Executive Abstract

Motivation of our project

The Japanese economy is rapidly aging. Population is expected to peak in 2004 and decline by 6.8% in the next twenty five years. The share of the aged 65 and older in total population will almost double to one thirds. The labor force, on the other hand, will decline by 0.6% per year. Is the declining labor force bound to bring about slower economic growth? This is one of the most important questions facing Japan. The current systems of social insurance such as the public pension and medical insurance are not expected to be sustainable in the rapidly aging economy. However, how serious the problem will be depends crucially on the potential growth rate of the economy.

The thesis that the declining labor force necessarily will lead the Japanese economy to slower growth is actually not so self-evident as it might appear. The results of the growth accounting typically assign the contribution of labor to a minimum role and show that capital and TFP are by far much more important factors than labor force to explain growth rates. The finding is qualitatively robust; Jorgenson and others have the same conclusion. We must inquire, therefore, how capital accumulation (investment) and TFP are determined in Japan.

To answer this question, our project explores the impact of aging on Japan’s economic growth from the following three perspectives: (1) the impact of aging on demand creation and industrial structure, (2) the impact of aging on TFP in Japan, and (3) international comparison.

(1) The impact of aging on demand creation and industrial structure

In the research, we first emphasize the sectoral differences in the growth of demand and changes in the industrial structure. Yoshikawa has been working on growth and demand in collaboration
with Masanao Aoki of U.C.L.A. In the standard literature, the fundamental factor to restrain
economic growth is diminishing returns to capital. We presented a model in which the factor to
restrain growth was saturation of demand. Our analysis began with a common observation that for
individual products/industries, there was a history of logistic development with initial acceleration
and eventual retardation of growth. Taking it as a 'stylized fact', we presented a formal model of
growth consistent with this important ‘fact’.

The existing literature on growth gives firm microeconomic foundation for R&D activities, and by
so doing leads us to a conclusion that the endowment of production factors used in R&D is
conducive to innovation and growth. The relation between innovation and growth has been
already much studied from this perspective. Instead of microeconomic foundations for R&D, our
analysis focused on the effects of the emergence of new products/industries on the growth of
demand.

In terms of the standard Ramsey model, it highlights the time-dependence of the utility function;
the utility function changes over time depending on the kind and the age of a product. The
assumption is consistent with a S-shaped life cycle of an individual product/industry which is
nothing but our starting point. We also presented a model in which a S-shaped growth of an
individual product/industry reflected a diffusion of the product among different households rather
than a shift of preference of the representative consumer. The rich in less developed countries often
attains the standard of living comparable to that of well developed countries. Economic growth
raises the average standard of living by way of diffusion of new products among different
households.

Under the assumption of a unitary elasticity of capital in production function (dubbed the AK
model), the economy grows whenever capital accumulates. However, the growth of demand for an
individual product/industry is, bound to slow down and fall ultimately to zero. And it restrains
capital accumulation. Growth of demand revives when major new product or industry emerges.
Technical progress creates demand. Then capital accumulates, and the economy grows. The
ultimate factor to sustain growth in steady state is the rate of emergence of new products/industries.

The model provides new perspectives to several important problems addressed by the economics
of growth. First and most important is the nature of technical progress or innovations. In the
standard analysis, technical progress brings about higher value added given the same level of inputs.
It is basically equivalent to an ‘upward shift’ of production function. The so called product variety
model using the Dixit/Stiglitz production/utility function, successfully endogenizes this kind of
technical progress. Empirically technical progress has been measured by growth accounting as
TFP (total factor productivity).

In our model, the aggregate production function is $Y=AK$. Since $A$ is constant, there is no TFP
growth. For the economy to grow, capital must accumulate. Innovation or technical progress in
this model creates major new product or industry which commands high growth of demand, thereby induces capital accumulation, and revives economic growth. Shumpeter in his famous book, distinguishes five types of innovations: (1) the introduction of a new good, (2) the introduction of a new production method, (3) the opening of a new market, (4) the conquest of a new source of supply of raw materials, and (5) the new organization of industry. His first and third types of innovations as an engine for growth seem to be most naturally interpreted in terms of a kind model presented here.

Our model is based on the idea that retardation of growth of demand sets limits to growth rather than diminishing returns on capital in production. In addition to the conventional TFP, technical progress also creates demand, thereby induces capital accumulation, and ultimately sustains economic growth. The model provides new perspectives to the analysis of economic growth, and has obvious implications for the relation between aging and economic growth. Based on this model, Yoshikawa will study the impact of aging on demand creation and industrial structure, and ultimately on economic growth.

(2) The impact of aging on TFP in Japan

Nishimura in collaboration with Shirai has studied TFP by sector. The purpose of this paper is two-folds. First, we examine the direction and the magnitude of substitutability or complementarity between information- and communication-related capital stock and various labor inputs to know about differential impacts of information and communication technology on labor demand. In this way, we can obtain information about what segments of workers information and communication technology can effectively substitute for. Second, we estimate contribution of information- and communication-related capital stock and various labor inputs on the value-added growth of the Japanese economy in the recent turbulent era (1980s and 1990s) and explore factors determining technological progress. In particular, we investigate whether rapid accumulation of information-related capital stock has a positive effect on technological progress, examining IT externality. We also discern the effect of compositional changes in labor inputs on technological progress, examining the inflexibility issue and IT-induced technological obsolescence issue.

Three remarkable facts emerge from our result with respect to substitutability/complementarity issues. First, IT capital stocks are shown to be significant substitutes for young workers with a low education level, whereas old workers with a low education level are consistently quasi-fixed in all industries under investigation. Second, IT capital stocks have complementary relationship with workers with a high education level in many industries. Third, workers with a high education level and those with a low education level are substitutes. These all suggest that IT investment and human capital accumulation are of utmost importance to overcome possible shortage (in relative terms) of young workers with a low education level caused by rapidly aging population.
As for IT externality, we find at first positive correlation between IT stocks and technological progress in manufacturing, suggesting a strong externality effect of IT capital stocks. In the first glance it is very promising, since this suggests that this IT externality can be used for boosting productivity growth. However, the correlation is not robust. First, if non-manufacturing industries are included, the correlation vanishes. Second, if "Electrical Machinery" is excluded from the sample of manufacturing, the correlation also vanishes. Thus, we fail to discern clear-cut evidence for IT externality. Thus, the proposition that IT "revolution" can pop up productivity growth and can counter the pressure of aging population is not supported by our data, although investment in IT-producing industries is surely an important driving force for economic growth through substitution effects.

As for the effect of labor force composition on the rate of technological progress, the results do not support that the "inflexible old worker" hypothesis of productivity slowdown. There is no correlation between the rate of technological progress and the ratio of old workers with low education in the total labor inputs. However, the results suggest that information technology development in the 1990s has a negative impact on the past strength of the Japanese economy: productivity increase through high-education workers' learning by doing. In manufacturing industries where Japan has been strong, the rate of technological progress in the 1980s has positive (though weak) correlation with "maturing" high-education labor force. That is, the ratio of old well-educated workers in the total labor inputs has a positive (though weak) effect on technological progress. This suggests that the increased average skill among well-educated workers due to longer experience has a positive effect to improve productivity. However, the relationship changes significantly in the 1990s, and we have rather negative relationship. The nature of technological progress apparently changed adversely.

(3) International comparison

Fukuda in collaboration with Morozumi studied the relation between a change in the demographic structure and economic growth and draw implications for the East Asian economies, particularly Japanese economy. Recent studies based on cross-country regressions establish the existence of strong linkages between demographic change and economic growth. In particular, several studies show that demographic variables have played a large role in East Asia’s economic success. These studies, however, point out that the favorable demographic characteristics have a purely transitional effect on economic growth; this effect operates only when the dependent and working-age populations are growing at different rates. Therefore, they predict that economic growth in East Asia will likely slow in the future, because of stabilization of fertility rates at their current low levels and increases in the dependency ratio as the population ages.

However, how serious the problem will be crucially depends on what determines the potential
growth rate of the economy. From the point of traditional “growth accounting”, the prediction that
the declining labor force will lead the economy to slower growth is actually not self-evident. In
fact, most of the results in the growth accounting have found that capital accumulation and TFP
growth are much more important factors than labor force to explain the growth rate of the economy.
The finding is qualitatively robust in many developed countries. We must inquire, therefore, how
large capital accumulation and TFP growth will be in the near future in Japan.

In order to answer this inquiry, this paper first considers an overlapping generations model with
capital accumulation and uncertain lifetime horizon. The main purpose of the analysis is to
investigate whether a country can sustain economic growth when a large proportion of a country’s
population consists of the elderly. When a proportion of the elderly is large in total population, a
large share of resources is needed by a relatively less productive segment of the population. To the
extent that this negative effect is large, countries with a high elderly dependency rate can thus have
slower rates of economic growth. Countries with a high proportion of the elderly, however, tend to
have high life expectancy and low rate of population growth. These demographic factors
contribute to capital accumulation per worker and can enhance economic growth. It is therefore not
clear whether countries with a high proportion of the elderly tend to have smaller rates of economic
growth or not.

In the second half of the paper, we examine this hypothesis by cross-country regressions. The
estimations of cross-country growth equations are standard in the literature. Most of previous
studies derived the equations from neoclassical growth models (e.g., Solow). In contrast, we,
derive the corresponding equation from an overlapping generations model. The derived equation
satisfies the standard convergence property. It also formulates the demographic impacts on
economic growth based on our model specification. In the estimations, several demographic
variables are highly significant. In particular, we find that given other variables, the share of the
retirement-age population has a significantly positive impact on per capita GDP growth. The result
suggests that a decline in working-age population will not slow down the rate of economic growth.

A crucial point in our analysis is that higher life expectancy and lower population growth
increases capital accumulation per worker. The negative impact of a decline in working-age
population can thus be dominated by the positive impact through capital accumulation. In that
population aging has a positive impact on capital accumulation, our theoretical implication is
consistent with previous studies. The implication is, however, never derived in the Solow type
growth models where the saving rates are exogenous. Allowing uncertain lifetime horizon, our
overlapping generations model derives the implication in an empirically tractable way.