money relative to a narrowly defined measure of money ($M1$). Liquidity aggregates of financial institutions, denoted as Lf , encompass all monetary trusts held by banks, savings deposits of non-monetary financial institutions, financial bonds, repurchase agreement (RP or repo), certificates of deposit, commercial papers, and securities issued by financial institutions, as well as $M2$. The use of Lf has several crucial advantages for our analysis. First, it serves as an alternative measure of $M2$, which is a narrowly defined measure of liquidity. Second, the ratio $M2 / GDP$ happens to be equal to the inverse of money velocity according to the quantity theory of money, so using it in the analysis may result in a wrong perception that the variation in $M2 / GDP$ is due to the change in velocity. In short, to ensure clear interpretation, we also use Lf / GDP as the dependent variable in addition to $M2 / GDP$. Table 1 below gives the descriptive statistics of the sample used in this paper.

Liquidity measures $M2 / GDP$ and Lf / GDP are approximately 1.3 and 1.7, respectively, when normalized through division by GDP. While the policy rate has a mean of about 2.5%, the min and max values show clear downward trends in interest rate. Fiscal debt exhibits an opposite trend, with a mean of only 25% during the sample period. While bonds held by the BOK are small in size, we should consider that this variable works essentially like high-powered money. MSB is a major device for the central bank to stabilize the policy rate by performing open-market operations. The size of MSB is rather large, implying that it plays a crucial role in neutralizing fiscal debt effects.

[Table 1] Descriptive statistics

Variables	mean	std.	min.	max.
<i>M2 / GDP</i>	1.267	0.172	1.018	1.691
<i>Lf / GDP</i>	1.716	0.265	1.381	2.317
<i>r</i>	2.546	1.297	0.5	5.25
<i>GB / GDP</i>	0.246	0.076	0.067	0.401
<i>BOKGB / GDP</i>	0.009	0.002	0.003	0.014
<i>MSB / GDP</i>	0.116	0.024	0.067	0.169
<i>Log exchange rate, Ex</i>	7.013	0.083	6.822	7.248

Notes: The sample period covers Q1 2003–Q4 2021, and the number of observations is 76.

b. Time series properties

The ARDL model to be used later allows us to analyze both the short-run and long-run effects of variables in a single regression model. However, the method is applicable only when the integration orders of variables do not exceed unity. To check the stationarity of the variables, we conduct unit root tests on the level and first-difference variables before regression analysis. The results of the augmented Dickey-Fuller (ADF) and Phillips–Perron (PP) tests are presented in Table 2. Except for the log exchange rate, all level variables have unit roots, while first-differenced variables are stationary. Thus, all variables are in the integration order of I(0) or I(1), lending support to the use of the ARDL model for our analysis.

[Table 2] Unit root test results: Korea

Variables	ADF test		PP test	
	Level	Differentiated	Level	Differentiated
<i>M2 / GDP</i>	2.688	-6.738***	2.226	-6.786***
<i>r</i>	-1.203	-5.952***	-1.487	-5.909***
<i>GB / GDP</i>	-1.252	-6.366***	-1.111	-6.607***
<i>BOKGB / GDP</i>	-0.873	-8.129***	-0.996	-8.156***
<i>MSB / GDP</i>	0.309	-6.170***	-0.181	-6.165***
<i>log exchange rate, Ex</i>	-2.238	-6.490***	-2.678*	-6.482***

Notes: 1) *, **, and *** represent significance levels at 10%, 5%, and 1%, respectively.

2) The sample period covers Q1 2003–Q4 2021.

While fiscal expenditure and GB variables may exhibit distinct patterns, the GB variable is preferred for this analysis because, in the 2000s, large-scale fiscal policy was mainly implemented through GB financing instead of tax financing. It is also more suitable because this study aims to verify the relationship between fiscal

spending following GB issuance and liquidity expansion.

We also perform comparable stationarity tests on U.S. data using the same approaches to draw more general conclusions. The M2/GDP is the reciprocal of the velocity of money supply (M2); the policy rate is the Federal Funds Effective Rate; the GBs are Treasury Securities of the Federal Government; and GDP is the nominal GDP. The U.S. data come from the Federal Reserve Bank of St. Louis. Similar to the Korean data, the level variables have unit roots but are stationary in the first-difference variables. Hence, we include the U.S. data in our analysis to check the validity of our approach. Quantitative easing directly involves fiscal spending, so our framework should be able to detect the fiscal spending effect on liquidity.

[Table 3] Unit root test results: the US

Variables	ADF test		PP test	
	Level	Differentiated	Level	Differentiated
$M2 / GDP$	0.577	-9.000***	0.688	-8.992***
r	-0.874	-4.359***	-1.539	-4.389***
GB / GDP	-0.227	-9.274***	-0.205	-9.253***

Notes: 1) *, **, and *** represent significance levels at 10%, 5%, and 1%, respectively.

2) The sample period covers Q1 2003–Q4 2021.

III. Results

For the sake of exposition, we begin with presenting the stylized fact of a positive correlation between fiscal debt and liquidity by showing two-step estimation results, followed by more formal ARDL model estimation results. Further interpretation and sensitivity analysis, including SVAR, will be carried out in a later section.

1. Stylized fact: a positive correlation between fiscal debt and liquidity

Empirical results: two-step analysis. Table 4 presents the results of a two-step regression model. The first panel shows the first-step estimation results. As mentioned earlier in the data subsection, we use two measures of liquidity, Lf / GDP and $M2 / GDP$, to ensure its response with respect to fiscal policy changes. In column (1), we run the regression of the more broadly defined liquidity measure Lf / GDP on the policy rate, and in column (2), we regress M2/GDP on r in the first step. Notably, the regression results using Lf as the dependent variable closely mirror those using M2. The only difference is that the estimated coefficients using Lf are larger than those using M2 because the former is larger

in scale by definition. As we will see later in Figure 4, the trends exhibited by L_f / GDP and $M2 / GDP$ are remarkably similar to each other, so the choice of liquidity does not seem a crucial issue. The first step estimation presents that the policy rate is an essential factor that affects liquidity negatively with strong statistical significance (see the estimated coefficient of r in Table 4). To interpret the economic significance of this estimate, a 1 percentage point increase in the policy rate reduces L_f / GDP and $M2 / GDP$ by 0.17 and 0.1 percentage points, respectively. Although this is a preliminary estimate—and there are many other important factors unaccounted for—we can deduce that the monetary policy is a crucial factor in determining liquidity.

[Table 4] Two-step regression results: the positive correlation

Step 1: dep. var. = L / GDP									
	(1)	(2)		(3)		(4)			
	L_f / GDP	$M2 / GDP$		$M2 / GDP$		$M2 / GDP$			
r	-0.174*** (0.012)	-0.112*** (0.008)		-0.121*** (0.010)		-0.036*** (0.007)			
$\log EX$	---	---		-0.255* (0.148)		---			
$Const.$	2.158*** (0.036)	1.575*** (0.023)		3.364*** (1.056)		0.671*** (0.014)			
N	76	76		76		76			
$Adj.R^2$	0.720	0.720		0.727		0.258			
Step 2: dep. var = \hat{u}_t									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\frac{GB}{GDP}$	0.860*** (0.186)	0.585*** (0.119)	---	0.630*** (0.117)	---	0.1201 (0.191)	0.509*** (0.123)	---	0.330*** (0.033)
$\frac{BOKGB}{GDP}$	---	---	21.10*** (3.529)	---	22.61*** (3.417)	18.20*** (5.826)	---	19.90*** (3.522)	---
$\log EX$	---	---	---	-0.267*** (0.107)	-0.281*** (0.010)	---	---	---	---
$Const.$	-0.211*** (0.048)	-0.144*** (0.031)	-0.184*** (0.032)	1.714*** (0.745)	1.774*** (0.696)	-0.187*** (0.032)	-0.126*** (0.032)	-0.174*** (0.032)	-0.227*** (0.024)
N	76	76	76	76	76	76	76	76	76
$Adj.R^2$	0.213	0.235	0.317	0.286	0.375	0.311	0.178	0.292	0.562

Notes: 1) *, **, and *** represent significance levels at 10%, 5%, and 1%, respectively.

2) GB here is redefined as a net portion of GB after excluding the amount purchased by the BOK.

The second panel shows the results of second step estimation. Here, the residual obtained from the first step is regressed on either GB / GDP or $BOKGB / GDP$ in columns (2) and (3), respectively. Columns (4) and (5) include an additional control variable, the log exchange rate, to the specifications used in columns (2) and

(3), respectively. Column (6) includes both GB/GDP and $BOKGB/GDP$. Columns (7) and (8) are based on adding the log exchange rate in step 1, and the residual is regressed on GB/GDP and $BOKGB/GDP$, respectively. Finally, column (9) is based on the same analysis as column (1), except that U.S. data are used for sensitivity analysis.

Columns (3), (5), and (8) involve the regression of \hat{u}_t on GBs held by the BOK rather than the GB balance. To achieve a more accurate analysis of the impact of the central bank's purchase of GBs on liquidity, we focus on the GBs held by the BOK ($BOKGB/GDP$) rather than solely on the size of the bonds (GB/GDP). This approach facilitates a more suitable comprehension of how the central bank's purchase of specific GBs influences the expansion of liquidity.

A positive correlation between fiscal debt and liquidity. As anticipated, step 1 displays a negative (−) correlation between the policy rate and liquidity in all regressions (columns (1)–(4) in the upper panel). In particular, high statistical significance reassures the modern monetary policy based on the policy rate. In step 2, both GB/GDP and $BOKGB/GDP$ appear to increase liquidity, while the fiscal variable $BOKGB/GDP$ has a much stronger impact on liquidity buttressed by a high adjusted R-squared (columns (1)–(9) in the lower panel). These findings reveal the existence of the channel through which excessive fiscal spending leads to liquidity. A notable finding is that the BOK's GB holding ($BOKGB/GDP$) indicates the supply of high-powered money to the economy, boosting liquidity with an expectedly large impact and strong statistical significance (see the estimated coefficient of the bond measure in Table 4). This effect is similar in Korea and the US.

By contrast, the impact of GB/GDP on liquidity is substantial but much lower than that of BOK/GDP , as shown in the lower panel. This outcome is consistent with our intuition that the net increase in high-powered money associated with fiscal debt occurs only when the BOK takes over public bonds ($BOKGB/GDP$). Since most of the fiscal debt has been financed by the bonds market fund, not the central bank, the resulting market liquidity increase is moderated. For instance, a 1 percentage point increase in the debt-to-GDP ratio raises Lf/GDP and $M2/GDP$ by 0.86 and 0.59 percentage points, respectively, indicating a large fiscal policy effect on liquidity. Note as well that the GB/GDP effect includes the effect of $BOKGB/GDP$ because $BOKGB$ is part of the GB.

Column (6) simultaneously regresses the residual on both GB/GDP and $BOKGB/GDP$ in step 2 to determine which variable directly influences liquidity. Note that GB here should be limited to the portion of public bonds purchased only by the private sector, excluding the BOK. As expected, the estimated coefficient of GB/GDP becomes negligible and insignificant, while that of $BOKGB/GDP$ is sizable and statistically significant. It may capture a weak endogenous response of

the private sector to acquire liquidity that has been tightened due to public debt through, for instance, liquifying public bonds to some extent to fight shortages in liquidity. Furthermore, the adjusted R-squared increases, further implying that while both fiscal measures may matter, the role of the BOK as a bondholder is more pivotal than the stock of GBs per se in boosting liquidity.

As column (3) in the lower panel of Table 4 shows, the BOK partly financed public debt, which boosted liquidity as expected. Contrary to this result, the net estimated effect of GB/GDP in column (6) lessens and becomes statistically insignificant when simultaneously controlling for $BOKGB/GDP$. This effect suggests that as long as $BOKGB/GDP$ is used to control for (implicit) fiscal monetization, public debt will involve liquidity transfers from one party to another without any change in the total liquidity available. The estimated coefficient value from the data shows that rising fiscal debt affects the economy through the central bank partially raising the money supply, leading to greater liquidity.

U.S. results. Column (9) in the lower panel shows the empirical results obtained from U.S. data, which are largely similar to the results based on model (2), which uses Korean data. This finding is sensible because the US has implemented outright quantitative easing since the 2008 financial crisis, with a substantial portion of it executed through fiscal programs. By contrast, Korea did not implement fiscal projects through explicit quantitative easing even during the COVID-19 crisis, though we cannot exclude the possibility of tacitly or passively raising liquidity. Interestingly, similar results are obtained despite the absence of quantitative easing. This suggests that liquidity has continued to increase in the low-interest rate environment since the 2000s and that fiscal monetization implicitly occurred in Korea when massive fiscal deficits accumulated over time.

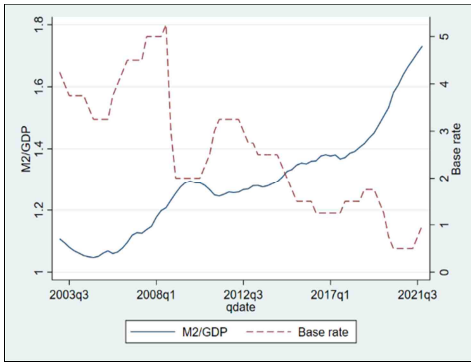
From the analysis and graphs, it appears that both low interest rates and increases in GBs contribute to liquidity expansion. Figure 3 displays the negative relationship between $M2/GDP$ and the target policy rate, which is almost identical to the relationship between Lf/GDP and the target rate shown in Figure 4. Meanwhile, Figures 5 and 6 present the residual in the first step versus the GB/GDP and BOK/GDP (GBs held by the BOK), respectively. Note that while interest rates are a significant predictor of liquidity flows in the 2000s, the GB market and the BOK's holdings can also exert a considerable influence on liquidity.

Exchange rate. The estimated coefficient of the exchange rate shows a negative effect of the exchange rate on liquidity, which is consistent with our expectations. Suppose the exchange rate appreciates. Domestic currency appreciation usually involves a trade surplus and a subsequent inflow of foreign capital. Part of the capital inflow eventually leads to an increase in the domestic money supply.¹⁴

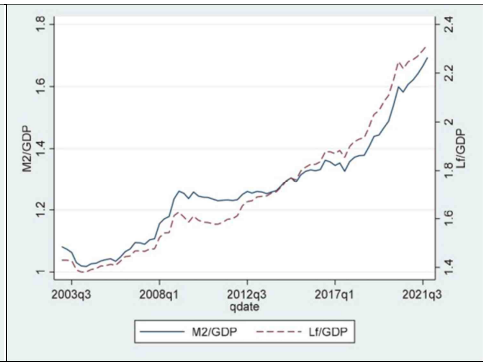
¹⁴ Some of the capital inflow will appear in the national foreign reserves account, and others will be

Placing the log exchange rate in either specification (1) or (2) does not matter as no change occurs in the estimated coefficient of the log exchange rate regardless of specification. Furthermore, the exchange rate has fluctuated substantially, but there is no clear trend over time during the sample period. This fact leads us to consider the implications of fiscal and monetary policies on liquidity more carefully, given their time trends over time.

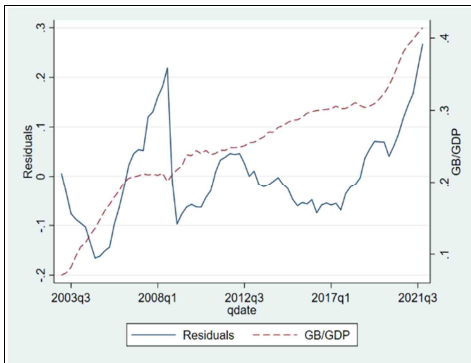
[Figure 3] $M2/GDP$ vs. policy rate



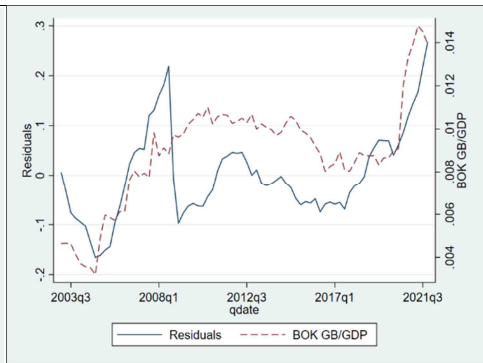
[Figure 4] $M2/GDP$ vs. Lf/GDP



[Figure 5] Residual vs. GB/GDP



[Figure 6] Residual vs. $BOKGB/GDP$



Sources: Bank of Korea.

Specifically, exchange rates can be a by self-fulfilling transactions, fluctuations in the exchange rates of trading partners, changes in the expectations of market participants in response to the arrival of news, and changes in the foreign exchange positions of banks. These complex relationships cannot be explained due to the limitations of the reduced-form model. Nevertheless, we know the international factor is one of those affecting liquidity. Controlling for an exchange rate variable also increases the explanatory power (adjusted R-squared) of the model. These

registered as international portfolio investments going out to the foreign sector.

results show that liquidity expansion is not fully explained by low policy rates alone but is a result of (i) an expansionary fiscal policy based on bond financing and (ii) external economic variables represented by the exchange rate.

Using more control variables. We also try to control for additional information that measures external institutional features of financial market freedom, since these factors affect our dependent variable of liquidity through the institutional background, but not the other way around. The Fraser index is a composite measure encompassing five individual aspects of financial side freedom. In Appendix Table A2, we present the overall Fraser index along with its subcategories, such as legal system and government size, and the definition of variables.¹⁵ We perform alternative regressions using the financial market freedom index, namely, the Fraser index. Interestingly, we still obtain similar empirical results. As shown in Table 5 below, the empirical results change little, with similar estimates across specifications. We find that the results are largely robust with the following details.

First, when using the composite measure of the Fraser index, we still obtain a relatively similar fiscal expenditure impact as seen in column (2). The estimated impact on our liquidity measure becomes slightly negative mainly because, among the five areas, the majority imply that as the areas improve, market liquidity falls rather than increases. Second, when using the individual measure of the Fraser index rather than the composite counterpart, we still obtain roughly the same fiscal expenditure impact (columns (3)–(7)). The estimated impact of the respective individual areas of financial market freedom on our liquidity measure varies from negative to positive, but their signs are often intuitive. Third, while controlling for all individual factors simultaneously may cause multicollinearity issues, we still obtain the robustness of our main result, as shown in column (8).

Instrumental variable estimation. To deal with possible endogeneity issues arising from omitted variable bias, we consider an IV estimation using the political stance of a government at a point in time as an instrument. More progressive (liberal or left-wing) stances lead to a greater government size and a rapid growth of public expenditures. We construct a dummy variable $D_{pro}=1$ if a government takes a progressive stance, and 0 otherwise. To implement this estimation, we perform the first difference on all variables to define fiscal spending effort measured at each point in time and then use the instrument D_{pro} for dGB/GDP , such that our IV estimation unravels the true fiscal effect on liquidity in an economically proper manner.

¹⁵ We originally thought about including a financial development index and/or bonds market development index. However, they are close to the dependent variable in nature, which is essentially adding an endogeneity issue by construction.

[Table 5] Step 2 results with the economic freedom (Fraser) index controlled for

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Step 2: dep. var. = \hat{u}_t							
<i>GB</i>	0.630***	0.844***	0.569***	0.611***	1.280***	0.639***	1.329***	1.962***
<i>GDP</i>	(0.117)	(0.116)	(0.160)	(0.118)	(0.167)	(0.114)	(0.145)	(0.217)
<i>log Ex</i>	-0.266**	-0.475***	-0.287**	-0.211*	-0.560***	-0.254**	-0.421***	-0.588***
	(0.107)	(0.108)	(0.113)	(0.117)	(0.111)	(0.104)	(0.0897)	(0.115)
<i>FEI</i>		-0.312***						
		(0.0733)						
<i>Area 1</i>			-0.0216					0.0781**
			(0.0386)					(0.0357)
<i>Area 2</i>				0.0935				-0.219**
				(0.0822)				(0.0853)
<i>Area 3</i>					-0.245***			-0.0563
					(0.0499)			(0.0673)
<i>Area 4</i>						-0.0990**		-0.0396
						(0.0469)		(0.0395)
<i>Area 5</i>							-0.213***	-0.279***
							(0.0338)	(0.0581)
<i>const.</i>	1.714**	5.503***	2.023**	0.697	5.954***	2.386***	4.158***	7.422***
	(0.745)	(1.116)	(0.930)	(1.162)	(1.081)	(0.794)	(0.716)	(1.471)
<i>N</i>	76	76	76	76	76	76	76	76
<i>Adj.R²</i>	0.286	0.421	0.279	0.289	0.457	0.318	0.534	0.609

Notes: 1) *, **, and *** represent significance levels at 10%, 5%, and 1%, respectively.

2) The Fraser Economic Freedom Index measures the degree to which the policies and institutions of countries are supportive of economic freedom. The index is divided into five areas: (1) Size of Government, (2) Legal System and Property Rights Protection, (3) Sound Money, (4) Freedom to Trade Internationally, and (5) Regulation. For each area, higher values indicate greater levels of freedom.

As shown in Table 6, the first-difference estimates, including IV results, are largely consistent with those in earlier tables.¹⁶ They also stay roughly constant and are higher with statistical significance even after controlling for additional variables, such as the Fraser economic freedom indices. Again, these results lend support to our theoretical background regarding the external nature of our fiscal variable given in the earlier subsection. The overall results combined suggest that our earlier correlation estimates can be interpreted as a causal effect. Additional results will be presented later as robustness checks.

¹⁶ We also consider the possibility of omitted third factors affecting both liquidity and fiscal spending. By first-differencing combined with using the instrument D^{pro} , we can obtain an unbiased estimate of fiscal spending effect under the assumption that political (ideological) factors that are correlated with excessive fiscal activities are uncorrelated with omitted third (long-run) factors that affect liquidity growth.

[Table 6] Results of instrumental variable estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Step 2: dep. var. = $\Delta \hat{u}_t$							
$\Delta \frac{GB}{GDP}$	3.939* (2.309)	3.953* (2.306)	4.084* (2.216)	4.236 (2.578)	5.690** (2.847)	5.082* (2.994)	3.926* (2.209)	6.408** (3.044)
$\Delta \log Ex$	-0.307*** (0.114)	-0.313*** (0.120)	-0.312*** (0.108)	-0.325*** (0.115)	-0.378*** (0.114)	-0.273** (0.127)	-0.403*** (0.108)	-0.469*** (0.110)
$\Delta_4 FEI$		-0.00887 (0.0506)						
$\Delta_4 Area 1$			0.0746*** (0.0272)					0.0980*** (0.0316)
$\Delta_4 Area 2$				-0.0286 (0.0529)				-0.0592 (0.0578)
$\Delta_4 Area 3$					-0.0960** (0.0389)			-0.0358 (0.0357)
$\Delta_4 Area 4$						0.0549 (0.0390)		0.0495 (0.0382)
$\Delta_4 Area 5$							-0.0612** (0.0275)	-0.0776* (0.0413)
<i>const.</i>	-0.0143 (0.0111)	-0.0143 (0.0111)	-0.0110 (0.0101)	-0.0153 (0.0120)	-0.0169 (0.0121)	-0.0185 (0.0135)	-0.0107 (0.01000)	-0.0123 (0.0112)
<i>N</i>	75	75	75	75	75	75	75	75
<i>Adj.R</i> ²	.	.	0.0346	.	.	.	0.0163	0.00192

Notes: 1) *, **, and *** represent significance levels at 10%, 5%, and 1%, respectively.

2) The Fraser Economic Freedom Index (FEI) measures the degree to which the policies and institutions of countries are supportive of economic freedom. The index is divided into five areas: (1) Size of Government, (2) Legal System and Property Rights Protection, (3) Sound Money, (4) Freedom to Trade Internationally, and (5) Regulation. For each area, higher values indicate greater levels of freedom.

3) $\Delta (\Delta_4)$ represents the change relative to the variable from one (four) quarter(s) ago.

2. Results from the ARDL model analysis

Table 7 below presents the results from estimating the ARDL model given in the previous empirical approach section. Column (1) shows the results using Lf as a dependent variable, while others use M2 as a dependent variable. Moreover, columns (1) and (2) are based on data from Korea, while (3) and (4) are based on U.S. data. The upper panel, denoted as ARDL, gives the long-run estimation results, while the bottom panel, denoted as ARDL ECM, estimates the short-run error correction terms of the ARDL model.

Long-run and short-run findings. Table 7 presents the results from estimating the ARDL and ARDL ECM models. Lf / GDP and $M2 / GDP$ are the dependent variables, and GB / GDP and r are the explanatory variables. The optimal lag length is chosen according to the SIC. In the ARDL ECM, ADJ denotes the speed of adjustment, $\phi \equiv -(1 - \alpha)$; LR indicates long-run coefficients, $\sum_{i=0}^{q-1} \frac{\beta_{ji}}{\phi}$; and SR is the short-run coefficients of first-difference variables. Columns (1) and (2) present the results using data from the first quarter of 2003 to the fourth quarter of 2021 in Korea, and column (3) presents the results from U.S. data during the same sample period. Column (4) presents the results from a much longer period: the first quarter of 1960 to the fourth quarter of 2021 in the U.S. The upper panel (ARDL) gives the relationships of level variables, while the lower panel (ARDL ECM) gives the relationships of differenced variables for short-run dynamics.

[Table 7] Results from ARDL and ARDL ECM

dep. var. = $L / GDP(t)$				
ARDL				
	Korea		U.S.: $M2 / GDP$	
	(1) Lf / GDP	(2) $M2 / GDP$	(3) short	(4) long period
Optimal Lag	(1,3,1)	(1,3,1)	(1,3,1)	(1,3,1)
$M2 / GDP(t-2)^a$	0.977*** (0.025)	0.951*** (0.031)	1.006*** (0.029)	1.012*** (0.007)
$GB / GDP(t)$	3.777*** (0.477)	3.117*** (0.348)	0.654*** (0.029)	0.617*** (0.023)
$GB / GDP(t-1)$	-4.642*** (0.716)	-3.448*** (0.543)	-0.618*** (0.042)	-0.640*** (0.032)
$GB / GDP(t-2)$	0.070 (0.717)	-0.068*** (0.541)	-0.042 (0.037)	-0.047 (0.031)
$GB / GDP(t-3)$	1.131*** (0.435)	0.602** (0.320)	0.026 (0.028)	0.070*** (0.023)
$r(t)$	-0.011* (0.005)	-0.010** (0.005)	-0.001 (0.002)	-0.0005 (0.0004)
$r(t-1)$	0.021*** (0.005)	0.018*** (0.004)	0.003 (0.002)	0.0003 (0.0004)
cons.	-0.062*** (0.029)	-0.044 (0.029)	-0.021 (0.009)	-0.007* (0.004)
ARDL ECM				
ADJ				
$M2 / GDP$	-0.023 (0.025)	-0.049 (0.031)	0.006 (0.029)	0.013* (0.007)
LR				
GB / GDP	14.467 (12.313)	6.855** (3.149)	-3.457 (19.48)	-0.027 (0.285)
r	0.402 (0.478)	0.177 (0.132)	-0.332 (1.663)	0.013 (0.014)

SR				
$\Delta GB / GDP(t-1)^b$	3.777*** (0.477)	3.117*** (0.348)	0.654*** (0.029)	0.617*** (0.023)
$\Delta GB / GDP(t-2)$	-1.201*** (0.451)	-0.670* (0.337)	0.016 (0.028)	-0.023 (0.023)
$\Delta GB / GDP(t-3)$	-1.131** (0.435)	-0.602* (0.328)	-0.026 (0.028)	-0.070*** (0.023)
$\Delta r(t-1)$	-0.011** (0.005)	-0.010** (0.004)	-0.001 (0.002)	-0.0005 (0.0004)
cons.	---	-0.044* (0.029)	-0.021 (0.009)	-0.007* (0.004)
# of obs.	73	73	75	238

Notes: 1) *, **, and *** represent significance levels at 10%, 5%, and 1%, respectively.

2) The lags for the US are taken at the same value as those for Korea for the sake of comparison.

3) For the U.S. sample, short = the same time period as Korea, and long = the entire (longer) time period.

^a: The sum of coefficients of $M2 / GDP(t-1)$ and $M2 / GDP(t-2)$ is close to unity, which means the impact is permanent.

^b: The sum of $\Delta GB / GDP(t-1)$, $\Delta GB / GDP(t-2)$, and $\Delta GB / GDP(t-3)$ exceeds unity. This implies that government bonds boost liquidity more than the size of an increase in bonds issued.

Some remarks are in order. First, from the ARDL model results in the first panel, our liquidity measure is highly persistent because the estimated coefficient of serial correlation $\hat{\alpha}$ is close to unity. As $\hat{\alpha} \approx 1$, most ARDL long-run estimates turn out insignificant with large standard errors. Thus, we make inferences using the ECM results. Second, looking at the error-correction model results, we find that short-run changes in fiscal debt $\Delta GB / GDP$ have statistically significant impacts on $M2 / GDP$ for both Korea and the US. The sum of GB balance coefficients, including lag terms, exceeds unity in column (2) (see the coefficients of $\Delta GB / GDP(t)$ and the lagged terms). This result indicates that when the government issues partly monetized bonds for fiscal spending, the liquidity pumped into the economy becomes substantially greater than the amount of bonds issued. Third, the ARDL ECM estimation results show that the estimate of the adjustment coefficient is close to 0 (see the coefficient of $M2 / GDP$ under ADJ in the second panel for ARDL ECM). This implies that an increase in short-run liquidity is likely to persist in the economy. As shown in column (1), this effect also emerges when Lf is used as the dependent variable. The estimated effect is more pronounced compared to that using M2.

Using the empirical results, we can examine which factor is more influential than the other in determining liquidity. First, we can find the role of fiscal debt. GBs increase liquidity by about 1.85 times their size. Second, the estimates suggest that most of the changes in liquidity come from fiscal policy. GB/GDP and M2/GDP

rise from 0.067 and 1.082 in the first quarter of 2003 to 0.401 and 1.691 in the first quarter of 2021, respectively. The corresponding changes between 2021 and 2003 are 0.334 and 0.609. Using the fiscal policy impact estimate of 1.845 and the over-time change in GBs of 0.334 gives a prediction that liquidity will rise by $0.334 \times 1.845 = 0.616$, which is almost equal to the 0.609 over-time change in $M2/GDP$.

Meanwhile, the change in policy rate during the sample period is approximately 3 percentage points. Evaluated with this estimate, the contribution of the monetary policy to liquidity is at most an order of 0.3 increase. While too simplistic, this simple calculation shows that fiscal debt accounts for the change in liquidity more than other factors.

Bounds test and interpretation. The test results appear to show weak cointegration relationships as a whole,¹⁷ but it is premature to conclude that no long-run relationship exists among the variables. The reason for obtaining almost no long-run relationship is that the bounds test is designed to identify the statistical significance of ϕ with $\phi = -(1-\alpha)$, where α is the coefficient for the autoregressive term of the dependent variable. Since our estimate is very close to unity, the estimate of $-(1-\alpha)$ turns out numerically close to 0 in all regressions. For this reason, the result from the ECM (the second panel in Table 7) indicates an insignificant adjustment speed, leading to the conclusion that there is no long-run relationship. However, in reality, the opposite may be true. Overall, given a specific boundary value, it seems a careful interpretation is necessary.

In our empirical model, $1-\alpha$ determines the speed of adjustment to the long-run equilibrium, and its value of $\alpha \approx 1$ means that market liquidity, once increased by short-run shocks, remains in the economy almost permanently. Note that this model aims to analyze the main policy factors that lead to the accumulation of liquidity shocks. Thus, the variables are divided by GDP to eliminate short-run fluctuations. While it is often observed that GDP and liquidity expand during economic booms—consistent with the quantity theory of money—such changes in liquidity over business cycles are usually temporary, and their effects disappear over time. However, our analysis shows the opposite: when fiscal spending expands liquidity through the central bank channel, the increased liquidity persists in the economy, unlike usual short-run effects. In addition to the findings above, the results of an Engle-Granger test further reinforce this inference. While the null hypothesis is not rejected, there is a notable correlation between the two variables, which is supported by the test statistic of -3.037, close to the critical

¹⁷ The F- and t-statistics of the bounds test are 22.847 and -1.867, respectively, in model (2). The F-statistic implies statistical significance at the 1% level, while the t-statistic shows a lack of statistical significance. The test results in model (3) are 3.857 and -0.033, respectively, where the F-test cannot judge whether a long-term relationship exists. Model (4) fails to reject the null hypotheses with test statistics of 0.367 and -0.094, respectively.

value of -3.101 at 10% significance.

Sensitivity check. In addition to the main findings, we also examine the applicability of our analytical model for the U.S. economy. If the model is appropriate, it should be able to capture the effect of fiscal debt on liquidity when applied to the U.S. economy, which has explicitly monetized fiscal spending when implementing quantitative easing in recent decades. We obtain similar results as expected. Nevertheless, as the US is a major currency-holding nation, the impact of quantitative easing on its liquidity expansion through fiscal spending might be attenuated if foreign countries purchase U.S. bonds (i.e., holding foreign exchange reserves for external risks), meaning dollars are stored outside the U.S. economy. The results in columns (3) and (4) support our view. The short-run coefficients $\Delta GB / GDP(t-i)$ with $i=1,2,3$ are lower than those of Korea, and the adjustment speed is very low. Still, short-term GBs tend to boost the stock of M2, and this increased liquidity remains in the market for a long time. As that our results are seminal, further empirical analysis seems warranted to confirm these findings and enhance the overall reliability of our study.

IV. Interpretation and Discussion of Results

Using suggestive and/or anecdotal evidence, we try to address why the central bank expanded liquidity in response to large-scale fiscal spending. Notably, debt-financed fiscal spending continues to rise with liquidity even after controlling for policy rates, considered the most influential factor affecting liquidity. This outcome cannot be explained solely by canonical public finance theories such as the Ricardian equivalence theorem¹⁸ or the neo-classical crowding-out hypothesis.¹⁹ In what follows, we consider macroeconomic perspectives beyond public finance theories and the specific socioeconomic policy and institutional characteristics of Korea.

1. Fiscal monetization

Empirical results support to some extent of fiscal monetization. Wasteful fiscal

¹⁸ According to the Ricardian equivalence theorem, households raise savings for future tax payments even if the government finances fiscal spending resources by issuing bonds. With households expecting the future government to increase taxes to repay its debt, the theorem emphasizes that it makes no difference whether the government conducts debt financing or tax financing.

¹⁹ The crowding-out effect arises when GBs are issued for fiscal spending. Private investment resources become insufficient, and interest rates rise, leading to an increase in the opportunity cost of investment, which crowds out private investment.

operations may boost liquidity more directly through cash grants to the private sector. However, it is unconventional that the channel through which fiscal deficit boosts liquidity exists in modern economies relying on an independent monetary policy authority. For instance, the issuance of GBs for large-scale fiscal spending does not mean liquidity expansion when taxes are levied first and then spent later in the form of public spending. Even if such a liquidity effect exists (e.g., due to the Keynesian effects that work through differential marginal propensity to consume among agents), short-run policies alone are insufficient to account for the long-run positive association. Liquidity cannot expand substantially without the intervention of the central bank and the subsequent reactions from financial markets.²⁰ In most advanced countries, the central banks are strictly and/or legally prohibited from directly purchasing GBs, except for special situations such as during World War II. Nevertheless, while direct debt monetization is unlikely or limited, large fiscal debt is partly monetized indirectly in Korea, which potentially has a substantial impact on market liquidity.

Fiscal debt and price level. Our empirical results can be understood in the context of the FTPL. FTPL is based on the identity that real public debt depends on future net surplus stream in terms of expected present value.

$$\frac{(1 + \rho Q_t)GB_{t-1}}{P_t} = E_t \sum_{k=0}^{\infty} R_{t,t+k} (\tau_{t+k} Y_{t+k} - G_{t+k} - Z_{t+k}) \quad (6)$$

where ρ = parameter related to bond maturity, Q_t = price of nominal bond, GB_t = nominal public bond issued, P_t = price of final goods, Y_t = output, G_t = government spending, Z_t = lump-sum transfer, τ_t = sales tax rate, and R_t = discount factor. Unlike in the original version of FTPL, the price level has been stable over the sample period, while public debt has risen fast.²¹ To account for this fact in Eq. (6), we can say that agents have expectations that the future net surplus stream is possible given the belief that $g > r$.

²⁰ We use the equation $M2 = m \cdot B$, where B , is the base currency and m is the $M2$ multiplier. As long as m is a structural parameter for an economy, an increase in $M2$ should be regarded as an increase in B .

²¹ Since the debt level of Korea was low and inflation was stable in the 2000s, it is difficult to justify that the central bank intentionally created fiscal inflation. With the debt of the central and local governments summed together, the ratio of national debt (D1) to GDP was about 10% in the early 2000s and about 50% in 2022 after the massive fiscal deficits in prior years. The national debt (D2), including undetermined liabilities such as pension provision liabilities for the payment of the government employee pensions and military pensions, amounted to twice that of D1 as of 2021. In addition, when implicit liabilities in pension finances (e.g., National Pension Service) are considered, the national debt becomes considerably larger.

2. Mechanism behind fiscal monetization

The following subsection discusses the mechanism behind fiscal monetization. Liquidity rises only through the intervention of the central bank. It does so only when the central bank either purchases domestic bonds (e.g., GBs) or reduces the effort to contain liquidity expansion using possible policy tools while implementing an independent monetary policy.

Stabilization purpose. A leading hypothesis of this research is that the central bank expanded liquidity to counteract the possible short-run fluctuations triggered by fiscal spending in the following context. A massive supply of GBs, especially in recent decades, can lead to upward pressure on market interest rates, creating negative shocks to financial markets.²² Considering the intention of the central bank to stabilize the financial market and, hence, the macroeconomy, such pressures cannot be left unattended. This motivates the monetary authority to suppress the upward interest pressure to preserve the target policy rate (Figure 2). The larger the divergence between the actual market rate and the policy rate, the more liquidity the central bank should provide to maintain the target policy rate at a specified level. In this case, liquidity expands *passively* without the central bank intending to create inflation.

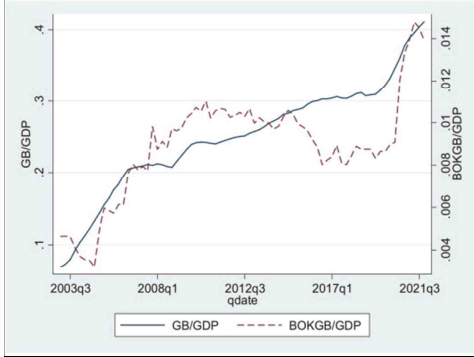
Looked at differently, a rise in interest rate driven by bond issuance can crowd out domestic consumption and investment. To prevent this crowding-out effect of shrinking investment in the private sector, the central bank has no choice but to supply more liquidity, which is often covered through the media. These factors are tacitly acknowledged at the level of practitioners but do not attract attention in the context of fiscal monetization. Central banks are the lender of last resort for the economy. This institutional background suggests that indirect debt monetization can explain the increase in liquidity due to the central bank's distinctive role of stabilizing the economy with an independent monetary policy. This explanation is also supported by an Engle-Granger test result that GB/GDP causes BOK/GDP at a 1% significance level.

Lastly, we admit that this view is based inflation not taking place with the ensuing money supply during the sample period. If excessive fiscal spending accompanies inflation, then the target policy rate must be adjusted upward, which usually tightens the money supply. Hence, the effectiveness of the mechanism mentioned above depends critically on maintaining a stable price level despite fiscal spending. In fact, inflation has only recently begun to affect economies where

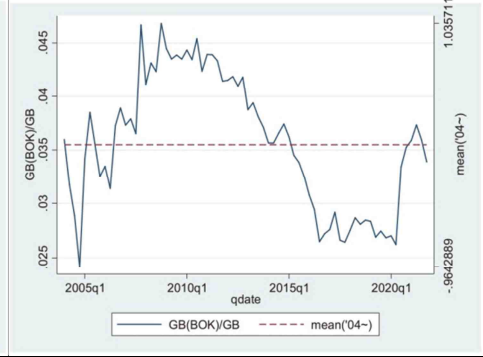
²² An episode may involve a public enterprise issuing a large volume of bonds. For example, when Korea Electricity Power Corporation did so in 2023, the capital market experienced an increase in bond yield rates.

significant quantitative easing occurred.

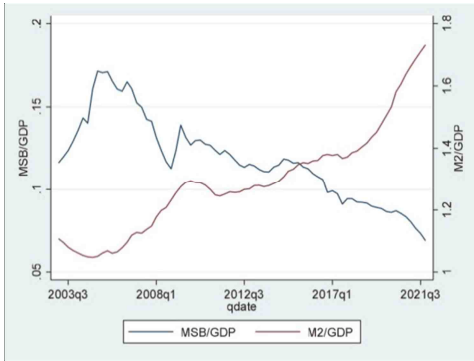
[Figure 7] Government bond balance vs. government bonds held by the BOK



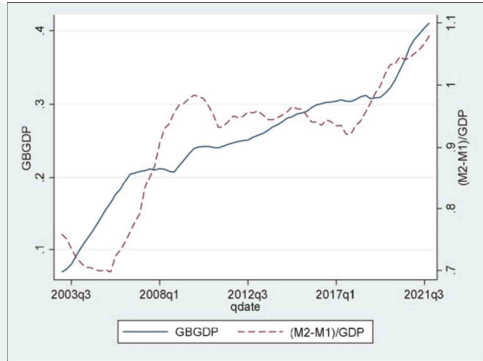
[Figure 8] Government bonds held by the BOK relative to government bond balance



[Figure 9] Monetary stabilization bonds vs. M2/GDP



[Figure 10] M2 - M1 vs. government bond balance



Money multiplier and liquidity. Figures 7 and 8 illustrate that the BOK consistently purchased around 3.5% of the GBs issued during the 2000s. Given that the monetary base multiplier for $M2$ is, on average, at a magnitude of 15–20 during the 2000s, its direct impact on liquidity is substantial. Based on a simple calculation, about 42.5%–70.0% of the net increase in GBs resulted in an increase in $M2$ through the BOK’s purchases of GBs.²³ In comparison with our previous ARDL estimate that GB issuance leads to an almost comparable increase in liquidity, the rough calculation given above seems smaller. However, the overall results are consistent with our main conclusion that fiscal debt is a main factor. This

²³ The ratio of $M2$ to GDP is approximately 1.7 as of 2021. The ARDL analysis shows that GB issuance directly leads to an increase in liquidity on a one-to-one basis, supporting the validity of this simple result.

explanation is also supported by an Engle-Granger test result that GB/GDP causes MSB/GDP at a 1% significance level.

Additional factors: monetary stabilization bond and liquidity. Liquidity also expands when the central bank reduces its effort to absorb market liquidity by issuing central bank bonds. Based on the ARDL ECM results, the estimated coefficient suggests that 1.85 times the GB issuance amount should be converted to $M2$. However, the multiplier calculation indicates that only 42.5%–70.0% of the amount is actually converted to $M2$. The remaining gap can be attributed to the decline in MSB issuance. As shown in Figure 9, the ratio of MSB issuance divided by GDP (MSB/GDP) has decreased since the mid-2000s.²⁴ This indicates that the central bank may have reduced the size of MSB issuance or more actively bought back the existing stock of MSBs, creating a surplus of liquidity in the market. After conducting the Engle-Granger test for MSB causing $M2$, we obtain a test statistic of -2.703 , which falls slightly short of the critical value of -3.101 required to reject the null hypothesis at the 10% significance level. However, note that the test statistic value is close to the critical value, suggesting a relationship between the two variables. Considering the test statistic of -0.679 obtained from the Engle-Granger test for r causing $M2$, it can be interpreted that MSB has a more substantial explanatory power for $M2$. These test results suggest that an alternative method of releasing liquidity may have been employed. We will empirically explore this finding in a later sensitivity analysis.

Liquidity expansion through the financial sector. $M2$ may increase under high public debt because commercial banks expand their balance sheet using GBs as collateral or high-quality assets required to comply with macroprudential regulations. Higher asset holding allows banks to raise liability by taking more deposits and supplying more loans. This could happen without the monetary authority increasing market liquidity.

To express the notion of liquidity that is created through borrowing and lending in the financial sector, we define the notional gap of $M2 - M1$. $M1$ includes cash and current deposits that arise from the liquidity expansion through (i) the monetary authority's purchase of public bonds (Figure 8) and (ii) the indirect money supply for stabilizing the target rate in the face of massive fiscal deficits. As a result, this gap $M2 - M1$ can capture the idea of leveraging-based liquidity expansion.²⁵ In the context of our study, excessive fiscal transfers (new public bonds)

²⁴ MSBs have maturities ranging from 14 days to 2 years, and their issuance size fluctuates yearly. However, our use of MSB does not account for this heterogeneity in maturity, which is a limitation in our analysis.

²⁵ The $M1$ part of market liquidity can be said to be contained at the individual level of transactions only.

received by individuals become part of the narrowly defined money $M1$ right away, while financial institutions can create new financial assets through successive lending based on public bonds, partially accounting for the gap $M2 - M1$. Figure 10 shows a clear trend of co-movement of the new measure of leveraging-based liquidity ($M2 - M1$) and the GBs issued, with a resulting correlation coefficient of 0.87 between GB / GDP and $(M2 - M1) / GDP$ with a standard error of 0.03.²⁶

We now consider how much of this liquidity expansion is due to (i) the original money supply of the monetary authority relative to (ii) the aforementioned balance sheet effect of the private financial sector owing to holding public bonds. First, given the nature of public bondholders (e.g., social security funds and insurance companies), these agents tend to hold public bonds for long-term portfolio management purposes; the magnitude of public bonds used as collateral would be relatively small in nature. Second, we look at the short-term RP markets data to see how much public bonds are used as collateral and rise rapidly over time.²⁷

According to our data (Table A3 in the appendix), the volume of the money (repurchases) market in which financial agents deal with public bonds is approximately 130 trillion won. This amount constitutes only a small fraction (3.3%) of $M2$, as we expected from the long-term characteristics of public bondholders. While these funds are traded at repo markets with a short-time repurchase condition, they are basically rolled over indefinitely, amplifying $M2$ through the usual credit creation channel. With the repo share rising over time, our calculation shows that leveraging through the RP markets accounts for about 70% of the gap $M2 - M1$.²⁸ Third, the liquidity provision through RP markets is not entirely through the leveraging of the private sector. Occasionally, the monetary authority directly intervenes in the RP markets through RP purchases (thereby supplying liquidity), but this behavior is limited only to exceptional events, such as COVID-19 and other equivalent urgent situations. Given the negligible fraction of the BOK's recent RP purchases, direct liquidity provision by the monetary authority seems inconsequential compared to the leveraging-based liquidity provision of the private sector in the RP market.²⁹ Roughly speaking, leveraging by the private sector

²⁶ The value in parentheses is a bootstrapped standard error with 10,000 replications. For each trial, 38 samples out of the total 76 samples were extracted.

²⁷ Some regulations apply to this type of leveraging. (i) The leveraging has been made possible since 2016 to facilitate asset management businesses from the policy perspective of financial market development. (ii) Since 2021, 20% of leveraged credits should be held in the form of cash equivalents like the usual reserve ratio applied to banks. As expected, the volume of this RP market tends to fluctuate significantly in business-cycle frequencies, especially rising when short-run financial shocks (e.g., the so-called real estate project financing) arise.

²⁸ The gap $M2 - M1$ is 1.4 times the GDP, which is roughly close to 2,860 trillion won. Given that the estimated size of 50% of $M2$ is 2,000 trillion won, the leveraging through the RP markets takes up approximately 70% of the gap, as shown in the bottom right column of Table A3.

²⁹ The RP purchase of the BOK in May 2024 amounted to 2.5 trillion won, which is less than 2% of

accounts for most of the gap $M2-M1$, while direct liquidity provision by the monetary authority to stabilize the target rate does part of $M1$.

3. Other hypotheses

This subsection reviews other hypotheses that may explain why a central bank eventually monetizes fiscal spending. Liquidity rises when the central bank either purchases domestic bonds (e.g., GBs) or reduces its effort to contain liquidity expansion using possible policy tools while implementing an independent monetary policy.

a. Quantitative easing and expansionary fiscal policy

The most commonly suggested alternative hypothesis is that a hyper-expansionary monetary policy, such as quantitative easing, combined with an expansionary debt-financed fiscal policy, has led to liquidity expansion. While the central bank operates independently of fiscal policy, both policies are often pursued during an economic downturn as a policy combination, and this is likely to happen in reality. However, this hypothesis is rejected because quantitative easing is inconsistent with Korea's macroeconomic facts. While quantitative easing may have been implemented in the short run during economic crises, it is questionable or difficult to believe that it was continuously employed throughout the 2000s to increase liquidity. Such quantitative easing occurred only during the financial and COVID-19 pandemic crises of Western economies in the 2000s.

b. Low interest rates: monetary policy

Another possible hypothesis is that the persistently low and downward policy rates in the 2000s contributed to liquidity expansion. However, the increase in $M2/GDP$ shown in Figure 3 cannot be solely attributed to an expansionary monetary policy. Liquidity expanded substantially during sustained low interest rates from 2017 to 2021 and from 2005 to 2007 when interest rates actually rose. Moreover, policy rates since 2008 have gone down in trend, but the speed of liquidity expansion after the interest rate cut between 2008 and 2017 was moderate, while liquidity expansion after 2018 was particularly remarkable.

Looking at monetary policy only to understand the overall rising liquidity trend seems incomplete. An examination of causal factors rather than reporting just a

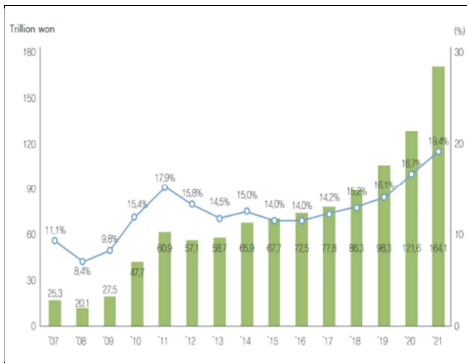
the daily average RP balance. Therefore, the gap $M2-M1$ would be smaller without the direct intervention of the monetary authority into the RP markets, possibly leading to our underestimation of leveraging through the RP markets.

simple correlation between expansionary fiscal and monetary policy stances is warranted to understand the positive correlation between fiscal debt and liquidity, which is the main topic of this study. Overall results reveal that the intervention of the central bank through the bond market seems to cause liquidity expansion.

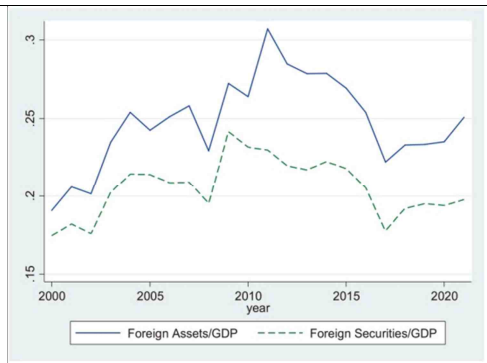
c. Foreign ownership of government bonds

While this study does not explicitly examine who owns public bonds, it is plausible that the surge in domestic liquidity may have been partially influenced by foreign ownership of GBs. According to Figure 12, foreign entities have held around 15%–20% of GBs since 2007, and the level and percentage have risen over time, particularly during the COVID-19 crisis. The inflow of foreign capital into domestic GB markets may have contributed to liquidity expansion. This effect is similar to what happens to a trade surplus, through which domestic liquidity usually expands. An increase in the supply of foreign currency in the domestic market can create pressure for the domestic currency to appreciate. To maintain exchange rate stability, the central bank may implement a smoothing operation to counteract this pressure, often called “leaning against the wind policy.” Alternatively, it may aim to maintain export competitiveness by purchasing foreign currencies to depreciate the domestic currency.

[Figure 11] Balance (histogram) and proportion (line) of government bonds held by foreigners



[Figure 12] Foreign securities and assets held by BOK



Sources: 1) Korea Treasury Bond, Ministry of Economy and Finance, 2021 (left).
2) Bank of Korea (right).

Note: A trillion won is roughly equal to a billion dollars at $e = 1,000$ (won/\$).

Assessing the extent to which central bank intervention in the foreign exchange market increases liquidity is a complex task. This is because the central bank issues MSBs to absorb the resulting increased liquidity, and the liquidity expansion size

depends on the extent of the smoothing operation.³⁰ However, the BOK's holdings of foreign assets and foreign holdings of domestic GBs since 2010 have shown a similar pattern with some differences in level. Over the last decade, foreign holdings of GBs increased by 80 trillion won (~80 billion U.S. dollars) and the proportion grew, while foreign assets held by the BOK rebounded but did not reach the former peak level (Figures 11 and 12). Overall, we can say that net foreign ownership of public bonds may put upward pressure on liquidity.

V. Sensitivity Analysis

1. Using Monetary Stabilization Bonds

As a further sensitivity analysis, we examine whether our results still hold when considering an additional policy variable, the MSB issuance, in the earlier (intuitive) two-step regression analysis. Suppose the government issues bonds to finance fiscal spending. If the central bank purchases some of these bonds directly, then liquidity definitely expands. A similar result still holds when the central bank takes other methods, such as reducing the issuance of MSB so that market liquidity rises. Therefore, as a sensitivity analysis, we additionally control for the size of MSB issuance in the second step to check whether (i) a negative relationship between MSB and M2 holds as expected and (ii) the relationship between M2 and public bonds still stands out firmly as in the previous benchmark analysis.

As a rough sketch of the story, Figure 9 shows the reverse relationship between MSB/GDP and $M2/GDP$ during the sample period, and Table 8 shows the empirical results. The first-step estimation is identical to the previous one in Table 4. Table 8 presents the second-stage results only. Columns (1) and (2) are identical to the previous analysis. Column (3) presents the new result of regression on the issuance of MSB/GDP instead of GB/GDP . In column (4), we control for both GB/GDP and MSB/GDP . Column (5) controls for both GB/GDP and $BOKGB/GDP$ to separate the bond purchases of the central bank from the fiscal side effects. In this regression, we redefine GB by confining GBs to the non-central bank part. Column (6) controls for all three terms, GB/GDP , BOK/GDP , and MSB/GDP , simultaneously to investigate which factors are more influential. Including both BOK/GDP and MSB/GDP allows for the possibility that the BOK supplies liquidity either through GB purchases or through reducing the size of MSB stock/issuance, respectively. Lastly, in column (7), the log exchange rate is additionally controlled for.

³⁰ Statistics from the BOK likewise show that the trade surplus boosts liquidity in Korea.

[Table 8] Results of sensitivity analysis (dep. var. = \hat{u}_t)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>GB / GDP</i>	0.585*** (0.119)	---	---	0.335* (0.187)	0.120 (0.191)	-0.191 (0.239)	-0.673*** (0.211)
<i>BOKGB / GDP</i>	---	21.104*** (3.529)	---		18.20*** (5.826)	18.86*** (5.705)	22.05*** (4.697)
<i>MSB / GDP</i>	---	---	-1.829*** (0.375)	-1.011* (0.588)		-1.155** (0.554)	-3.152*** (0.561)
<i>log Ex</i>	---	---	---				-0.628*** (0.104)
<i>const.</i>	-0.144*** (0.031)	-0.184*** (0.032)	0.212*** (0.044)	0.035 (0.108)	-0.187*** (0.032)	0.015 (0.102)	4.739*** (0.786)
<i>N</i>	76	76	76	76	76	76	76
<i>Adj. R²</i>	0.235	0.317	0.233	0.255	0.311	0.341	0.559

Notes: 1) *, **, and *** represent 10%, 5%, and 1% significance levels, respectively.

2) Only the second-step estimation results are presented.

Estimation results from the sensitivity analysis suggest that the MSB/GDP ratio is a good indicator of liquidity. Specifically, our analysis shows a negative relationship with a high statistical significance between the MSB/GDP ratio and liquidity. This means that reducing the size of MSB stock/issuance can expand liquidity. We find in column (4) that the estimated coefficient for GB falls when both GB and MSB are controlled for simultaneously. This outcome is understood in the context of an omitted variable's bias, indicating that liquidity expansion occurs through the pathway where GB reduces MSB, that is, a negative correlation between GB and MSB combined with a negative effect of MSB on liquidity. Column (5) shows that when both GB and BOKGB are simultaneously controlled for, BOKGB is a more powerful explanatory variable in magnitude and statistical significance. Furthermore, GB per se does not have a direct impact on liquidity as previously expected.

When simultaneously including GB, BOKGB, and MSB in our analysis, we can see that GB's influence turns out negligible as seen in column (5), whereas the effects of BOKGB and MSB are more pronounced. This result demonstrates that while GB appears to be a crucial factor in raising liquidity in earlier columns, the driving forces are both BOKGB and MSB variables. A change in GB involves changes in both BOKGB and MSB, masking the true relationship (i.e., omitted variable bias). At the very least, we demonstrate that adjusting the size of MSB stock/issuance can help change market liquidity, as theory predicts. The main takeaway is that even if the central bank does not directly purchase GBs, it can influence market liquidity indirectly through MSBs.

2. SVAR Analysis

a. Constructing an SVAR model

Now, we conduct a more formal fiscal shock analysis as an additional sensitivity analysis. While the previous analysis uses intuitive regression frameworks, we do not directly identify fiscal shocks and the resulting responses. Here we reexamine the previously analyzed liquidity channel of fiscal deficit shock using an SVAR model with short-run restrictions on shock structures. In principle, we can derive a reduced-form VAR model out of an SVAR model, where the variables of interest have a certain contemporaneous relationship. Therefore, the reduced-form errors represent a combination of structural shocks; each shock is not necessarily identified separately. The error terms of a reduced-form VAR model reflect both the exogenous shock of a variable and the effects transferred from the shocks of other variables. To address this issue, we use short-run Cholesky restrictions in the SVAR model to determine the order in which short-run structural shocks spread over time. These restrictions allow the first variable to affect the second variable but not vice versa. While an SVAR model helps identify structural shocks, these restrictions may not always be straightforward and may require theoretical support to ensure their validity. Despite possible limitations, our SVAR analysis is designed to complement the results of our earlier empirical models and provide further evidence to support the main findings.

Assume that the VAR model for our problem is given as $Y_t = C^* + L_1^* Y_{t-1} + B \epsilon_t$, where A and B are coefficient matrices of a contemporaneous relationship among dependent variables and errors, respectively; and C and L are the intercept and coefficient matrices of lagged dependent variables, respectively. The original VAR model can be rearranged to a reduced-form VAR model as $Y_t = C + L_1 Y_{t-1} + u_t$, when multiplying it with the A^{-1} matrix. Symbols ϵ_t and u_t are error terms of the structural and reduced-form VAR models, respectively, and $E(\epsilon_t) = E(u_t) = 0$, $E(\epsilon_t \epsilon_t') = I_n$, and $E(u_t u_t') = \Sigma_u$. The relationship between the error term (u_t) of the reduced-form VAR model and the error term (ϵ_t) of the structural VAR model with short-run Cholesky restrictions can be constructed as $Au_t = B\epsilon_t$. Given that $\Sigma_u = A^{-1}BB'A^{-1}$, after estimating $\hat{\Sigma}_u$, we apply appropriate theory-based restrictions to the A and B matrices to identify structural shock. The relationship $Au_t = B\epsilon_t$ with three variables is presented as follows:

$$\begin{pmatrix} 1 & 0 & 0 \\ a_{21} & 1 & 0 \\ a_{31} & a_{31} & 1 \end{pmatrix} \begin{pmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 \\ 0 & b_{22} & 0 \\ 0 & 0 & b_{33} \end{pmatrix} \begin{pmatrix} \epsilon_{1t} \\ \epsilon_{2t} \\ \epsilon_{3t} \end{pmatrix}, \tag{7}$$

This recursive (or Cholesky) form of SVAR is used to identify exogenous shocks. From the perspective of Blanchard and Perotti's (2002) analysis, combined with the conventional fiscal theories mentioned earlier, fiscal spending variable is the most exogenous variable because fiscal variables are highly external in nature (e.g., politically motivated), taking a long internal time from decision-making to actual implementation. Thus, variables are ordered as follows: first-differenced GB ratio ($\Delta \frac{GB}{GDP}$), base interest rate (r), and then first-differenced M2 ratio ($\Delta \frac{M2}{GDP}$). Our fiscal debt change measure is a net-of-tax fiscal activity. Given the rigid tax structure of Korea, we can say that changes in public debt arise from fiscal spending shocks.

Liquidity variables are typically considered the most endogenous because they are affected by fiscal and monetary policies. Moreover, it is difficult to establish a short-run reverse impact running from liquidity to fiscal spending or interest rates. Through the first-order difference, we can construct stationary variables as long as the integration order of variables does not exceed $I(1)$. Using the Schwarz criterion, we select an optimal lag length of 1, while the level variable r is used in accordance with prior research.

b. Estimated impulse-responses

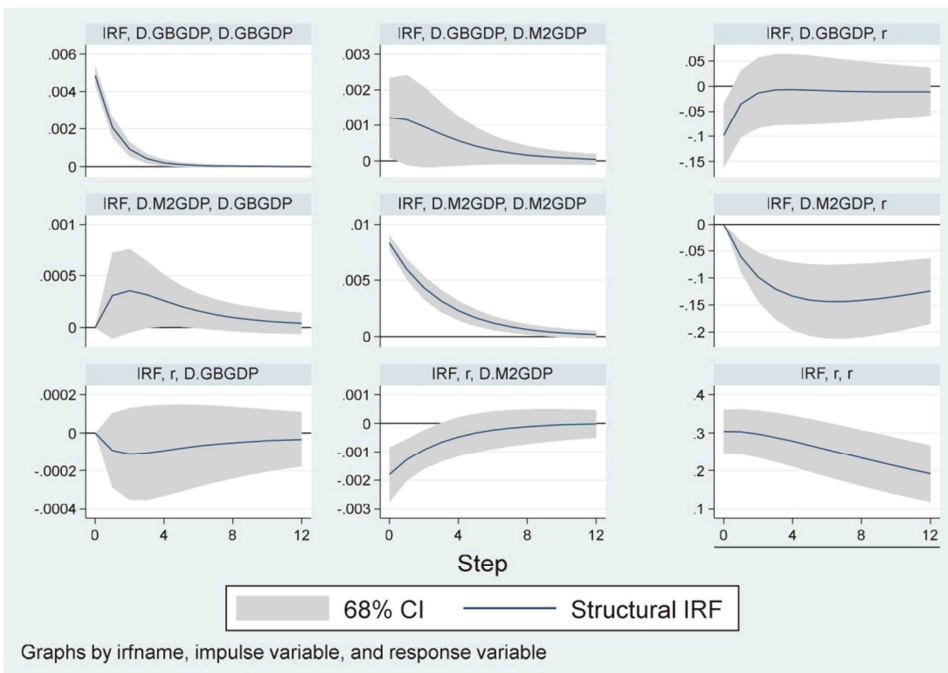
Figure 13 displays the impulse-response graphs, which confirm the basic findings of numerous prior studies. Specifically, the estimated impulse-response function demonstrates that a positive policy rate shock leads to a decrease in liquidity, while a shock that increases liquidity causes a drop in interest rate. These results restate an inverse relationship between interest rates and liquidity (i.e., the principal mechanism behind monetary policy). We also find that an interest rate shock does not affect GB balances as expected, consistent with our intuition that public finances are regarded as an externally determined event.

As a central part of this study, the estimated impulse-response function reveals that liquidity increases when a fiscal spending shock occurs with a rising GB stock. The SVAR analysis confirms our earlier empirical results that fiscal deficits cause liquidity expansion. Technically, with repurchase agreement (RP) transactions of the central bank, the overall liquidity would not change in the long run because the issued RP will be purchased again later. However, the so-called simple purchases of GBs have the effect of increasing liquidity because the central bank makes net purchases permanently. Most of our results reinforce usual findings regarding the relationship among GBs, liquidity, and interest rates.

Meanwhile, the impulse-response results show that market interest rates fall in response to a positive GB shock. In a standard setting, when fiscal spending increases, a crowding-out effect occurs: the interest rate rises in response to an increase in GB supply, along with a rise in GB yields. This puzzling dynamic often appears in other studies (e.g., Kim, 2011) where an expansionary monetary policy

has been implemented during the sample period. While still unclear, we believe the finding here suggests that a shock in GBs driven by fiscal deficits leads to an accompanying increase in money supply to keep the market interest rate at a specific target level. In this setting, the resulting money supply change is endogenous, which implies that the conventional SVAR models might be mis-specified.³¹

[Figure 13] Results of the Impulse-Response Analysis



Notes: IRF = impulse response function; $D.GBGDP = \Delta \frac{GB}{GDP}$; $D.M2GDP = \Delta \frac{M2}{GDP}$; and $r =$ the policy rate.

VI. Summary and Conclusion

This study examines the positive systematic relationship between fiscal debt and liquidity, a topic that has not been considered from the perspective of conventional macroeconomic stabilization policies or modern public finance studies. Given the

³¹ Part of the SVAR results partially contradict the conventional findings from other major economies, and we admit that their interpretation may not be straightforward. It is possible that the discrepancy reflects the result of the simultaneous implementation of fiscal and monetary policies. If this interpretation holds true, it may suggest a specification error in the SVAR identification model. However, a detailed analysis of this issue is beyond the scope of this research, and we acknowledge the need for more accurate empirical or modeling work as a follow-up study.

independent or at least distinct role of fiscal and monetary policies, it is difficult to justify a systematic relationship between fiscal debt and liquidity, especially when controlling for the policy rate as a central target variable for the monetary policy. However, our analysis of recent Korean data confirms a salient positive correlation between them even after controlling for the policy rate (i.e., the monetary policy part), which is also established through more rigorous time-series analysis. Interestingly, while fiscal debt is not severe, and intentional inflation does not happen in the form of inflation taxes, some extent of monetization of fiscal debt indeed occurs, leading to a positive correlation between the two seemingly unrelated variables. Additional factors also lie behind the correlation pattern. Along with price stability, international factors seem less crucial, given the absence of a time trend of the exchange rate during the sample period.

Considering competing hypotheses, we pursue a more compelling explanation. As the leading hypothesis for fiscal monetization, this study considers the endogenous response (e.g., money supply) of the central bank to maintain the target policy rate when a rapid increase in fiscal debt is financed by GBs. This is because large fiscal deficits create capital market pressure, leading to higher interest rates. We demonstrate that this passive stabilizing response of the central bank leads to greater liquidity during periods of price stability.

The implication of this study is that liquidity can rise in a macroeconomy when monetizing fiscal deficits financed by public bonds. Monetary policy is generally known to have direct influences on liquidity. Apart from the theory of asset pricing, practitioners acknowledge that an increase in liquidity caused by an expansionary monetary policy actually causes a rise in asset prices. This study shows that even large-scale fiscal spending shocks (e.g., populism or the government's external spending motives unrelated to stabilization policies) can also contribute to liquidity growth. We conclude the paper by mentioning that such fiscal shocks come at a cost even without severe inflation: the recent sharp increase in asset prices in Korea are likely related to the fiscal side of the macroeconomy. Follow-up studies on this topic are a promising future research agenda.³²

Finally, we would like to mention that our empirical evidence on the correlation between fiscal debt and liquidity may hold only under periods of low borrowing rates and price stability. With rising inflation and interest rates, the stylized fact shown in this paper may no longer prevail, simply regarded as a snapshot of the era of debt. Further empirical investigation appears necessary. Potential avenues might include testing the generality of our view by (i) utilizing data from other countries or (ii) examining the impact on asset markets resulting from liquidity expansion due to fiscal deficits.

³² While the specific fiscal policy effects in our study are distinct from those of other key currency countries, the essence of our results may be applied to the increase in asset prices in those countries. Specifically, even if fiscal spending leads to an increase in money supply and liquidity, it can be held by foreign investors. The resulting asset price hike channel is expected to be weak.

[Table A1] Trends in revenue, expenditure, and fiscal deficit

(unit: trillion won, %)

Year	2017	2018	2019	2020	2021	2022	2023
<i>Revenues</i>	430.6	465.3	473.1	478.8	570.5	609.1	625.7
<i>Expenditures</i>	406.6	434.1	485.1	549.9	601	679.5	638.7
<i>Revenue growth rate</i>	7.2	8.1	1.7	1.2	19.2	18.4	13.0
<i>Expenditure growth rate</i>	5.6	6.8	11.7	13.4	9.3	12.3	5.1
<i>Fiscal deficits</i>	-18.5	-10.6	-54.4	-112	-90.6	-117	-87
<i>Fiscal deficit relative to GDP(%)</i>	-1	-0.6	-2.8	-5.8	-6.2	-5.1	-3.9

Sources: NABO fiscal stat system; 2023–2024 budget of the Ministry of Finance; Open Fiscal Expenditure.

[Table A2] Description of the Fraser Index

Fraser Economic Freedom Index	The index published in <i>Economic Freedom of the World</i> measures the degree to which the policies and institutions of countries are supportive of economic freedom. The cornerstones of economic freedom are personal choice, voluntary exchange, freedom to enter markets and compete, and security of the person and privately owned property. A total of 45 data points are used to construct a summary index, along with a Gender Legal Rights Adjustment, to measure the extent to which women have the same level of economic freedom as men. The degree of economic freedom is measured in five broad areas.
Area 1	Size of Government. As government spending, taxation, and the size of government-controlled enterprises increase, government decision-making takes the place of individual choice, and economic freedom is reduced.
Area 2	Legal System and Property Rights. The protection of persons and their rightfully acquired property is a central element of both economic freedom and civil society. Indeed, it is the most important function of government. If property is not secure, if individuals are not safe, if the judiciary is not impartial, or if the rule of law is undermined, then, again, economic freedom is reduced.
Area 3	Sound Money. Inflation erodes the value of rightfully earned income and savings and changes the terms of agreed-upon contracts. Sound money is thus essential to protect property rights. When inflation is high or volatile, it becomes difficult for individuals to plan for the future and their economic freedom is limited.
Area 4	Freedom to Trade Internationally. Freedom to exchange—in its broadest sense, buying, selling, making contracts, and so on—is the essence of economic freedom. This freedom is reduced when government impediments to trade make it costly or even impossible to exchange with businesses and individuals in other nations.
Area 5	Regulation. Governments not only use a number of tools to limit the right to exchange internationally but may also impose onerous regulations—on both domestic and international trade—that limit the right to exchange, gain credit, hire or work for whomever one wishes, or freely operate one’s business. As these limits multiply, economic freedom decreases.

Sources: Fraser Index database. <https://www.fraserinstitute.org/sites/default/files/economic-freedom-of-the-world-2023-execsum.pdf>

[Table A3] Trends of Money Market Funds (RP)

(unit: trillion won, %)

Year	Daily average balance (RP)	Overnight RP		GB / RP Avg. (%)	in balance Ratio	$\frac{Velocity \cdot GB}{M2 - M1}$
2016	51.9	n.a.	n.a.	26.4	48%	24.6%
2017	61.4	n.a.	n.a.	30.8	46%	27.7%
2018	75.4	n.a.	n.a.	39.5	48%	33.2%
2019	92.6	76.3	82%	56.6	55%	43.9%
2020	106.4	83.0	78%	64.6	56%	48.2%
2021	126.4	86.4	68%	83.4	60%	58.2%
2022	149.2	93.4	63%	101.0	63%	63.4%
2023	176.0	109.6	62%	119.1	63%	67.7%
2024	200.9	131.0	65%	129.8	60%	70.1%

Notes: 1) We use data from *Korea Securities Depository*. The 2024 values are the average from January to August.

2) The balance amount is measured at the end of the month.

3) Velocity of 15 is used in the last column.

4) Much of the gap $M2 - M1$ can be explained by leveraging based on government bonds GB (see the final column).

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재정지출과 유동성*

심재찬** · 이철인***

초 록 | 현대경제에서 재정정책과 화폐/금융정책의 역할이 뚜렷이 구분되므로 국가부채와 유동성간의 체계적 관계는 상정하기 어렵다. 그러나 최근 자료를 살펴보면 한국에서 대규모 양적완화정책이 없었는데도 뚜렷한 양의 상관관계가 관측됨을 정형화된 사실로 보여준 후, 보다 적절한 회귀분석을 통해 재확인한다. 과도한 재정지출충격이 적어도 부분적으로 통화당국의 국채매입과 공개시장조작정책 등을 통해 대응되고 있으며, 이에 따라 이러한 정형화된 사실이 설명될 수 있음을 보인다. 본 결과의 이면에는 낮은 차입이자율과 물가안정이라는 시대적 환경이 작용하며, 결과적으로 국가부채가 표본기간동안 유동성을 상당히 견인했음을 보인다.

핵심 주제어: 재정지출, 재정적자/부채, 유동성, 국채, 부채회피화

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** 제1저자, NH금융연구소 책임연구원, e-mail: jcwc88@gmail.com

*** 교신저자, 서울대학교 경제학부 교수, e-mail: leeci@snu.ac.kr