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Long-term Estimates of Japan's Potential GDP – the impact of economic stimulus measures and the implications of the estimates upon the current economy –

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Long-term Estimates of Japan's Potential GDP

– the impact of economic stimulus measures and the implications of the estimates upon the current economy –

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Summary

1. According to estimates of parameters assuming the Cobb–Douglas production function which explains output as a function of capital input, labor input and total factor productivity shown by a linear time trend, Japan's capital share is 38% and total factor productivity growth is 0.8%. Moreover, Japan's capital share would be 41% and total factor productivity growth would be 0.7% up to 2000 and 1.0% from 2001 onward when taking into consideration the recent rise of productivity stemming from the progress of information technology. In other words, Japan's total factor productivity growth is pushed up approximately 0.3% by the progress of information technology.
2. Estimates of Japan's potential labor input based upon the working population, potential labor force participation rate and potential employment rate by gender and age groups and the potential working hours by work patterns reveal that Japan's potential labor input has already started to decline after peaking in 1989. Furthermore, the working–age population, potential labor force participation rate and potential working hours are predicted to keep falling, serving as a drag upon Japan's potential labor input.
3. According to estimates based upon capital investment, fixed capital consumption and potential capital utilization rate, Japan's potential capital input is continuing to rise. Looking forward, the increase of potential capital input is expected to slow down due to a slower pace of capital investment growth and rise of fixed capital consumption.
4. According to long–term estimates of Japan's potential gross domestic product (GDP) based upon potential labor input and potential capital input, Japan's potential GDP as of 2007 is approximately 549 trillion yen and the potential rate of growth is 1.54%. Looking forward, Japan's potential growth will be subject to strong downward pressures stemming from the decline of the working population, the fall of the labor force participation rate,

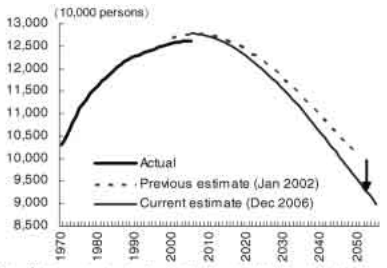
the decrease of working hours, the slowdown of capital investment and the rise of fixed capital consumption. Potential GDP is set to decline after peaking at 737 trillion yen in 2040. From then onward, Japan's potential economic growth should continue to decline.

5. Assuming population decline as a given, perceivable economic stimulus measures to prevent the decline of economic growth would include measures such as the following: (1) raise the minimum eligible age for receiving pension benefits, (2) promote the labor force participation among women, (3) promote the acceptance of foreign workers, (5) promote innovations. While each and all of these measures would contribute to Japan's potential growth, the mere promotion of the labor force participation among the elderly and women would be insufficient to maintain Japan's economic growth at the current level. Dependence upon foreign capital or foreign labor or the steady rise of innovations would be necessary. Note, however, the difficulty to guarantee the feasibility of these measures.
6. Envisaging changes in behavior of economic entities under conditions of negative economic growth, domestic demand–led industries would be driven to reduce costs, enlarge their size and seek overseas markets. Although the rise of per capita GDP would lead to a higher per capita standard of living, the concentration of corporate and public investment in terms of fields and geographic areas would lead to a wider gap in living conditions among different geographic areas.
7. Given a permanent decline of the growth rate, monetary policy itself may serve as deflationary pressures since the policy interest rate would face nonnegativity constraints. Moreover, considering the long–term estimates of potential GDP, downward pressures will tend to build upon interest rates in proportion to the length of the maturity and the yield curve will tend to flatten.

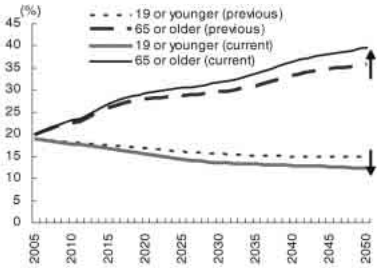
1. Introduction

In December 2006, the National Institute of Population and Social Security Research published the *Population Projections for Japan* up to 2055 (Note 1). Compared with the previous population projection in January 2002, the birthrate and average life expectancy serving as the basic premise of projection were both revised. As a result of a downward revision of the birthrate and an upward revision of average life expectancy, Japan's future demographic shifts are characterized by the decline of the total population and an acceleration of movements toward an aging population combined with a diminishing number of children (**Chart 1**).

Chart 1: Percentage of the youth and elderly population in Japan's population projections and total population



Note: Medium variant projections with respect to births and deaths.
Sources: Ministry of Internal Affairs and Communications,
National Institute of Population and Social Security Research.



Note: Medium variant projections with respect to births and deaths.
Source: National Institute of Population and Social Security Research.

These demographic shifts have serious implications upon the economy. In direct terms, a diminishing or aging population implies the decrease of labor input. Furthermore, in the event the aging population pushes down the saving rate in macroeconomic terms, capital investment would also be subject to negative impacts, thereby also affecting capital input. Companies would be compelled to develop management strategies based upon a diminishing domestic population. In the financial and capital markets, the fair value of

assets would be adjusted through changes in implicit economic growth expectations. Even in terms of economic policy, it may become necessary to shift away from a policy stance based upon assumptions of steady economic growth.

As Japan enters an age of a diminishing population, the purpose of this paper is to comprehend the impact of demographic shifts upon Japan's economy and to discuss the implications upon current economic conditions. Despite the difficulty to gain an accurate and comprehensive understanding of the economic impact of demographic shifts given its widespread and diverse impact upon the economy, this paper discusses the impact of demographic shifts upon future potential GDP on the basis of the production function approach.

In Section 2, this paper sets forth the methods for estimation of potential GDP which will serve as the basis of further discussions. More specifically, parameters are set upon the assumption of Cobb–Douglas production functions. On the basis of estimations and forecasts of potential labor input and potential capital input, Section 3 will conduct long–term estimates (up to 2055) of Japan's potential GDP and potential growth rate based upon the production functions obtained in Section 2. In Section 4, this paper will discuss the impact of policy measures upon potential GDP and the potential growth rate on the assumption that economic stimulus measures are taken in a bid to address changes in production factors (referred to as the "Case with stimulus measures"). Section 5 will examine the impact of the conclusions derived as a result of estimations and discussions up to Section 4 upon economic entities and financial markets, thereby drawing forth its implications upon the current economy.

2. The production functions

(1) The production function as an estimation method of potential GDP

We assume a Cobb–Douglas form production function as follows.

$$Y = \alpha K^{\beta} L^{(1-\beta)} e^{\gamma} u \quad \cdots \text{Eq (1)}$$

Equation (2) is derived by a logarithmic transformation of Equation (1) after dividing both sides of Equation (1) by labor input. β represents capital share and γ represents total factor productivity growth (Note 2).

$$\log\left(\frac{Y}{L}\right) = \alpha + \beta * \log\left(\frac{K}{L}\right) + \gamma * t \quad \cdots \text{Eq (2)}$$

(2) The variables

To identify the parameters of the production function, the parameters are estimated by assigning each of the variables *Y*, *K* and *L* in Eq (2). Further explanations (Note 3) are necessary since *Y*, *K*, and *L* may differ according to the estimator.

a. Y: Real GDP

With respect to real GDP, the real GDP figures (actual) in the *National Accounts* published by the Cabinet Office shall be assigned. Since data under the current standards are only available from 1994 onward, data series with respect to periods before 1994 are based upon a year–on–year comparison of the data under the former standards (Note 4). The results reveal that Japan's real GDP grew from approximately 200 trillion yen in 1970 to approximately 550 trillion yen in 2006. In contrast, the growth rate continued to follow a downward trend.

b. K: Capital Input

Although capital input in reality is calculated by multiplying

capital stock by the capacity utilization ratio (Note 5), there are significant variations depending upon what figures are assigned as capital input.

Firstly with respect to capital stock, a significant volume of prior studies refer to the actual real GDP figures in the *Gross Capital Stock of Private Enterprises* of the Cabinet Office. However, since these statistics are based upon a "gross" concept of capital which does not take into consideration the consumption of capital, there is a large possibility that actual capital input is overestimated. Therefore, this paper refers to capital stock on a "net" basis in the *JIP Database 2006* released by the Ministry of Economy, Trade and Industry (METI) (Note 6)

While there is also a considerable degree of variation in terms of the capacity utilization ratio, this paper refers to the "capacity utilization index" published by the METI with respect to manufacturers. As for nonmanufacturers, this paper applies a data series calculated in accordance with a method referred to as the "applied Wharton School method" used by the METI to calculate the activity level and capacity utilization ratio among nonmanufacturers (Note 7).

c. L: Labor input

Labor input in reality is calculated by multiplying the number of employed persons by working hours. Here we comply with the common practice of applying the figures in the *Labor Force Survey* of the Ministry of Internal Affairs and Communications for the number of employed persons and the figures in the *Monthly Labor Survey* of the Ministry of Health, Labor and Welfare for working hours.

(3) Parameter estimates

a. Productivity gains through the progress of information technology

As a result of calculations so far, we have obtained time series data with respect to Y, K and L. The parameters may now be

estimated by assigning these figures to Eq (2). Incidentally, a singular linear trend had been assumed as total factor productivity growth in Eq (2). In recent years however, we cannot rule out the possibility of structural productivity gains through the streamlining of operational processes, advances in inventory control and improvements in information accessibility as a result of the progress of information technology. Therefore, we shall also consider Eq (3) which factors in the impact of information technology advances upon real GDP (Note 8).

$$\log\left(\frac{Y}{L}\right) = \alpha + \beta * \log\left(\frac{K}{L}\right) + \gamma * t_1 + \delta * t_2 \quad \cdots \text{Eq (3)}$$

Where γ is total factor productivity growth during the entire period and δ is additional total factor productivity growth during the period in which information technology started to have an impact upon economic growth. In this paper, the estimation period of the production function is 1971 to 2006 and the time trend represented as t_1 increases during that time span. Furthermore, we assume that t_2 increases from 2001 onward. Although it is difficult to pinpoint the exact time in history when information communication technology started to have an impact upon the economy, this paper assumes that this point in time is 2001 when across–the–board corporate Internet access became the norm (Note 9).

b. Estimation of parameters

The estimations of the parameters in the production function are set forth in **Chart 2**. In the case of Eq (2) where total factor productivity growth is constant during the entire period, capital share is 38% and total factor productivity growth is 0.8%. In Eq (3), capital share is 41%, revealing a slightly higher contribution by capital. Total factor productivity growth is 0.7% for the period from 1971 to 2000 and 1.0% from 2001 onward because of a 0.3% rise due to the progress of information technology (Note 10).

As exemplified by the prolonged and stable expansion of the global economy, the current economy is following a growth pattern

very different from the past. The odds are high that productivity gains stemming from the progress of information technology are contributing in some way to growth. Thus, we shall adopt Eq (3) as the framework for the estimation of potential GDP.

Chart 2: Output function parameters

		α	β	γ	δ	Adj. R2	D.W.
Equation ②	coefficient	-6.716	0.380	0.008		0.997	1.079
	p-value	0.000	0.000	0.000			
Equation ③	coefficient	-6.904	0.407	0.007	0.003	0.997	1.089
	p-value	0.000	0.000	0.000	0.083		

Note: Time span of estimate: 1971~2006.
Source: Mizuho Research Institute Ltd. (MHRI)

3. Estimations of potential GDP and potential growth rate

In this Section, we shall conduct a long–term estimate of potential GDP and potential rate of growth during the period from 1971 to 2055. The estimates of future growth are based upon assumptions that no economic stimulus measures will be implemented for the changes in potential GDP and that the future path of potential labor input and potential capita input will continue to follow past trends.

(1) Potential labor input and its future path

While we stated before that labor input is calculated by multiplying the number of employed persons by working hours, the number of employed persons may be factorized as follows: working–age population × labor force participation rate × employment rate. Then, working–age population × potential labor

force participation rate × potential employment rate × potential working hours = potential labor input. We shall therefore estimate the potential labor input by examining the trends and future paths of (1) the working–age population, (2) the potential labor force participation rate, (3) the potential employment rate, and (4) potential working hours.

a. The working–age population

The working–age population refers to the population within the age group capable of engaging in productive activity, generally referring to the population aged 15 and above. The future working–age population in this paper is based upon the medium variant projections for fertility rates and death rates in the *Population Projections for Japan (January 2006)* by the National Institute of Population and Social Security Research (Note 11).

As of 2006, Japan's working–age population is 110.21 million (male population: 53.28 million, female population: 56.93 million). Even though the working–age population is still continuing to grow, the pace of increase is definitely slowing down. The working–age population will start to decline after reaching a peak at 110.73 million in 2012 and drop below 100 million in 2036. By 2055, the final year of the projection, the working–age population is estimated to diminish sharply to 82.41 million.

b. The potential labor force participation rate

The labor force participation rate is the percentage of persons with the incentive to work in the working–age population, excluding full–time housewives, students and pensioners. Therefore, changes in weights in terms of gender and age brackets in the working–age population would lead to changes in the macroeconomic labor force participation rate.

Given the large impact of gender and age brackets upon the labor force participation rate, the potential labor force participation rate in this paper is calculated by (1) estimating the potential labor force participation rate by gender and age brackets and (2) deriving the

weighted averages of the potential labor force participation rate under (1) by the population weights of each of the population brackets in each year. With respect to the potential labor force participation rates of each of the population brackets up to the present, trend components of the actual labor force participation rate are extracted by the H–P filter. The future potential labor force participation rates are estimated upon the assumption that there is a linear time trend with respect to the potential labor force participation rate up to the present and by making adjustments as necessary with respect to each population bracket. The potential labor force participation rate thus estimated is following a downward trend, due primarily to (1) a larger weight of the elderly population group having a low labor force participation rate to start out with, and (2) the decline of the labor force participation rate of the elderly population group. On the other hand, it is also true that the upward trend of the labor force participation rate of the young and middle–aged female population has served to alleviate somewhat the decline of the potential labor force participation rate due to aging.

Looking forward, the odds are high that the potential labor force participation rate will decline at a faster pace because of reasons such as the following: (1) a further rise of the ratio of the population aged 65 or older to the working–age population, (2) the decline of the potential labor force participation rate of the population aged 65 or older, and (3) the eventual peaking of the potential labor force participation rate of females in the 25~34 age group.

c. The potential employment rate

The employment rate refers to the percentage of persons who actually hold a job in the working–age population and is equivalent to the value derived by subtracting the unemployment rate from 1. Further explanations on the potential unemployment rate are as follows. In this paper, we shall perceive the potential unemployment rate as "the unemployment rate consistent with zero inflation". The estimation equations are set forth as Eq (4) and Eq (5) below. As in the previous section, we estimated the "unemployment rate

consistent with zero inflation" by gender and age groups on the basis of historical data and estimated the overall potential unemployment rate by a weighted average using the labor force population weights.

$$U^* = \sum W_i * U_i^* \quad \cdots \text{Eq (4)}$$

$$U_{i,t} = U_i^* + \alpha * \pi_{i,t} \quad \cdots \text{Eq (5)}$$

Where U^* is the potential unemployment rate, W is the labor force population weights of each population group, and π is the year–on–year percentage change of core CPI. (Note 12)

Even though the potential unemployment rate thus calculated is gradually falling due to changes in population and labor force participation rate, it is still moving at a level around 3.5% and should continue to follow a similar trend.

d. Potential working hours

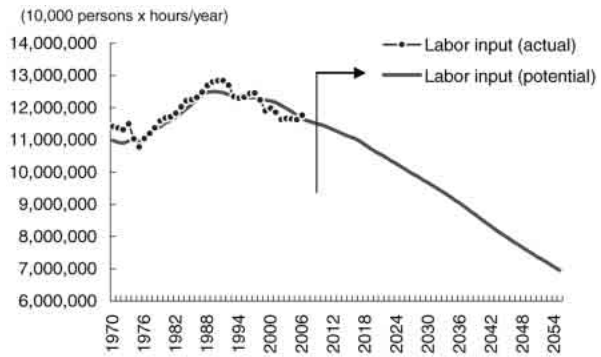
Total actual working hours have been following a downward trend, due to background factors such as policy initiatives for the reduction of work hours and the rise in percentage of part–time workers in the total number of employed persons. Therefore, it would be necessary to take due consideration of the reduction of working hours and the rise in ratio of part–time workers in the estimates of potential work hours. In this paper, working hours are divided into the following three segments: (1) scheduled (full–time workers), (2) scheduled (part–time workers), and (3) non–scheduled. Total working hours are estimated by totaling the foregoing segments. The total potential working hours obtained in this way is following a downward trend. The total potential working hours which stood at 2,227 hours/year in 1970 has diminished to 1,826 hours/year in 2006. Although a further reduction of working hours is not expected, potential working hours should continue to follow a gradual decline reflecting the moderate rise in ratio of part–time workers and the downtrend of nonscheduled working hours. Total potential working hours are predicted to fall below 1,800 hours/year in 2022 and fall to approximately 1,776 hours/year in

2005.

e. Potential labor input

Given the estimations on the working–age population, the potential labor force participation rate, the potential employment rate and the potential working hours, the potential labor input can be computed by multiplying the estimations. This is represented in **Chart 3**. As the chart shows, even though potential labor input has continued to rise since the 1970s, it is already declining after peaking in 1989 given the sharp decline of potential working hours due to the reduction of working hours. Looking forward, the working–age population, the potential labor force participation rate and the potential working hours are all set to diminish or decline. As a result, potential labor input is also set to follow a steady decline. Assuming that potential labor input in 2006 is 100, potential labor input would be 59.6 in 2055.

Chart 3: Past trends and future estimates of potential labor input



Source: MHRI, based upon Ministry of Internal Affairs and Communications, National Institute of Population and Social Security Research.

(2) Potential capital input and its future path

Capital input is calculated as: capital stock × capacity utilization rate, and its potential level would be: capital stock × potential capacity utilization rate. Capital stock is a function of capital

investment and capital consumption, which can be represented as Eq. 6 below. Therefore, estimations of capital investment and the rate of capital consumption for each term also enable the estimation of capital stock.

$$K_t = K_{t-1} + I_t - K_{t-1} * D_t \quad \cdots \text{Eq (6)}$$

Where K is capital stock, I is capital investment, D is fixed capital consumption.

In the following section, we shall examine the trends and future paths with respect to each of (1) capital investment, (2) fixed capital consumption, and (3) potential capacity utilization rate, and thereby estimate potential capital input.

a. Capital investment

Among the various concepts regarding the capital investment function, we shall refer to Kozu, Sato and Inada (2003) and stand upon the following assumption, focusing particularly upon the impact of demographic shifts upon capital investment (Note 13).

$$\log\left(\frac{Y_t}{L_t * H_t}\right) = \alpha + \beta * \log\left(\frac{K_{t-1} * O_t}{L_t * H_t}\right) + \gamma * t_1 + \delta * t_2 \quad \cdots \text{Eq (7)}$$

$$I_t / Y_t = 1 - C_t / Y_t - G_t / Y_t - NX_t / Y_t - OTH_t / Y_t \quad \cdots \text{Eq (8)}$$

$$C_t = Y_{d,t}(1 - s_t) \quad \cdots \text{Eq (9)}$$

$$Y_{d,t} = f(Y_t, t_t) \quad \cdots \text{Eq (10)}$$

Where Y is real GDP, L is the number of employed persons, H is working hours, O is the capacity utilization rate, C is household final consumption expenditures, G is government consumption + public investment, NX is net exports, OTH is other demand components, Yd is disposable income, s is the household saving rate, and t is the household tax burden rate.

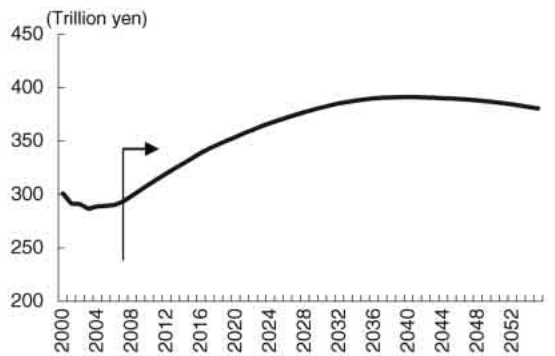
In Eq 7, L and H have been estimated already and O will be estimated below. It follows therefore, that Y in the current term may

be determined by determining K in the previous term. In Eq 8, C is a function of Yd and s. Yd is determined by Y and t, and s is determined based upon demographics. G, NX and OTH shall be determined separately.

(a) Household disposable income

To obtain capital investment by Eq 8, it would be necessary to determine each of the components of demand including household final consumption expenditures, government expenditures + public investment, net exports and other demand components. Let us turn first to household final consumption expenditures. Household final consumption expenditures is the value derived by subtracting savings from household disposable income (Eq 9). Here, we assume that an empirically observed linear relationship between household disposable income and labor compensation and household tax burdens will continue over the future (Eq 10). We assume that future labor compensation will change at the same rate as real GDP. We also assume that household tax burdens will change at the same rate as real GDP as long as there are no major changes in the tax system. The future trends in household disposable income thus estimated are set forth in **Chart 4** (Note 14).

Chart 4: Past trends and future estimates of household disposable income

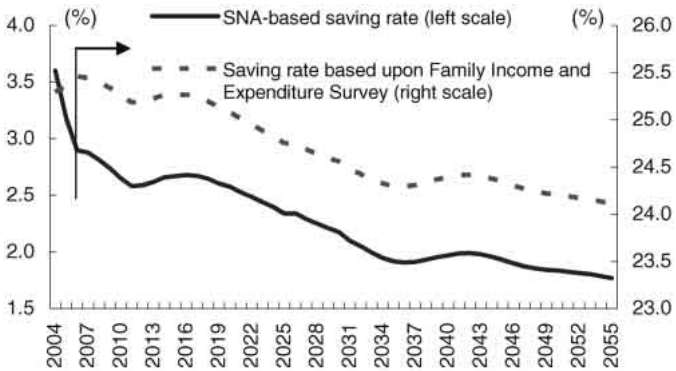


Source: MHRI, based upon Cabinet Office, *National Accounts* and others.

(b) Household saving rate

The household saving rate is believed to be affected strongly by changes in age structure due to demographic shifts. Put simply, the smaller the proportion of the elderly population having a high saving rate, the lower the saving rate. Assuming that the saving rates of each the age groups of the household head in the *Annual Report on the Family Income and Expenditure Survey* (FIES) of the Ministry of Internal Affairs and Communications will remain unchanged going forward, we shall examine how the savings rate will change as a result of changes in demographic structure in each age bracket. The trends in household savings rate, after adjusting the FIES–based saving rate to the SNA–based saving rate, is set forth in **Chart 5** (Note 15). The FIES–based saving rate, standing at 25.5% as of 2006, will fall to 24.1% in 2055. Likewise, the SNA–based saving rate is forecast to decline from 2.9% to 1.8%.

Chart 5: Past trends and future estimates of the household saving rate



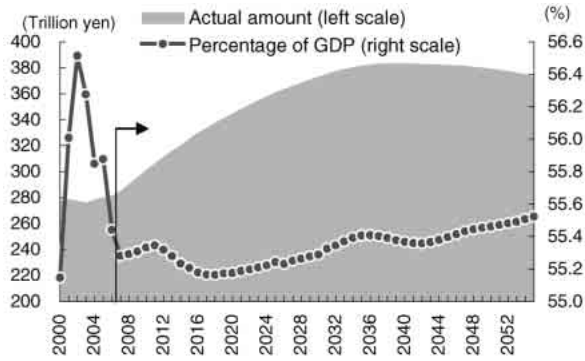
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications and others.

(c) Household final consumption expenditures

Calculations thus far enable the estimation of household final consumption expenditures. **Chart 6** below sets forth the trends in

household final consumption expenditures both in actual value and as a percentage of real GDP. Even though household final consumption expenditures increase along with the rise of household disposable income, it will take a downturn in the 2040s. In contrast, household final consumption expenditures as a percentage of real GDP should gradually increase.

Chart 6: Past trends and future estimates of household final consumption expenditures



Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications and others.

(d) Other components of demand

Although it is extremely difficult to accurately estimate the future paths of the components of demand other than household final consumption expenditures, this paper stands upon the following assumptions.

Exports, which we assume will grow at a pace comparable to global economic growth, are computed on the basis of the long–term forecast on the global economy by the Japan Center for Economic Research (JCER).

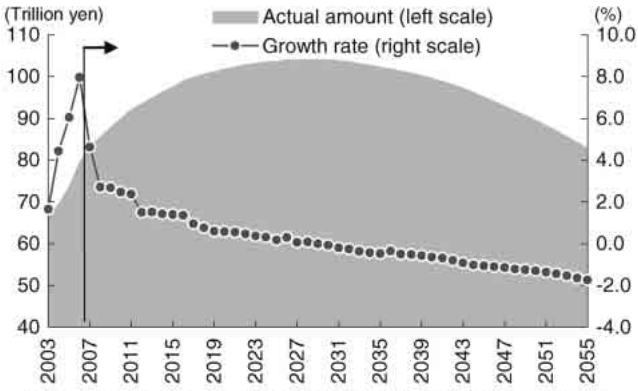
As for imports, a regression of the rate of import growth into export growth and household final consumption expenditure growth reveals that the contributions of each are approximately 0.2 : 0.8. Estimates on imports assume that such relations will continue in the

future.

Estimates on government–related demand and other components of demand are based upon assumptions that their ratios (the average during the past five–year period) as a percentage of real GDP will remain unchanged in the future. An exception is public investment which we assume will decrease at a rate of 3% per annum up to 2011 in accordance with the policies of the current Cabinet to pare down public works.

Estimates of future capital investment based upon the foregoing assumptions are set forth in **Chart 7**. Under these assumptions, capital investment growth will gradually slow down and its ratio as a percentage of real GDP will start to decline. Among the background factors are the rise in percentage of household final consumption expenditures in real GDP due to the decline of the household saving rate and the rise in percentage of real exports reflecting the global economic boom.

Chart 7: Future estimates of capital investment



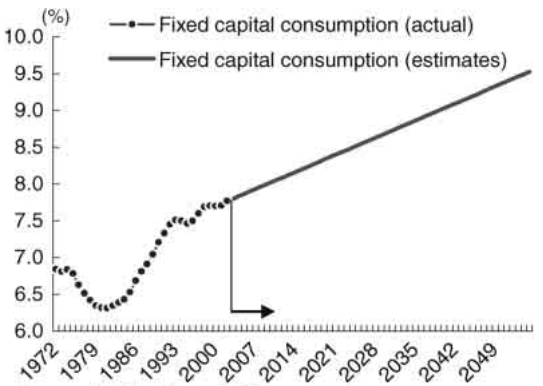
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications and others.

b. Fixed capital consumption

While fixed capital consumption is following a gradual upward trend, this may be an indication that the faster pace of technological

innovation is leading more readily to the obsolescence of equipment and facilities. Considering the slight slowdown in pace of fixed capital consumption in the 1990s, we assume a moderate rise of fixed capital consumption along a path following the trend from 1994 onward. Fixed capital consumption, currently standing around 7.9%, is estimated to reach approximately 9.5% in 2055 (**Chart 8**).

Chart 8: Past trends and future estimates of fixed capital consumption

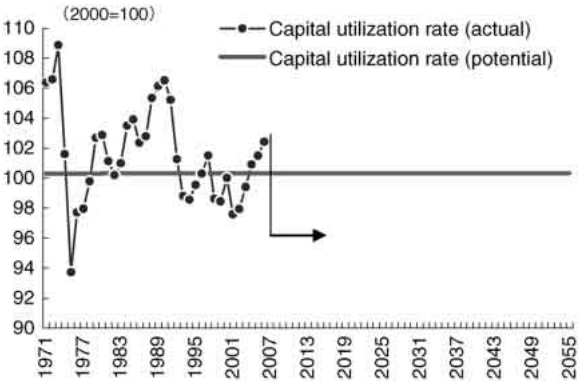


Source: JIP Database 2006.

c. Potential capital utilization rate

The potential capital utilization rate is deemed as "the rate of capital utilization consistent with zero inflation" as in the case of the unemployment rate. The value to date is calculated by the capital stock–weighted averages of the potential capital utilization rates of the manufacturing and nonmanufacturing sectors. Looking forward, the current capital utilization rate is assumed to remain unchanged. The results are set forth in **Chart 9** and the current potential capital utilization rate is 100.31. The actual capital utilization rate is rotating cyclically with the potential capital utilization rate as the axis. Currently, the actual capacity utilization rate is slightly above potential.

Chart 9: Past trends and future estimates of the potential capital utilization rate



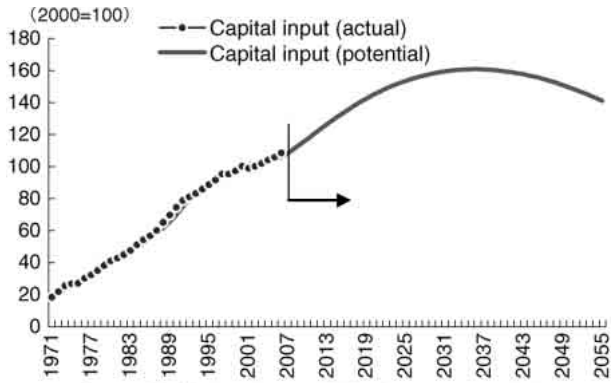
Source: MHRI, based upon Ministry of Economy, Trade and Industry, Ministry of Internal Affairs and Communications and others.

d. Potential capital input

Chart 10 sets forth the past trends and future path of potential capital input calculated on the basis of capital investment, fixed capital consumption and the potential capital utilization rate. Note that potential capital input has continued to rise consistently in the past. Based upon an index with 2000 as the base year (= 100), potential capital input has tripled in the past 30 years, rising from 31 in 1976 to 106 in 2006. In this respect, potential capital input differs from potential labor input which has already started to decline after peaking in 1989.

Looking forward, the rise of potential capital input should slow down as a result of (1) the slowdown of capital investment growth stemming from a fall of the saving rate due to the aging of the population and the rise of net exports as a percentage of real GDP, and (2) the rise of fixed capital consumption along with the acceleration of technological innovations. The amount of capital investment will trend above the amount of fixed capital consumption until around 2035. From then onward, potential capital input should start to decline, reaching approximately 141 in 2005

Chart 10: Past trends and future estimates of potential capital input



Source: MHRI, based upon JIP Database 2006 and others.

(3) Potential GDP and the potential growth rate: past trends and future paths

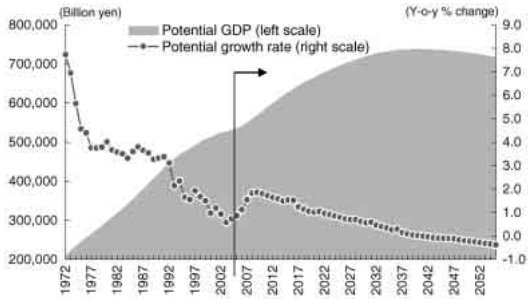
Given the estimates of potential labor input and potential capital input above, the past trends and future paths of Japan's potential GDP and potential growth rate may be estimated by assigning the production functions identified in Section 2.

The results of the estimates are set forth in **Chart 11**. Japan's potential GDP has grown from around 193 trillion yen in 1971 to approximately 541 trillion yen in 2006. The rate of GDP growth has gradually slowed down, from 5.7% in the first half of the 1970s to the 3.5%–level in the 1980s and the 1~2%–level in 1990s. The average rate of growth during the five years since 2000 has fallen to the 0%–level. While the slowdown of the potential growth rate is most prominent since the 1990s, this is due to the peak–out of potential labor input along with the reduction of working hours, the increase in percentage of part–time workers and the aging of the population. Furthermore, these results are also subject to the impact of corporate enterprises' restraints upon capital investment and efforts to reduce capital stock during Japan's so–called "Lost Decade".

Japan's current potential growth rate is estimated to be around 1.54%. As for the future, Japan's potential growth rate should remain

at the upper end of the 1%–level for the next ten years or so. This stems from (1) the recent rise of capital investment driving up potential capital input, and (2) the rise of total factor productivity growth due to the progress of information technology. However, from then onward, Japan's potential growth rate will be subject to strong downward pressures from both labor and capital such as the decrease of the working–age population, the fall of the labor force participation rate, the decline of working hours, the slowdown of capital investment, and the rise of fixed capital consumption. As a result, Japan's potential GDP is expected to peak out at 737 trillion yen in 2040 and follow a constant decline from then onward.

Chart 11: Past trends and future estimates of potential GDP and potential growth rate



Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry, Ministry of Health, Labor and Welfare and others.

(Billion yen, %)

Time span	Potential GDP	Potential growth rate	Time span	Potential GDP	Potential growth rate
1972 ~ 1975	227,236	5.71	2016 ~ 2020	651,454	1.18
1976 ~ 1980	275,975	3.94	2021 ~ 2025	684,354	0.90
1981 ~ 1985	330,448	3.52	2026 ~ 2030	710,132	0.65
1986 ~ 1990	393,431	3.51	2031 ~ 2035	728,658	0.40
1991 ~ 1995	456,460	2.52	2036 ~ 2040	736,743	0.11
1996 ~ 2000	499,169	1.52	2041 ~ 2045	736,161	-0.07
2001 ~ 2005	526,856	0.85	2046 ~ 2050	731,358	-0.18
2006 ~ 2010	559,772	1.62	2051 ~ 2055	721,852	-0.32
2011 ~ 2015	608,613	1.59			

Note: The potential GDP and potential grow th rates are averages during each of the time spans.
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry, Ministry of Health, Labor and Welfare and others.

4. The impact of economic stimulus measures upon potential GDP

In Section 4, this report will estimate Japan's potential GDP and potential growth rate again, upon the assumption that the government will adopt economic stimulus measures in order to avoid a slowdown/loss of momentum of the potential growth rate (Case with stimulus measures). By comparing the results with the estimates in Section 3 (Case without stimulus measures), the report examines the possibility of maintaining the rate of potential growth through economic stimulus measures.

(1) Economic stimulus measure ①: raise the minimum eligible age to receive pension benefits

One way to secure the labor force population in a country with an aging population, a fewer number of children and a diminishing working–age population would be to promote the labor force participation of the elderly. Even though the population aged 65 or older is expected to grow even as the population declines, the potential labor force participation rate of the population aged 65 or older is 19.3% as of 2006 (male: 28.6%, female: 12.5%). In addition to this figure being considerably lower than younger age brackets, it is also following a downtrend. Put simply, Japan's entire labor force population would be affected substantially depending upon the labor force participation rate of the population aged 65 or older.

As a result of past amendments to Japan's laws related to pensions, the special payments (payments of pension benefits as a transitional measure to persons aged 60~64 even) under the old–age employee's pension (*Rorei Kosei Nenkin*) and the mutual aid retirement pension (*Taishoku Kyosai Nenkin*) will be phased out and the minimum eligible age to receive pension benefits will be fixed at 65 from 2025 onward (Note 16). Furthermore, in response to the actual hike of the minimum eligible age to receive pension benefits starting in April 2001, corporate employers have introduced measures such

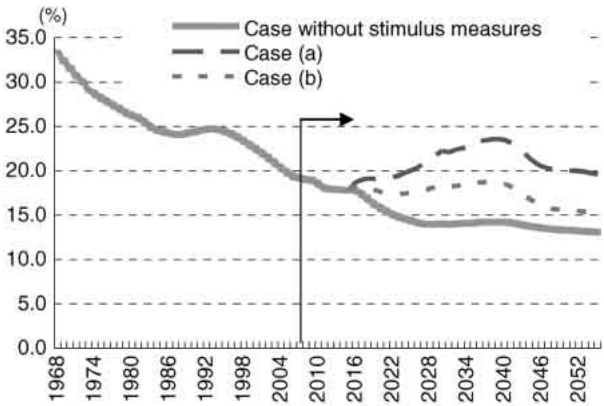
as the extension of the retirement age and reemployment of elderly workers. These measures have succeeded to keep the population in the 60~64 age bracket in the labor market and increase the labor force population.

Considering that the hike of the minimum eligible age for pension benefits is an effective policy tool to raise the labor force participation rate of the elderly, we will examine the impact of raising the minimum eligible age further from 65 to 70 and to facilitate the full–fledged entry of the population in the 65~69 age bracket to the labor market. More precisely, we will examine a case where the minimum eligible age is raised by one year every year from 2026, reaching 70 in 2030. We also assume that this new system will be adopted in 2016, ten years in advance, and that the labor force participation rate of the population in the 65–69 age bracket will gradually rise from 2016. As for the breadth of the rise of the labor force participation rate, we assume two cases ((a) and (b)), taking into consideration the impact of the policy measures and global levels. In Case (a), the labor force participation rate of the population in the 65~69 age bracket rises to the same level (both male and female) as the 55~64 age bracket by 2030. In Case (b), the labor force participation rate of the 65~69 age bracket rises to 69.3% among the male population and 36.6% among the female population by 2030. This is the highest labor force participation rate among the OECD countries (as of 2005, the male and female labor force participation rates in Iceland).

A comparison of the labor force participation rates of the population aged 65 or over in the Case without stimulus measures and the Case with stimulus measure ① is set forth in **Chart 12**. Since the labor force participation rate of the population in the 65~69 age bracket starts to rise from 2016 onward in the Case with stimulus measure ①, the overall labor force participation rate of the population aged 65 or older will start to rise toward the 2040s in Case (a) and will start to be restrained in Case (b). However, on a longer–term perspective, the decline of the labor force participation rate of the population aged 65 or older cannot be avoided from the

2040s onward even in the Case with stimulus measure ①. This is because the percentage of those aged 70 or older in the 65 or older age bracket will rise and push down the overall labor force participation rate.

Chart 12: The labor force participation rates under the Case without stimulus measures and the Case without stimulus measures ①



Source: Ministry of Internal Affairs and Communications, National Institute of Population and Social Security Research.

The impact of economic stimulus measure ① upon potential GDP and the potential growth rate is set forth in **Chart 13**. A further hike of the minimum eligible age to receive pension benefits will ease the slowdown of Japan's potential growth rate. In terms of averages during the period from 2051 to 2055, potential GDP would be pushed up by approximately 88 trillion yen by (a) and by approximately 34 trillion yen by (b). Even so, the potential growth rate would still fall into negative territory from 2040 onward even in the case of (a) which is deemed considerably challenging. Thus, it would be difficult to maintain the potential rate of growth only by economic stimulus measure ①.

Chart 13: The impact of economic stimulus measure ① upon potential GDP and the potential growth rate

(Billion yen, %)

		Case without stimulus measures	Case (a)	Policy impact	Case (b)	Policy impact
Potential GDP	2016 ~ 2020	651,454	659,949	8,495	656,161	4,707
	2021 ~ 2025	684,354	706,887	22,533	696,849	12,495
	2026 ~ 2030	710,132	751,099	40,967	732,512	22,380
	2031 ~ 2035	728,658	785,543	56,885	758,085	29,427
	2036 ~ 2040	736,743	811,045	74,302	773,338	36,595
	2041 ~ 2045	736,161	817,092	80,931	772,874	36,713
	2046 ~ 2050	731,358	812,850	81,492	764,277	32,918
	2051 ~ 2055	721,852	809,594	87,742	755,651	33,799
Potential growth rate	2016 ~ 2020	1.18	1.60	0.42	1.42	0.23
	2021 ~ 2025	0.90	1.31	0.41	1.13	0.23
	2026 ~ 2030	0.65	1.16	0.51	0.92	0.27
	2031 ~ 2035	0.40	0.72	0.32	0.53	0.13
	2036 ~ 2040	0.11	0.53	0.42	0.28	0.17
	2041 ~ 2045	-0.07	-0.07	-0.00	-0.17	-0.10
	2046 ~ 2050	-0.18	-0.05	0.12	-0.20	-0.03
	2051 ~ 2055	-0.32	-0.14	0.18	-0.28	0.04

Note: The potential GDP and potential growth rates are averages during each of the time spans.
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry and others.

(2) Economic stimulus measure ②: promotion of women's labor force participation rate

As mentioned in Section 3, Japan's female labor force participation rate is rising, particularly with respect to the 25~34 age bracket. This stems most likely from the development of a social infrastructure tolerant of marriages later in life and dual–career families. While these factors are leading to a gradual dissolution of the so–called M–curve, a global comparison of the age–structure based labor force participation rates of the male and female population reveals that the labor force participation rate of women is lower than men in Japan (**Chart 14**).

Chart 14: Global comparison of the gap in labor force participation rate between men and women

(% point)

	25～34		35～44		45～54		55～64	
1st	Portugal	5.9	Sweden	5.7	Finland	-1.7	Finland	0.4
5th	Netherlands	9.9	Slovakia	7.6	Sweden	4.2	Norway	11.7
10th	Switzerland	12.9	Portugal	11.3	UK	10.3	Hungary	14.7
Japan	27th	26.7	27th	30.2	22nd	25.0	26th	32.3

Note: Ranking of the gap in labor force participation rate between men and women (the country with the smallest gap at the top of the ranking) among the 30 member countries of the OECD.
Source: OECD.

From a different perspective, Japan still has room to raise the female labor force participation rate. Therefore, we shall examine a case where the labor force population increases as a result of the implementation of measures to promote the female labor force participation rate (economic stimulus measure ②). We assume that the gap in labor force participation rate between men and women in all age brackets from 25 to 64 shrinks to 10%. According to the global ranking of the male–female gap in labor force participation rate in **Chart 14**, a 10% contraction of the gap in either of the age brackets would raise Japan's ranking to the top–10 (the top one–third). As for the time frame for achievement of the 10% gap contraction, we will assume that the gap will shrink by 2025 in step with the government's policy initiative *Innovation 25*.

While the economic stimulus measure ② will raise the potential labor force as a whole, it will also raise the percentage of the 25~64–age female population in the total number of employed persons. As a side effect, the measure would also drive up the potential ratio of part–time workers. Since the labor force participation of women would require a balance with household chores unless women are totally released from household, childcare and nursing care duties, women's work hours would tend to be shorter than conventional full–time workers. Furthermore, if men assume a more active role in household chores along with the

promotion of female labor force participation, it may lead to shorter work hours among men.

An estimate on the impact upon potential GDP reveals that the increase in number of potential employed persons as a result of the rise of female labor force participation would be offset by the reduction of potential labor hours due to a higher percentage of potential part–timer workers. As a result, both potential GDP and the potential rate of growth would turn out to be virtually the same as the Case without stimulus measures (Case (b) in **Chart 15**).

Case (a) in **Chart 15** sets forth the potential GDP and potential growth rate based upon the assumption that the female labor force participation is maintained as in the Case without stimulus measures. In this case, the rise in number of employed persons would directly push up potential GDP. In terms of the 2051~2055 average, potential GDP is estimated to grow approximately 64 trillion yen higher than the Case without stimulus measures. A key to success of the promotion of female labor force participation rests upon how to stem the decline of working hours which is its side effect.

Chart 15: The impact of economic stimulus measure ② upon potential GDP and the potential growth rate

(Billion yen, %)

		Case without stimulus measures	Case (a) Maintenance of part-time worker ratio	Policy impact	Case (b) Rise of part-time worker ratio	Policy impact
Potential GDP	2006 ~ 2010	559,772	562,478	2,706	559,370	-401
	2011 ~ 2015	608,613	619,884	11,271	606,914	-1,700
	2016 ~ 2020	651,454	674,361	22,907	647,951	-3,504
	2021 ~ 2025	684,354	721,068	36,714	678,629	-5,725
	2026 ~ 2030	710,132	756,372	46,240	702,802	-7,330
	2031 ~ 2035	728,658	782,551	53,893	720,002	-8,656
	2036 ~ 2040	736,743	794,529	57,785	727,382	-9,361
	2041 ~ 2045	736,161	796,522	60,361	726,285	-9,876
	2046 2050	731,358	793,896	62,538	720,993	-10,365
	2051 2055	721,852	786,214	64,362	711,030	-10,822
Potential growth rate	2006 ~ 2010	1.62	1.82	0.20	1.59	-0.03
	2011 ~ 2015	1.59	1.88	0.29	1.54	-0.05
	2016 ~ 2020	1.18	1.55	0.36	1.12	-0.06
	2021 ~ 2025	0.90	1.21	0.31	0.85	-0.05
	2026 ~ 2030	0.65	0.84	0.19	0.61	-0.04
	2031 ~ 2035	0.40	0.54	0.13	0.38	-0.03
	2036 ~ 2040	0.11	0.18	0.07	0.09	-0.01
	2041 ~ 2045	-0.07	-0.01	0.07	-0.09	-0.01
	2046 2050	-0.18	-0.11	0.06	-0.19	-0.02
	2051 2055	-0.32	-0.25	0.07	-0.34	-0.02

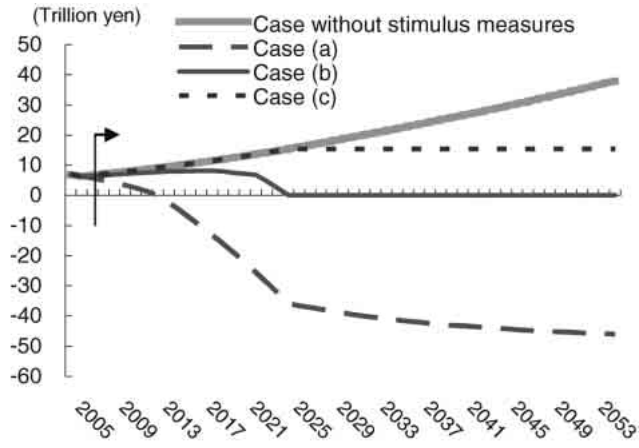
Note: The potential GDP and potential growth rates are averages during each of the time spans.
Source: MHRI based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry and others.

(3) Economic stimulus measure ③: accelerate foreign capital inflows

Earlier on in this report, we estimated the future path of capital input – one of the key production factors along with labor input – by the capital investment function set forth as Eq 8 and fixed capital consumption set forth in **Chart 8**. As for capital investment in particular, we assumed that the percentage of capital investment would gradually decline along with the fall of the saving rate as a result of the aging of the population. Having said so, capital investment would be implemented if there is enough inflow of funds from overseas (Note 17) to meet the demands for capital investment. Therefore, we shall examine a case where domestic capital investment is boosted as a result of the reduction of net capital outflows through the acceptance of foreign capital, resulting in the increase of potential capital input.

More precisely, we envision a case where net capital outflows are reduced through policy measures to enhance the attractiveness of Japan's domestic financial and capital markets and the globalization of the yen, which in turn reduces net exports in GDP statistics. In the Case without stimulus measures, the future path of net exports and imports is estimated through the correlation of the global economy and domestic demand. Net exports are assumed to rise due to the gap between the rate of growth of the global economy and the Japanese economy (**Chart 16**). Three hypothetical cases are assumed up to 2025 as follows: (a) capital inflows continue until the ratio of net capital inflows to GDP reaches 5% (Note 18). (b) net capital inflows continue until net capital outflows reach zero (Note 19), (c) net capital outflows remain constant. Since net capital outflows are equivalent to net exports, (a) would mean that Japan would fall deep into a current account deficit. Therefore, note that the achievement of such a situation solely by taking a financial approach would be extremely difficult, considering the current trade and industry structure of Japan.

Chart 16: Net capital outflows in economic stimulus measure ③



Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Health, Labor and Welfare.

The impact of economic stimulus measure ③ is set forth in **Chart 17**. Since the reduction of net capital outflows means that more funds are available for domestic capital investment, the larger the reduction of net capital outflows, the larger the amount of potential capital input and the nominal GDP. In the intermediate Case (b), potential GDP in terms of the 2051~2055 average would increase by 113 trillion yen compared with the Case without stimulus measures.

Chart 17: The impact of economic stimulus measure ③ upon potential GDP and the potential growth rate

(Billion yen, %)

		Case without stimulus measures	Case (a)	Policy impact	Case (b)	Policy impact	Case (c)	Policy impact
Potential GDP	2006 ~ 2010	559,772	560,334	562	559,912	140	559,898	127
	2011 ~ 2015	608,613	615,281	6,667	609,752	1,139	609,513	900
	2016 ~ 2020	651,454	675,483	24,029	654,982	3,528	653,804	2,350
	2021 ~ 2025	684,354	739,500	55,146	693,713	9,359	689,511	5,157
	2026 ~ 2030	710,132	805,722	95,590	733,594	23,462	723,448	13,316
	2031 ~ 2035	728,658	862,402	133,744	768,797	40,139	753,772	25,114
	2036 ~ 2040	736,743	904,122	167,378	793,824	57,081	775,200	38,457
	2041 ~ 2045	736,161	933,379	197,218	810,550	74,389	789,340	53,179
	2046 ~ 2050	731,358	956,770	225,412	824,149	92,791	801,021	69,663
	2051 ~ 2055	721,852	974,929	253,077	834,668	112,816	810,126	88,274
Potential growth rate	2006 ~ 2010	1.62	1.68	0.06	1.64	0.01	1.63	0.01
	2011 ~ 2015	1.59	1.89	0.30	1.63	0.04	1.62	0.03
	2016 ~ 2020	1.18	1.84	0.66	1.28	0.09	1.23	0.05
	2021 ~ 2025	0.90	1.84	0.94	1.14	0.24	1.01	0.11
	2026 ~ 2030	0.65	1.61	0.96	1.09	0.44	0.94	0.29
	2031 ~ 2035	0.40	1.20	0.79	0.83	0.42	0.73	0.32
	2036 ~ 2040	0.11	0.80	0.69	0.53	0.42	0.46	0.36
	2041 ~ 2045	-0.07	0.56	0.64	0.37	0.44	0.32	0.39
	2046 ~ 2050	-0.18	0.45	0.63	0.31	0.48	0.27	0.45
	2051 ~ 2055	-0.32	0.33	0.65	0.22	0.54	0.20	0.52

Note: The potential GDP and potential grow th rates are averages during each of the time spans.
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry and others.

(4) Economic stimulus measure ④: accelerate acceptance of foreign labor

As economic stimulus measure ④, we shall identify the impact of the acceleration of foreign labor upon potential GDP. Given a downward trend of the domestic population, the acceptance of more foreign labor would seem to be the most popular option.

Pausing briefly, we shall look at the current number of registered foreigners in Japan's population. According to the Immigration Bureau of Japan's Ministry of Justice, there are 2.01 million registered aliens as of the end of 2005, equivalent to 1.57% of the total population. The number of registered aliens in Japan increased by a net total of 649 thousand persons during the decade since the end of 1995. In terms of a yearly average, this means that the number of foreigners in Japan have increased at a rate of 65 thousand persons per year. The *Population Projections for Japan* by the National Institute of Population and Social Security Research, upon which this report is based, provides future estimates on the net international migration to Japan. According to the *Population Projections for Japan*, net international migration (entries minus exits) to Japan are

forecast to grow in accordance to past trends, reaching 63 thousand in 2010, 70 thousand in 2020 and 73 thousand in 2020. Looking overseas, OECD data reveals that Luxembourg has the highest ratio of foreigners at 33.0%, Canada ranks fifth place with 18.2%, and France in 10th place with a 10.0% foreigner ratio (Note 20).

We shall therefore contemplate cases in which policy measures are taken to promote the acceptance of foreign workers on a more proactive level, apart from the natural rise of foreigners in the *Population Projections*. For the purpose of this report, we shall consider two cases in which the number of foreigners accepted into Japan are gradually raised to reach the following targets by 2055 (Note 21): (a) 18.2% (on par with Canada), (b) 10.0% (on par with France). For the sake of simplification, we shall assume that the foreign workers are single male workers aged 25 at the time of entry. All the workers are assumed to settle in Japan and that the age group to which they belong will change along with the lapse of time. The labor force participation rate and the employment rate are assumed to be the same as those of Japanese domestic workers. Considering the long time span of the estimations, we will assume that the single male workers entering Japan will have one male child at the age of 30 and that the child, upon reaching working age, will follow the same life cycle.

Based upon these preconditions, the number of foreign workers accepted into Japan every year would be 150 thousand in Case (a) and 50 thousand in Case (b). Furthermore, the number of foreign residents as of 2055 would be 16.1 million in Case (a) and 9.1 million in Case (b). In comparison to the Case without stimulus measures, the working–age population would increase 10.5 million in Case (a) and 3.5 million in Case (b), alleviating the pace of decline of the domestic population.

Chart 18 indicates the impact of economic stimulus measure ④ upon potential GDP and the potential economic growth rate. As a result of the increase of foreign workers mitigating the pace of decline of Japan's potential labor input, potential GDP would increase in comparison to the Case without stimulus measures. In terms of

the 2051~2055 average, the stimulus measure would raise potential GDP by 128 trillion yen in Case (a) and 46 trillion yen in Case (b).

Chart 18: The impact of economic stimulus measure ④ upon potential GDP and the potential growth rate

(Billion yen, %)

		Case without stimulus measures	Case (a)	Policy impact	Case (b)	Policy impact
Potential GDP	2006 ~ 2010	559,772	559,772	0	559,772	0
	2011 ~ 2015	608,613	611,179	2,565	609,472	859
	2016 ~ 2020	651,454	659,721	8,267	654,233	2,779
	2021 ~ 2025	684,354	700,456	16,102	689,790	5,436
	2026 ~ 2030	710,132	736,178	26,046	718,964	8,832
	2031 ~ 2035	728,658	767,395	38,737	741,883	13,225
	2036 ~ 2040	736,743	791,349	54,605	755,552	18,809
	2041 ~ 2045	736,161	812,095	75,934	762,580	26,419
	2046 2050	731,358	834,141	102,783	767,505	36,147
	2051 2055	721,852	850,029	128,177	767,426	45,574
Potential growth rate	2006 ~ 2010	1.62	1.62	0.00	1.62	0.00
	2011 ~ 2015	1.59	1.73	0.15	1.64	0.05
	2016 ~ 2020	1.18	1.37	0.19	1.25	0.06
	2021 ~ 2025	0.90	1.14	0.23	0.98	0.08
	2026 ~ 2030	0.65	0.92	0.27	0.75	0.10
	2031 ~ 2035	0.40	0.76	0.35	0.53	0.13
	2036 ~ 2040	0.11	0.54	0.43	0.27	0.16
	2041 ~ 2045	-0.07	0.54	0.61	0.16	0.23
	2046 2050	-0.18	0.53	0.71	0.10	0.28
	2051 2055	-0.32	0.27	0.59	-0.08	0.24

Note: The potential GDP and potential grow th rates are averages during each of the time spans.
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry and others.

(5) Economic stimulus measure ⑤: promotion of innovations

As mentioned in Section 2, output depends not only upon the volume of production factors but also upon total factor productivity which may be deemed as the quality of production factors. We shall therefore examine a case where Japan's total factor productivity is raised by policy measures to promote innovations.

Given the difficulty to establish a rational balance between the policy lag and innovations, we shall base our assumptions upon the *Economic Growth Strategy* currently pursued by the government of Japan. Firstly, we shall assume that innovations will be achieved by 2025 in accordance with the government's strategic guideline *Innovation 25*. We will consider three resulting cases. As a result of

innovations, (a) total factor productivity growth rises 1% and the rise of potential GDP as a result thereof achieves a positive effect upon potential capital input, (b) total factor productivity growth rises 1% and potential capital input is not affected, (c) total factor productivity growth rises 0.5% and potential capital input is not affected.

In **Chart 19**, we have set forth the impact of economic stimulus measure ⑤. Obviously, Japan's potential growth rate would rise in proportion to the magnitude of the innovation. In terms of the 2051~2055 average, Cases (a), (b) and (c) would result in the rise of potential GDP by 643 trillion yen, 330 trillion yen and approximately 150 trillion yen respectively. Turning to the potential rate of economic growth, the potential growth rate would be maintained at a level of 1.5%~2% until the end of the estimation period in Case (a). Even in Case (c), Japan's potential growth rate will avoid falling into negative territory. In the light of the foregoing, the government's growth strategy would have substantial effect in the event they succeed.

Chart 19: The impact of economic stimulus measure ⑤ upon potential GDP and the potential growth rate

(Billion yen, %)

		Case without stimulus measures	Case (a)	Policy impact	Case (b)	Policy impact	Case (c)	Policy impact
Potential GDP	2006 ~ 2010	559,772	559,772	0	559,772	0	559,772	0
	2011 ~ 2015	608,613	615,267	6,654	614,691	6,077	611,645	3,032
	2016 ~ 2020	651,454	679,675	28,220	675,504	24,050	663,379	11,924
	2021 ~ 2025	684,354	754,628	70,274	740,653	56,299	711,980	27,626
	2026 ~ 2030	710,132	840,761	130,629	807,424	97,292	757,298	47,166
	2031 ~ 2035	728,658	934,167	205,509	870,481	141,823	796,553	67,895
	2036 ~ 2040	736,743	1,030,458	293,714	924,882	188,138	825,659	88,916
	2041 ~ 2045	736,161	1,131,020	394,859	971,270	235,109	845,830	109,669
	2046 ~ 2050	731,358	1,242,247	510,888	1,014,200	282,842	861,549	130,191
	2051 ~ 2055	721,852	1,364,387	642,535	1,052,186	330,334	871,868	150,016
Potential growth rate	2006 ~ 2010	1.62	1.62	0.00	1.62	0.00	1.62	0.00
	2011 ~ 2015	1.59	1.96	0.38	1.92	0.33	1.75	0.17
	2016 ~ 2020	1.18	2.00	0.82	1.85	0.67	1.52	0.33
	2021 ~ 2025	0.90	2.23	1.33	1.90	1.00	1.40	0.50
	2026 ~ 2030	0.65	2.16	1.51	1.65	1.00	1.15	0.50
	2031 ~ 2035	0.40	2.08	1.68	1.40	1.00	0.90	0.50
	2036 ~ 2040	0.11	1.93	1.82	1.11	1.00	0.61	0.50
	2041 ~ 2045	-0.07	1.88	1.95	0.93	1.00	0.43	0.50
	2046 ~ 2050	-0.18	1.90	2.08	0.82	1.00	0.32	0.50
	2051 ~ 2055	-0.32	1.89	2.21	0.68	1.00	0.18	0.50

Note: The potential GDP and potential grow th rates are averages during each of the time spans.
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry and others.

(6) Combinations of economic stimulus measures

In the preceding sections, we examined the impact of five economic stimulus measures upon potential GDP and found that each of the measures can raise the level of Japan's economic power by increasing potential labor input, potential capital input and total factor productivity.

Our discussions thus far have been based upon the assumption that each of the stimulus measures would be implemented one at a time. However, the actual implementation of policy measures would be more multi–faceted and complex. Some measures might even be difficult to implement in reality. In our final conclusion, we shall examine the implementation of a combination of the policy measures discussed above.

More specifically, we shall examine the impact of each policy mix upon potential GDP as in the matrix in **Chart 20** in consideration of the feasibility of each of the measures.

Chart 20: Combinations of economic stimulus measures

Case	Explanation	Raise the minimum eligible age to receive pension benefits	Promotion of women's labor force participation rate	Accelerate foreign capital inflows	Accelerate acceptance of foreign labor	Innovation
(A)	All measures are effective (maximum impact)	(a)	(a)	(a)	(a)	(a)
(B)	All measures are effective (medium impact)	(b)	(b)	(b)	(b)	(b)
(C)	All measures are effective (small impact)	(b)	(b)	(c)	(b)	(c)
(D)	Failure in innovation	(b)	(b)	(c)	(b)	×
(E)	Failure in innovation and acceptance of foreign labor	(b)	(b)	(c)	×	×
(F)	Success in raising domestic labor force participation rate and innovation	(b)	(b)	×	×	(b)
(G)	Success only in raisng the domestic labor force participation rate	(b)	(b)	×	×	×

Source: MHRI

In **Chart 21**, we have set forth the estimation results of potential GDP and potential GDP in Cases (A) to (G) in **Chart 20**. In (A), in which all of the economic stimulus measures yield significant policy results, Japan's potential growth rate will remain above 3% up to the 2030s and will continue to grow at a rate above 2% up to 2055. Even in the event qualitative improvements of production factors may not

be realized due to the lack of innovation, a drop into negative growth may be avoided as long as Japan can depend upon foreign capital and labor such as in cases (D) and (E). In Case (F) where innovations are achieved, Japan would be able to avoid negative growth without depending upon foreign capital or labor. However, Case (G), which depends only upon the labor force participation of the elderly and female population, would not have much effect and would leave Japan to fall into negative growth in 2045.

In view of the foregoing, mere efforts to raise the labor force participation of the elderly and female population would be insufficient. If a further dependence upon foreign capital and labor is not possible or deemed undesirable, efforts to convert innovations into tangible format and raise total factor productivity – however long it may take – would be indispensable.

Having said so, it is also true that there is a considerable level of uncertainty regarding the feasibility of policies to promote effective innovations and the inflow of foreign capital and labor. It would be extremely difficult to guarantee the effectiveness of innovations since the government's role would be limited to financial support for technological development and the provision of frameworks such as the improvement of training programs for the qualitative enhancement of workers. Turning to the stimulation of foreign capital inflows, even if measures to capture global money flows such as the adoption of triangular mergers and tax measures to stimulate securities investment from overseas were to be taken, its impact would depend largely upon Japan's attractiveness as an investment target. As for the promotion of foreign labor, Japan may pose comparatively higher hurdles for foreign workers in terms of language and culture than countries of Europe and the US even if the Japanese government relaxes its regulations on immigration. To start out with, it still remains uncertain whether Japan's social climate will grow to accept the expansion of its foreign population to reach as much as 10% of the entire population.

Chart 21: The impact of comprehensive measures upon potential GDP and potential growth

(Billion yen, %)

		Case without stimulus measures	Composite Case (A)	Composite Case (B)	Composite Case (C)	Composite Case (D)	Composite Case (E)	Composite Case (F)	Composite Case (G)
Potential GDP	2006 ~ 2010	559,772	563,041	559,510	559,370	559,370	559,370	559,370	559,370
	2011 ~ 2015	608,613	634,379	614,995	610,803	607,776	606,914	612,975	606,914
	2016 ~ 2020	651,454	737,722	683,290	667,423	655,433	652,665	676,755	652,665
	2021 ~ 2025	684,354	879,825	763,899	724,600	696,518	691,142	747,953	691,142
	2026 ~ 2030	710,132	1,053,778	860,825	783,151	734,461	725,803	824,423	725,200
	2031 ~ 2035	728,658	1,241,067	957,870	837,812	766,553	753,698	895,082	749,439
	2036 ~ 2040	736,743	1,434,815	1,052,081	888,732	793,266	775,188	958,754	763,979
	2041 ~ 2045	736,161	1,624,783	1,135,529	929,344	809,187	783,813	1,006,314	763,013
	2046 2050	731,358	1,822,693	1,217,852	967,624	821,819	787,058	1,045,232	753,962
	2051 2055	721,852	2,032,195	1,307,207	1,009,875	836,662	793,382	1,085,475	744,918
Potential growth rate	2006 ~ 2010	1.62	1.88	1.61	1.59	1.59	1.59	1.59	1.59
	2011 ~ 2015	1.59	2.60	1.97	1.76	1.59	1.54	1.88	1.54
	2016 ~ 2020	1.18	3.33	2.18	1.75	1.42	1.36	2.02	1.36
	2021 ~ 2025	0.90	3.75	2.39	1.66	1.16	1.08	2.08	1.08
	2026 ~ 2030	0.65	3.60	2.39	1.51	1.01	0.93	1.88	0.88
	2031 ~ 2035	0.40	3.13	2.01	1.25	0.75	0.64	1.51	0.51
	2036 ~ 2040	0.11	2.80	1.78	1.11	0.61	0.47	1.27	0.27
	2041 ~ 2045	-0.07	2.39	1.41	0.79	0.29	0.09	0.81	-0.19
	2046 2050	-0.18	2.32	1.46	0.87	0.37	0.14	0.78	-0.22
	2051 2055	-0.32	2.10	1.37	0.81	0.31	0.14	0.70	-0.30

Note: The potential GDP and potential grow th rates are averages during each of the time spans.
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry and others.

5. Implications upon the current economy

In the Case without stimulus measures, the Japan's economic growth rate would eventually slide into negative territory. What are the implications of a negative growth economy upon economic entities, economic measures and the financial market and how would their behavior change under such an environment?

(1) Corporations

Regardless of whether the profit structure of an industry or corporation is cyclical or defensive, and regardless of the stage in product life cycle, there is no doubt that corporate profits are inseparably related with macroeconomic currents. In this respect, shifts in long–term macroeconomic growth expectations would lead to significant changes in corporate behavior.

Negative growth would have a large impact upon industrial sectors driven by domestic demand. According to discussions in

Section 3, the decline of the population would serve as a damper upon household consumption expenditures and corporate capital spending. Therefore, domestic demand–led sectors would eventually be subject to the decline of sales across the entire industrial spectrum. How would corporate behavior change under such circumstances?

The first behavioral change which would occur or which would be desirable in domestic demand–led industries would be the reduction of costs. Corporations must keep cutting costs in order to generate profits amid the decline of sales. Furthermore, the odds are high that the efforts to reduce costs would surpass mere cost cuts in order to maintain profit margins. More likely, corporations would be compelled to cut costs at a pace surpassing the decline of sales in response to growth expectations.

The second shift in behavior would be the pursuit of scale economics. Since cost cuts would sooner or later cease to serve as an effective tool, corporations would have to turn to M&As in order to maximize the possibility of cost cuts. Furthermore, since the expansion of scales would also serve as the pursuit of survivor merits under a shrinking market, companies would benefit from being able to secure a comparatively large gross profit on sales.

The third behavioral change would be overseas market development. Even if corporations pursue survivor merits within Japan and succeed in monopolizing the market, it would only lead to a diminishing equilibrium. Therefore, corporations would have to seek overseas markets in order to realize permanent growth.

In contrast to domestic demand–led industries, industries driven by external demand have little reason to worry about a market contraction along with global economic growth. In this respect, external demand–led industries are in a better position in comparison to domestic demand–led industries. However, since it would still be necessary to cover the short–falls in domestic sales in the mother market (Japan) through the expansion of overseas sales, corporations would have to take a more globally competitive management stance. Be it through a cost leadership strategy or a

product differentiation strategy, the maintenance of a competitive edge in global intra–industry competition is no easy task. The reduction of production costs is a key factor for cost leadership and the reduction of domestic labor costs is an unavoidable option for Japanese corporations from the perspective of production factor price equalization and should stimulate a further shift of production sites overseas. In the event a product differentiation strategy is taken, investment to upgrade technological capabilities would be necessary since the technology to produce outstanding products would be the source of competitiveness. As typified in the pharmaceutical industry, it is necessary to divert a larger portion of funds to research and development than other companies in order to create differentiated products on a stable basis. The expansion of management scale is necessary for this purpose.

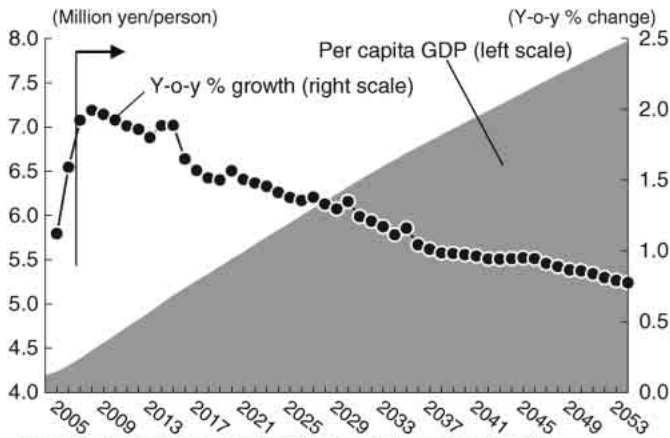
(2) Households

Given the declining growth of the entire economy, macroeconomic household spending and savings would follow a downhill curve. However, on a per–capita basis, the odds are high that living standards will continue to improve since the pace of population decline will surpass the pace of economic slowdown (**Chart 22**).

However, since it is unlikely for corporations to invest under conditions of low profitability or conditions in which investment returns may not be expected, investment would converge in areas and locations where demand growth may be expected in the long run. Public investment and public services by the central and local governments would also fall into similar conditions, even though circumstances may not be as drastic as private corporations. It would become difficult to implement public investment and services on a uniform nationwide scale due to the contraction of the scale of government finances, making it necessary to focus upon certain fields and geographic locations. This would lead to a further concentration of the population in urban areas in search of better living conditions, serving to widen the regional disparities in living

conditions.

Chart 22: Future estimates of per capita GDP



Note: The level of per capita GDP is based upon prices in 2000.
Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Health, Labor and Welfare and others.

(3) Public finance

Tax revenues should follow a downtrend in an economy with a declining birthrate, a declining and aging population and a continuous fall of the potential rate of economic growth. Meanwhile, the elderly population should continue to grow even as the total population diminishes, leading to the ongoing rise of social security benefits. Over the long term, Japan continues to face extremely stringent fiscal conditions. If the rise of social security benefits occurs along with the fall of tax revenues, the primary balance may fall into a deficit. Furthermore, under such circumstances, the government bond yield would surpass the rate of nominal growth due to the rise of the fiscal risk premium, raising the possibility of the fiscal deficit growing larger than the primary balance deficit.

The key point to avoid such a situation is to ensure the stable growth of tax revenues through the maintenance and rise of the economic growth rate. It would be necessary to prevent the decline

of potential growth stemming from population decline through the maximum utilization of the economic stimulus measures discussed in the previous section. Furthermore, it would also be necessary to continue studies on how to control social security–related expenditures which would inevitably occur due to the declining birthrate and aging of the population. In addition to raising further the minimum eligible age to receive pension benefits as mentioned before, there are numerous other issues requiring examination such as the fundamental overhaul of the pension system from a pay–as–you–go pension system to a funded pension system, the improvement of productivity in the medical sector and the review of the public medical cost burdens.

(4) Monetary policy

The purpose of monetary policy is the stabilization of prices and the minimization of economic cycles. Since this paper has discussed the GDP path consistent with zero inflation, we have refrained from commenting in particular on prices. However, in an economy with the ongoing decline of the potential growth rate as a given condition, it is important to keep in mind that monetary policy itself may serve as deflationary pressures.

Desired monetary policy, as described by the Taylor Rule would be as follows.

$$R_{policy} = \overset{*}{R}_{real} + \overset{*}{\pi} + \alpha * GAP_{gdp} + \beta * GAP_{\pi} \quad \cdots \text{Eq (11)}$$

Where R_{policy} is the policy interest rate, $\overset{*}{R}_{real}$ is the equilibrium real interest rate, $\overset{*}{\pi}$ is the desired rate of inflation, GAP_{gdp} is the output gap, and GAP_{π} is the price gap.

Assuming that the equilibrium real interest rate approximates the potential growth rate in accordance with the Taylor Rule, when the desired rate of inflation is zero, the level of interest rate consistent with a negative rate of potential growth would be negative. Meanwhile, since the policy interest rate possesses nonnegativity constraints, monetary policy would always tighten the economy under negative economic growth and could lead to a deflationary

spiral through its cumulative effect.

Given nonnegativity constraints of nominal interest rates, note the importance of preventing the potential growth rate from falling into negative territory. In this context, policy coordination is desirable between monetary policy and the government's policy to lift the potential growth rate. Furthermore, it would also be necessary to prepare logical options with respect to monetary policy in a case where the potential growth rate falls into negative territory.

(5) The bond market

The long–term interest rate is decomposed into real interest rates and the expected rate of inflation and real interest rates are determined by expectations on macroeconomic growth and various other risk premiums. Holding all else constant, if the rate of economic growth declines, the long–term interest rate would also decline and if the rate of economic growth rises, the long–term interest rate would also rise.

Under this basic framework, given the gradual decline of the potential growth rate of the Japanese economy, the longer the maturity, the greater the fall of real interest rates. **Chart 23** compares **the estimated long–term interest rate** based upon the real interest rate calculated on the basis of the long–term path of the potential growth rate without taking into consideration the various risk premiums and the expected rate of inflation calculated on the basis of current market expectations and the Bank of Japan's (BOJ) "understanding of medium– to long–term price stability" with **the actual long–term interest rate**. As for the estimated interest rate, since the real interest rate is inversely proportional to the length of the remaining period, the yield curve would be an inverted yield–curve. The actual interest rate, however, is a forward yield curve with the yield growing higher in longer maturities. The comparison reveals that the estimated interest rate is higher than the actual interest rate with respect to 10–yr rates but that the estimated interest rate falls below the actual interest rate in the 20–yr and 30–yr zones.

Factors other than macroeconomic growth expectations such as liquidity risk premiums, fiscal risk premiums and the supply–demand structures in each maturity zone are included in the actual real interest rate. For example, it is easier to add on the liquidity risk premium to the 30–year JGB than the 10–yr JGB, because of its small volume of issuance and outstanding issues. Furthermore, in terms of the supply–demand structure, it is said that a positive correlation between the maturity and the strength of demand is recently growing stronger since pension funds and life insurers – the major investors of long–term government bonds – are expanding the duration of their assets from the perspective of asset liability management (ALM). In this respect, 30–yr rates are more vulnerable to downward pressures than 10–yr rates.

Therefore, despite the inadequacy to evaluate the validity of interest rate levels simply in terms of the rate of potential growth and the expected inflation rate, it is still debatable whether the gap between the estimated rate and the actual rate in the 10–yr and 30–yr zones can be explained solely by risk premiums and supply–demand structure. Conversely, is there any possibility that Japan's economic growth rate is overvalued or undervalued in the bond market? At the very least, it is necessary to keep in mind that the slope of the interest rate curve will tend to flatten out from the perspective of economic fundamentals.

Chart 23: Comparison of the actual and estimated long–term interest rates

(%)

	Actual interest rate	Estimated interest rate			Difference
	(a)	(b)	Real interest rate	Expected inflation rate	(a) - (b)
10-yr	1.67	2.09	1.64	0.44	-0.41
20-yr	2.13	1.98	1.25	0.73	0.14
30-yr	2.39	1.71	0.89	0.81	0.68

Notes: 1. Based upon JGB spot rates
2. The actual interest rate is the average in August 2007.

Source: MHRI, based upon Cabinet Office, Ministry of Internal Affairs and Communications, Ministry of Health, Labor and Welfare and others.

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Notes:

1 The Population Projections for Japan reflects the *First Basic Complete Tabulation Results of the 2005 Population Census* and the final figures of the *Vital Statistics of Japan* for the same year and is the 13th release of the Population Projections by the National Institute of Population and Social Security Research. It also provides estimates on the future population up to 2105 as referential material.

2 Although this paper assumes a linear trend with respect to total factor productivity (TFP), there are other cases which not stand upon such an assumption – defining TFP as a Solow residual (its trend component), or cases in which TFP is defined as the trend components of the Solow residual to a linear trend.

3 Unless otherwise specified, this paper is based upon calendar year data. Therefore, estimates of production functions are also based upon calendar year data.

4 The same process is conducted for all other variables in which past data series are unavailable under the current standards.

5 In this paper, capital input is calculated as (capital stock at end of previous term × capacity utilization ratio of the current term)

6 More accurately, capital stock in *JIP Database 2006* is converted into SNA base, drawing upon Bank of Japan (2006).

7 Refer to Ministry of Economy, Trade and Industry (2003) for more details on the applied Wharton School method.

8 Institute of Posts and Telecommunications (2000) is an example of an attempt to extract the TFP refraction by establishing plural time trends

9 This assumption is made for the sake of simplification. The contribution by information communication technology to the economy is not limited to Internet access. Examples of the application of IT technology in the economy are virtually limitless such as the facilitation of communications through the spread of cellular phones and electronic mail, concentrated operational control of mechanical equipment by a few number of people and POS management in the distribution industry. Therefore, we estimated the parameters by shifting the commencement of t_2. The results of estimations remained virtually unchanged.

10 Although there would be few objections to the view that the development of information communication technology is a factor contributing to the recent rise of productivity, note that the rise of productivity from 2001 onward may not be attributed solely to this factor.

11 It has been pointed out that the projections by the National Institute of Population and Social Security Research are overly optimistic since the actual population has continued to fall below the projections (medium variant projections for fertility rates and death rates) in the past. In view of the conservative projections on fertility rates in the December 2006 estimates, this paper has adopted the medium variant projections for fertility rates and death rates.

12 The impact of the introduction of the consumption tax and the tax hike is corrected.
13 The following approaches are frequently taken when forecasting capital input from the supply–side: (1) an approach from the saving rate by assuming that "saving = investment" (or assuming a certain level of capital inflow from overseas), and (2) an approach from the substitute relationship between capital and labor without taking into consideration (assuming a certain level of) changes in demand. Although we are fully aware of the difficulty to forecast (or the arbitrariness of) the exogenous variables, we assume the following function form, in consideration of (1) the guarantee of flexibility to perform simulations on the impact of policy measures upon capital investment in the following Section, and (2) the sense of discomfort in assuming a substitute relationship between capital and labor in an economy with a dwindling population.
14 As changes in household tax burden already determined, we have factored in the impact of the abolishment of the across–the–board tax cut.
15 The methodology in Kozu, Sato and Inada (2003) are used for the estimation method of the household saving rate and the method to adjust the saving rate based upon the *Family Income and Expenditure Survey* to the saving rate based upon the SNA.
16 The minimum eligible age to receive the old–age employee's pension in the national pension has always been 65.
17 Or, put differently, the contraction of capital outflows from Japan.
18 Comparing net capital outflows as a percentage of GDP among the OECD countries, in terms of the average during 2001 to 2005, net capital outflows as a percentage of GDP in a country ranking fifth place from the lowest is approximately –5% (net capital inflow).
19 As in (a), this is the median value of net capital outflows (inflows) as a percentage of GDP during the OECD countries.
20 Data regarding Luxembourg and Canada are as of 2001 and data on France are as of 1999.
21 Since simulations setting the target year in 2025 in accordance with *Innovation 25* yielded unrealistic results in terms of the annual number of foreign workers accepted, we have set the target year as 2055.

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