openness is comparatively small, but largest in Brazil given relatively high import tariffs.

For all countries, raising labor productivity growth by moving to best practices in various policy areas appears especially desirable in the current context where productivity growth has been trending down and some research suggests that there could be a negative link between demographics and productivity growth (Feyrer, 2007[5]; Jones, 2020[6]). If productivity growth depends on the generation of new ideas and inventions, and if the rate at which this occurs is proportional to the size of the population, then it is worrisome for productivity that global population growth is slowing, and that the population is projected to fall by 2060 in six of the G20 countries, including Japan and China. Even where the population will continue to grow, workers are getting older. Given findings that suggest a negative association between productivity growth and the average age of the workforce, investing in youth through more and better education and boosting productivity with institutional and policy reforms seems all the more appealing.

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[1] See Box 1 in Guillemette and Turner (2018[7]) for an overview of the model and for references to more detailed explanations.

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How does population aging affect the effectiveness of monetary and fiscal policy?

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INTRODUCTION

How does population aging affect the effects of macroeconomics policies? Due to declining fertility and rising life expectancy, many countries are facing rapid aging of their populations. According to the population projection by the United Nations, the old-age dependency ratio (the proportion of people aged 65 or older in a working-age population) will double by 2050 (Figure 1). These demographic changes cause qualitative and quantitative changes in the demand and supply of the entire economy. In response to population aging, research analyzing the impact of population aging on the macroeconomy is growing. However, little attention has been paid to the impact of population aging on the effectiveness of macroeconomics policies.

The purpose of this article is to study how population aging would affect the macroeconomic effects of monetary and fiscal policies. It is based on a longer paper (Yoshino and Miyamoto, 2019) that exam-

ines the effects of population aging on economic performance and the effectiveness of monetary policy by using a dynamic stochastic general equilibrium (DSGE) model with heterogeneous households (comprising young and old households).

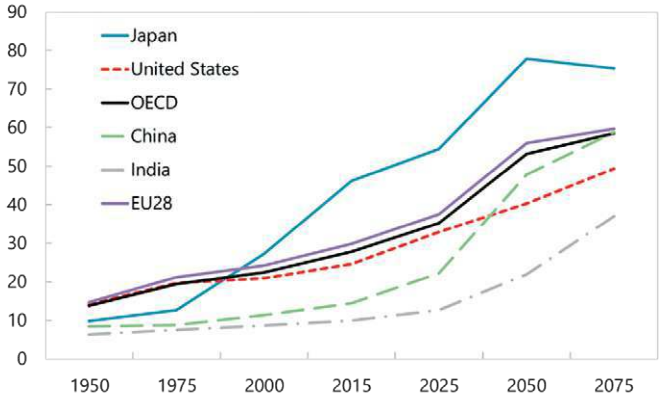
The novelty of the study is the development of a tractable DSGE model that enables us to examine the effects of demographic changes on the economy without assuming the life-cycle of the agents. Our model shows that a decline in the working population reduces aggregate output, consumption and investment by reducing total labor supply in the long run. We also find that the effectiveness of monetary policy diminishes when the working population declines.

The article also empirically examines the effect of population aging on the output effects of fiscal policy shocks by using a panel data of Organisation for Economic Co-operation and Development (OECD) countries. We identify the fiscal policy shocks as forecast errors of government spending, estimate their output effects, and examine how population aging modifies the output effects of fiscal policy shocks.

We find that demographic structure affects the output impact of government spending shocks. While in non-aging economies, the government spending shock increases output significantly in both the short- and medium-term, in aging economies, output responses are not statistically significant.

These results have important policy implications. Our analyses show that neither monetary policy nor fiscal policy would be effective in aging economies, and structural reform measures would have a more important role. Our model suggests that postponing retirement age by paying a productivity wage rate and asking people to work as long as possible are helpful factors. This policy recommendation would increase the labor force and reduce the burden of social security expenses. Budget deficits would decrease, and fiscal sustainability could be achieved even if the economy is faced with an aging population.

Figure 1: Old-age dependency ratios (%)



Source: United Nations.

Most related to this study is Yoshino and Miyamoto (2017), which shows that population aging weakens the effectiveness of macroeconomic policies by using a new Keynesian DSGE model. Imam (2013) and Wong (2019) also point out that population aging would reduce the effects of monetary policy on inflation and output. Rachedi and Basso (2019) show that fiscal multipliers depend on the age structure of the population at the state level in the US.

QUANTITATIVE ANALYSIS

The economic model in Yoshino and Miyamoto (2019) allows the examination of how a demographic change influences the economy. We first examine the long-term effects of a change in the proportion of the working population on the aggregate economy. We then investigate how a change of demographic structure alters the effectiveness of monetary and fiscal policies in the short run.

The long-term effect of population aging

An increase in the proportion of workers caused by making retired people return to the labor force increases output, aggregate consumption, aggregate investment, and total labor input. These responses can be understood by examining the response of taxes paid by workers. In the economy, the pension benefits are transfers from tax payments by workers to retirees. Since the amount of pension benefits per retiree is fixed, an increase in the proportion of the working population reduces each worker's tax burden. As a retired person receives a fixed amount of pension benefits and consumes all of it in each period, consumption of retirees does not change. In contrast, worker consumption increases due to the reduction of tax. This leads to a higher aggregate consumption.

»Demographic structure affects the output impact of government spending shocks.«

The positive disposable income effect caused by a reduction of taxes also reduces the labor supply of each worker. However, an increase in the working population caused by making retired people return to the labor force pushes up the total labor supply, leading to higher output. The decrease in the proportion of retirees reduces the amount of investment of each worker. However, aggregate investment increases due to the increase in the working population.

Interestingly, wages rise as labor participation increases. This is because the increase in the working population increases the capital–labor ratio. Since an increase in the working population increases workers' consumption, welfare increases as labor participation increases.

»Population aging weakens the effectiveness of monetary policy on the economy.«

Dynamics of aging populations and monetary policy

We now examine the dynamic responses of the economy to a monetary policy shock and how population aging affects the effectiveness of monetary policy.

Lowering the interest rate increases inflation. In turn, the resulting decrease in the real interest rate boosts consumption and investment. Increased demand puts upward pressure on the process of production factors, leading to higher wages and increased working hours.

An expansionary monetary policy shock on an economy with a lower proportion of workers also has a dynamic effect. A change in the demographic structure does not affect the qualitative responses of the economy to the monetary policy shock. However, it does affect the quantitative responses of endogenous variables to the shock.

Population aging weakens the effectiveness of monetary policy on the economy. In particular, the positive impact of the monetary policy shock on consumption is weakened in an aging economy. This is because the proportion of the working population that is positively affected by the expansionary monetary policy shock decreases. Given the fact that consumption accounts for about 60% of gross domestic product (GDP) in the Japanese economy, the reduction of total consumption brings about a significant negative impact on the economy. While monetary policy has had less of an impact on investment in recent years, as shown in the work of Yoshino, Taghizadeh-Hesary, and Miyamoto (2017), our result implies that the effects of monetary policy are weakened in an aging economy.

EFFECTIVENESS OF FISCAL POLICY AND POPULATION AGING

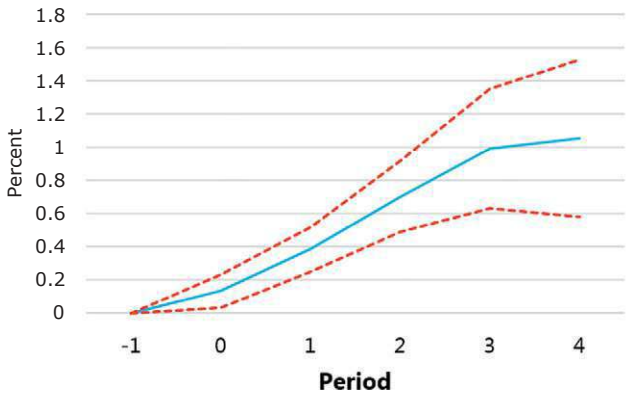
Population aging also affects the output effects of a government spending shock. The government spending shock is identified by a forecast error, and its output effects are estimated by using the local projection method. Using data from the OECD's Statistics and Projections Database, we find that the output effect of fiscal policy is more likely to be smaller in countries where population aging is proceeding.

Empirical results

We first examine the average effect of the government spending shock. Figure 2 displays the impulse responses to an increase of government consumption by 1%. In this and subsequent figures, the horizontal axis measures years, while the vertical axis measures the deviation from pre-shock in percent for output. Dashed lines indicate 90% confidence bounds. An expansionary government spending shock increases output by about 0.1% in the same year. Using the sample average of government spending as a share of GDP, this implies a short-term fiscal multiplier of 0.7. The government spending shock also has long-lasting effects on output. Output increases by about 1.1% four years after the shock.

We now turn to examining how population aging affects the output impact of the government spending shock. Figure 3 shows the results of the empirical analysis further detailed in Yoshino and Miyamoto (2019). The output effects of government spending shocks differ between countries with a high share of youth population (non-aging economies) and countries with a low share of youth population (aging economy). In non-aging economies, the positive government spending shock increases output by about 0.3% in the same year and by about 1.5% in the medium term. The implied short-term fiscal multiplier is 1.46. In contrast, in aging economies, the response of output is not statistically significant. This result is consistent with the prediction of Yoshino and Miyamoto (2017). They show that macroeconomic impacts of fiscal policy shocks are weakened when population aging occurs by using a new Keynesian DSGE model with heterogeneous households.

Figure 2: Output effects of an expansionary government spending shock



Note: t=0 is the year of the shock. Solid and dashed lines denote the point estimates and 90% confidence bands, respectively.

CONCLUSION

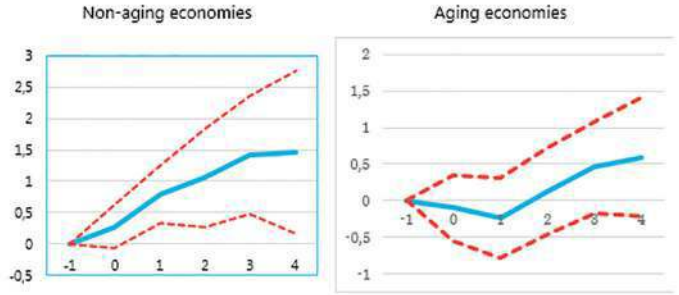
The world is in the midst of a demographic change toward population aging. Population aging can have significant effects on the macroeconomy. This article studies how population aging affects the effectiveness of monetary and fiscal policies. By using a DSGE model and panel data analysis, we find that population aging weakens the output effect of monetary and fiscal policies.

We can draw out important policy implications from our analyses. As neither monetary policy nor fiscal policy would be effective in aging economies, structural reform measures would have a more important role.

Let us consider specifically the case of Japan, which has the world's oldest population. Japan's economy continues to suffer from long-term stagnation that dates back to bursting of its economic bubble three decades ago. Monetary and fiscal policies have been implemented to help the Japanese economy recover. Although these macroeconomic policies have brought temporary relief, a number of studies show that the effectiveness of monetary and fiscal policies has diminished (Nakahigashi and Yoshino, 2016; Yoshino et al., 2017). This is consistent with results of our analyses.

Our analyses suggest the following policy recommendations for Japan: (1) postpone the retirement age and ask people to work as long as possible; and (2) the wage rate must be based on productivity rather than following a seniority-based wage rate. These two recommendations will increase the labor force and reduce the burden of social security expenses. Budget deficits will decline, and fiscal sustainability could be achieved even if the economy is faced with an aging population. The results for Japan may also be applicable to other G20 countries facing aging populations.

Figure 3: Population aging and output effects of government spending shocks



Note: t=0 is the year of the shock. Solid and dashed lines denote the point estimates and 90% confidence bands, respectively.

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