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*on Demographic Issues*

## Productivity of Older Workers, Pension Reform and Savings: An International Comparison

*by Sang-Hyop Lee*

*No. 2012/02*

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# Productivity of Older Workers, Pension Reform, and Savings: An International Comparison

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# Productivity of Older Workers, Pension Reform, and Savings: An International Comparison

Abstract

The study conducts an international comparison in order to evaluate the effects of an increase in the normal retirement age on savings and old-age support. According to descriptive analysis, an increase in the normal retirement age would increase labor income and decrease public pension benefits of the older people, but the effect varies a lot across countries. The results based on the simulation model show that the effect of delayed retirement on savings depends on several factors, such as the country's old-age support system, the level of public pension benefits, and the productivity of older workers. The results generally show that delayed retirement reduces life-cycle pension wealth for the study countries, but it is less likely to reduce savings. The paper also reports the changing patterns of the simulated results for eight countries over time, in accordance with their respective demographic changes.

Keywords: older workers, population aging, savings, pension reform, labor productivity
JEL Classification: J26, J24. J14

## 1. Introduction

Some governments have considered policies to reduce the pace and depth of future population aging by modifying the age patterns of consumption and labor income in a way that raises support ratios. For example, the normal retirement age (full retirement age) at which full benefits are payable had remained at 65 in the U.S. for many years. However, according to the Social Security Amendments of 1983, beginning with people born in 1938 or later, that age has been gradually increased so that it reaches 67 for people born after 1959. Congress cited “improvements in the health of older people and increases in average life expectancy” as a primary reason for increasing the normal retirement age.

Individuals may respond to the policy in several different ways. In a simple life-cycle model, workers might accumulate wealth in anticipation of future needs to support consumption for longer periods of retirement without pension benefits. They may do this through personal saving, employment-based funded pension systems, or publicly funded retirement programs. This response initially leads to higher savings and lower consumption, but the additional capital is growth enhancing, and eventually income per worker rises. In addition, the incentive structure created by public pension programs can have an additional effect on individual behavior in a way that individuals delay their retirement. This possibility is supported by previous studies on the link between pay-as-you-go retirement pension benefits and earlier retirement practices (e.g., Gruber and Wise 1999). If workers delay their retirement substantially in response to the policy change then the aforementioned effect on savings may be muted, since the future needs to support consumption for retirement decreases.

The economic effects might vary substantially across countries. First, countries differ greatly in consumption, labor force participation, and productivity among the elderly. Second, population age structures are different across countries. Third, countries vary greatly in the system they employ to fund the consumption needs for their retirees: i.e., the reallocation system. Retirees in some countries heavily rely on publicly provided pensions and healthcare systems, while some countries rely more on savings and asset-based reallocations.

The effect of demographic change on savings and growth has been explored in a number of previous studies (Kelly and Schmidt 1995; Higgins and Williamson 1997; Lee, Mason, and Miller 2000; Bloom and Canning 2001; Bloom, Canning, and Graham 2003; Kinugasa and Mason 2007; Mason and Lee 2007, Bloom, Canning et al. 2007). Not until recently, however, did researchers demonstrate that the effect of demographic change on savings varies a lot across countries due to different old-age support systems. For example, Bloom, Canning et al. (2007) suggest that the response to a longer life span is not same across countries, varying by social security arrangements of countries. Likewise, Zhang and Zhang (2004) demonstrate that social security arrangements of countries affect savings and growth.

Mason and Lee (2007) show that population aging can lead to an increase in the demand for wealth if workers accumulate capital during their working years in anticipation of aging. Based on this, Mason, Lee, and Lee (2010a) simulate that Asian countries could vary greatly in the effect of demographic change on savings, due to different old-age support systems. Lee and Ogawa (2011) also demonstrate that countries vary greatly in the effect of delaying retirement, in large part due to the difference in productivity of older workers across countries. Change in population age structure also has a strong effect on public finances, due to the age patterns of public transfer inflows and outflows. Miller (2011) reports the fiscal support ratio to assess the pressures to fiscal sustainability arising from public transfers, which vary greatly across countries due to public transfer systems as well as population age structure.

This study examines the effect of the increase in the normal retirement age on savings. The simulation in the model requires comprehensive age profiles of productivity, labor force participation, consumption, savings, public pension transfers, asset and the other measures of public and private transfers. All the measures are obtained from the National Transfer Accounts (NTA). The purpose of the NTA is to measure the reallocations of economic resources across age that respond to the economic life-cycle. With its age component, the NTA enables us to measure the intergenerational reallocation of economic resources in comprehensive detail, such as intergenerational transfers and assets, both public and familial. The estimates, when aggregated, are consistent with the National Income and Product Accounts (NIPA). More detailed information on methodology is available from Lee, Lee, and Mason (2008), Mason, Lee et al. (2009), or on the project website: http://www.ntaccounts.org.

The descriptive results suggest a huge variation across countries in terms of its effect on old-age support; some elderly people are earning relatively less in some countries, even though the elderly in these countries have relatively high labor force participation rates. The lesson to be learned from this is the importance of policies that can maintain the productivity of older workers. A solution to the aging problem in these countries might be found not in simply delaying retirement but in a more fundamental change in the society, including retraining programs for the elderly.

The results based on the simulation model show that the effect of delayed retirement on savings varies across countries and that it depends on several factors, such as the country's old-age support system, the level of public pension benefits, the productivity of older workers, and the level of labor force participation. The simulation results suggest further that an increase in the normal retirement age reduces life-cycle pension wealth. The decrease in pension wealth does not necessarily increase savings, however, although it often does so. Savings tend to increase more due to the policy, when pension benefits are high relative to the productivity of older workers. This paper also describes the changing patterns of the simulated results for each country over time, in accordance with their respective demographic changes.

The paper is organized as follows. The next section describes the simulation model. It is followed by a discussion of the data and a descriptive analysis. Next, the simulation results for eight countries are discussed, along with the differences between results across countries. The final section concludes.

## 2. An Overview of the Model

The basic theoretical model draws upon Mason and Lee (2007). One of the main innovations of this paper is to simulate the model using different policy parameters. That is, the parameters are allowed to change according to a policy change. Most of all, all parameters and estimates are calculated based upon actual age profiles of labor income, consumption, net public transfers, and net public pension transfers from the NTA database. The sketch of the model is as follows.

The economy is subject to an aggregate budget constraint on flows that determines the time path of assets, transfer wealth and implicit debt, and income. If the profiles of consumption and labor income follow a given path, then we can calculate a life-cycle wealth that all adults must hold in year *t* in order to achieve the path over the remainder of their life. Life-cycle wealth thus defined can be decomposed into a portion that funds consumption in retirement and another portion that funds consumption by children. The first is called "pension wealth" and the second "child wealth." Pension transfer wealth is the present value of net transfers that year *t* adults will receive from year *t* children and from future generations. Child wealth is defined similarly. These transfers may be familial transfers or public transfers.

Lee (1994) postulates that this wealth can take several different forms. For the elderly, the reallocation can take any form of public transfers (e.g., social security), familial transfers, or asset-based reallocation (property income, dis-saving), while the asset-based reallocation is not important for children. Following this distinction, Mason and Lee (2007) distinguish private and public pension transfer wealth as the component of general transfer wealth that is used to fund retirement. The other component of general transfer wealth will be funded from asset-based reallocation. The impact of demographic change on asset accumulation and consumption growth depends on the extent to which the economy in question relies on pension transfer wealth versus capital accumulation to support consumption in old age.

Mason and Lee (2007) project the effect of future demographic change on the future demand for pension wealth. The demand for capital depends on population change as well. Holding the age profiles of asset income and savings, the changes in age distribution over the demographic transition would clearly lead to a rising ratio of capital to income. However, the demand for wealth by age also depends on fertility and mortality in their model. Couples with fewer children assign a greater share of their life-cycle earnings to their own consumption, and therefore have a greater demand for wealth to provide for higher consumption in retirement.

People who expect to live longer have a greater demand for wealth to finance their longer period of post-work consumption. These changes associated with the demographic transition and changes in age structure are also reflected in my analysis.

A brief mathematical formulation is as follows.

$$\begin{aligned}
&W(t) = A(t) + T_k(t) + T_p(t) \\
&W_p(t) = W(t) - T_k(t) = A(t) + T_p(t) \\
&\tau(t) = T_p(t) / W_p(t) \\
&\tau_k(t) = T_k(t) / W(t) \\
&A(t) = (1-\tau(t))(1-\tau_k(t))W(t)
\end{aligned} \tag{1}$$

The share of total life-cycle wealth that is held in the form of pension transfer wealth in some future year *t* is called $\tau(t)$, which is equal to $T_p(t)/W_p(t)$, where $T_p(t)$ represents pension transfer wealth and $W_p(t)$ the pension wealth. The pension wealth is the sum of assets and pension transfer wealth. The relative size of child transfer wealth is called $\tau_k(t)$, which is equal to $T_k(t)/W(t)$, where $T_k(t)$ is child transfer wealth and $W(t)$ is total life-cycle wealth. The total life-cycle wealth is the sum of pension wealth and child transfer wealth. Assuming that only adults hold assets, the aggregate assets in year *t*, *A(t)*, will be given as the last equation of (1).

For my simulation model, the value of $\tau$ is still treated as an exogenous variable as Mason and Lee (2007). One innovation of this paper is that $\tau$ is allowed to change due to change in policy (*R*). That is, I treat $\tau$ a function of social security reform (*R)*. Ignoring the year index *t*, the value of $\tau$ can be rewritten as

$$\tau(R) = \frac{T_p(R)}{T_p(R) + A(f(R))} \tag{2}$$

where *R* is government policy, such as pension reform or long-term healthcare reform. The function *f* is a behavioral response of individuals with respect to reform. For example, asset will change if people work more due to the policy change. The derivative of Equation (2) with respect to *R* yields

$$\tau'(R) = \frac{T_p{}'(R)A(f(R)) - T_p(R)A'(f(R))f\,'}{[T_p(R) + A(f(R)]^2} \tag{3}$$

Arranging Equation (3) yields

$$\frac{\tau'}{\tau} = (1-\tau)(\frac{T_p'}{T_p} - \frac{A'}{A} f') \quad (4)$$

The final equation (4) suggests that reduction in public transfers ($T_p$) decreases $\tau$. On the other hand, if people decreases their savings (*A*) by working more, then it increases $\tau$. If people respond (*f*) more sensitively to the change in policy, then it enforces the increase in $\tau$. The country effect depends on the level of $\tau$, changes in $T_p$, *A,* and *f*. The combined effect of increase in normal retirement age on the change in $\tau$ is ambiguous.

According to the budget constraint, the change in assets from one period to the next must equal saving during the period. The change in assets are determined by total labor income in year *t, Y(t)*, and by total consumption in year *t, C(t)*. *Y(t)* is also determined by the total number of effective producers and labor productivity, and *C(t)* is determined by the total number of effective consumers and consumption index. This leads to a mathematical formulation of

$$\begin{aligned} &(1+r)A(t) + (1+r)[Y(t) - C(t)] = A(t+1) \\ &Y(t) = \overline{y}(t)L(t) \\ &C(t) = \overline{c}(t)N(t) \end{aligned} \quad (5)$$

where *r* is the rate of interest, $\overline{c}(t)$ and $\overline{y}(t)$ respectively represent the consumption index and the labor productivity index, and $L(t)$ and $N(t)$ are respectively the effective number of producers (workers) and the effective number of consumers.

In the steady-state, assets grow at the same rate as total labor income, and thus the following condition should hold:

$$\begin{aligned} &A(t^*) = \frac{1+r}{r-g_y}[\overline{c}(t^*)N(t^*) - \overline{y}(t^*)L(t^*)] \\ &\frac{\overline{c}(t^*)}{\overline{y}(t^*)} = \frac{L(t^*)}{N(t^*)}\left[1 + (r-g_Y)(1-\tau(t^*))w_p(t^*)\right] \end{aligned} \quad (6)$$

where $g_Y$ is the growth rate. Equation (6) tells us the level of consumption that can be sustained in the steady-state, given any level of labor income. It is clear from the equation that a high level of consumption can be achieved for a smaller $\tau$, as long as *r* is greater than $g_Y$, holding other variables constant.

This model relies on the assumption that the cross-sectional shapes of the labor income and consumption age profile are given and constant. However, the levels of labor income and consumption profiles are assumed to change. They shift at exogenously given rates. Hence, variations in the relative levels of the consumption and earnings profiles, as well as variations in the population age distribution, lead to different aggregate saving rates and therefore determine the trajectory of asset accumulation. If the shape of cross-sectional age profiles of labor income and consumption do not change, then we can calculate the change in life-cycle wealth for each period that is necessary to sustain the life-cycle needs in the future.

For my simulation, the $\tau$ for each country is treated as a policy variable and it is calculated from data based on different policy scenarios. The demand for capital depends not only on values of $\tau$ and $\tau_k$, but also on the future consumption needs and the shape of labor income. In addition to $\tau$, calculations are based on the actual age profiles of labor income, consumption, net public transfers, and net public pension transfers, which are constructed from the NTA datasets. The new value of $\tau$ is governed by Equation (4). But the simulation requires a further assumption about whether and by how much an increase in normal retirement ages would have an effect on the actual age of retirement. To avoid complexity, we assume that the behavioral response of individuals delaying retirement with respect to the change in normal retirement age is constant (i.e., $f' = \sigma$). If the value of $\sigma$ is equal to zero, an increase in the normal retirement age has no impact on actual retirement age. As is implied by Equation (4), this unambiguously decreases $\tau$ since the share of public transfers decreases in the aggregate pension wealth. If the value of $\sigma$ is equal to one, an increase in normal retirement age leads to the same delay of retirement. The paper considers three values of $\sigma$: zero, 0.2, and one. The last sets of simulations also consider other scenarios, such as the effect considering substitution between public transfers and familial transfers, or the effect of an alternative policy such as reducing pension benefits rather than increasing the normal retirement age.

## 3. Data and Descriptive Analysis

Labor income here is defined as all compensation to workers, including earnings of employees and the portion of self-employment income which is a return to labor including the ones in the informal sector of the economy. The major difference between this measure and the usual concept of the labor earnings profile is that this measure is estimated using the entire population. Thus, the measure includes non-workers in the denominator, whereas the usual labor earnings profile is typically estimated only for the employees in the formal sector of the economy. The literature often focuses on the age profiles of the labor force participation rate and ignores productivity by age. This approach is appropriate when the model seeks to explain some particular behavioral question, for example, what determines the age at which men retire. This conventional approach, however, has limited implications for the paper. For some countries where a substantial portion of the elderly still participate in the labor market at low productivity levels or on a part-time working basis, looking at either the age at retirement or the wage of full-time employees misses an important picture of the economic life-cycle.

What would be the impact of delaying retirement on funding consumption for older people? The impact of delaying retirement can be implemented by stretching the labor force participation profile by adding more years of activity at the peak and shifting the profile after the peak to the right, weighted by the productivity of each age group.[1] Before providing some estimates, however, it should be noted that the real world is much more complex than theory. Most of all, the decision to work and the productivity of workers are not independent, because the productivity of older workers conditional on working is closely related to the decision to work. For example, it is not surprising to see that declining productivity of labor due to poor physical and mental health leads a person to retire. On the other hand, those who are going to retire soon are less likely to invest in their human capital, which leads to lower productivity of workers.[2,3] Because of this interdependence, the productivity of labor conditional on working may not appear to decrease from a certain age, especially around retirement age, if only those who have high productivity remain in the labor market.

It is difficult to identify these factors and examine theories using real-world data sets. Even the basic information needed (such as working hours by age) is not readily available for all countries. Institutions also constrain wages to rise with age through seniority systems, regardless of productivity. The productivity of labor will therefore depend on other macroeconomic conditions that are outside the control and foresight of an individual. However, some of the important factors can vary between countries, leading to important differences and changes in the way per capita labor income varies with age.

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[1] There are two issues of simulating the delayed retirement, though. First, the proportion of working population at each age and the labor income of the working population are not estimated separately for the NTA. But activity rates by age are available for most study countries from different sources, and hence, it is possible to calculate the productivity of the working population by dividing the per capita labor income by activity rates by age. While this procedure may not provide very accurate decomposition results, it may provide some useful insights. Second, activity rates are also available by five-year age groups for most countries. In order to get the average productivity profile by single year of age, I have smoothed the activity rates profile using the population age structure as a weight. I select the year of the survey for activity rates in a manner that it is closest to the year of the NTA data. The activity rates by age groups, the year of survey, and the original source of information for these activity rates are available upon request.

[2] See Skirbekk (2003) for review of literature, pointing to an inverse U-shaped individual productivity profile.

[3] Thus, an increase in normal retirement age may affect labor productivity too since human capital investment depends on expected duration of retirement. This additional effect is not considered in the simulation model.

Figure 1 presents the estimation results for people ages 65-74 on the labor income as a source of consumption. Delaying effective (actual) retirement by 2 years has a substantial impact on the labor incomes of the elderly in many countries, but the impact varies a lot by country. The magnitude of the effect is usually larger for countries with high productivity and low labor force participation of the elderly. Obviously, work plays a smaller role for the elderly in all European and other economically advanced countries, but the increase in the importance of labor income is substantial for these countries. On average, delaying retirement by 2 years increases the labor income as a source of funding consumption by 17 percent for people ages 65-74. All European countries except Slovenia are above the average. On the contrary, all Asian countries and Latin American countries except Taiwan and Costa Rica are below the average. The insight from this comparison is somewhat clear. Let us take Mexico as an example. Although Mexico has quite high activity rates for people ages 65-74 (36 percent), the productivity of these people (measured in earnings and two-thirds of self employed income for the working elderly) is quite low on average. Thus, delaying retirement will have a limited implication for solving old-age problems in countries with low productivity (but high labor force participation) for elderly in Mexico. The U.S. and Japan are intermediate.

<Figure 1 about here>

The importance of pension programs also varies by country. Figure 2 presents age profiles of labor income, consumption, net public pension transfers, and net public transfers for selected countries. The two most distinctive features across groups are the importance of net pension transfers in old age, and the importance of public pension transfers vs. other public transfer programs. Developing countries, such as Thailand, show little net public transfers to the elderly, while most European countries show substantial net public transfer inflows to them. The importance of the other public transfer programs is also different across countries. The difference between net public transfers and net pension transfers shows net other transfers, such as public health, unemployment insurance, and social assistance programs. In some countries, governments spend more money on programs other than pension provision. Tax sources are also different across countries.

<Figure 2 about here>

Again, the impact of increasing the normal retirement age is implemented by stretching the net pension transfers (by shifting the profile to the right by 2 years). Two issues, however, have to be addressed. First, it would be unreasonable to shift the profiles of some countries (such as South Korea) to the right for long term simulation. Although the importance of pension transfers is different by country, shapes are similar: rapidly increasing at a certain age, peaking at a certain age, and remaining flat from that age. The notable exception is South Korea, which has a peak at around age 60 and a sharp decrease thereafter. Because 2008 was the first year of normal benefit disbursement from the new National Pension Scheme in South Korea, the age profiles of net public pension transfers based on 2000 data show small inflows of pension transfers to the people older than 60. Thus, for countries like South Korea, the policy is implemented by stretching the net transfers profile by adding more years at the peak and shifting the profile after the peak to the right.

Second, to calculate the effect of the policy on $\tau$, we have to make a certain assumption about private transfers. If private transfers and public transfers are independent, then public transfers are a perfect substitute for asset-based reallocation. On the other hand, if private transfers respond to the change in public transfers, then public transfers and asset-based reallocation do not have to substitute on a one to one basis. In this paper, I consider both cases. I simulate the model first assuming that that public transfers and asset-based reallocations are perfect substitutes, and then relaxing the assumption by allowing up to 50 percent of substitution between public transfers and private transfers.

Table 1 summarizes the level of public pension benefit as a percentage of life-cycle deficit (the gap between labor income and consumption) for people ages 65 and older, the magnitude of the delayed retirement on labor income by two years, and the fiscal impact of an increase in normal retirement age by two years. There is surely a lot of variation across countries. Most European countries will experience an increase in labor income of about 4 percent or more. The United States, Japan, and Taiwan will experience an increase of slightly less than 3 percent, while for all the Latin American and Asian countries the increase will be about 2 percent or less, due to delaying their retirement by two years. The fiscal impacts of reducing pension benefits vary as well.

<Table 1 about here>

**4. Simulation Results**

The steady-state results are used to present dynamic simulation results from 1950 to 2300. The year 2300 is chosen since it is sufficiently far enough in the future to reach a steady-state. In addition, it is possible to project up to 2300 due to the availability of UN long-range projections. The simulation results were prepared for Costa Rica, Germany, Japan, Mexico, Slovenia, South Korea, Spain, and the U.S., where the information on all needed age profiles and other information are available. These countries show a wide range of development stages across different regions, from less advanced to most advanced countries.

The baseline assumptions are as follows. Productivity growth is 1.5 percent per annum. The interest rate is 6 percent until 2000 and decrease linearly to 4.75 percent between 2000 and 2300. Two-thirds of the cost of children is met through familial transfers. The analysis is carried out by constructing populations with medium projections about fertility and mortality, based on the UN *World Population Prospects* (2008 revision). The UN long-range projection to 2300 is used for additional calculations. The baseline pension transfer wealth is computed by measuring the product of the annual flow and the difference between the average age of inflow and outflow.

Table 2 provides a summary of the steady-state results for partial effects of varying policy parameters. Although the changes in interest rate, labor productivity growth, and level of consumption also have substantial effects on steady-state values, our focus is on the effect of delayed retirement and the increase in normal retirement age.

<Table 2 about here>

The table provides four simulation results for eight countries. Under column A are the values of baseline $\tau$, which are calculated for each country. Note that age profiles as well as $\tau$ change at the same time for each policy scenario. Column B shows the partial effect on the asset to labor income ratio as a result of delaying retirement by two years. As expected, delaying retirement decreases the ratio for all countries. It is quite large for Spain and Costa Rica, being over negative 20 percent, where the increases in $\tau$ are larger than other countries. It is about negative 10 percent for all other countries. The partial effects depend on several factors, such as the change in population age structure and consumption profiles for people 65 and older, in addition to the change in $\tau$ in our model. If net transfers do not change, then the decrease in the life-cycle deficit should reduce the life-cycle wealth, leading to an increase in the value of $\tau$, i.e., the share of total life-cycle wealth that is held in the form of pension transfer wealth. In general, a bigger increase in $\tau$ can decrease the asset to labor income ratio more, but the effects vary by country depending on other factors. For example, $\tau$ increases more for South Korea than for Japan due to the delayed retirement, but the combined effect with the increase in normal retirement age is higher for Japan than for South Korea.

Column C shows the partial effect of the increase in normal retirement age by two years on the asset to labor income ratio, holding the labor income profiles unchanged. Profiles of net public transfers are constructed using the new net public pension profiles. The values of $\tau$ are recalculated accordingly. Unlike the simulation for delayed retirement, this policy does not change the life-cycle deficit, but it decreases $\tau$. This policy increases the asset to labor income ratio for all countries, but again the effect varies substantially across countries. The impact of this policy on $\tau$ in large part depends on the importance of public pension for old age support, but again other factors play a role.

Column D shows the partial effect of the increase in normal retirement age and age at retirement by two years, respectively. The effect is positive for Japan and the U.S., but negative for all the other countries. Given the mixed results, it is natural to ask whether an increase in normal retirement ages would have much effect on the actual age of retirement. A boundary for this effect ( $\sigma$ as described above) would be zero and one. Thus the boundaries of percentage change for asset to labor income, shown in columns D and C (corresponding to $\sigma$ =1 and $\sigma$ =0), are (-22.6, 6.0) for Costa Rica, (-2.6, 8.2) for Germany, (-0.2, 14.1) for Japan, (-12.4, 0.3) for Mexico, (-8.2, 2.0) for Slovenia, (-12.4, 0.3) for South Korea, (-12.3 10.8) for Spain, and (-6.8, 4.9) for the U.S.

There have been some studies on this issue for the U.S., especially in the late 1980s. Almost all previous studies found that even a substantial change in the social security program would cause only small changes in the actual retirement age. For example, Burtless and Moffitt (1985) first showed that increasing the normal retirement age for social security benefits from 65 to 68 would delay retirement by about 4 months, suggesting that $\sigma$ is only 0.11 on average. Although Mastrobuoni (2009) shows a largest $\sigma$ with 0.6, a few existing studies concluded that they are not more than 0.2 if we restrict the policy change to the increase in normal retirement age (Krueger and Pischke 1992; Bloom, Canning, Fink, and Finlay 2009). It might also vary depending on countries' social welfare programs. For example, an increase in normal retirement age may not affect the actual retirement age where disability insurance is quite generous. For example, a country like Austria may not be affected by the policy since individuals may switch to disability insurance rather than delaying actual retirement (i.e., program substitution). On the other hand, $\sigma$ can be high in a country like Switzerland where generous unemployment insurance may complement the old-age pension system. A country like Finland would be another case where pension system was reformed to make it more attractive for older workers to continue working. Although this is an interesting research questions, to my best knowledge, there is no systematic studies which compares the value of $\sigma$ amongst European countries. Based on the existing literature, I select 0.2 for the value of $\sigma$ , and conducted another simulation. The results are shown in Column E.

If $\sigma$ is 0.2, then an increase in the normal retirement age by two years increases the asset to labor income ratio for Germany, Spain, Japan, Mexico, and the U.S. (ranging from 2.1 percent for the U.S. to 11.5 percent for Mexico). An increase in normal retirement age by two years virtually does not affect the asset to labor income ratio for Slovenia. For only Costa Rica and South Korea, it slightly decreases saving. It should be noted that the estimated impact of the delayed retirement could be overstated. The reason is that it may be only the group of people near retirement who are affected by the policy although I implemented the impact by stretching the labor income profile from the peak of the profile. Combined with the low value of $\sigma$ in the literature, it is more likely that delayed retirement induced by an increased normal retirement age would increase the life-cycle savings, rather than decreasing them.

The results in Table 2 assume that assets and pensions are perfect substitutes. However, it is possible that a decrease in public pension is replaced by another support system, such as familial transfers. Although this is not a possibility for European and Latin American countries, it is possible in Asia, where the familial transfer system is quite important (see Mason, Lee, and Lee 2010b for the comparison of the old-age support system across region). Columns CI-EI (corresponding C-E in Table 2) in Table 3 reports the results assuming that a 50 percent decrease in public pension is replaced by a familial transfer. As we expect, the effect of the policy on asset accumulation is smaller, but the direction of change is same. What would be the economic effect if countries reduce pension benefits, say by 5 percent, rather than increase the normal retirement age? The answer to this question also surely depends on how older people respond. Columns CII-EII in Table 3 reports these simulation results. The effect is positive for all countries. That is, decreasing the pension benefit by 5 percent has a much more positive effect on savings than increasing the normal retirement age by 2 years, if people respond the same way to these two different policy options.

<Table 3 about here>

How do demographic changes affect our simulation results? By using backward recursion, governed by Equation (5), I plot the simulation results in Figure 3. The results are reported only for the baseline $\tau$ to show the shape, because the shapes of other simulation results are similar. Although the results are available for the entire period from 1950 to 2300, only the results up to 2100 are presented in the figure to make it more easily readable. The results are presented for some components: assets ($A$), child transfer wealth ($T_k$), pension wealth ($W_p$), and life-cycle wealth ($W$). In order to compare the results across countries, all components are normalized, as a ratio of labor income ($Yl$). Child transfer wealth is plotted as a positive value to make it more readily readable in the figure.

<Figure 3 about here>

The changing patterns of the simulated results are related to the demographic change. For example, the child transfer wealth ($T_k$), the net wealth required to finance the life-cycle deficit for children, is closely related to the baby boom. Let's take South Korea as an example. The child transfer wealth for South Korea peaked after the Korean War which was equal to about 9 times labor income. As the baby boom ended, child transfer wealth began to decline steadily to less than 4 times labor income in 2010. Pension wealth ($W_p$), the net wealth required to finance the old-age life-cycle deficit, is related to an increase in life expectancy and changing age structure. For example, the pension wealth in the U.S. has been increasing, primarily due to increasing life expectancy and changing age structure. However, for South Korea, it increased until the mid-1980s, but started to decrease thereafter and continued to decrease until most recently. The reason for the decrease in the pension wealth is the consequence of the rapid increase in the relative number of young and prime age adults during the period, lowering support ratio. The pattern of total life-cycle wealth of adults (*W*) reflects the pattern of both child transfer wealth and pension wealth, because it is the sum of two. Some countries have experienced a change from a large negative value to a positive value (e.g., Costa Rica, Mexico, and South Korea), implying that the value of resources for retirement now exceeds the obligation to children in these countries. Finally, the figure shows that the substantial rise in wealth as form of assets (*A*) depends on the extent to which the elderly rely on transfers. Given the current transfer policy, assets rise much faster in the U.S. than in any other countries, because the U.S. relies much less on transfer wealth than any other study countries do.

## 5. Conclusion

Societies can respond to population aging in several ways. One possibility is that members of the population can work longer. Despite rapid improvements in health and life expectancy that enable people to continue to be productive longer than in the past, however, many countries have been slow to adjust normal retirement ages upward. In fact, the positive correlation between rising levels of economic development and earlier retirement suggests that many people are spending longer in retirement because they can afford to do so, relying on their own resources or on public resources.

An increase in normal retirement age is believed to partly slow the downward trend in labor force participation for older workers. However, the descriptive results suggest that the solution to the aging problem differ by countries. For low- and middle income countries, the solution to aging problem might not be jobs for the older people at a low wage rate. Rather it may have to be a more fundamental change in the society, including retraining programs for the elderly.

The simulation model focuses on this important aspect of the policy change, an increase in the normal retirement age and a delay in retirement on life-cycle saving. The paper uses the simulation model by Mason and Lee (2007) and presents results for eight economies. The results generally show that delayed retirement reduces life-cycle pension wealth for the study countries, but it is unlikely to reduce savings if it is induced by an increase in the normal retirement age. However, this effect varies a lot across countries.

There are numerous limitations in this paper. Some result from the assumptions of the NTA approach, whereas others originate from the assumptions of the simulation model. Assumptions such as the exogenous interest rate, fixed shape of cross-sectional consumption and labor profile needs to be improved. The fixed ratio of child transfer wealth is also a strong assumption, and a recent study shows that child transfer wealth does vary across countries.[4] The parameter $\sigma$ is also exogenously given in the model. A better form of model is needed for this parameter, which is left for future studies. The budget constraint implicitly assumes that there is no bequest, which is not properly addressed in the paper. There are limitations resulting from the way I utilize the data, too. For example, these are estimates from many countries, and it would be better if I can explain the results in connection with their public programs or labor market policies.

Nonetheless, the results are suggestive and interesting. Most of all, the results demonstrate that the economic effect depends on several country-specific factors, such as the country's old-age support system , the level of pension benefits, and the productivity of older workers. As government efforts to encourage later retirement are important policy initiatives, governments need to consider these factors.

[4] The value of $\tau_k$ does vary across countries (Mason, Lee, and Lee 2010b). However, the variation across countries is much smaller compared with the variation of the relative size of pension transfer wealth ($\tau$).

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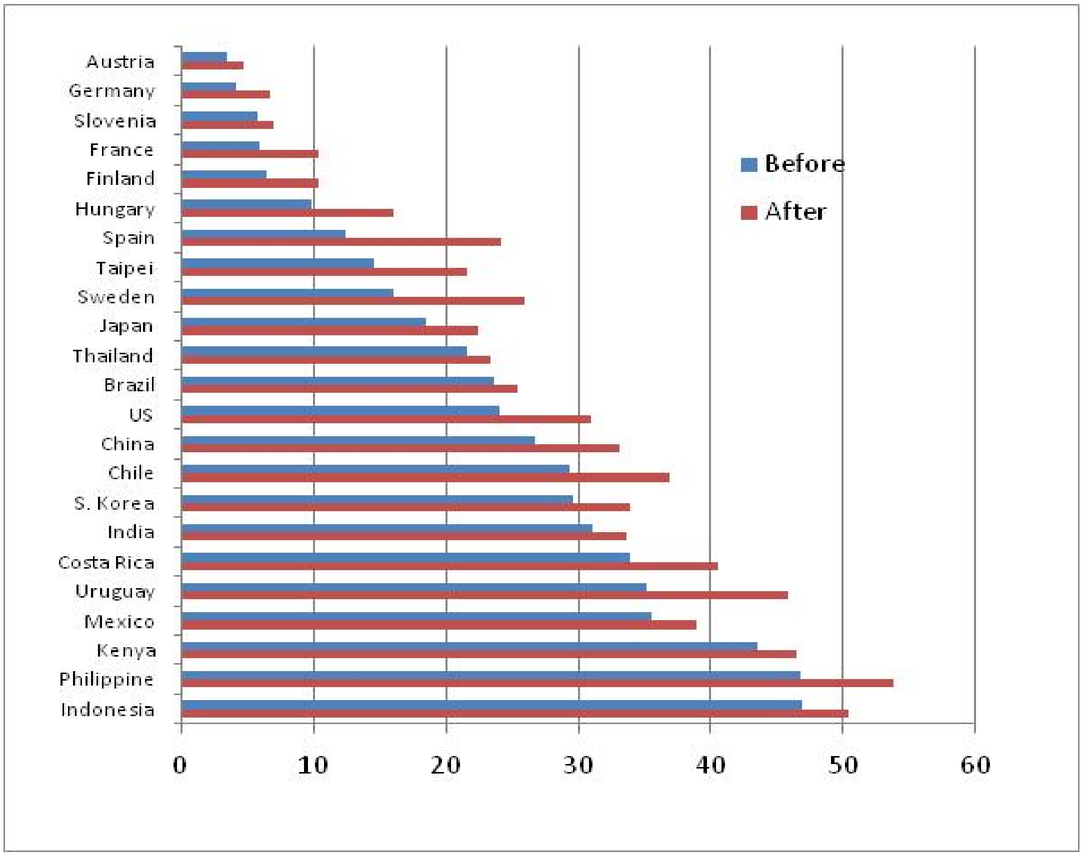
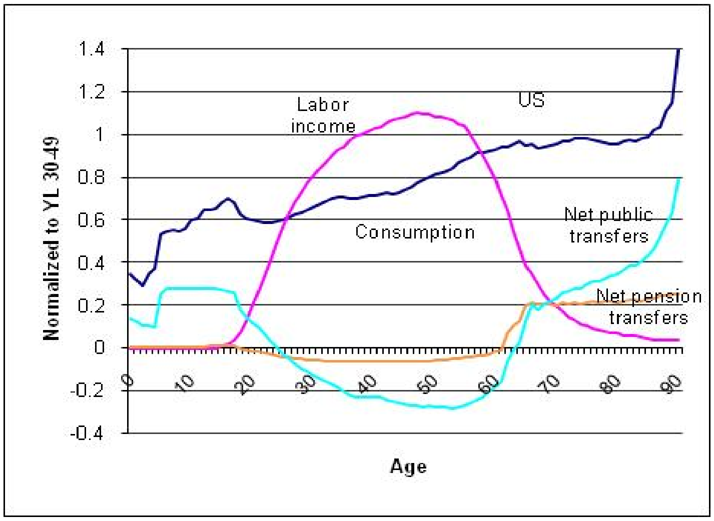
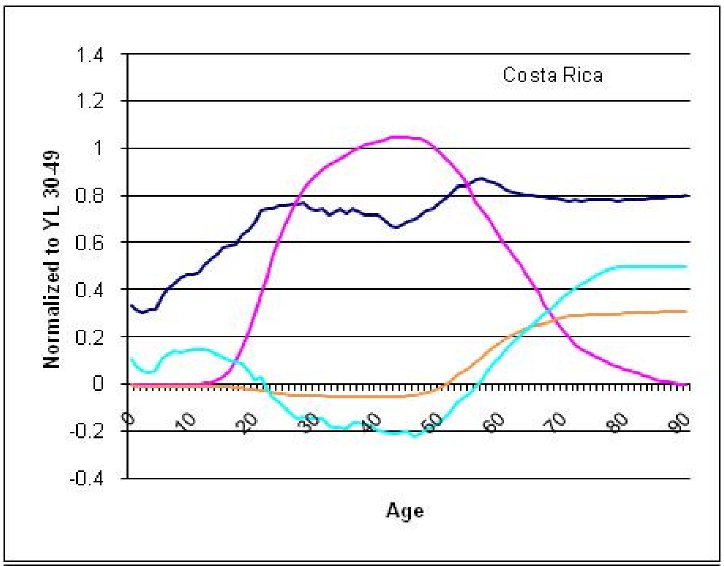


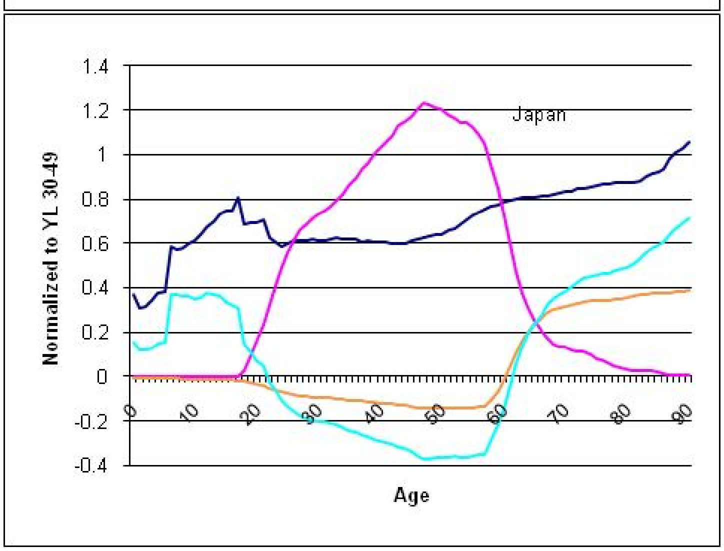

Figure 1. Labor income as a source of funding consumption (%) for people ages 65-74 before and after delaying retirement by 2 years, 23 economies, recent years.
Source: www.ntaccounts.org database.
Note: These are synthetic cohort values which are calculated using recent data on survival weights of the US. Hence, the results are not direct consequence of different mortality of the elderly across countries. Values are the ratio of the sum of per capita labor income at each single-year-of-age and the sum of per capita consumption at each single-year-of-age.



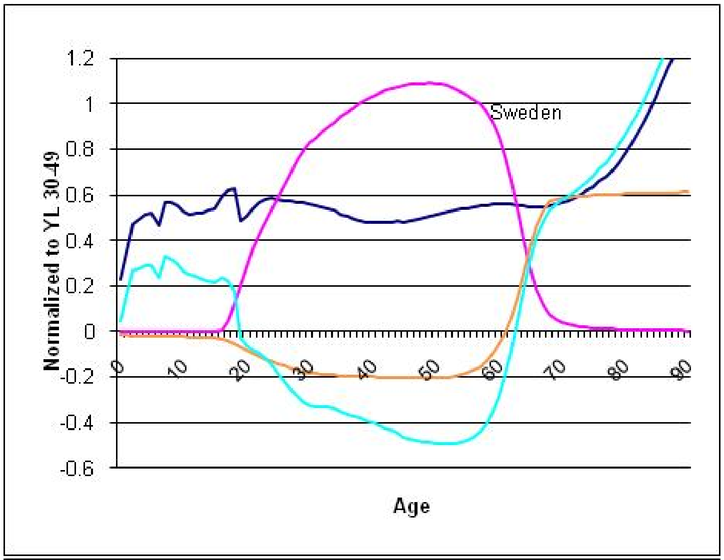
US
Labor income
Consumption
Net public transfers
Net pension transfers
Normalized to YL 30-49
Age

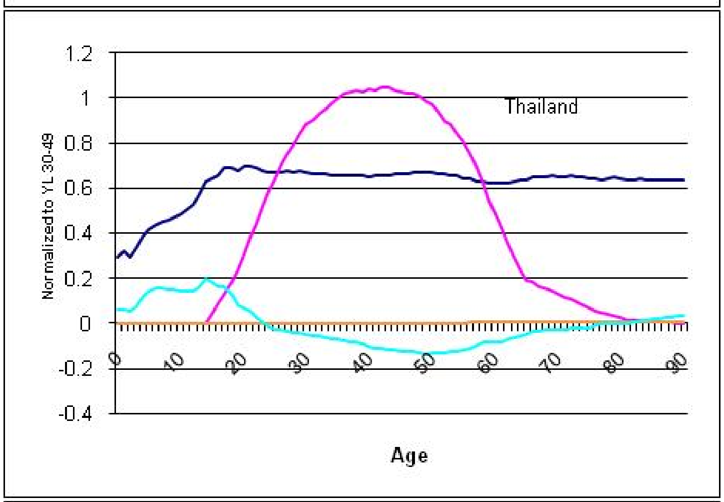



Costa Rica
Normalized to YL 30-49
Age

Japan
Normalized to YL 30-49
Age



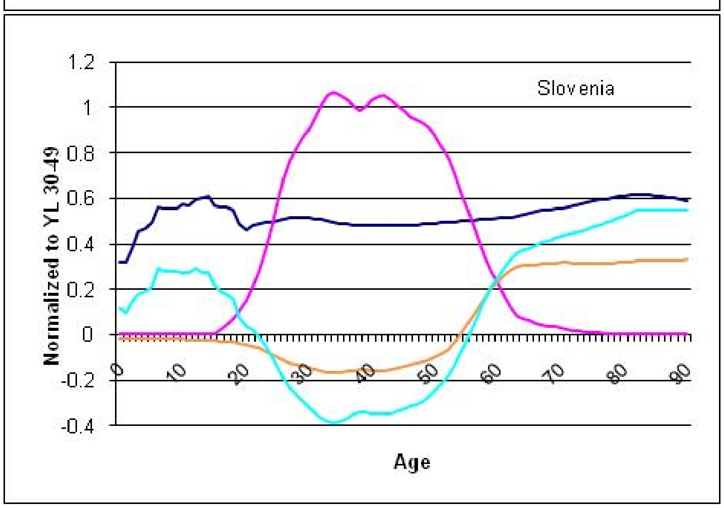
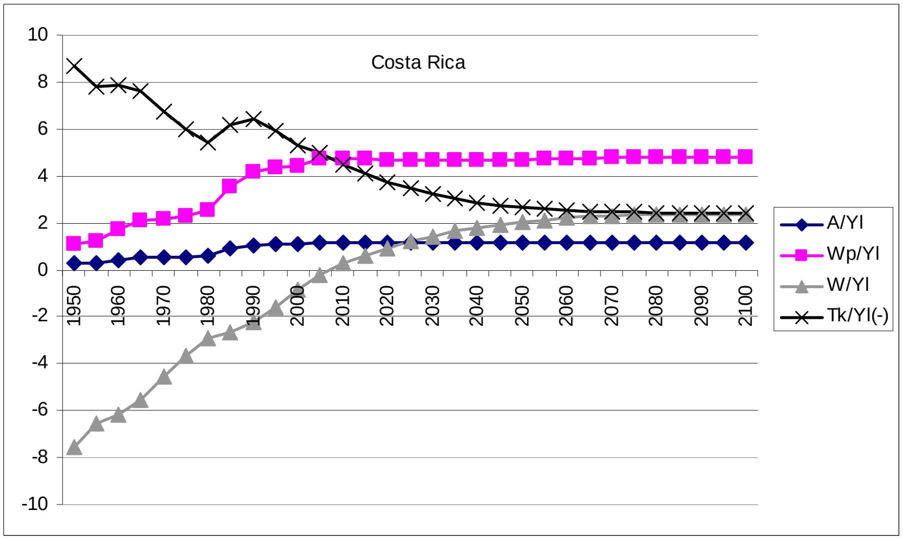




Figure 2. Age profiles of labor income, consumption, net public transfers, and net public pension transfers, selected countries.

Source: www.ntaccounts.org database.

Note : All profiles are expressed as the ratio of average labor income ages 30-49.


Costa Rica
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-6
-8
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1950
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1970
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A/YI
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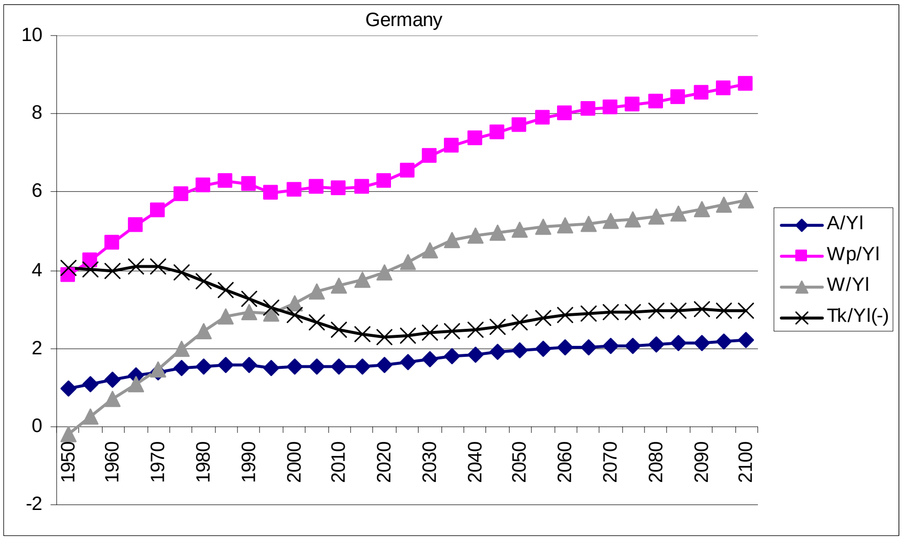
W/YI
Tk/YI(-)


Germany
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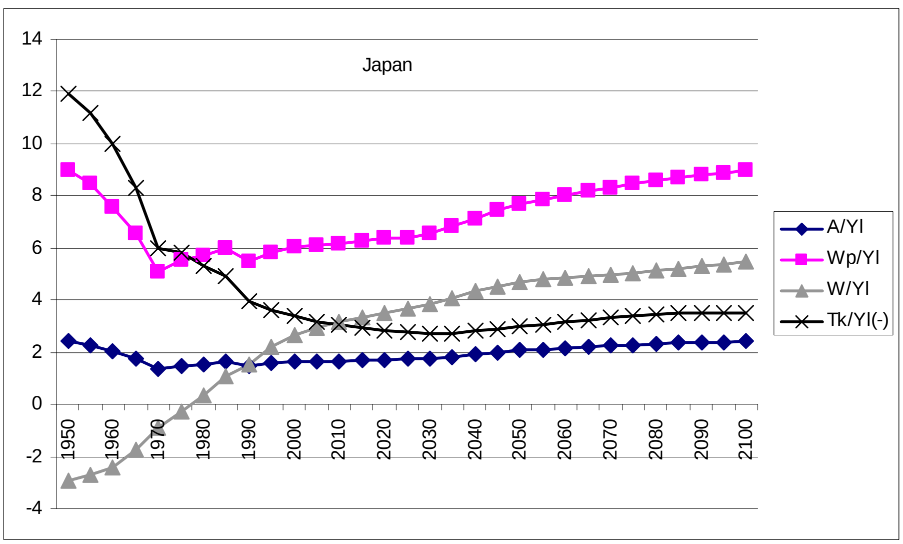
Japan
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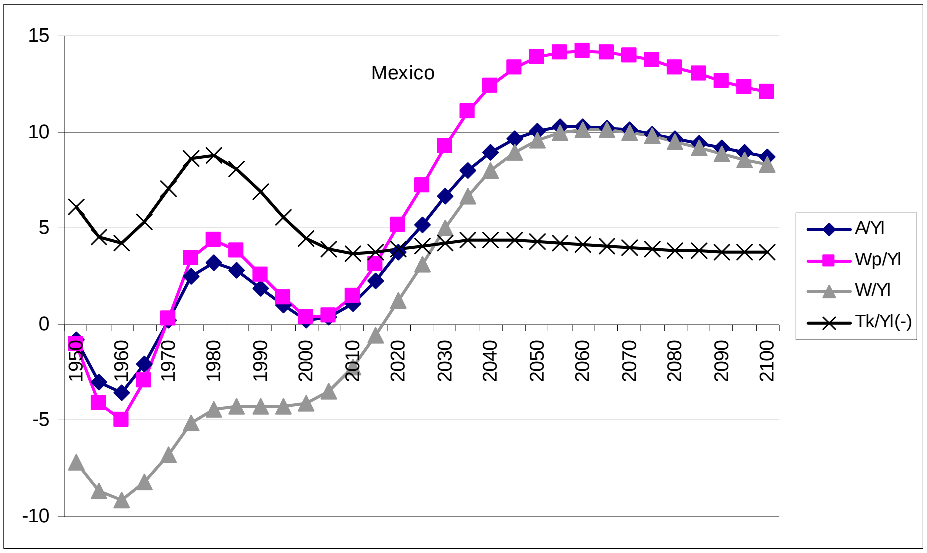
Mexico
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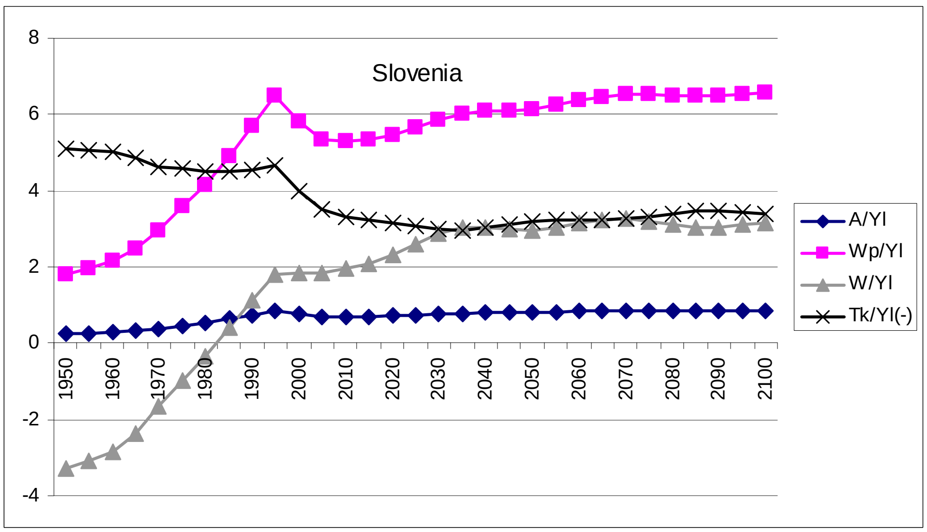
Slovenia
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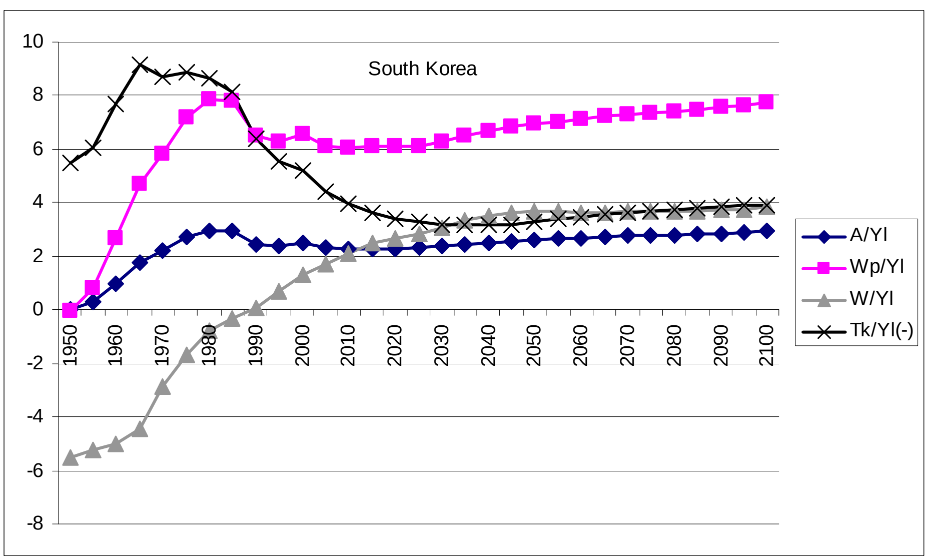
South Korea
A/Yl
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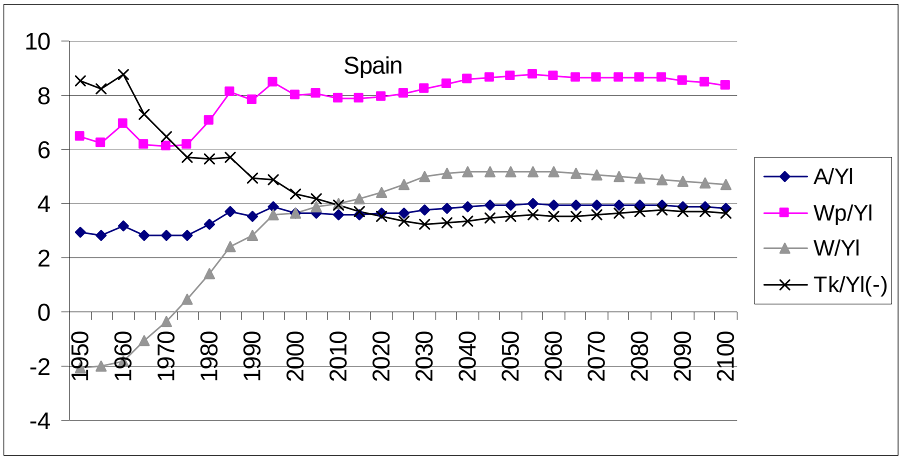


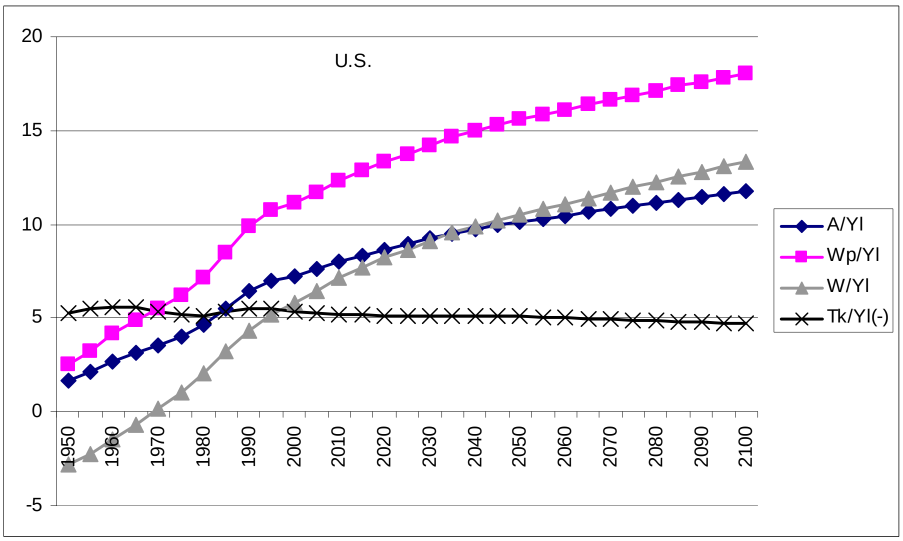


Figure 3. Simulation results for assets, pension wealth, life-cycle wealth, and child transfer wealth for eight countries, 1950-2100.
Note: A, Wp, W, Tk, and Yl refer to assets (A), pension wealth (Wp), life-cycle wealth (W), child transfer wealth (Tk), and labor income (Yl), respectively.

Table 1. Effects of delayed retirements and increase in normal retirement age (NRA) by 2 years.

| | A | B | C | D |
|---|---|---|---|---|
| | % increase in labor income for 65+ (after delaying retirement) | Pension benefits as % of life-cycle deficit for 65+ (before) | Pension benefits as % of life-cycle deficit for 65+ (after increase in NRA) | Fiscal impact, % decrease in pension benefits (after increase in NRA) |
| Austria (2000) | 4.4 | 85.3 | 84.4 | 9.8 |
| Chile (1997) | 2.1 | 61.7 | 58.3 | 11.1 |
| China (2002) | 2.1 | 36.4 | 35.9 | 12.2 |
| Costa Rica (2004) | 2.0 | 39.3 | 38.5 | 12.3 |
| Finland (2004) | 4.4 | 71.8 | 70.8 | 10.1 |
| Germany (2003) | 4.1 | 62.2 | 60.9 | 11.6 |
| Hungary (2005) | 6.5 | 57.1 | 56.0 | 10.0 |
| India (2004) | 1.1 | 19.2 | 19.0 | 8.8 |
| Indonesia (2005) | 1.1 | 0.2 | 0.2 | 9.6 |
| Japan (2004) | 2.8 | 45.4 | 43.4 | 11.3 |
| Mexico (2004) | 1.3 | 14.6 | 13.5 | 12.5 |
| Slovenia (2004) | 4.0 | 61.7 | 61.6 | 9.5 |
| S. Korea (2000) | 1.1 | 24.5 | 24.5 | 10.6 |
| Spain (2000) | 5.2 | 59.0 | 56.4 | 8.0 |
| Sweden (2003) | 3.2 | 91.2 | 86.6 | 10.2 |
| Taiwan (1998) | 2.7 | 5.8 | 5.8 | 10.6 |
| Thailand (2004) | 1.7 | 1.1 | 1.1 | 5.8 |
| Uruguay (1994) | 4.0 | 54.9 | 51.3 | 10.9 |
| US (2003) | 2.9 | 22.6 | 21.6 | 10.3 |

Source: www.ntaccounts.org database.

Note: Calculation for South Korea is done by stretching the transfers profile at the peak.

Table 2. Partial effects on assets due to change in age at retirement and normal retirement age (NRA), steady-state population.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| | Baseline | Delayed retirement | Increased NRA (sigma=0) | Increased NRA (sigma=1) | Increased NRA (sigma=0.2) |
| **Costa Rica** | | | | | |
| Tau | 0.75 | 0.80 | 0.74 | 0.79 | 0.75 |
| Asset/labor income | 1.87 | 1.35 | 1.99 | 1.45 | 1.84 |
| % change | | -28.15 | 6.04 | -22.60 | -1.49 |
| **Germany** | | | | | |
| Tau | 0.75 | 0.76 | 0.73 | 0.75 | 0.74 |
| Asset/labor income | 2.92 | 2.61 | 3.16 | 2.84 | 3.08 |
| % change | 0.00 | -10.39 | 8.23 | -2.57 | 5.63 |
| **Japan** | | | | | |
| Tau | 0.73 | 0.75 | 0.70 | 0.72 | 0.71 |
| Asset/labor income | 3.03 | 2.62 | 3.46 | 3.03 | 3.35 |
| % change | 0.00 | -13.53 | 14.09 | -0.16 | 10.50 |
| **Mexico** | | | | | |
| Tau | 0.28 | 0.29 | 0.24 | 0.24 | 0.24 |
| Asset/labor income | 7.24 | 6.64 | 8.21 | 7.57 | 8.07 |
| % change | 0.00 | -8.20 | 13.47 | 4.66 | 11.49 |
| **Slovenia** | | | | | |
| Tau | 0.87 | 0.88 | 0.87 | 0.87 | 0.87 |
| Asset/labor income | 0.90 | 0.81 | 0.92 | 0.82 | 0.90 |
| % change | 0.00 | -10.13 | 2.00 | -8.24 | -0.13 |
| **S. Korea** | | | | | |
| Tau | 0.62 | 0.65 | 0.62 | 0.65 | 0.63 |
| Asset/labor income | 3.57 | 3.12 | 3.58 | 3.13 | 3.47 |
| % change | 0.00 | -12.57 | 0.25 | -12.35 | -2.96 |
| **Spain** | | | | | |
| Tau | 0.54 | 0.59 | 0.51 | 0.55 | 0.52 |
| Asset/labor income | 3.14 | 2.45 | 3.47 | 2.75 | 3.32 |
| % change | 0.00 | -21.75 | 10.81 | -12.25 | 5.88 |
| **U.S.** | | | | | |
| Tau | 0.35 | 0.37 | 0.34 | 0.35 | 0.34 |
| Asset/labor income | 10.98 | 9.73 | 11.52 | 10.23 | 11.21 |
| % change | 0.00 | -11.38 | 4.92 | -6.81 | 2.11 |

Note : Calculated for an increase in NRA by two years. Tau is the share of pension wealth in total life-cycle wealth. Sigma is the change in actual retirement age due to change in the normal retirement age.

Table 3. Simulation results using different scenarios, steady-state population.

| | Scenario I (50% substitution b/w asset and public transfers) | | | Scenario II (5% reduction in pension benefit) | | |
|---|---|---|---|---|---|---|
| | CI | DI | EI | CII | DII | EII |
| **Costa Rica** | | | | | | |
| Tau | 0.75 | 0.77 | 0.75 | 0.72 | 0.77 | 0.73 |
| Asset/labor income | 1.93 | 1.60 | 1.85 | 2.17 | 1.61 | 2.02 |
| % change | 2.99 | -14.32 | -1.34 | 15.71 | -13.78 | 8.00 |
| **Germany** | | | | | | |
| Tau | 0.74 | 0.75 | 0.74 | 0.71 | 0.72 | 0.71 |
| Asset/labor income | 3.04 | 2.82 | 2.99 | 3.49 | 3.16 | 3.41 |
| % change | 4.08 | -3.39 | 2.38 | 19.71 | 8.30 | 16.98 |
| **Japan** | | | | | | |
| Tau | 0.72 | 0.73 | 0.72 | 0.70 | 0.72 | 0.70 |
| Asset/labor income | 3.24 | 2.98 | 3.18 | 3.53 | 3.09 | 3.42 |
| % change | 6.93 | -1.72 | 4.84 | 16.43 | 2.05 | 12.80 |
| **Mexico** | | | | | | |
| Tau | 0.26 | 0.26 | 0.26 | 0.25 | 0.26 | 0.25 |
| Asset/labor income | 7.71 | 7.20 | 7.60 | 7.84 | 7.22 | 7.70 |
| % change | 6.50 | -0.48 | 4.99 | 8.35 | -0.23 | 6.42 |
| **Slovenia** | | | | | | |
| Tau | 0.87 | 0.87 | 0.87 | 0.83 | 0.84 | 0.83 |
| Asset/labor income | 0.91 | 0.84 | 0.89 | 1.21 | 1.10 | 1.19 |
| % change | 1.00 | -6.68 | -0.58 | 34.63 | 22.72 | 32.16 |
| **S. Korea** | | | | | | |
| Tau | 0.62 | 0.64 | 0.63 | 0.60 | 0.63 | 0.61 |
| Asset/labor income | 3.58 | 3.30 | 3.51 | 3.83 | 3.37 | 3.71 |
| % change | 0.11 | -7.64 | -1.77 | 7.14 | -5.74 | 3.86 |
| **Spain** | | | | | | |
| Tau | 0.53 | 0.55 | 0.53 | 0.51 | 0.55 | 0.52 |
| Asset/labor income | 3.30 | 2.79 | 3.19 | 3.52 | 2.79 | 3.36 |
| % change | 5.30 | -11.07 | 1.90 | 12.28 | -10.94 | 7.32 |
| **U.S.** | | | | | | |
| Tau | 0.34 | 0.35 | 0.34 | 0.33 | 0.35 | 0.34 |
| Asset/labor income | 11.25 | 10.30 | 11.03 | 11.60 | 10.31 | 11.30 |
| % change | 2.42 | -6.17 | 0.48 | 5.69 | -6.09 | 2.88 |

Note: See Table 2. Column alphabets are consistent with the case for Table 2.

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