Why Do Interest Rates Remain Low Despite the Accumulation of Government Debt in Japan?*

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Abstract

This paper conducts a quantitative analysis of the determinant factors of the nominal long-term interest rate based on panel data concerning 25 developed countries in the period from 1990 to 2019. While the main factors of the decline in long-term interest rates around the world since the 1990s are falls in the potential growth rate and the expected inflation rate that have been observed in many developed countries, there are also various other interconnected factors. In Japan, as government debts continue to grow, there is upward pressure on interest rates. However, the upward pressure on interest rates has been curbed by unconventional monetary policy.

Since the beginning of the 2000s, the nominal long-term interest rate has fallen below the nominal growth rate in many countries. The factors affecting this trend include investors' preference for safety, unconventional monetary policy, and the sovereign spillover effect.

While investors' preference for safety, which is due to a decline in expectations for future growth, is unlikely to change much in the short term, the downward pressure on interest rates due to unconventional monetary policy could change if the monetary policy changes. The sovereign spillover effect could also exert upward pressure on interest rates in Japan, depending on interest rate movements abroad. Therefore, the situation of the nominal growth rate being higher than the nominal long-term interest rate is not a permanent phenomenon.

Keywords: long-term interest rates, potential growth rate, fiscal problems, unconventional monetary policy, sovereign spillover

JEL Classification: E43, E52, H63

I. Introduction

Over the last few years, there has been widespread emphasis on the effects of fiscal policy on macroeconomic policy among mainstream economists in the United States. What drew the attention of the American Economic Association in 2019 was a speech by President Blanchard, who said, "If long-term interest rates below the nominal growth rates con-

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tinue for a long time, fiscal policy should be used to sustain demand" (Blanchard, 2019). An environment in which investors want low-yielding government bonds below the growth rate means that the return on private investment capital is extremely low. Under these circumstances, crowding out is unlikely to occur, even if the issuance of government bonds increases and fiscal spending is expanded. In other words, if there is a shortage of private investment due to a low rate of return on capital, the government will compensate for the shortage of demand, which will stimulate demand and achieve optimization over time.

If this is applied to Japan, the high levels of government debt become a constraint. Blanchard recommends increasing fiscal spending in Japan, despite recognizing that severe fiscal conditions can lead to higher interest rates[1]. This is based on the view that if the rate of return on capital is low, significant government debt does not immediately lead to an increase in interest rates, which can be controlled by monetary policy. From a different perspective, it can be interpreted that whether fiscal stimulus works depends on the condition that low interest rates will continue. Therefore, in Japan, where the accumulation of government debt continues, it is possible to discuss whether to increase fiscal spending after determining what causes the current low interest rates and what raises interest rates.

However, in FY2020, large-scale fiscal spending was decided without sufficient discussion about Japan's fiscal problems. In Japan, three supplementary budgets were established to contain COVID-19, and a fiscal expenditure of 70 trillion yen or more was decided. Of course, they are indispensable measures in an emergency, and such large-scale fiscal spending is being made not only in Japan but also in many other countries. However, Japan's government debt-to-GDP ratio is the highest among the G7 countries. The expansion of fiscal spending will worsen Japan's government finances. Interest rates have been stable to date, but we cannot be optimistic about future interest rates.

Why do interest rates remain low despite the accumulation of government debt in Japan? According to previous studies, Nakazato et al. (2003) point out two reasons severe fiscal conditions have not led to higher long-term interest rates in Japan. First, investors recognize that fiscal consolidation is possible in the future because the national burden ratio is still low. Second, investors are less aware of the seriousness of fiscal problems due to the short holding period of government bonds. Nakamura and Yagi (2015) report that although the budget deficit and the huge government debt push up long-term interest rates, the low national burden ratio raises expectations for fiscal consolidation and has the effect of curbing interest rate rise. This is the same conclusion as that of Nakazato et al. (2003). However, Ichiue and Shimizu (2015) cite the following three factors for low interest rates: (1) huge external assets, (2) future forecasts for the aging population, and (3) global excess savings.

Low interest rates are seen not only in Japan but also in many countries worldwide. For example, in European countries such as Germany, Switzerland, and France, yields on 10-year government bonds were negative by the end of 2020. In addition, during the global financial crisis that occurred in 2008, government debt expanded not only in Japan but also in

[1] For example, Blanchard and Tashiro (2019) emphasize fiscal policy options for Japan.

European countries and the United States, but long-term interest rates are declining in these countries as well[2]. There are various views on the causes of low interest rates, one of which is the "Secular Stagnation" by Summers (2014).

Summers (2014) argues that the natural rate of interest may have become negative in the United States due to the sharp decline in demand during the global financial crisis. Furthermore, under the zero interest rate constraint, conventional monetary policy was not unable to generate interest rates below the natural rate of interest. Consequently, the US economy was stuck in stagnation and fell into "secure stagnation." The natural rate of interest here seems to refer to the short-term natural rate of interest. However, in the long run, under certain assumptions, the natural rate of interest can be approximated as the potential growth rate[3]. Therefore, we can point out a decline in the potential growth rate behind the decrease in interest rates.

Some previous studies on the change in savings and investment occurred simultaneously as the decline in the potential growth rate. Many of these studies are based on a long-term perspective and find that demographic factors affect both savings and investment. Specifically, the decline in the younger generation, who are eager to consume, leads to excessive savings and a lack of capital investment, resulting in lower potential growth rates and interest rates. Lunsford and West (2019) investigated the causes of the long-term (1890-2016) decline in real interest rates in the United States and pointed out that demographic factors contributed more than productivity issues. Fiorentini et al. (2018) also find that demographic factors change savings trends, which have a significant impact on interest rates.

Bernanke (2005) argues that it was the "Global Saving Glut" that kept interest rates low in the mid-2000s boom before the global financial crisis. While emerging Asian countries such as China are making rapid progress, and crude oil prices are rising, excessive savings in emerging and oil-producing countries, which were previously overinvested, created a global imbalance and raised long-term interest rates. Bean et al. (2015) also report that an increase in the global share of savings in emerging economies has boosted global savings.

These findings are based on the idea that changes in the balance between savings and investment in each country have a cross-border impact that affects other countries. In today's globalized economy, monetary policy and risk events in one country can spread to other countries through financial markets and affect interest rates in that country. This is the "sovereign spillover effect." Ehrmann and Fratzscher (2017) and Silvapulle et al. (2016) report that the sovereign spillover effect occurred during the European sovereign debt crisis in the early 2010s. With that in mind, we need to consider the path by which monetary easing in one country after the global financial crisis affects interest rates in other countries across national borders.

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[2] The global financial crisis refers to the period of global recession with extreme stress in global financial markets and banking systems triggered by the bankruptcy of Lehman Brothers in September 2008.

[3] The following equation can be derived using standard economic growth theory.
Natural rate of interest = (Relative risk aversion × Technological progress rate) + Time preference rate + Population growth rate
Here, when the relative risk aversion is 1 and the time preference rate is 0, the natural rate of interest is equal to the potential growth rate (technological progress rate + population growth rate).

However, information asymmetry, transaction costs, and regulations limit the transmission of cross-border effects. Thus, it is also necessary to consider the possibility that home bias mitigates the sovereign spillover effect.

In addition, notably, the credit crunch caused a shortage of investment during the global financial crisis. For example, Eggertsson and Krugman (2012) report that the credit crunch reduces capital spending, puts downward pressure on the economy, and lowers interest rates. The International Monetary Fund (IMF) (2015) argues that the loss of strength from private investment after the global financial crisis has slowed the pace of current growth, lowered expectations for future growth, and pushed down subsequent private investment.

Meanwhile, some previous studies argue that low potential growth rates and weak capital investment lower interest rates because investors are willing to hold government bonds under these circumstances. Eichengreen (2016) reports that low interest rates are associated with a shortage of government bonds that are regarded as liquid and safe assets. Negro et al. (2019) also show that investors' demand for safe and liquid financial assets during a slowing global economy has helped lower interest rates.

The findings above are related to low interest rates through the real economy channel. However, there is also an inflation expectation channel, where a decline in the expected inflation rate pushes down the nominal interest rates. This effect is believed to be significant in Japan, where the inflation rate remains low for a long time.

Central banks in Japan, the United States, and Europe have carried out bold monetary easing to overcome low growth and inflation. This monetary easing also puts downward pressure on interest rates. However, to stimulate the economy, it is necessary to lower the actual real interest rate than the natural rate of interest, which is difficult to achieve with conventional monetary easing under the zero interest rate constraint. Therefore, after the global financial crisis, some developed countries adopted unconventional monetary policies. There are various views on the depressing effect of this policy on long-term interest rates. Fukunaga et al. (2015) report that the Bank of Japan's quantitative and qualitative easing (QQE) has a way to put downward pressure on long-term interest rates by changing the supply and demand of government bonds.

These previous studies show that low interest rates throughout the world are due to lower potential growth, global savings glut and investment shortages, increase in demand for safety assets, the sovereign spillover effect, and lower expected rate of inflation. In addition, the effects of unconventional monetary policy and expectations for future fiscal consolidation facilitated by the low national burden ratio are discussed. We can say that these combined factors have resulted in low interest rates.

This study aims to find a significant factor for the decline in long-term interest rates worldwide and determine why interest rates remain low despite the accumulation of government debt in Japan. To discuss the feasibility of fiscal policy in Japan, where government debt continues to increase, it is essential to examine the impact of expanding fiscal spending on long-term interest rates and find means to curb the rise in interest rates. This enables evidence-based discussions of fiscal policy options for Japan.

The remainder of this paper is organized as follows. Section II focuses on the decline in potential growth and low inflation, which are assumed to be directly related to the decline in long-term interest rates. We present these data and summarize the background of the decline in the potential growth rate (factors that determine the real interest rate) and that of low inflation (factors that determine the expected inflation rate) from previous studies. Section III outlines the empirical analysis. Section IV presents the results of the empirical analysis and discusses the reasons for the low interest rates in Japan despite severe fiscal conditions. Finally, Section V concludes the paper.

II. Decline in Potential Growth and Low Inflation

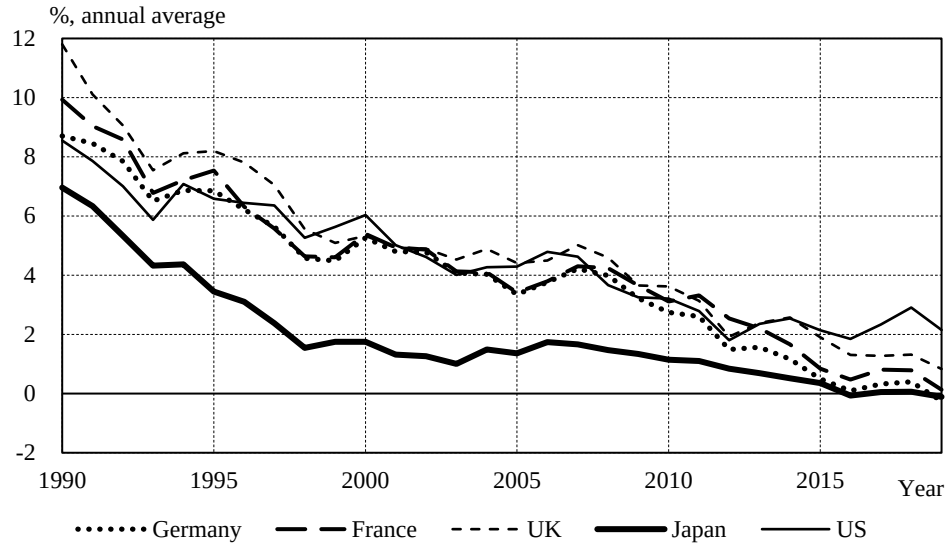
II-1. Decline in Nominal Long-Term Interest Rates

Nominal long-term interest rates can be broken down into three elements: the real long-term interest rate, the long-term expected inflation rate, and the risk premium, based on the term structure model of interest rates and the Fisher equation. This is expressed by equation (1) below.

Nominal long-term interest rate = real long-term interest rate + long-term expected inflation rate + risk premium (1)

Figure 1 shows that the yields on 10-year government bonds, which are representative indicators of nominal long-term interest rates, have been declining since 1990 in all five major countries (Germany, France, the United Kingdom, Japan, and the United States). However, comparing the government debt-to-GDP ratio between 1990-2019, it has risen in all

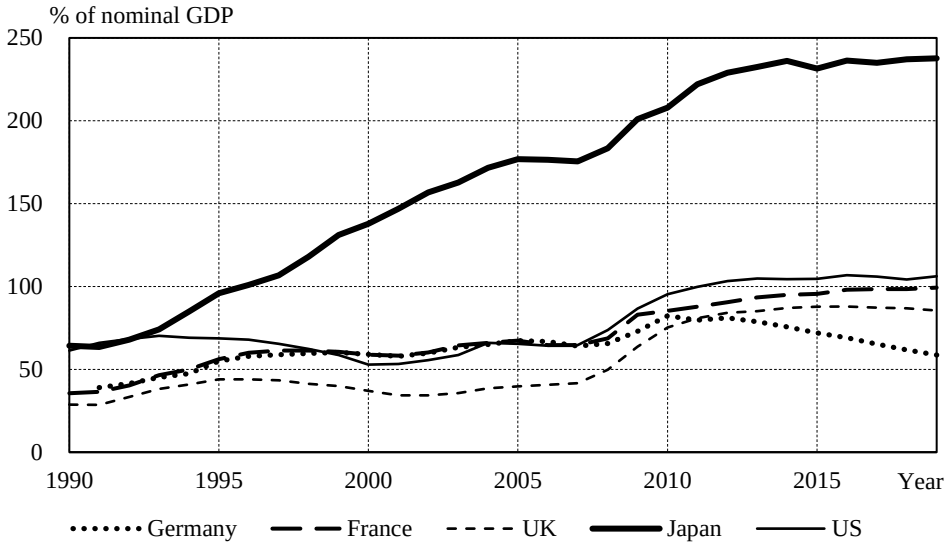
Figure 1. International Comparison of Nominal Long-Term Interest Rates



(Note) Yields on 10-year government bonds
(Source) IMF "International Financial Statistics"

five countries (Figure 2). The risk premium—one of the components of the nominal long-term interest rate—comprises the term premium stemming from uncertainties about the future term structure of the interest rate and the sovereign risk premium associated with the creditworthiness of government bonds. These two figures suggest that the decline in the yields on 10-year government bonds in each country is unlikely to be due to a reduction in the sovereign risk premium. In Japan, in particular, a significant rise in the government debt-to-GDP ratio is thought to have prompted the rise in the sovereign risk premium. However, Japan's nominal long-term interest rates have continued to decline and have remained around 0% since 2014.

Figure 2. International Comparison of General Government Gross Debt to GDP



(Source) IMF "World Economic Outlook"

Next, we focus on the other components: the real long-term interest rate and long-term inflation expectations. The former is the real economy channel, which, in the long run, is assumed to reflect the natural rate of interest, which is affected by trends in potential growth. The latter is the inflation expectation channel. The trend of low inflation is seen not only in Japan but also worldwide in the 2010s.

II-2. Decline in Potential Growth

There are two perspectives on the cause of the decline in potential growth after the global financial crisis: the supply side and the demand side.

Gordon (2015) focuses on the supply side and dates back to the first Industrial Revolution from the late 18th to the early 19th centuries. In those days, the efficient transportation and automation of manufacturing processes brought about by the invention of the steam en-

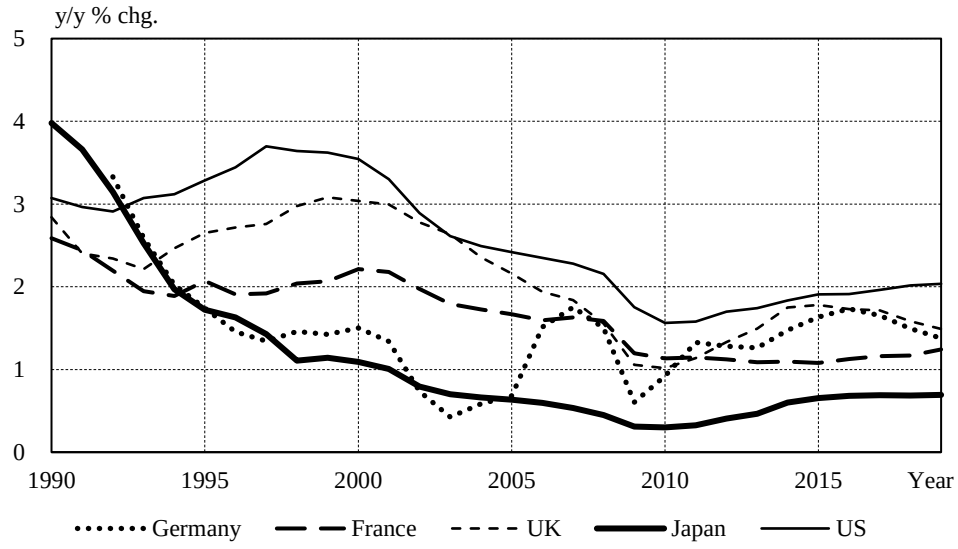
gine made significant progress in productivity, which can be called a revolution. However, he asserts that recent technological innovations in the fields of computers, information, and communications do not lead to dramatic productivity gains as they once did and that these limits of technological progress are the cause of the decline in potential growth.

The representative who focused on the demand side is Summers (2014), who insists on "secular stagnation." In this view, the starting point for secular stagnation in the United States is the sharp decline in demand after the global financial crisis. In standard economics, interest rate is adjusted to balance savings and investment. However, when demand drops sharply due to a major shock, and the natural rate of interest, which is neutral to the economy, turns negative, monetary policy does not work under the constraint of zero interest rates. Therefore, the mechanism that helps balance investment and savings through adjusting interest rates does not work.

In such cases, the equilibrium between savings and investment takes time as the pace of growth slows down. However, if savings exceed investment over the long term, secular stagnation will occur, and potential growth will decline.

Both of the two different views suggest a decline in the potential growth rate, and the two are not in great contradiction. Although the potential growth rate cannot be observed, Figure 3 shows the potential growth rate estimated by the Organisation for Economic Co-operation and Development (OECD). In Japan and Germany, there has been a downward trend since the 1990s and in the United States, the United Kingdom, and France since 2000. The rates of all five countries fell during the global financial crisis and have remained sluggish since then.

Figure 3. International Comparison of Potential Growth Rate



(Source) OECD "Economic Outlook"

II-3. Low Inflation Rate

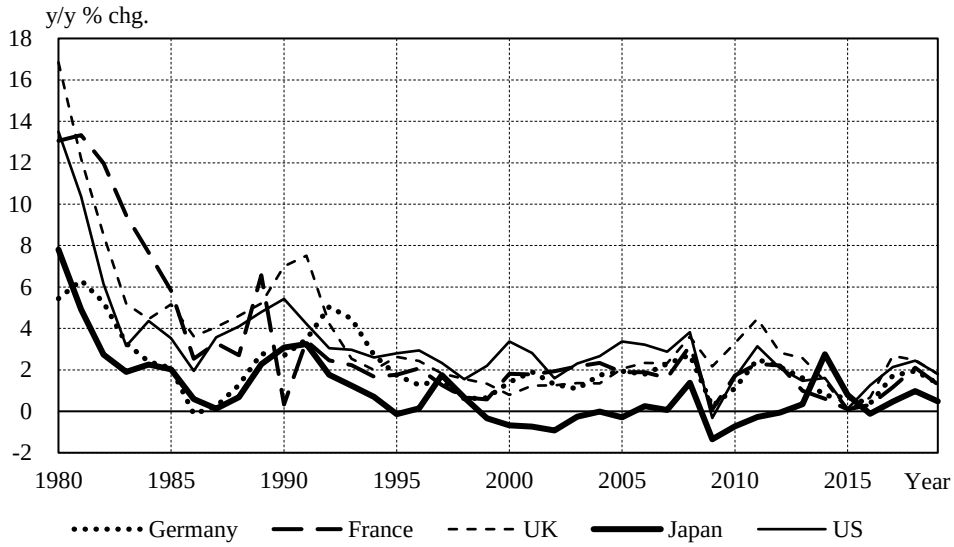
Low inflation is a global phenomenon. Figure 4 shows the inflation rates of the five major countries. In Japan, there has been a tendency for deflation since the end of the 1990s, and the current inflation rate is less than 1%. The other four countries have not fallen into deflation, but the inflation rate has often fallen below 2% since the mid-2010s.

Although many developed countries are not suffering from high inflation rates as they were in the 1980s, they are now facing a declining inflation rate. Under these circumstances, flattening of the Phillips curve has been observed in many countries. This phenomenon leads to chronic low inflation because prices are unlikely to rise even when the labor market is in tight conditions during a boom.

Ahmad and Civelli (2016) show that economic globalization affects the flattening of the Phillips curve. The IMF (2016) states that globalization has had a major impact on the spread of low inflation throughout the world after the global financial crisis. It also states that the fact that trade goods have lower inflation than the service sector is related to China's growth as a leader in exports to the world. Globalization seems to be one of the factors leading to the flattening of the Phillips curve through the expansion of the global value chain and the increase in the international movement of labor.

We should also pay attention to the role of expectations. According to the "Comprehensive Assessment" by the Bank of Japan in September 2016, inflation expectations can be regarded as consisting of two components: a forward-looking component shaped by the price stability target set by the central bank and a backward-looking or adaptive component re-

Figure 4. International Comparison of Inflation Rate



(Note) Consumer Price Index (all items)
(Source) IMF "International Financial Statistics"

flecting the observed inflation rate. In Japan, however, as the price stability target has not yet been achieved due to prolonged deflation, it is the adaptive component that dominates the formation of inflation expectations (Bank of Japan, 2016). In addition, the IMF (2016) argues that it is a global phenomenon that inflation expectations are not anchored and depend heavily on past inflation rates.

Watanabe and Watanabe (2016) argue that about half of the components of Japan's consumer prices have a price increase rate of around 0%; therefore, they are likely to fall into the negative as soon as they are under downward pressure. Thus, such adaptive expectations formed under low inflation and deflation over the long term are likely to lead to a flattening of the Phillips curve, which facilitates chronic low inflation.

III. Empirical Methods and Data

III-1. Empirical Methods

We conduct a quantitative analysis of the determinant factors of the nominal long-term interest rates based on panel data concerning developed countries. The analysis covers 25 member countries of the OECD: Austria, Belgium, Finland, France, Germany, Greece, Italy, Luxemburg, Netherlands, Portugal, Spain (the 11 countries above are Euro area members), Australia, Canada, Czech Republic, Denmark, Israel, Japan, South Korea, New Zealand, Norway, Poland, Sweden, Switzerland, the United Kingdom, and the United States (the 14 countries above are other than Euro area members).

Ichiue and Shimizu (2015), Nakamura and Yagi (2015), and Fiorentini et al. (2018) have conducted empirical studies based on panel data. However, as Ichiue and Shimizu (2015) cover 1990-2010, and Nakamura and Yagi (2015) cover 1980-2013, they include a shorter period of unconventional monetary policy. Fiorentini et al. (2018) cover 1960-2016, but they focused on capturing the long-term effects of demographic factors and do not pay much attention to the factors behind low interest rates in recent years.

In Japan and other developed countries, the factors that are expected to affect long-term interest rates are changing steadily, such as an increase in government debt, an increase in the holding of government bonds by central banks, and an increase in the national burden ratio. Therefore, this study covers 30 years, from 1990-2019.

As mentioned above, the nominal long-term interest rate is composed of three factors: (1) real long-term interest rate (the real economy channel); (2) long-term expected inflation rate (the inflation expectations channel); and (3) risk premium (the risk channel). We selected data representing these factors and constructed panel data of 25 developed countries.

III-2. Data

We use the yields on 10-year government bonds (annual average) as the nominal long-term interest rates, which are the dependent variables. The explanatory variables are ex-

plained below by dividing them into three components of the nominal long-term interest rates.

III-2-1. Real Long-Term Interest Rate (the Real Economy Channel)

First, we use the potential growth rate as an explanatory variable. As mentioned above, the potential growth rate matches the natural rate of interest under certain conditions. The potential growth rate is based on the long-term concept, and the natural rate of interest here also refers to the long-term natural rate of interest. However, the natural rate of interest, which is neutral to the economy, fluctuates due to economic shocks in the short term. Therefore, we use the output gap ([actual real GDP - potential GDP] / potential GDP) as a proxy variable of short-term economic fluctuations.

As seen in section II-2, the potential growth rate is declining in developed countries. Changes in savings and investment, accompanied by a decline in potential growth, also affect real long-term interest rates. Global excess savings began to attract attention in the 2000s, and Summers (2014) argues that the imbalance between savings and investment after the global financial crisis led to a negative natural rate of interest. This study adopts the total savings rate, which includes both the private sector and the government sector, as a proxy variable of excess savings.

Savings tend to depend on demographic factors in the long run. Lunsford and West (2019) and Fiorentini et al. (2018) argue that changes in savings behavior due to demographic factors have a significant impact on interest rates. Lunsford and West (2019) show that the rise in the proportion of the middle-aged population aged 40-64 pushes down the real interest rates in the United States. Fiorentini et al. (2018) report that a decline in the younger generation between the ages of 20-39, with high consumption, led to a higher national household savings rate. In this study, following Fiorentini et al. (2018), we use the share of people aged 20-39 years old over the total population as a proxy variable of demographic factors.

Meanwhile, we are concerned that the credit crunch affected the investment shortage after the global financial crisis, as pointed out by Eggertsson and Krugman (2012). Therefore, this study uses the year-on-year rate of change in private debt outstanding as an explanatory variable to capture the impact of financial institutions' lending attitudes.

Bernanke (2005) and Bean et al. (2015) argue that the economic growth of emerging economies since the beginning of the 2000s has led to a global saving glut. Under economic globalization, interest rates are not determined solely by domestic fundamentals. Therefore, although this study covers 25 developed countries, we select 16 other countries, such as emerging and oil-producing countries, which expanded the current account surplus in the 2000s[4]. We calculate the ratio of the current account balance to the nominal GDP based on the sum of these 16 countries, and we use this ratio as a proxy variable of the global saving

[4] The 16 countries are China, South Korea, Hong Kong, Taiwan, Singapore, Indonesia, Malaysia, Thailand, Philippines, Saudi Arabia, United Arab Emirates, Kuwait, Algeria, Nigeria, Russia, and Qatar.

glut.

Moreover, as the cross-border ties of financial markets deepen, we also need variables that represent the sovereign spillover effect that monetary policies and risk events in one country spread to other countries through financial markets and affect interest rates in that country. The extent to which interest rates in one country are affected by interest rates in another country depends on the degree of economic ties between the two countries. Therefore, we construct the following variable called "impact of foreign interest rates." In the statistics on financial institutions operating abroad, built by the Bank for International Settlements (BIS), we can see which countries to which each country has overseas exposure. By calculating the weighted average of the long-term interest rates of other countries based on these data, it is possible to determine the overseas interest rates faced by each country. The value obtained by multiplying this by the ratio of overseas exposure is defined as the "impact of foreign interest rates."

However, home bias blocks these foreign influences. Assuming that home bias works, the current account surplus, which corresponds to excess domestic savings, enables government bonds to be absorbed domestically; therefore, it is not necessary to raise funds from overseas. There is no upward pressure on interest rates from overseas. In short, the current account balance may affect the domestic absorption of government bonds. Therefore, we use the ratio of the current account balance to nominal GDP as an explanatory variable. This variable has armon lags of three years, following Nakamura and Yagi (2015). In addition, the ratio of net external assets to nominal GDP is used as an explanatory variable because sufficient net external assets may facilitate domestic absorption of government bonds.

Finally, we employ variables that represent investor behavior. As expectations for future growth decline, so does the rate of return on investment. Under these circumstances, it is expected that investment will not grow due to a shortage of promising investment, and demand for government bonds, which are safe assets, will increase. The aging of the population and the decrease in the working-age population put downward pressure on the potential growth rate, leading to lower expectations for future growth. The United Nations announced forecasts for the aging of each country. Ichiue and Shimizu (2015) adopt a 6-to-10-year-ahead forecast of the annualized growth rate of the working-age population ratio as an explanatory variable. With reference to this, we use a 10-year-ahead forecast of the working-age population ratio (15-64 years old population ratio).

III-2-2. Long-Term Expected Inflation Rate (the Inflation Expectations Channel)

The second component of the nominal long-term interest rate is the long-term inflation rate. Although the United States and Japan have inflation forecasts based on questionnaire surveys and break-even inflation rates that reflect inflation expectations in financial markets, long-term data series are not available in all 25 countries. Nakamura and Yagi (2015) use the actual inflation rate of consumer prices (comprehensive) as a proxy for the long-term expected inflation rate, but we can also estimate this in some way.

The IMF (2016) argues that adaptive expectation formation, in which expected inflation

is strongly dependent on past inflation, is a global trend. Based on this view, it is possible to estimate the expected inflation rate using the autoregressive moving average mode. This study assumes that the consumer price index is predicted based on ARIMA (p, d, q), which is a first-order difference (d = 1), as follows:

$$y_t - y_{t-1} = c + \varepsilon_t + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{j=1}^{q} \beta_j \varepsilon_{t-j} + \sum_{k=1}^{s} \gamma_k dum_{k,t}, \quad (2)$$

where *y* is the consumer price index.

As consumer prices are affected by changes in the value-added tax rate, we use a dummy variable (*dum*) that is represented by 1 after the change in the value-added tax rate. Notably, many countries have changed their value-added tax rate multiple times[5]. Therefore, it is necessary to introduce a dummy variable for each change, and the subscript *s* indicates the number of changes in each country. The estimation covers the period from the first quarter of 1980 to the fourth quarter of 2019.

III-2-3. Risk Premium (the Risk Channel)

The risk premium is mostly composed of the sovereign risk premium stemming from the creditworthiness of government bonds and the term premium stemming from uncertainties about the future term structure of the interest rate.

First, we select variables that indicate the fiscal risk of the general government. We use the ratios of fiscal balance to nominal GDP as the flow variable and the ratio of gross government debt outstanding to nominal GDP as the stock variable. Nakamura and Yagi (2015) assume that when the government debt reaches a certain level, the effect of the fiscal balance on the nominal long-term interest rate will increase and employ a cross-product of debt outstanding dummy with fiscal balance as the explanatory variable. However, although Japan's government debt-to-GDP ratio exceeds 200%, interest rates remain low. Moreover, during the global financial crisis, interest rates did not rise significantly in most countries despite rising government debt-to-GDP ratios. Although the government bonds of each country can be regarded as safe assets, it is assumed that the government bonds held by investors who invest in the world are determined by relative evaluation. In other words, it is important to make a relative evaluation of which country's finances are more creditworthy than those of other countries. Therefore, regarding the ratio of government debt to nominal GDP, we use the deviation from the all-sample average every year as an explanatory variable.

Nakamura and Yagi (2015) argue that net government debt, which offsets the financial assets held by the government, is more appropriate for expressing the government's solvency; however, in the case of the net, the number of samples decreases. Therefore, in this study, we mainly use gross government debt and net government debt to examine the robustness of our estimation results.

The 25 countries included those whose interest rates surged during the European sover-

[5] Especially in European countries, the value-added tax rate is frequently changed for each item. However, this paper only covers the timing when the basic tax rate, which is considered to have a significant impact on prices, was changed.

eign debt crisis in the early 2010s. Investors holding government bonds in these countries are likely to sell their holdings as soon as possible to avoid swelling losses. As such, investor behavior leads to an increase in interest rates that deviate from the fundamentals. Therefore, for those countries, the European sovereign debt crisis dummy variables are used as explanatory variables for periods in which they received financial support from the IMF or EU, following Nakamura and Yagi (2015)[6].

However, according to Nakazato et al. (2003) and Nakamura and Yagi (2015), the low national burden ratio despite the severe fiscal conditions in Japan raises expectations for future fiscal consolidation. This is because when the national burden ratio is low, there is room for increased tax and social security burdens, and sovereign risk does not increase. Therefore, this study adopts the national burden ratio as an explanatory variable. We also follow the same procedure as the government debt outstanding to nominal GDP using the deviation from the all-sample average every year.

Another element of the risk premium is the term premium. After the short-term interest rates fell to near zero during the global financial crisis, Japan, the United States, and the Euro area introduced unconventional monetary policy and purchased large amounts of long-term government bonds. It is assumed that the large-scale purchase of long-term government bonds by each central bank promoted a decline in long-term interest rates by reducing the term premium. Therefore, we adopt the ratio of the monetary base to nominal GDP as a proxy variable of the unconventional monetary policy measure[7].

The monetary policies of Euro area members have been unified since joining the Euro. Therefore, data from each country is used before joining the Euro, and data aggregated in the Euro area is used for all Euro members after joining the Euro.

III-3. Data Description

Table 1 lists the variables used in this study. Data sources are the IMF's "World Economic Outlook" and "International Financial Statistics," the OECD's "Economic Outlook," the UN's "World Population Prospects," and the BIS's "Consolidated Banking Statistics" and "Credit to the non-financial sector." We also use the data from the central bank of each country.

Table 2 presents the summary statistics for the data from 1990-2019. The data frequency is annual. Most of the variables, except the dummy variables, are the ratio to nominal GDP and year-on-year rate of change, and these are all expressed as percentages.

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[6] During the currency collapse of Asian countries in 1997, the so-called "Asian currency crisis," the Korean currency fell sharply, leading to economic turmoil and receiving support from the IMF. Therefore, we also conducted an analysis using a dummy variable during the period in which South Korea received support, but the effect of this was minor. In this paper, we report the estimation results without the Korean dummy variables.

[7] In conventional monetary policy that controls interest rates, the policy interest rate tends to move in response to the explanatory variables adopted in this paper, such as the output gap, potential growth rate, and expected inflation rate. For example, monetary policy that follows the Taylor rule. Therefore, we do not use proxy variables of conventional monetary policy.

Table 1. List of Variables

Variables	Notes	Data Sources	Sign
Dependent Variables			
nominal long-term interest rates	yields on 10-year government bonds	IMF	
Real Long-term Interest Rate (the Real Economy Channel)			
potential growth rate	estimated by OECD and IMF	OECD, IMF	+
output gap	(actual real GDP - potential GDP) / potential GDP	IMF	+
total savings rate	sum of the private sector and the government sector	OECD	−
young share	share of people aged 20–39 years old over total population	UN	+
private debt growth rate	year-on-year rate of change in private debt	BIS, IMF	+
global saving glut	ratio of the current account balance to the nominal GDP constructed based on the sum of these 16 countries	Constructed by author	−
impact of foreign interest rates	sovereign spillover effect	Constructed by author	+
current account balance	ratio of the current account balance to nominal GDP	IMF	−
net external assets	ratio of net external assets to nominal GDP	IMF	−
10-year-ahead working-age population	10-year-ahead forecast of the working-age population ratio	UN	+
Long-term Expected Inflation Rate (the Inflation Expectations Channel)			
expected inflation rate	long-term expected inflation rate	Estimated by author	+
Risk Premium (the Risk Channel)			
fiscal balance	ratio of fiscal balance to nominal GDP	IMF	−
government debt outstanding	ratio of gross government debt outstanding to nominal GDP	IMF	+
net government debt outstanding	ratio of net government debt outstanding to nominal GDP	IMF	+
European sovereign debt crisis dummy	1: periods during which each country receives financial support from the IMF or EU 0: other periods	Constructed by author	+
national burden ratio	ratio of tax and social security burden to national income	OECD	+
monetary base	ratio of the monetary base to nominal GDP	IMF, Central Banks	−

(Note) “Sign” represents the sign condition that is assumed when the nominal long-term interest rate is used as the explained variable.

Table 2. Summary Statistics

	Obs.	Mean	Std. Dev.	Min	Max
nominal long-term interest rates	720	4.89	3.35	-0.49	23.92
potential growth rate	744	2.35	1.48	-7.17	9.65
output gap	732	-0.45	2.54	-15.81	9.25
total savings rate	722	23.64	6.30	4.81	41.74
young share	750	28.35	2.66	21.31	38.06
private debt growth rate	733	6.79	12.81	-39.20	91.60
global saving glut	750	3.45	3.15	-4.05	9.39
impact of foreign interest rates	446	2.28	1.69	0.04	7.42
current account balance	740	0.82	4.95	-14.48	16.22
net external assets	653	-6.81	52.44	-159.34	238.64
10-year-ahead working-age population	750	65.39	2.85	58.20	73.41
expected inflation rate	748	3.05	6.30	-0.57	106.00
fiscal balance	731	-1.97	4.15	-15.15	18.63
government debt outstanding	734	0.00	38.72	-58.81	161.64
net government debt outstanding	677	0.00	57.31	-338.41	118.61
European sovereign debt crisis dummy	750	0.03	0.16	0.00	1.00
national burden ratio	726	0.00	6.93	-16.96	14.13
monetary base	721	11.08	11.54	0.77	92.76

(Note) Data for the 30 years from 1990-2019.

IV. Results of the Empirical Analysis

IV-1. Estimation Results for the Whole Period

We now conduct an empirical analysis to identify the determinants of the nominal long-term interest rates. The analysis covers 25 OECD member countries. We use panel data covering 1990-2019. The Wu-Hausman test determines whether the fixed effects model or random effects model is suitable. Consequently, all the estimation results reported below are fixed effects models that control country-specific fixed factors, and no time dummy variable is added[8].

Some of the explanatory variables used in this study are slightly correlated. For exam-

[8] The explanatory variable "Global Saving Glut" is the same data in all 25 countries and also acts as a fixed effect of time.

ple, the total savings rate and the share of people aged 20-39 years old over the total population are likely to move in the same way, which is affected by the potential growth rate.

Therefore, the explanatory variables used in the estimation model of the baseline case are potential growth rate, current account balance, expected inflation rate, fiscal balance, government debt outstanding, European debt crisis dummy, and national burden ratio. Subsequently, we estimate by adding other explanatory variables to the baseline case. Some explanatory variables are lagged by one year to avoid endogeneity.

Table 3 presents the estimation results for the entire period. In column (1), which is the baseline case, all the coefficients show correct and significant signs. This indicates that the potential growth rate and expected inflation rate affect the nominal long-term interest rates. In addition, an increase in fiscal risks is the upward pressure on nominal long-term interest rates because fiscal balance, government debt outstanding, and the European debt crisis dummy are all significant. However, the national burden ratio is also significant, suggesting that a low national burden ratio may facilitate expectations for future fiscal consolidation. Furthermore, a significant sign of the current account balance suggests the effect of home bias, and a significant sign of the monetary base shows the effect of lowering interest rates by monetary easing.

Next, other explanatory variables were added to the baseline case. In column (2), where the output gap is added as an explanatory variable, the sign of its coefficient is incorrect. In column (3), the coefficient of the total savings rate shows a significantly negative sign, but the coefficient of the current balance shows an incorrect sign in this case.

In column (4), the coefficient of the young share shows a significantly positive sign. This suggests that the decline of the younger generation with high consumption puts downward pressure on interest rates[9]. However, as this variable is suspected to be slightly correlated with the potential growth rate, the coefficient of the potential growth rate is lower than that of the baseline case, and the coefficient of the current account balance shows an opposite sign. Therefore, it is possible that the savings rate affected by changes in the share of the younger generation may also have an impact on the current account balance.

In column (5), the private debt growth rate is added as an explanatory variable, but no significant result is obtained.

In column (6), the coefficient of the global saving glut shows a significantly negative sign. This result supports Bernanke's (2005) claim that surplus savings in emerging and oil-producing countries drive lower interest rates in developed countries.

In column (7), the coefficient of the impact of foreign interest rates shows a significant positive sign. In addition, in this case, the coefficient of determination was higher than other estimation results. However, the coefficient of the potential growth rate, which shows significant signs in all other estimates, is no longer significant. In addition, the coefficient of the

[9] In column (4), following Fiorentini et al. (2018), we show the estimation results using the ratio of the population aged 20 to 39, who is a young generation with strong demand, as an explanatory variable. We also have obtained consistent results from the estimation using the ratio of the middle-aged population aged 40 to 64, who is highly motivated to save, as an explanatory variable.

monetary base shows the opposite sign. This estimation result suggests that the decline in interest rates in one country is due to not only its own factor but also the spillover of the decline in interest rates in other countries.

In column (8), the 10-year-ahead working-age population is added as the explanatory variable. The variable is based on the assumption that investors will prefer safe assets when the rate of return on investment is expected to decline as future growth expectations decline. Its coefficient shows a significant negative sign, and this result suggests that investors' willingness to have safe assets promotes a decline in interest rates. In this case, however, the coefficient of the potential growth rate is lower than the other estimation results.

In column (9), we change the proxy of the home bias from the current account balance to the net external assets to examine the robustness of our estimation results. The coefficient of the net external assets shows a significant and correct sign; we can also find the home bias effect in this estimation result.

In column (10), we change the government debt outstanding from gross to net. The coefficient of the net government debt outstanding shows a significant and positive sign, and this result is the same as in the case of gross government debt outstanding.

We are interested in the impact of unconventional monetary policies on nominal long-term interest rates. The estimation results in Table 3 show the effect of lowering interest rates by monetary easing. However, notably, our sample includes 11 Euro member countries.

As the monetary policy is unified in the ECB in the Euro area, the member countries in the Euro area cannot implement their own monetary policy. In addition, Ehrmann and Fratzscher (2017) and Silvapulle et al. (2016) show that the sovereign spillover effect was seen during the European debt crisis in the early 2010s. Therefore, we cannot rule out the possibility that the impact of foreign interest rates across the border may have a strong effect in the Euro area. Although we employ the European debt crisis dummy to diminish its effects, we can only control the countries with the support of the IMF and others.

Therefore, we reduce the number of countries and make another estimate to eliminate the inherent conditions of the Euro area members. We take 14 of the 25 countries outside the Euro area and only Germany from the Euro area, with a total of 15 countries as new samples[10]. Table 4 shows the estimation results for 15 countries, which are almost the same as those for the 25 countries. Comparing the two, the results for 15 countries have higher coefficients of determination in all cases and more significant coefficients.

Next, we discuss the impact of the inherent conditions in the Euro area. The coefficients of the monetary base are generally significantly negative in both cases of 25 and 15 countries, but the absolute values of the coefficients are larger in the results for the 25 countries. This suggests that the sovereign spillover effect works more strongly in the Euro area than in other countries.

[10] We have also conducted an analysis of 14 countries excluding the United States and found that the estimation results are not significantly different from those of the 15 countries including the United States.

Table 3. Estimation Results 1 (25 countries, 1990-2019)
Dependent variable: Nominal long-term interest rates

sign		(1)		(2)		(3)		(4)		(5)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	1.042	8.914 **	1.072	8.628 **	1.149	8.767 **	0.424	4.342 **	1.036	9.189 **
+	output gap(-1)			-0.145	-2.703						
-	total savings rate(-1)					-0.196	-3.935 **				
+	young share							0.482	8.830 **		
+	private debt growth rate(-1)									0.004	0.470
-	global saving glut(-1)										
+	impact of foreign interest rates(-1)										
-	current account balance	-0.025	-2.094 *	-0.035	-2.629 **	0.005	0.280	0.005	0.407	-0.025	-2.043 *
-	net external assets(-1)										
+	10-year-ahead working-age population										
+	expected inflation rate	1.3819	8.111 **	1.4475	8.528 **	1.4296	8.039 **	1.2363	7.990 **	1.375	8.018 **
-	fiscal balance(-1)	-0.165	-3.243 **	-0.105	-2.066 *	-0.096	-2.160 *	-0.088	-2.219 *	-0.168	-3.230 **
+	government debt outstanding(-1)	0.019	4.715 **	0.019	4.772 **	0.015	3.541 **	0.015	3.404 **	0.019	4.713 **
+	net government debt outstanding(-1)										
+	European sovereign debt crisis dummy	7.444	6.770 **	6.668	5.480 **	7.537	6.906 **	7.278	6.186 **	7.470	6.791 **
+	national burden rate(-1)	0.174	2.981 **	0.129	2.195 *	0.114	2.250 *	0.171	3.216 **	0.174	2.991 **
-	monetary base	-0.045	-11.263 **	-0.044	-10.452 **	-0.047	-12.138 **	-0.013	-2.518 *	-0.044	-12.101 **
	constant	-0.646	-1.644	-0.783	-1.764	3.718	4.129 **	-12.772	-9.216 **	-0.655	-1.673
	Adjusted R-squared	0.724		0.731		0.732		0.762		0.724	
	S.E. of regression	1.640		1.621		1.618		1.524		1.641	
	Number of Observations	674		674		674		674		674	

sign		(6)		(7)		(8)		(9)		(10)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	0.863	6.331 **	0.217	1.107	0.432	4.560 **	0.873	6.963 **	0.714	5.829 **
+	output gap(-1)										
-	total savings rate(-1)										
+	young share										
+	private debt growth rate(-1)										
-	global saving glut(-1)	-0.146	-2.919 **								
+	impact of foreign interest rates(-1)			1.029	9.376 **						
-	current account balance	-0.032	-2.597 **	-0.026	-1.635	-0.025	-2.039 *			-0.016	-1.158
-	net external assets(-1)							-0.019	-5.795 **		
+	10-year-ahead working-age population					0.645	9.841 **				
+	expected inflation rate	1.324	8.125 **	0.878	3.503 **	1.128	5.875 **	1.415	7.654 **	1.423	7.434 **
-	fiscal balance(-1)	-0.085	-1.608	-0.039	-0.700	-0.091	-2.227 *	-0.173	-4.261 **	-0.170	-3.272 **
+	government debt outstanding(-1)	0.024	5.750 **	-0.003	-0.682	0.022	4.906 **	0.014	2.203 *		
+	net government debt outstanding(-1)									0.008	3.014 **
+	European sovereign debt crisis dummy	7.124	6.547 **	9.859	4.363 **	6.644	6.097 **	6.754	5.823 **	7.095	6.221 **
+	national burden rate(-1)	0.120	1.869	0.116	1.662	-0.024	-0.473	0.143	2.977 **	0.264	4.119 **
-	monetary base	-0.051	-12.085 **	0.001	0.323	0.009	1.490	-0.038	-8.295 **	-0.052	-12.214 **
	constant	0.682	1.057	-0.722	-1.561	-41.178	-9.998 **	-0.689	-1.771	-0.112	-0.253
	Adjusted R-squared	0.740		0.823		0.780		0.701		0.689	
	S.E. of regression	1.594		1.208		1.464		1.625		1.663	
	Number of Observations	674		415		674		605		623	

(Note) “Sign” represents an assumed sign condition. Absolute t-values, computed from heteroskedasticity-consistent standard errors, are in the right frame of each column. * and ** indicate that the sign of the coefficient is correct and statistically significant: * = significant at the 5% level; ** = significant at the 1% level.

Table 4. Estimation Results 2 (15 countries, 1990-2019)
Dependent variable: Nominal long-term interest rates

sign		(1)		(2)		(3)		(4)		(5)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	1.336	10.090 **	1.333	10.080 **	1.384	10.127 **	0.661	5.473 **	1.322	10.481 **
+	output gap(-1)			-0.091	-2.120						
-	total savings rate(-1)					-0.176	-2.699 **				
+	young share							0.578	11.289 **		
+	private debt growth rate(-1)									0.008	1.093
-	global saving glut(-1)										
+	impact of foreign interest rates(-1)										
-	current account balance	-0.038	-3.368 **	-0.045	-3.931 **	-0.009	-0.482	-0.014	-1.657	-0.039	-3.358 **
-	net external assets(-1)										
+	10-year-ahead working-age population										
+	expected inflation rate	1.302	6.542 **	1.311	6.483 **	1.388	6.593 **	1.077	8.507 **	1.289	6.375 **
-	fiscal balance(-1)	-0.186	-3.421 **	-0.146	-2.753 **	-0.122	-2.406 *	-0.068	-1.597	-0.191	-3.491 **
+	government debt outstanding(-1)	0.010	3.478 **	0.009	3.189 **	0.005	1.347	0.007	2.681 **	0.010	3.528 **
+	net government debt outstanding(-1)										
+	national burden ratio(-1)	0.214	3.271 **	0.208	3.166 **	0.142	2.224 *	0.230	3.986 **	0.206	3.201 **
-	monetary base	-0.029	-8.206 **	-0.030	-7.931 **	-0.031	-8.002 **	0.000	0.006	-0.028	-8.475 **
	constant	-0.959	-2.032 *	-0.957	-1.973 *	2.880	2.234 *	-15.412	-11.799 **	-0.978	-2.105 *
	Adjusted R-squared	0.781		0.783		0.787		0.851		0.781	
	S.E. of regression	1.339		1.333		1.321		1.105		1.337	
	Number of Observations	412		412		412		412		412	

sign		(6)		(7)		(8)		(9)		(10)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	1.208	7.751 **	0.423	3.041 **	0.860	7.752 **	1.217	7.476 **	1.095	6.242 **
+	output gap(-1)										
-	total savings rate(-1)										
+	young share										
+	private debt growth rate(-1)										
-	global saving glut(-1)	-0.115	-2.501 *								
+	impact of foreign interest rates(-1)			0.908	11.744 **						
-	current account balance	-0.037	-3.575 **	-0.018	-2.214 *	-0.033	-3.034 **			-0.039	-3.433 **
-	net external assets(-1)							-0.023	-8.187 **		
+	10-year-ahead working-age population					0.4198	6.387 **				
+	expected inflation rate	1.254	6.599 **	0.939	4.867 **	1.152	5.046 **	1.326	8.656 **	1.305	6.676 **
-	fiscal balance(-1)	-0.125	-2.217 *	-0.059	-1.369	-0.129	-2.923 **	-0.188	-4.277 **	-0.158	-2.681 **
+	government debt outstanding(-1)	0.015	4.132 **	-0.005	-1.685	0.015	4.254 **	0.000	0.093		
+	net government debt outstanding(-1)									0.007	4.258 **
+	national burden ratio(-1)	0.200	2.907 **	0.150	2.979 **	0.055	0.909	0.166	2.796 **	0.240	3.628 **
-	monetary base	-0.034	-9.377 **	0.008	1.752	0.001	0.218	-0.023	-6.264 **	-0.032	-7.514 **
	constant	0.031	0.046	-0.716	-1.526	-27.398	-6.528 **	-1.170	-2.241 *	-0.378	-0.558
	Adjusted R-squared	0.791		0.885		0.816		0.772		0.744	
	S.E. of regression	1.306		0.862		1.227		1.269		1.344	
	Number of Observations	412		251		412		373		371	

(Note) “Sign” represents an assumed sign condition. Absolute t-values, computed from heteroskedasticity-consistent standard errors, are in the right frame of each column. * and ** indicate that the sign of the coefficient is correct and statistically significant: * = significant at the 5% level; ** = significant at the 1% level.

IV-2. Factor Decomposition of Interest Rate Decline

From 1990-2019, covered by this study, nominal long-term interest rates tended to decline in many countries worldwide. Therefore, we attempt to break down the factors of interest rate decline based on our estimation results. Specifically, we adopt the parameters obtained from the baseline case of 15 countries (column (1) in Table 4), in which the coefficient of determination is high, and all the coefficients show significant and correct signs. Figure 5 shows the factor decomposition of the decline in estimated nominal long-term interest rates in Japan, the United States, and Germany.

First, we can see that in Japan, from the early 1990s (1990-1994) to the early 2000s (2000-2004), the potential growth rate and expected inflation rate are the main factors for the decline in interest rates. Nominal long-term interest rates were pushed down by 0.34% a year due to a decline in the potential growth rate and by 0.23% a year due to a decline in the expected inflation rate. Although fiscal balance and government debt increased by 0.23% a year, the impacts of the potential growth rate and expected inflation rate are stronger. From the early 2000s (2000-2004) to the late 2010s (2015-2019), rising inflation expectations and fiscal risks put pressure on interest rates. As the national burden ratio is gradually rising, the effect of expectations for fiscal consolidation due to the low national burden ratio has diminished[11]. However, long-term interest rates remained low because the annual 0.12% depressing effect produced by the monetary base offset those upward pressures.

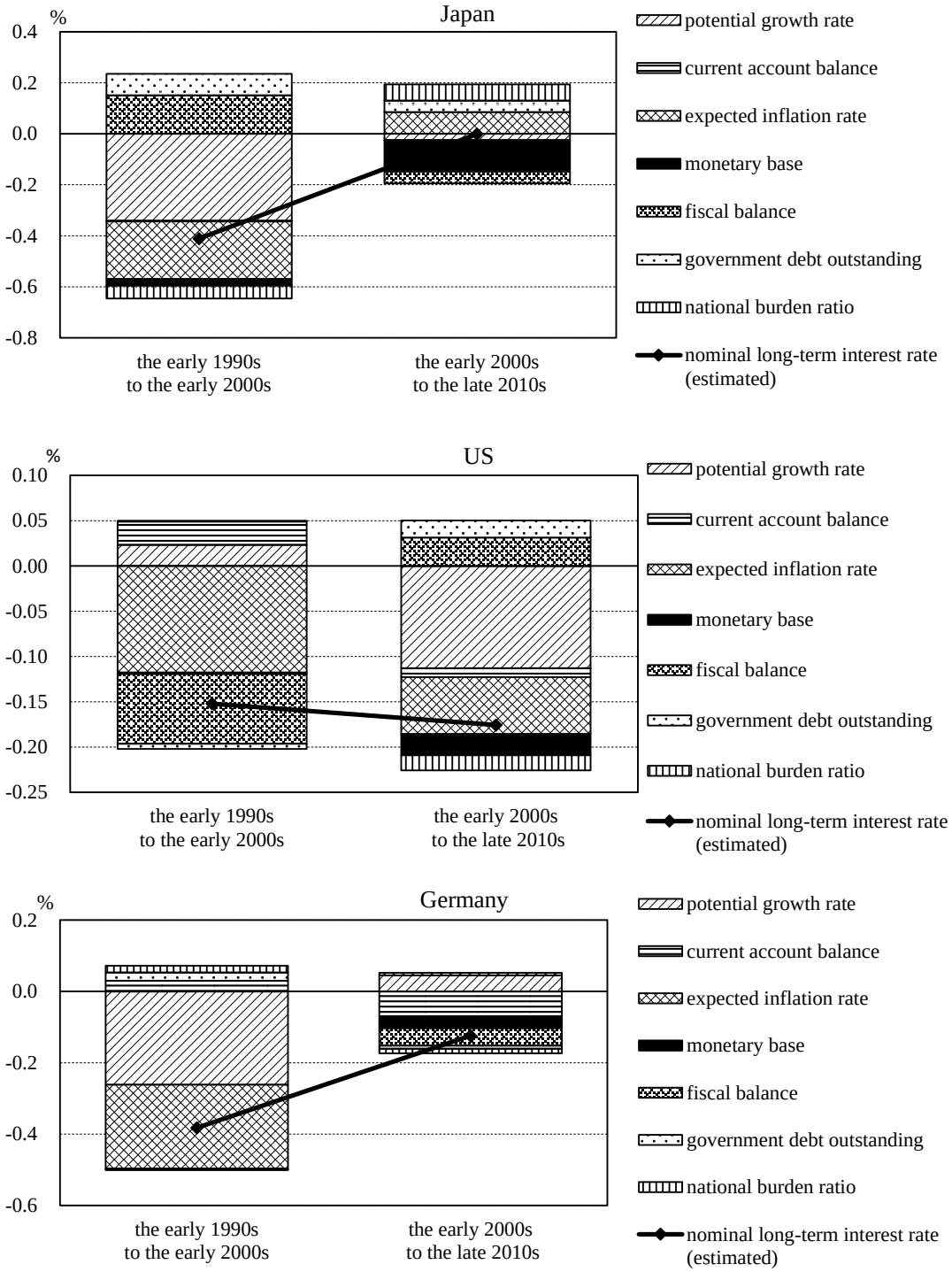
The above factor decomposition shows that in Japan, the nominal long-term interest rate did not rise due to the decline in the potential growth rate, the decline in the expected inflation rate, and the unconventional monetary policy, despite the upward pressure on them due to fiscal risks that have consistently increased. In the late 2010s, however, unconventional monetary policy played a major role in curbing the rise in interest rates.

In the United States, the decline in nominal long-term interest rates from the early 1990s to the early 2000s was caused by two factors: a decline in the expected inflation rate and a weakening of fiscal risks due to an improvement in the fiscal balance. However, the main factors behind the decline in interest rates from the early 2000s to the latter half of the 2010s were the decline in the potential growth rate and expected inflation rate. This finding is consistent with "secular stagnation" by Summers (2014). In addition, the rise in the monetary base due to unconventional monetary policy was a factor pushing down interest rates.

In Germany, the main factors behind the decline in long-term interest rates from the early 1990s to the early 2000s is the decline in the potential growth rate and the expected inflation rate, which are similar to those in Japan. However, one of the factors behind the decline

[11] For the national burden ratio, the deviation from the all-sample average every year is used. Japan's national burden ratio is gradually increasing due to the increase in social security burden and tax revenue, and the gap with the national average is gradually narrowing. If the national burden ratio is lower than the national average, it will push down interest rates due to expectations for future fiscal consolidation. However, the depressing factor became smaller in the latter half of the 2010s than in the first half of the 2000s; therefore, the national burden ratio became a factor for raising interest rates from the first half of the 2000s to the latter half of the 2010s

Figure 5. Factor Decomposition of the Decline in Estimated Nominal Long-term Interest Rates



(Note) The early 1990s is 1990-1994, the early 2000s is 2000-2004, and the late 2010s is 2015-2019. The rate of change is the annual average.

in interest rates from the early 2000s to the latter half of the 2010s is the rise in the monetary base due to unconventional monetary policy, as in Japan and the United States. Nevertheless, the reduction in fiscal risks due to the improvement in the fiscal balance and the expansion of the current account surplus also contributed to lowering interest rates.

What should be pointed out through the comparison of the three countries is the factor that pushed down interest rates from the early 2000s to the latter half of the 2010s. In Japan, unlike the United States and Germany, low interest rates rely exclusively on expanding the monetary base. Many other factors increase interest rates. Therefore, if monetary policy reaches a turning point and weakens monetary easing or shifts to tightening, the factors that curb the upward pressure on interest rates will disappear, and interest rates may rise rapidly in Japan.

IV-3. Period Division

The 1990-2019 period covered by our analysis includes the period of the global financial crisis that began in 2008. In this section, the estimated period is divided into before and after the global financial crisis—that is, the first half (1990-2007) and the second half (2008-2019).

First, the estimation results of the 25 countries are shown in Table 5 (first half) and Table 6 (second half). In the first half, the coefficients of the potential growth rate show positive signs significantly in all of the columns (1)-(5); however, in the second half, not all of them are significant, and some of them are negative. This suggests that the determinants of nominal long-term interest rates changed from the first to the second half. In addition, the coefficient of determination often declined in the second half.

Although the coefficients of the output gap show significant and positive signs in the second half, they show opposite signs in the first half. The total savings rate and the private debt growth rate are not significant in both the first and second halves, but the coefficients of the young share show significant signs in both periods.

The coefficient of the global saving glut shows a significant negative sign in the first half, but the sign is opposite in the second half. These estimation results are consistent with the claim by Bernanke (2005), who points out the global saving glut before the global financial crisis when oil prices soared, and China emerged as a global "factory."

The coefficients of the impact of foreign interest rates show significant and positive signs in both periods. On the other hand, the current account balance as a proxy for home bias tends to show its effect more strongly in the second half than in the first half.

The coefficients of expected inflation rate often show positive signs significantly in both periods.

Next, we focus on the fiscal risk indicators. The coefficients of the fiscal balance tend to be significantly negative in the first half but are not significant in most estimates in the second half. Conversely, the government debt outstanding does not give significant results in the first half, but it is significantly positive in many estimates in the second half. These find-

Table 5. Estimation Results 3 (25 countries, 1990-2007)
Dependent variable: Nominal long-term interest rates

sign		(1)		(2)		(3)		(4)		(5)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	0.574	4.053 **	0.617	4.128 **	0.636	3.664 **	0.311	1.983 *	0.574	3.997 **
+	output gap(-1)			-0.094	-1.609						
-	total savings rate(-1)					-0.064	-0.978				
+	young share							0.410	4.634 **		
+	private debt growth rate(-1)									-0.001	-0.076
-	global saving glut(-1)										
+	impact of foreign interest rates(-1)										
-	current account balance	-0.012	-1.180	-0.019	-1.840	-0.003	-0.283	0.012	1.112	-0.012	-1.181
-	net external assets(-1)										
+	10-year-ahead working-age population										
+	expected inflation rate	1.654	12.881 **	1.689	12.818 **	1.671	11.893 **	1.534	13.18 **	1.654	12.832 **
-	fiscal balance(-1)	-0.224	-5.638 **	-0.182	-5.582 **	-0.200	-4.289 **	-0.152	-3.860 **	-0.223	-5.625 **
+	government debt outstanding(-1)	0.002	0.262	0.003	0.415	0.002	0.206	-0.009	-1.235	0.002	0.253
+	net government debt outstanding(-1)										
+	European sovereign debt crisis dummy										
+	national burden ratio(-1)	-0.011	-0.253	-0.030	-0.615	-0.027	-0.592	-0.046	-1.153	-0.011	-0.243
-	monetary base	-0.052	-1.555	-0.052	-1.490	-0.050	-1.526	0.039	1.028	-0.052	-1.540
	constant	-0.646	-1.644	-0.027	-0.054	1.451	1.232	-11.481	-4.703 **	0.112	0.241
	Adjusted R-squared	0.808		0.810		0.808		0.832		0.808	
	S.E. of regression	1.202		1.196		1.201		1.123		1.204	
	Number of Observations	375		375		375		375		375	

sign		(6)		(7)		(8)		(9)		(10)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	0.328	1.941	0.126	0.644	0.753	4.125 **	0.248	1.749	0.086	0.494
+	output gap(-1)										
-	total savings rate(-1)										
+	young share										
+	private debt growth rate(-1)										
-	global saving glut(-1)	-0.175	-3.168 **								
+	impact of foreign interest rates(-1)			0.483	4.921 **						
-	current account balance	-0.010	-1.121	-0.043	-3.097 **	-0.010	-0.635			-0.001	-0.094
-	net external assets(-1)							0.001	0.216		
+	10-year-ahead working-age population					0.145	1.359				
+	expected inflation rate	1.501	8.784 **	1.312	6.396 **	1.403	6.739 **	1.605	9.410 **	1.674	10.980 **
-	fiscal balance(-1)	-0.105	-2.298 *	-0.088	-1.802	-0.206	-4.238 **	-0.237	-6.754 **	-0.228	-5.475 **
+	government debt outstanding(-1)	0.002	0.280	0.007	0.890	-0.001	-0.064	0.005	0.507		
+	net government debt outstanding(-1)									-0.007	-1.174
+	European sovereign debt crisis dummy										
+	national burden ratio(-1)	-0.042	-1.011	0.092	1.684	-0.013	-0.168	-0.011	-0.230	0.081	2.163 *
-	monetary base	0.038	0.958	-0.108	-2.385 *	0.069	0.954	-0.048	-1.576	-0.093	-3.436 **
	constant	1.340	1.722	1.276	2.567 *	-9.986	-1.330	1.021	1.558	1.511	2.127 *
	Adjusted R-squared	0.829		0.843		0.802		0.772		0.788	
	S.E. of regression	1.135		0.915		1.165		1.211		1.167	
	Number of Observations	375		207		219		311		336	

(Note) “Sign” represents an assumed sign condition. Absolute t-values, computed from heteroskedasticity-consistent standard errors, are in the right frame of each column. * and ** indicate that the sign of the coefficient is correct and statistically significant: * = significant at the 5% level; ** = significant at the 1% level.

Table 6. Estimation Results 4 (25 countries, 2008-2019)
Dependent variable: Nominal long-term interest rates

sign		(1)		(2)		(3)		(4)		(5)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	0.206	1.327	-0.014	-0.070	0.131	0.846	0.033	0.180	0.204	1.340
+	output gap(-1)			0.157	2.130 *						
-	total savings rate(-1)					0.137	1.639				
+	young share							0.479	4.366 **		
+	private debt growth rate(-1)									0.023	1.387
-	global saving glut(-1)										
+	impact of foreign interest rates(-1)										
-	current account balance	-0.059	-2.200 *	-0.050	-1.828	-0.082	-2.447 *	-0.025	-0.995	-0.060	-2.262 *
-	net external assets(-1)										
+	10-year-ahead working-age population										
+	expected inflation rate	0.747	2.923 **	0.520	2.338 **	0.682	2.717 **	0.633	2.512 *	0.601	2.461 *
-	fiscal balance(-1)	-0.047	-0.441	-0.118	-1.243	-0.095	-0.997	-0.043	-0.432	-0.079	-0.814
+	government debt outstanding(-1)	0.048	2.285 *	0.052	2.511 *	0.053	2.396 *	0.056	2.610 **	0.049	2.393 *
+	net government debt outstanding(-1)										
+	European sovereign debt crisis dummy	4.041	3.547 **	4.487	3.615 **	4.005	3.498 **	3.799	3.336 **	4.103	3.652 **
+	national burden ratio(-1)	-0.043	-0.364	0.073	0.754	0.010	0.089	-0.020	-0.167	-0.018	-0.166
-	monetary base	-0.041	-4.521 **	-0.041	-4.926 **	-0.041	-4.096 **	-0.021	-2.414 *	-0.037	-3.935 **
	constant	1.808	3.033 **	2.495	3.720 **	-1.166	-0.666	-10.836	-4.436 **	1.829	3.080 **
	Adjusted R-squared	0.668		0.673		0.671		0.682		0.735	
	S.E. of regression	1.354		1.342		1.348		1.324		1.733	
	Number of Observations	299		299		299		299		299	

sign		(6)		(7)		(8)		(9)		(10)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	-0.090	-0.947	-0.091	-0.459	-0.037	-0.290	0.388	1.915	-0.061	-0.487
+	output gap(-1)										
-	total savings rate(-1)										
+	young share										
+	private debt growth rate(-1)										
-	global saving glut(-1)	0.506	10.345								
+	impact of foreign interest rates(-1)			1.198	9.245 *						
-	current account balance	-0.037	-1.365	-0.055	-1.791	-0.039	-1.343			-0.033	-2.332 *
-	net external assets(-1)							-0.015	-1.760		
+	10-year-ahead working-age population					0.729	7.049 **				
+	expected inflation rate	0.101	0.503	-0.088	-0.271	0.466	2.237 *	0.884	4.569 **	0.837	3.432 **
-	fiscal balance(-1)	-0.131	-3.316 **	-0.037	-0.670	-0.005	-0.080	-0.143	-1.564	-0.038	-0.377
+	government debt outstanding(-1)	0.036	1.921	0.045	2.183 *	0.030	1.306	0.023	1.054		
+	net government debt outstanding(-1)									0.000	-0.043
+	European sovereign debt crisis dummy	4.168	3.935 **	7.081	4.286 **	3.995	3.731 **	3.905	3.101 **	4.233	3.431 **
+	national burden ratio(-1)	-0.062	-0.727	-0.234	-1.801	-0.141	-1.729	-0.053	-0.542	0.077	0.668
-	monetary base	0.011	2.167	0.009	1.472	-0.008	-1.879	-0.038	-4.699 **	-0.043	-4.529 **
	constant	-0.144	-0.362	0.960	1.573	-44.153	-6.839 **	0.738	1.287	2.027	4.113 **
	Adjusted R-squared	0.782		0.800		0.734		0.664		0.641	
	S.E. of regression	1.098		1.100		1.212		1.370		1.426	
	Number of Observations	299		208		299		294		287	

(Note) “Sign” represents an assumed sign condition. Absolute t-values, computed from heteroskedasticity-consistent standard errors, are in the right frame of each column. * and ** indicate that the sign of the coefficient is correct and statistically significant: * = significant at the 5% level; ** = significant at the 1% level.

ings suggest that the indicators that warn global investors of fiscal risks have changed as the government debt of each country increased after the global financial crisis. However, the coefficients of the European debt crisis dummy show significant and positive signs in the latter period, but the national burden ratio gives almost no significant results in either period.

The coefficients of the monetary base show almost negative signs in both periods, and there are more significant results in the second half than in the first half. Therefore, we can point out the effect of depressing long-term interest rates by unconventional monetary policy.

The estimation results of the 15 countries are shown in Table 7 (first half) and Table 8 (second half). As they are almost the same as the estimation results of the 25 countries, we can see that our estimation results are robust. However, a detailed comparison of both estimation results shows some differences in the second half. In the 15 countries, the potential growth rate has a strong effect on interest rates, the effect of home bias is strong, and the effect of the national burden ratio on interest rates is found.

IV-4. Nominal Growth Rate and Nominal Interest Rate

In section I, we mention that the emphasis on the effects of fiscal policy on macroeconomic policy are widespread among mainstream economists in the United States. Behind this is the fact that many countries have recently been confronted with the phenomenon in which nominal long-term interest rates fall below nominal growth rates.

Figure 6 shows the results of comparing nominal growth rates and nominal long-term interest rates in 25 countries. The percentage of countries whose nominal growth rates exceed the nominal long-term interest rates is only 26% on average over the 20 years from the 1980s to the 1990s but reaches 63% on average over the 20 years from the 2000s to the 2010s. Since 2015, the nominal growth rates have been higher in more than 80% of countries.

Therefore, to identify what causes the difference between the nominal growth rates and the nominal long-term interest rates, in this section, the “nominal growth rate - nominal long-term interest rate” is used as the dependent variable. Given the growing tendency for growth rates to exceed interest rates since the 2000s, the analysis in this section covers 2000-2019. As a result of the Wu-Hausman test, all the estimation results reported below are fixed effects models that control country-specific fixed factors, and no time dummy variable is added.

As explanatory variables, we use variables that are significant when the long-term interest rates are used as dependent variables. However, the potential growth rate and expected inflation rate are excluded because they affect both the nominal growth rate and nominal long-term interest rates. On the other hand, from our estimates up to the previous section, we find that the output gap does not significantly affect nominal long-term interest rates. However, the output gap is considered to affect the nominal growth rate; therefore, we adopt the output gap as an explanatory variable in this section. Some explanatory variables are lagged by one year to avoid endogeneity.

Table 7. Estimation Results 5 (15 countries, 1990-2007)
Dependent variable: Nominal long-term interest rates

sign		(1)		(2)		(3)		(4)		(5)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	0.723	4.370 **	0.768	4.896 **	0.694	4.177 **	0.397	2.086 *	0.725	4.350 **
+	output gap(-1)			-0.183	-2.928						
-	total savings rate(-1)					0.053	0.689				
+	young share							0.501	4.872 **		
+	private debt growth rate(-1)									-0.008	-0.920
-	global saving glut(-1)										
+	impact of foreign interest rates(-1)										
-	current account balance	-0.016	-1.052	-0.028	-1.464	-0.024	-1.045	-0.009	-0.726	-0.014	-0.907
-	net external assets(-1)										
+	10-year-ahead working-age population										
+	expected inflation rate	1.376	6.909 **	1.401	7.088 **	1.353	6.386 **	1.127	7.020 **	1.380	6.717 **
-	fiscal balance(-1)	-0.204	-4.317 **	-0.123	-2.486 *	-0.223	-4.065 **	-0.061	-1.054	-0.200	-4.390 **
+	government debt outstanding(-1)	-0.001	-0.162	0.001	0.099	0.000	-0.033	-0.010	-1.140	-0.003	-0.304
+	net government debt outstanding(-1)										
+	national burden ratio(-1)	-0.007	-0.111	-0.013	-0.196	0.015	0.196	-0.041	-0.675	0.003	0.047
-	monetary base	0.024	0.420	0.003	0.055	0.024	0.413	0.100	1.681	0.030	0.519
	constant	0.132	0.195	0.118	0.169	-0.994	-0.723	-13.561	-4.820 **	0.158	0.236
	Adjusted R-squared	0.798		0.807		0.800		0.840		0.799	
	S.E. of regression	1.154		1.128		1.170		1.028		1.153	
	Number of Observations	233		233		233		233		233	

sign		(6)		(7)		(8)		(9)		(10)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	0.458	2.346 *	0.248	1.371	0.690	4.120 **	0.410	1.788	0.162	0.867
+	output gap(-1)										
-	total savings rate(-1)										
+	young share										
+	private debt growth rate(-1)										
-	global saving glut(-1)	-0.180	-3.258 **								
+	impact of foreign interest rates(-1)			0.471	4.267 **						
-	current account balance	-0.011	-0.806	-0.007	-0.574	-0.017	-1.127			-0.018	-1.176
-	net external assets(-1)							-0.012	-1.404		
+	10-year-ahead working-age population					0.144	1.414				
+	expected inflation rate	1.218	5.021 **	1.249	6.025 **	1.360	6.596 **	1.293	6.843 **	1.313	6.511 **
-	fiscal balance(-1)	-0.072	-1.115	-0.151	-3.078 **	-0.188	-4.154 **	-0.180	-3.982 **	-0.200	-3.666 **
+	government debt outstanding(-1)	0.000	-0.004	-0.010	-1.081	0.002	0.201	0.003	0.348		
+	net government debt outstanding(-1)									-0.013	-1.874
+	national burden ratio(-1)	-0.026	-0.395	0.216	2.999 **	-0.029	-0.388	-0.118	-1.643	0.130	2.055 *
-	monetary base	0.096	1.428	0.046	0.716	0.052	0.758	0.080	1.198	-0.030	-0.707
	constant	1.503	1.697	0.202	0.260	-9.503	-1.337	0.491	0.568	2.133	2.356 *
	Adjusted R-squared	0.824		0.864		0.799		0.762		0.772	
	S.E. of regression	1.076		0.840		1.151		1.132		1.084	
	Number of Observations	233		133		233		197		204	

(Note) “Sign” represents an assumed sign condition. Absolute t-values, computed from heteroskedasticity-consistent standard errors, are in the right frame of each column. *and ** indicate that the sign of the coefficient is correct and statistically significant. * = significant at the 5% level; ** = significant at the 1% level.

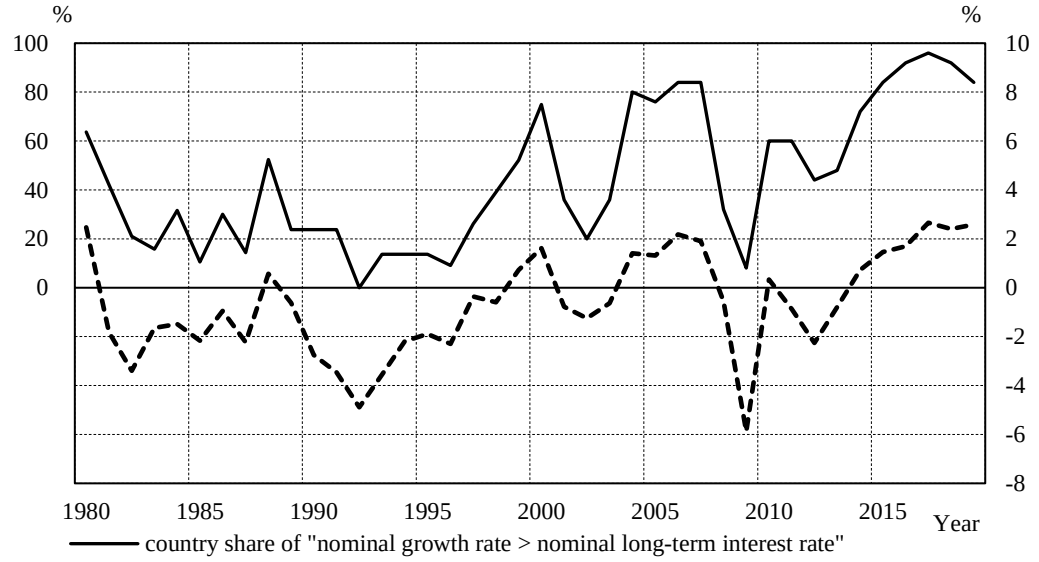
Table 8. Estimation Results 6 (15 countries, 2008-2019)
Dependent variable: Nominal long-term interest rates

sign		(1)		(2)		(3)		(4)		(5)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	0.607	3.734 **	0.421	1.812	0.613	3.850 **	0.538	2.849 **	1.413	4.234 **
+	output gap(-1)			0.135	1.819						
-	total savings rate(-1)					-0.007	-0.094				
+	young share							0.412	5.874 **		
+	private debt growth rate(-1)									0.025	1.649
-	global saving glut(-1)										
+	impact of foreign interest rates(-1)										
-	current account balance	-0.037	-4.449 **	-0.030	-3.933 **	-0.036	-2.588 **	-0.021	-3.076 **	-0.041	-5.177 **
-	net external assets(-1)										
+	10-year-ahead working-age population										
+	expected inflation rate	0.695	5.928 **	0.551	6.773 **	0.698	5.603 **	0.568	5.044 **	0.579	5.072 **
-	fiscal balance(-1)	-0.069	-0.770	-0.131	-1.846	-0.067	-0.771	-0.064	-0.747	-0.087	-1.080
+	government debt outstanding(-1)	0.024	5.166 **	0.026	6.820 **	0.024	4.057 **	0.026	5.819 **	0.025	3.773 **
+	net government debt outstanding(-1)										
+	national burden ratio(-1)	0.261	3.051 **	0.337	4.611 **	0.259	3.252 **	0.318	3.195 **	0.233	2.995 **
-	monetary base	-0.032	-6.605 **	-0.032	-8.080 **	-0.032	-6.655 **	-0.017	-3.496 **	-0.029	-6.072 **
	constant	1.461	3.699 **	2.265	3.441 **	1.607	0.951	-9.444	-5.778 **	1.413	4.234 **
	Adjusted R-squared	0.726		0.732		0.724		0.753		0.753	
	S.E. of regression	0.823		0.813		0.826		0.782		0.782	
	Number of Observations	179		179		179		179		179	

sign		(6)		(7)		(8)		(9)		(10)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
+	potential growth rate(-1)	0.089	0.915	0.260	1.469	0.041	0.339	0.492	3.617 **	0.446	2.247 *
+	output gap(-1)										
-	total savings rate(-1)										
+	young share										
+	private debt growth rate(-1)										
-	global saving glut(-1)	0.406	9.714								
+	impact of foreign interest rates(-1)			0.927	6.704 **						
-	current account balance	-0.017	-2.336 *	-0.025	-3.829 **	-0.009	-1.013			-0.043	-5.605 **
-	net external assets(-1)							-0.020	-4.401 **		
+	10-year-ahead working-age population					0.552	7.609 **				
+	expected inflation rate	0.268	3.252 **	0.440	3.111 **	0.561	9.302 **	0.908	5.600 **	0.773	5.835 **
-	fiscal balance(-1)	-0.078	-1.975 *	-0.020	-0.385	0.002	0.045	-0.106	-1.588	-0.078	-0.894
+	government debt outstanding(-1)	0.018	8.187 **	0.015	4.826 **	0.018	5.082 **	0.007	0.756		
+	net government debt outstanding(-1)									0.010	2.830 **
+	national burden ratio(-1)	0.062	0.932	-0.017	-0.239	0.097	1.753	0.143	2.938 **	0.252	2.913 **
-	monetary base	0.001	0.154	0.002	0.363	-0.014	-5.312 **	-0.030	-6.400 **	-0.031	-5.323 **
	constant	0.223	0.638	-0.015	-0.040	-32.946	-7.370 **	0.760	2.024 *	1.442	3.267 **
	Adjusted R-squared	0.894		0.857		0.820		0.764		0.712	
	S.E. of regression	0.512		0.552		0.668		0.769		0.843	
	Number of Observations	179		118		179		176		167	

(Note) “Sign” represents an assumed sign condition. Absolute t-values, computed from heteroskedasticity-consistent standard errors, are in the right frame of each column. * and ** indicate that the sign of the coefficient is correct and statistically significant: * = significant at the 5% level; ** = significant at the 1% level.

Figure 6. Relationship of Nominal Growth Rate and Nominal Long-Term Interest Rate in 25 Countries



(Source) Author calculations, IMF “International Financial Statistics”

The estimate results in Table 9 show that the output gap tends to be significantly negative in the 15 countries. This suggests that in the 15 countries, nominal long-term interest rates are not significantly affected by economic trends, resulting in a gap between nominal long-term interest rates and nominal growth rates.

In both the 25 countries and the 15 countries, the following three show significant signs: the impact of foreign interest rates, the 10-year-ahead working-age population, and the monetary base.

The impact of foreign interest rates is a proxy for the sovereign spillover effect. In the Euro area, the unique conditions of the Euro area, such as the unification of monetary policy and the sovereign spillover effect during the European debt crisis, may create a gap between the nominal growth rates and nominal long-term interest rates. However, the coefficients of impact of foreign interest rates show significant signs not only in the 25 countries but also in the 15 countries. Therefore, the cause of this gap cannot be explained only by special factors in the Euro area. In other words, it is assumed that this gap will occur in one country due to the spread of interest rate declines in other countries caused by slowing growth and unconventional monetary policy.

The 10-year-ahead working-age population has a larger impact on the future nominal growth rate than the current nominal growth rate. As expectations for future growth decline, investors are willing to pay for safe assets, and government bonds become more popular. Such investor behaviors push down nominal long-term interest rates, which creates a gap between nominal growth rates and nominal long-term interest rates. In addition, a shortage of safe assets to investor demand accelerates the decline in government bond yields. This

trend can be prolonged, as demographics are unlikely to change much in the short term. In other words, we can predict that investors' preference for safety will continue to put downward pressure on nominal long-term interest rates over the long term.

In addition, the expansion of the monetary base has significantly contributed to the de-

Table 9. Estimation Results 7 (2000-2019)
Dependent variable: Nominal growth rates - nominal long-term interest rates

＜25 countries＞

sign		(1)		(2)		(3)		(4)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
-	output gap(-1)	-0.286	-1.739	-0.325	-1.942	-0.355	-1.713	-0.323	-2.014 *
+	total savings rate(-1)	-0.127	-1.347						
-	young share			0.176	0.792				
-	impact of foreign interest rates(-1)					-1.050	-4.815 **		
+	current account balance	0.097	3.570 **	0.091	2.478 *	0.046	1.917	0.062	2.114 *
-	10-year-ahead working-age population							-0.285	-2.642 **
+	fiscal balance(-1)	0.122	1.558	0.065	0.589	0.169	1.502	0.123	1.446
-	government debt outstanding(-1)	-0.040	-2.164 *	-0.036	-1.989 *	-0.012	-0.855	-0.032	-1.657
-	European sovereign debt crisis dummy	-12.893	-7.060 **	-12.804	-7.503 **	-19.400	-4.470 **	-13.086	-7.305 **
-	national burden ratio(-1)	-0.063	-0.384	0.017	0.081	0.130	0.718	-0.031	-0.199
+	monetary base	0.043	3.167 **	0.059	2.874 **	-0.013	-1.041	0.020	1.801
	constant	2.865	1.359	-5.253	-0.771	2.624	4.854 **	18.630	2.593 **
	Adjusted R-squared	0.395		0.396		0.553		0.404	
	S.E. of regression	2.926		2.925		2.505		2.906	
	Number of Observations	487		487		312		487	

＜15 countries＞

sign		(1)		(2)		(3)		(4)	
		coeff.	t-values	coeff.	t-values	coeff.	t-values	coeff.	t-values
-	output gap(-1)	-0.294	-1.905	-0.318	-2.060 *	-0.591	-2.822 **	-0.390	-2.629 **
+	total savings rate(-1)	-0.179	-1.772						
-	young share			-0.144	-0.778				
-	impact of foreign interest rates(-1)					-1.049	-3.715 **		
+	current account balance	0.095	2.278 *	0.055	1.533	0.004	0.126	0.040	1.086
-	10-year-ahead working-age population							-0.308	-2.962 **
+	fiscal balance(-1)	0.051	0.495	0.020	0.156	0.262	3.448 **	0.070	0.633
-	government debt outstanding(-1)	-0.015	-0.947	-0.010	-0.551	0.009	1.144	-0.008	-0.510
-	national burden ratio(-1)	-0.147	-0.702	-0.144	-0.570	0.050	0.356	-0.067	-0.342
+	monetary base	0.039	3.201 **	0.034	2.122 *	-0.018	-1.420	0.019	1.845
	constant	3.851	1.639	3.623	0.694	2.954	3.569 **	19.969	3.123 **
	Adjusted R-squared	0.105		0.101		0.321		0.125	
	S.E. of regression	2.682		2.688		1.977		2.653	
	Number of Observations	297		297		183		297	

(Note) "Sign" represents an assumed sign condition. Absolute t-values, computed from heteroskedasticity-consistent standard errors, are in the right frame of each column. * and ** indicate that the sign of the coefficient is correct and statistically significant: * = significant at the 5% level; ** = significant at the 1% level.

cline in nominal long-term interest rates. In other words, unconventional monetary policy is also a significant factor in nominal long-term interest rates below the nominal growth rates. However, we must be aware that the gap created by monetary policy will inevitably be close if monetary policy changes.

The major difference between the 25 and the 15 countries is the impact of fiscal risks. As the 25 countries include those facing the European debt crisis, the coefficients of government debt and the European debt crisis dummy show significant signs. However, in the 15 countries, not including those in the European debt crisis, fiscal risks have little impact.

V. Conclusion

In Japan, nominal long-term interest rates remain near 0%, despite the accumulation of government debt. Such anomalous low interest rates are now a global phenomenon, not just in Japan. In this paper, we identify the main factors behind the decline in nominal long-term interest rates worldwide and analyze why interest rates remain low in Japan despite the accumulation of government debt. We conduct a quantitative analysis based on panel data of 25 OECD members from 1990-2019. The main results are summarized below.

First, the long-term movement of nominal long-term interest rates is shaped by two factors: the potential growth rate and expected inflation rate. Thus, the decline in potential growth and expected inflation experienced by many advanced economies has been a major factor in the global trend of nominal long-term interest rates since the 1990s.

Demographic changes also affect interest rates. We find that the decline in the younger generation with high consumption and excess savings helps lower interest rates. In addition, as the working-age population is expected to decline in the future, lower expectations for future growth lead to a shortage of capital investment, and investors' preference for safety seems to put downward pressure on interest rates.

On the other hand, fiscal risks put upward pressure on interest rates. The indicators that warn global investors of fiscal risks have changed since the global financial crisis, which triggered the expansion of government debt worldwide. It is the fiscal balance before the crisis that put pressure on interest rates, but after the crisis, it changed to government debt outstanding. In addition, the countries in the European debt crisis appear to be under additional upward pressure on interest rates. Moreover, the national burden ratio also affects interest rates. In countries with relatively low national burden ratios, such as Japan, it is thought that a low burden leads to expectations for future fiscal consolidation, and the upward pressure on interest rates decreases. In Japan, however, the national burden ratio is gradually rising, and the gap with other countries is narrowing. Therefore, we cannot expect much from this in the future.

Monetary policy also has an impact on interest rates. In particular, the impact of the unconventional monetary policy adopted in Japan, the United States, and the Euro area after the global financial crisis plays a significant role in lowering the global interest rate.

Furthermore, due to the progress of economic globalization, the decline in interest rates

in one country spreads to other countries through the spillover effect. This means that the downward pressure on interest rates due to the unconventional monetary policy of major central banks spread to other countries. In addition, the global savings glut caused by the expansion of savings in emerging and oil-producing countries in the 2000s is also a factor in the decline in interest rates in developed countries. Although there are cross-border effects in this way, the effects of home bias are also observed.

As mentioned above, low interest rates worldwide are caused by a combination of various factors. Therefore, we identify which of these factors have a strong effect in Japan. Government debt is continuously expanding in Japan, and there is pressure to raise interest rates due to fiscal risks. However, until the early 2000s, the decline in potential growth and expected inflation curbed this upward pressure on interest rates. From then onward, unconventional monetary policy plays that role.

Since the beginning of the 2000s, nominal long-term interest rates have been observed to fall below the nominal growth rates in many countries. If this situation continues, the budget deficit will not be a major problem, but there is no guarantee that low interest rates below the nominal growth rates will continue.

The analysis of the factors that create the gap between the nominal growth rates and the nominal long-term interest rates shows that investors' preference for safety, unconventional monetary policy, and the sovereign spillover effect play a principal role.

Investors' preference for safety stemming from lower expectations for future growth strongly depends on demographic changes, such as a decline in the working-age population in the future. Considering that demographics will not change much in the short term, it is highly likely that the downward pressure on interest rates due to investors' preference for safety will remain for a long time. On the other hand, the downward pressure on interest rates due to unconventional monetary policy will change completely if monetary policy changes. In Japan, the upward pressure on interest rates due to fiscal risks is suppressed by unconventional monetary policy. Taking this into account, it is necessary to pave the way for fiscal consolidation before the transition of monetary policy.

If unconventional monetary policy continues in the United States and the Euro area, the sovereign spillover effect may curb the rise in interest rates in Japan. However, if the Federal Reserve and ECB's monetary policy shifts earlier than Japan, it will act to put upward pressure on Japan's interest rates through the sovereign spillover effect. In fact, since the spring of 2021, financial market participants have begun to expect the Fed may raise interest rates sooner than their previous expectation as the United States pulls out of the COVID-19 pandemic.

Based on the discussion above, we should not consider the condition in which the nominal growth rates exceed the nominal long-term interest rates as eternal. However, as Blanchard argues, fiscal risks do not immediately lead to soaring interest rates, but it is difficult to suppress the upward pressure on interest rates due to the expansion of fiscal risks. The unconventional monetary policy in advanced countries will also end one of these days. Therefore, there is not much room for the expansion of fiscal spending in Japan, where gov-

ernment debt accumulates.

Finally, we describe the future issues left in the empirical studies in this paper. This study emphasizes the fact that low interest rates are a global phenomenon and analyzes the factors for the decline in long-term interest rates using panel data covering 25 countries. Therefore, we do not pay sufficient attention to Japan's unique circumstances, such as the high domestic holding ratio of government bonds and the trend of holding government bonds by private financial institutions. In addition, more attention should be paid to the dynamics of each variable and the role of future expectations. To verify the robustness of the empirical results in this study, we need a general equilibrium model that incorporates variables that represent Japan's unique circumstances and future expectations and handle the dynamism of each variable. The above will be an issue for future research.

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