Reform and Support Systems for the Elderly in Developing Countries:
Capturing the Second Demographic Dividend

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Abstract

Many third world countries face rapid population aging over the coming decades. The demographic trend poses two significant policy challenges – sustaining strong economic growth and establishing effective economic support systems for the elderly. This paper shows that the demographic transition presents two opportunities for more rapid economic growth, or "dividends". The first dividend arises because of the rapid growth of the productive population relative to the consuming population. The second dividend arises because population aging provides a powerful force for saving and asset accumulation. The second dividend will not be realized, however, if old-age security relies on transfer systems. In this paper our emphasis is on familial transfer systems rather than public systems. We show the importance of early reform that emphasizes the accumulation of pension assets rather than continued reliance on the family. Given appropriate policies, population aging could lead to wealthier and more prosperous societies.

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Introduction

In many developing countries and in East Asia's NIEs, demographic change has favored economic growth. A demographic dividend or demographic window arises because the working-age populations are growing more rapidly than the number of consumers. This provides an extra boost to per capita income. As is widely appreciated, the demographic dividend is transitory. In the coming decades, the number of consumers will begin to grow more rapidly than the number of workers as a large part of population growth is concentrated at older ages where labor productivity is low and importantly is less than the preferred levels of consumption. By 2050 the dividend will have entirely dissipated in many countries.

This seemingly pessimistic scenario has a silver lining, however. Given appropriate policy formulation, population aging will yield a second dividend. The same demographic changes that lead to low support ratios (high dependency ratios) in the future, namely few children and longer life, also both raise capital per worker other things equal, and additionally create a powerful incentive for individuals to accumulate assets to provide for old age. The result can be a period of rapid growth in per capita income. The rapid pace of asset accumulation is also transitory. However, per capita assets and income stabilize at a level that is permanently higher. In this respect, the second dividend persists whereas the first dividend is transitory.

The qualification "given appropriate policy formulation" is an important one because population aging may lead us down other paths. One possibility is that average incomes of and consumption by the elderly would be allowed to decline relative to others as they become more numerous and more burdensome. This is an unattractive and, we believe, avoidable scenario. A second possibility is that intergenerational transfer programs are strengthened. This could be accomplished either by expanding or initiating PAYGO public pension programs similar to those found in the US, Japan, Europe and Latin America or by strengthening familial support systems that stress support for the elderly by their adult children. This option can meet the lifecycle objectives of individuals and the distributional objectives of societies, but the saving incentives that would lead to a second demographic dividend are deeply undermined.

In a sense, the first dividend and the second dividend are opposite sides of the same coin. The first dividend arises because (working-age) parents have fewer (dependent) children. The second dividend arises because one generation later, (post-working-age) parents will have fewer (working age) children. Low fertility is not the only demographic factor that underlies the second dividend, however. Steady and continuing improvements in adult mortality are also important, as is the rising proportion of the population at the older ages.

Although the second dividend is a consequence of population aging, the accumulation of wealth occurs in anticipation of aging. The exact sequencing depends on a variety of complex details, but the first and second dividends may overlap to a considerable degree. Indeed, one of the important conclusions we reach below is that an early policy response is essential to realizing the second dividend. This is particularly true and a major policy challenge for developing countries that will experience unusually rapid population aging.

The paper is organized as follows. In the first section we present a theoretical model that shows how changes in age structure influence economic growth and distinguishes the first and the second demographic dividends. In the second section, we present and discuss estimates of the first dividend for countries around the world. In the third section we turn our attention to the second dividend relying on a simulation model with parameters based on Taiwan's economy and population. We conclude with a discussion of limitations of the analysis and highlights of the key findings.

Two Demographic Dividends

The First Dividend

The first demographic dividend arises and dissipates as changes in age structure over the demographic transition influence the rates of growth of producers and consumers. This is demonstrated by a simple model. Define the effective number of consumer (N) and the effective number of producers (L) as:

$$\begin{aligned} N(t) &= \int f(x)P(x, t)\,dx \\ L(t) &= \int g(x)P(x, t)\,dx \end{aligned} \tag{1}$$

where $f(x)$ is an age-specific weight that captures variation by age in consumption related to physiological needs, culture, preferences, etc., $g(x)$ is an age-specific weight that captures variation in productivity related to age, and *P(x,t)* is the population of age *x* in year *t*. Income per effective consumer, *y(t)*, is determined by two multiplicative factors:

$$y(t) = SR(t) \times y_l(t). \tag{2}$$

The first is the support ratio, $SR(t) = L(t)/N(t)$, which captures how changes in age structure influence the concentration of the population in the relatively productive ages. The second term is the average income per worker ($y_l(t) = Y(t)/L(t)$).In a closed economy this will be influenced by a myriad of factors, e.g., the level of technology, human capital, physical capital, the strength of political and economic institutions, natural resources, etc. In an open economy, income per worker is also influenced by income earned on assets invested abroad.

The rate of growth in income per effective consumer, $g[y(t)]$, is the sum of the rate of growth of the support ratio, $g[SR(t)]$, and rate of growth in income per worker, $g[y_l(t)]$.

$$g[y(t)] = g[SR(t)] + g[y_l(t)]. \tag{3}$$

The first dividend is defined as the rate of growth of the support ratio, which equals the rate of growth of effective labor less the rate of growth of the number of effective consumers: $g[SR(t)] = g[L(t)] - g[N(t)]$. The first dividend is positive when the effective number of producers is growing more rapidly than the effective number of consumers. In recent decades fertility decline in many countries has led to slower growth in the number of children. In Asia, the number of children is no longer increasing at all. The working-age populations have continued to grow, however, yielding the first demographic dividend. As the transition proceeds, the working-age population will also begin to grow more slowly, and the first dividend will decline in importance. Growth in the elderly population will continue unabated for decades to come. In the absence of changes in labor force participation and the productivity of older populations, the effective number of consumers will grow more rapidly than the effective number of producers. The first demographic dividend will turn negative. The decline in the first dividend between 2000 and 2050 will outweigh the gains between 1960 and 2000 in many European countries and some East Asian countries as we show below (Table 1).

The sustained period during the demographic transition when the support ratio is rising is defined here to be the "demographic window" or the "window of opportunity". During this period, income per effective consumer is growing more rapidly than productivity growth. Some of this dividend can used to increase consumption, raising current standards of living, and some can be invested in human or physical capital or in stronger institutions that will lead to permanently higher economic growth.

The Second Dividend

The second demographic dividend arises more or less automatically to some extent, but its full potential will be realized only to the extent that consumers and policymakers are forward-looking and respond effectively to the demographic changes that are coming. With the decline in the support ratio on the horizon, consumption can be maintained only through the accumulation of wealth in some form. One possibility is that individuals and/or governments acting on their behalf will accumulate assets. If invested in the domestic economy, the result will be capital deepening and more rapid growth in output per worker. If invested abroad, net foreign income and national income will grow more rapidly. In both cases, there must be an initial reduction in consumption. But it is also true that in both cases, income per effective consumer will grow more rapidly – yielding a second demographic dividend.

As an alternative to accumulating assets individuals or governments may accumulate transfer wealth, i.e., claims against future generations. Two institutional arrangements can be used to accumulate transfer wealth. First, governments can establish transfer programs of which PAYGO pension programs are the most prominent example. Under these arrangements, pension benefits of current retirees are paid by taxing current workers. Transfer wealth for current generations is created because future generations are obligated to pay future pension benefits to current generations. The flip side of transfer wealth is the implicit debt imposed on future generations. Second, families can also create transfer wealth by undertaking intergenerational transfers. Under these arrangements, working-age family members provide support to family members who are retired and, in turn, expect to receive support from their adult children upon reaching retirement. Familial support systems create transfer wealth for current generations and implicit debt for future generations just as public support systems accomplish this through PAYGO pension programs. In both cases, population aging causes no initial reduction in consumption since no funds are set aside for capital formation.

Transfer wealth and assets are close substitutes as a means of reallocating resources across the lifecycle. Either can be used to sustain consumption of low productive age groups. Transfer wealth and assets differ, however, in that accumulating transfer wealth has no effect on economic growth or per capita income. Accumulating transfer wealth does not yield a second demographic dividend.

The second dividend differs from the first dividend in several important respects. First, population aging is leading to an increase in the effective number of consumers relative to the effective number of producers. This causes the first dividend to dissipate but it is the source of the second dividend. Anticipation of the future decline in the support ratio leads to an increase in wealth and possibly assets. Second, the first dividend is transitory in nature. The support ratio rises over the demographic transition resulting in higher per capita income, but it eventually declines to pre-transition levels. In the absence of other changes, i.e., changes in income per worker, per capita income would return to a level near the pre-transition per capita income. The second dividend is not transitory in that capital deepening and higher per capita income may be permanent.

In one important respect, the first and second dividends are similar. Both depend on effective complementary economic policy. The first dividend, for example, is realized only if employment keeps pace with growth in the working age population. The second dividend is realized only if support systems encourage the substitution of capital for transfer wealth.

To simplify formal analysis of the second demographic dividend, we abstract from the cost of children and consider the consumption and labor income only of adults.[1] This focuses our attention exclusively on the implications of the growth of the older population. Lifecycle wealth consists entirely of assets and transfer wealth accumulated to finance old-age consumption in excess of labor income.

Intergenerational transfer policy is defined as the proportion τ(t) of total lifecycle wealth W(t) held as transfer wealth at each point in time, so that:

$$A(t) = (1 - \tau(t))W(t) \qquad \tau(t) \le 1. \tag{4}$$

If transfer policy is constant, the rate of growth of assets will equal the rate of growth of wealth. Likewise, the ratio of assets to income will be determined entirely by the ratio of lifecycle wealth to income. If intergenerational transfer policy is undergoing change, however, asset growth will occur more rapidly or more slowly than the underlying change in lifecycle wealth. This is an important feature of the analysis presented below.

The wealth for each cohort at time *t* follows from the intertemporal budget constraint. Wealth must equal the present value of future consumption less labor income.[2] Thus, the wealth for the cohort aged *z* in year *t* is:

$$W(z,t) = \int_0^{w-z} e^{-r(t,x)x} C(z+x,t+x)dx - \int_0^{w-z} e^{-r(t,x)x} Y_l(z+x,t+x)dx \tag{5}$$

where $r(t,x)$ is the average interest rate for the period *t* to *t+x*, C and Y_l are the consumption and labor income of the cohort in the current and each future period of its existence, and w is the maximum age achieved. Note that the values for the cohorts incorporate the effects of mortality, because the number of individuals remaining alive in each cohort declines with time due to mortality.

Assume that the shape of the cross-sectional consumption profile is constant, i.e., proportional to the $f(x)$ values in equation (1), but the level of the consumption profile shifts over time. Designating the average rate of change in the profile between period *t* and period *t+x* as $g_c(t,x)$, the consumption of the cohort at age *z+x* in year *t+x* is equal to:

$$C(z+x,t+x) = \bar{c}(t)e^{g_c(t,x)x} N(z+x,t+x). \tag{6}$$

where $\bar{c}(t)$ is the consumption per effective consumer in year *t*. Likewise, a cohort's labor income in period *t+x* depends on the number of effective producers belonging to the cohort, $L(x,t) = g(x)P(x,t)$, and the rate at which the age-profile of productivity is shifting over time. Designating the average rate of increase of the age-productivity profile between period *t* and period *t+x* as $g_y(t,x)$, the labor income of the cohort age *z+x* in year *t+x* is:

$$Y_l(z+x,t+x) = \bar{y}_l(t)e^{g_y(t,x)x} L(z+x,t+x), \tag{7}$$

where $\bar{y}_l(t)$ is labor income per effective worker in year *t*. Substituting for consumption and labor income in equation (5) yields an expression for cohort wealth that is determined, in part, by

[1] The cost of children are formally incorporated into the model in Mason and Lee (forthcoming)
[2] In this formulation bequests are assumed to be zero.

current and future values of the elements of the support ratio – the effective numbers of consumers and producers:

$$W(z,t) = \bar{c}(t)\int_0^{w-z} e^{[g_c(t,x)-r(t,x)]x} N(z+x,t+x)\,dx$$
$$-\bar{y}_l(t)\int_0^{w-z} e^{[g_y(t,x)-r(t,x)]x} L(a+x,t+x)\,dx \tag{8}$$

Wealth for the population is found by integrating across all ages at time *t:*

$$W(t) = \bar{c}(t)\int_0^{w}\int_0^{w-z} e^{[g_c(t,x)-r(t,x)]x} N(z+x,t+x)\,dxdz$$
$$-\bar{y}_l(t)\int_0^{w}\int_0^{w-z} e^{[g_y(t,x)-r(t,x)]x} L(z+x,t+x)\,dxdz. \tag{9}$$

Changing the order of integration and adjusting the limits of integration yields:

$$W(t) = \bar{c}(t)\int_0^{w} e^{[g_c(t,x)-r(t,x)]x}\int_0^{w-x} N(z+x,t+x)\,dzdx$$
$$-\bar{y}_l(t)\int_0^{w} e^{[g_y(t,x)-r(t,x)]x}\int_0^{w-x} L(z+x,t+x)\,dzdx. \tag{10}$$

Represent the lifetime labor income of all adults, i.e., their labor wealth, by $W_l(t)$ and the ratio of total consumption to total labor income by $c(t) = \bar{c}(t)N(t)/\bar{y}_l(t)L(t)$. Dividing both sides of equation (10) by labor wealth yields:

$$\frac{W(t)}{W_l(t)} = c(t)\frac{SR(t)}{LSR(t)} - 1$$
$$LSR(t) = \frac{\int_0^{w} e^{[g_y(t,x)-r(t,x)]x}\int_0^{w-x} L(z+x,t+x)\,dzdx}{\int_0^{w} e^{[g_c(t,x)-r(t,x)]x}\int_0^{w-x} N(z+x,t+x)\,dzdx}. \tag{11}$$

LSR(t) is the lifetime support ratio. The numerator is the effective number of producers discounted and cumulated over the lifetime of all year t adults while the denominator is the effective number of consumers discounted and cumulated over the lifetime of all year t adults.

The exponential terms "discount" future consumers and producers by differences between the rates of growth consumption and production and the rate of interest. The rates of growth capture out-of-steady-state changes over time in consumption and labor income, while the interest rates convert future consumption and earnings streams into present values.

The key feature of equation (11) is that wealth is directly related to the current support ratio, but inversely related to the lifetime support ratio. The low lifetime support ratios that anticipate population aging necessitate the accumulation of wealth in the current period.

Given a stable population, the per capita age-profiles of effective consumption and production are constant. Given steady-state economic growth, the rate of growth of consumption per equivalent adult and production per equivalent worker would be constant and equal to the rate of technological change. The ratio of consumption to labor income would also be constant as would the wealth to income ratio. In the closed economy case, the capital-output ratio and income and consumption per equivalent adult would be determined by $w^*(1-t^*)$, the equilibrium wealth to output ratio and the intergenerational transfer policy. We only sketch these results out here because the steady-state equilibria are not our primary interest. Our focus here is squarely on dynamic effects that arise over the demographic transition. For this purpose we employ simulation analysis to analyze how changes in age structure and transfer policy influence wealth and consumption paths

Estimates of the First Demographic Dividend

The world as a whole and all major regions experienced a favorable first demographic dividend between 1960 and 2000 with one important exception – the least developed countries located primarily in Africa (Table 1, column 5). In other regions of the world the gains were relatively modest. Income per effective consumer was higher by 7.7 percent in 2000 as compared to 1960 for the world as a whole due to the cumulative effect of the demographic dividend. Income per effective consumer was higher by 12 percent in Asia, 15 percent in Latin America and the Caribbean, and 11 percent in Northern America. Some of the high performing countries of East Asia enjoyed a very favorable dividend. Income per effective consumer increased by 22 percent in China, by 30 percent in Thailand, by 35 percent in South Korea, and by 38 percent in Singapore as compared to 1960 due to the first dividend.

<Table 1 about here>

Two approaches have been taken to estimating the first dividend. The first approach relies on growth models typically estimated using cross-national aggregate time-series data (Bloom and Williamson 1998; Kelley and Schmidt 2001; Bloom, Canning et al. 2002; Bloom and Canning 2003). The second approach – the one used here – relies on growth accounting or direct calculation (Mason 2001). The growth accounting approach uses micro-data based estimates of the age profiles of consumption, $f(x)$, and labor earning, $g(x)$, to implement equation (1). For any population age distribution the effective number of producers and consumers is calculated directly as can be the difference in their rates of growth over any period.

The estimates presented in Table 1 are constructed using the same age profiles for all countries. The profiles are estimated for Taiwan in 1977 using an extensive amount of data income and public and private consumption. The effective worker age profile is an estimate of labor income by age and the effective consumer age profile is an estimate of public and private consumption by age (Figure 1).[3] The Taiwan profiles are broadly similar to those estimated for other countries with earnings heavily concentrated in the working ages of 20-64 and consumption spread more evenly across all age groups. There are some important differences between the Taiwan profiles and recent estimates for the United States (Lee, Lee et al. 2006; Mason, Lee et al. forthcoming) In the U.S. consumption is much higher among the elderly, primarily because of spending on health care. Using such a profile would increase the speed with which the demographic dividend will disappear in the future and would increase the affects on lifecycle

[3] Methods, data sources, and age profiles for other countries are available at www.ntaccounts.org.

wealth and possibly the demand for assets associated with the second demographic dividend. The US profile appears to be somewhat atypical with regard to consumption by the elderly because of the nature of the US health care system and the high expenditure on health care for the elderly.[4]

<Figure 1 about here>

Projections of the demographic dividend to 2050 are also presented in Table 1. These are based on the medium scenario of the UN population projections (United Nations 2003). The dividend is projected to be the most favorable in the least developed countries where the effective labor force will grow faster than the effective number of consumers by 0.68 percent per year, calculated as the rate of growth of the effective labor force (2.95) less the rate of growth of the number of effective consumers (2.27). A dividend of this magnitude will produce an increase in income per effective consumer of about 30% over the fifty year period. A similar result is produced by calculations for Africa.

For other regions of the world the dividend will be much smaller in the future or turn negative. The greatest decline is in Europe where income per effective worker will decline by 0.31 percent per year due to its demographic burden. In most of the high flying East Asian economies the first dividend will also turn negative. In Japan, Hong Kong, South Korea, and Singapore the effective labor force will grow more slowly than the effective number of consumers by at least 0.4 percent per year.

The final column in Table 1 compares income per effective consumer in 2050 with income per effective consumer in 1960. The purpose is to assess the extent to which the 1960-2000 dividend has dissipated by 2050. In Europe the cumulative net effect of the dividend is to reduce per capita income by 7 percent as compared with 1960. Northern America is essentially at the same point in 2050 as in 1960. Among Asian countries, Hong Kong's support ratio in 2050 will be no different than in 1960, but Japan will experience a substantial deterioration in the first dividend with income per effective consumer reduced by 9 percent as compared with 1960. The other East Asian countries will have total gains ranging from 9.2 percent in Singapore to 36 percent in Malaysia.

Simulating the Second Dividend

The simulation results presented here are based on a model described in more detail in Lee, Mason, and Miller (2000; 2001b).[5] Here we touch on only a few key points. We assume that the economy is closed to migration and open to international capital flows. The domestic capital stock adjusts to satisfy the arbitrage condition that the domestic rate of return to capital is equal to the world rate of return. Hence, domestic capital is independent of the total assets held by residents and the domestic interest rate equals the world interest rate. The effective labor force is determined as the product of age-specific productivity of workers, age-specific labor force participation rates and the population of each age. Population change is determined by exogenous age-specific fertility and mortality rates. The age-profile of worker productivity shifts proportionately over time at a rate governed by exogenous labor-augmenting technological change. National income is equal to earnings plus returns to total assets held by residents.

In accordance with the life cycle theory, adults save and dissave in order to achieve a smooth consumption path despite fluctuations in their labor earnings, changes in the numbers of children present in their households and their eventual retirement. Because household size and age distribution change over the life cycle, we assume that it is consumption per equivalent adult

[4] Estimates of the first dividend based on US profiles are available in Mason (2005)
[5] Complete documentation is available at http://www.ceda.berkeley.edu/papers/rlee/.

consumer that is smoothed, rather than household consumption itself.[6] The consumption path is also influenced by time preference, the rate of interest, and attitudes towards uncertainty.[7]

Consumption plans are made such that the present value of the survival-weighted consumption for the household equals the survival-weighted present value of expected labor earnings for all members of the household, plus the survival-weighted expected value of net transfers received (where negative values represent net contributions made to others). To formulate these plans, then, people must form an expectation of how rapidly their wage rates will rise; when they will retire; survival probabilities for all household members; ages at which children will leave the household and establish their own; future interest rates; and the future of all relevant transfer systems. Then they must carry out complex calculations to solve the optimization problem.

The model parameters are based on available data for Taiwan on age-earnings profiles, productivity growth rates, interest rates, and demographic rates. We abstract from immigration. We assume that the total fertility rate stabilizes at 2.1 births per woman and life expectancy at birth stabilizes at 78.8 years in 2036.

Wealth in the absence of transfers

We begin with simulations of saving and wealth in the absence of transfers. These results provide the maximum simulated path for assets that is consistent with lifecycle needs and provides a benchmark for assessing the effect on assets and the second demographic dividend of relying on alternative transfer systems.

The simulated path for the ratio of assets to income under the pure life cycle model, labeled "no transfers," is presented in Figure 2. The dominant trend is an increase in the asset/income ratio. This change reflects a complex interaction of the effect of longer life expectancy on the demand for wealth for retirement at the household level, declining numbers of coresident children for whom consumption must be provided during earlier adult years, and shifts in the age composition of the population towards older age groups with higher wealth holdings and low labor earnings. Taiwan's ratio stabilizes at about 6 in 2050 reflecting the assumption that life expectancy stabilizes. If life expectancy were to continue to rise, the wealth income ratio would also continue to increase. The trend towards greater wealth was interrupted for three to four decades in the middle of the 20th century due to the major increase in the number of children due to rapid decline in infant and child mortality. But with the drop in fertility to low levels in the early 1980s, the influences of rising life expectancy and aging reasserted themselves.

<Figure 2 about here>

The "no transfers" saving rate series that corresponds to the "no transfers" asset/income series is presented in Figure 3. The simulated saving rate increases from a low level in 1900, a brief pause during the 1960s, followed by a sharp rise reaching a peak in the early 21st Century. This peak occurs because saving rates are particularly high at older working ages where populations are concentrated. The upswing in saving is very pronounced in Taiwan because of its rapid fertility decline and consequent larger swings in age structure (Lee, Mason et al. 2001a). Saving then declines dramatically as population growth becomes concentrated among the low-saving elderly and as life expectancy stabilizes.

<Figure 3 about here>

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[6] We employ a very simple weighting scheme: children count 0.5 and adults 1.0. Lee, Mason, and Miller (2001b) considers the impact of varying weights for children and the elderly on saving and wealth.

[7] Note that the lifecycle assumption used in the simulation model is different than the consumption profile determination assumed in the first part of the paper. In steady-state equilibrium the two assumptions are equivalent, but not during transitions.

One might think that population aging would cause a reduction in assets per person as saving rates plummet during the first part of the 21st Century. But this does not happen because the decline in fertility, which causes population aging, also causes slower population growth. Because population growth is slower, the saving needed for asset "widening" is reduced, and a greater proportion of savings goes for asset "deepening". The asset-income ratio continues to rise as shown in Figure 2 and assets per person (not shown) rises correspondingly.

Anyone with a passing knowledge of Taiwan saving would note important differences between actual saving rates and the simulated no transfer, life cycle saving rates presented in Figure 3. This lack of correspondence between theory and fact is one of the motivations for considering the role of transfers.

Modeling Transfer Systems and their Change

We model family transfers as though each elder is fractionally coresident with each of the elder's surviving children and consumes an amount equivalent to adults in those households. Equivalent approaches from the perspective of our model are to randomly assign each elder to the household of one of the elder's adult children or to model support as a financial transfer to a separate household of the elder. For accounting convenience, we assume separate coresidence for the elder, with financial transfers from children. This governs planning by both young and old.

The extent to which the family support system in East Asia has eroded and the speed with which changes are occurring are unknown at this point. In some economies, Japan, South Korea, and Taiwan, the proportion of the elderly co-residing with adult children has dropped quite rapidly in recent years, but the implications for transfers are unclear. In our simulation we assume a sudden break in 1960, around the time when fertility began to decline. This sudden break makes it easier to identify consequences in the simulations. Under one scenario labeled "Collapse," we assume that all obligations, even to those already old, are suddenly and unexpectedly canceled in 1960. This is highly unrealistic because retirees would receive no help at all from their children, so we consider two other scenarios as well. In both, children continue to honor their traditional parental support obligations by the fraction of the parent's lifetime earnings that had been earned at the time of the transfer system change. In the second scenario, labeled "Unexpected," the change in support system is not anticipated. In the third scenario, labeled "Anticipated," everyone has full foresight about the system change, so they begin to save more before it actually occurs.

Each transfer system for old-age support provides an income stream for the elderly. This income stream may or may not be adequate for the elderly to achieve the life cycle consumption path that is desired. If not, then people save over their working years so as to accumulate the assets needed to achieve their optimal consumption paths. It could also happen, in principle, that transfer income exceeded the desired level for old-age consumption, in which case people would like to borrow against their transfer income to increase consumption earlier in the life cycle. It is also possible that working-age people may borrow and save in order to smooth their consumption over the periods in which they have elder support obligations as a result of the system.

Results of Simulations: Transfer Wealth and Implicit Debt

Our simulations provide a measure of the demand for life cycle wealth, conditional on demography, economic expectations, expectations about transfer systems, and various technical parameters in the utility function. Under the assumption of a pure life cycle model, with no transfers, this demand for wealth is also the demand for assets.[8] Our simulations also provide a measure of the demand for capital in the presence of a transfer system. The difference between these two hypothetical demands for assets measures the transfer wealth generated by the transfer

[8] Assets include domestic and foreign capital owned by residents.

system. This transfer wealth is equal to the implicit debt generated by the transfer system, which is the sum of the unfunded obligations not covered by future taxes imposed on the *existing* adult population.

For Taiwan in the year 1960, the implicit debt generated by the family transfer system (as we have modeled it) is about 47% of the demand for wealth or about 0.9 times GDP. It is interesting to compare these figures to the ratio of implicit debt to GDP for public pension programs elsewhere. In the US in the year 2000, the implicit debt (discounting at 3%) generated by Social Security (OASI) amounts to 46% of the total demand for wealth or 1.7 times GDP (Lee, Mason et al. 2003). In Latin America for *circa* 1990, Bravo (2001) estimates implicit debt to GDP ratios as high as about 1 for Costa Rica, about 1.5 for Chile, Panama and Cuba, about 2 for Brazil, and about 3 for Uruguay and Argentina.

When a transfer system is phased out and replaced by a system of individual responsibility through saving, this implicit debt must be somehow repaid. The generations responsible for repaying it, who are mostly the current and future working-age population, will then have a double task: to make payments out of current income to honor past obligations by repaying the implicit debt and to save out of their current income to prefund their own retirements.

Capital and Saving with Transfers

As shown in Figure 2, the family transfer system in Taiwan significantly reduces, but does not eliminate, the demand for life cycle assets. The gap between the asset-income ratio with and without transfer systems, representing the transfer wealth and implicit debt, widens substantially over time. This is an important point. As the transition proceeds in Taiwan, the size of the implicit debt relative to income increases from a ratio of 0.5 in 1900, to 0.9 in 1960, to 1.5 in 2000, to 2.9 by 2050. It will become increasingly costly and difficult to phase out the family support system in Taiwan the later this is done. At the same time, if it is done relatively early before implicit debt is great, then population aging will drive up assets and capital invested in domestic and foreign economies. This is a fundamental result.

Now let's turn to the transitional phase itself. If the system collapses, then the demand for assets immediately increases in a discontinuous fashion from its previous path (Figure 2). Aggregate saving rates immediately shoot up by 10 to 15 percentage points (Figure 3). This is "super saving" arising as people in the working ages strive to catch up in their asset accumulation, while the elderly, deprived of their income source, no longer dissave. This scenario is an unrealistic, polar case, and we turn to alternative scenarios.

Under the scenarios in which family obligations are honored, the asset-reducing effects of the transfer system are prolonged, so that assets and saving rates are both substantially below the "no transfer" level for a few decades. When the demise of family support is anticipated, saving rates begin to rise some decades before. Thus, even assuming a sudden change in the system, modeling foresight and honoring obligations creates a gradual transition. In the long run, however, they all end up indistinguishable from the no transfer scenario, once all the original participants in the family system have died off.

A Brief Discussion of Simulated and Actual Values

In this paper, we offer only a brief and general comparison of actual and simulated wealth and saving values. In Taiwan, the actual capital-output ratio in 1965 was similar to the "family transfer" simulated asset-income value for the same year. The ratio increased rapidly during the next two decades reaching a level similar to the "no transfer" scenario. Since then, however, the ratio has increased very gradually (Figure 2). Saving rates have also increased very rapidly from the early 1950s in a fashion broadly consistent with a transition from a family transfer to a no transfer transition. Household saving rates were somewhat higher whereas net private saving rates were somewhat lower than the "no transfer" scenario in 1993.

In its broad outlines, the saving experience of Taiwan has been repeated in several East and Southeast Asian countries but not in Latin America. Saving rates have not risen to high levels in Latin America even where PAYGO pension programs have been phased out.[9] Two of the factors emphasized here may account for part of the difference between East Asia and Latin America. Because Latin America's demographic transition has been slower, the swings in life cycle saving and wealth should be more moderate (Lee, Mason et al. 2001a). Moreover, the public transfer systems are much more important in Latin American than in Asia. Many other factors may also account for the differences, however. Until recently Asia escaped the financial crises that plagued Latin America. Moreover, income inequality is much lower in Asia. Thus, to the extent that the poor do not engage in lifecycle saving (Fox and Palmer 2001), aggregate saving may respond less to transition in support systems in Latin America than in Asia.

The Bottom Line: Income and Consumption

The accumulation of wealth simulated above translates into higher per income. For a small open economy, the appropriate assumption for Taiwan, the additional wealth is invested abroad yielding gains in national income. Given a Cobb-Douglas production function and assuming that depreciation is zero, the ratio of national income per worker to domestic output per worker is equal to:

$$\frac{Y/L}{GDP/L} = 1 + b\,\frac{(A-K)}{K} \tag{12}$$

where b is the elasticity of output with respect to domestic capital, A is the total assets including those held abroad, and K is the domestic capital stock. Taking the equilibrium capital output ratio for the domestic economy to be 3 and the elasticity of output with respect to domestic capital to be 0.35, we can readily calculate the growth effect of the increases in the ratio of assets to income in the simulations presented in Figure 2. Consider first the life cycle simulation in which family support systems do not operate. An increase in the ratio of total assets to income from 2.5 to 5.75 between 2000 and 2050 would lead to an increase in national income forty percent greater than the increase in GDP. In annual terms, income per effective worker would grow faster by 0.67 percent per year due to the increase in total assets induced by lower fertility and increased life expectancy.

Under the fully operating family support system, the asset-income ratio increases from approximately 1 in 2000 to 2.9 in 2050. The effect is to increase income per effective worker by an additional 29% over the 50 year period. Annual growth would be higher by 0.51% per year. Finally, consider the implications of moving from the family transfer system to the no transfer system between 2000 and 2050. Income per effective worker would increase by 72% relative to GDP per worker. The annual rate of growth of income per worker would be higher by nearly 1.1% per year between 2000 and 2050. Consumption per effective worker grows even more rapidly than income under the influence of the second demographic dividend. As shown in Figure 2, consumption rates drop considerably between 2000 and 2050.

The large gains after 2000 are not a free lunch, however. Incomes are higher and growing faster because of increased capital accumulation achieved through higher rates of saving and lower rates of consumption. Under any of the simulations, consumption rates rise substantially after 1975 and reach very high levels around 2010. Under the no transfer

[9] See Holzmann (1997), for example, for an analysis of the effect of pension reform on saving in Chile.

simulation, the sacrifice, in the form of reduced consumption, is substantially higher. More rapid economic growth is achieved, in part, through the sacrifice of current consumers.

Figure 4 shows this more clearly by comparing total consumption in each year under alternative transfer arrangements to the no transfer simulation. Continued reliance on the family transfer system leads to higher consumption than the no transfer system until approximately 2020. Per capita income is growing more slowly under the family support system, but individuals are consuming a high percentage of all that is earned. The adverse consequences of the failure to accumulate assets in anticipation of population aging begins to emerge after 2020. Consumption drops steadily relative to the system with no transfers.

<Figure 4 about here>

An anticipated abandonment of the family support system yields the smoothest transition in consumption. Consumption is reduced relative to the family transfer system, but remains higher than the no transfer system until 1960 – the date of the change over. After 1960, consumption is depressed relative to the no transfer system but eventually consumption converges to the higher level attained by the no transfer system.

The other approaches to reform, both of which offer no opportunity for preparation, lead to very substantial drops in consumption at the date of reform. The more realistic approach to reform, the "unexpected" transition, yields a decline in consumption of nearly eight percent – an enormous "tax" to impose in a single year. Not only are the costs of reform concentrated at a single point in time under this approach, implementing reform becomes all the more difficult politically.

Comparing these approaches to reform shows that anticipated changes are considerably less painful than the alternatives. It is also the case that implementing early in the demographic transition has clear advantages over delay. The pain of transition arises because workers essentially pay twice for old age support. First, they pay by honoring the obligations to elderly parents that persist after the phase out of the family support system begins. Second, workers must begin to save for their own retirement leading to further reductions in their consumption.

The first cost of transition is measured by the implicit debt in the transfer system. This is captured in Figure 2 as the difference between "no transfer" capital and "family transfer" capital. The difference measures the present value of the obligations of future generations. Early in the demographic transition the implicit debt is small. In 1900, for example, the implicit debt was about half of national income. By 2000, however, the implicit debt had increased to 150% of national income. The burden of retiring that debt represents a considerable cost of reform. The earlier reform is undertaken, the easier its implementation.

Qualifications and Conclusions

The research reported is subject to a number of important limitations. First, the simulation analysis has considered only the case of a small open economy. To the extent that increased capital is invested domestically, rates of return to capital will be depressed and wages will be raised. The effect on income under these circumstances requires further exploration.

Second, we have focused our analysis entirely on the accumulation of physical capital. A potentially important and widely noted possibility is that parents or societies respond to reduced fertility by increasing investment in the human capital of children. To the extent that this is a lifecycle strategy for parents, the extended family is providing an investment opportunity rather than serving as a transfer system. Income flows from adult children to their parents are returns to investment in human capital, not familial transfers. Thus, the second demographic dividend would encompass investing both in physical and in human capital.

Third, the focus here is entirely on familial support systems with no attention to public support systems. Public transfer systems have been extensively analyzed and in previous work we compare public and familial support systems (Lee, Mason et al. 2003). The effects on capital accumulation are largely independent of whether transfers are provided directly to the elderly or mediated by the public sector. Replacing family support systems with PAYGO public systems achieves none of the potential gains of the second demographic dividend.

Fourth, capturing the gains from the second dividend is no more automatic than from the first dividend. Individuals may not understand the financial implications of an extended retirement or may be incapable of exercising the self-control required to forego current consumption. Frequently, retirement saving plans involve an element of compulsion for exactly these reasons. Underdeveloped financial markets in many countries may limit the investment opportunities available to consumers. Similarly, international capital markets do not operate with the ease assumed in our simulations. Globalized capital markets offer a clear advantage to pensioners in aging societies.

Finally, it seems unlikely that governments would resort to banning family support systems nor is it our intention that they should. Experience has shown that the family has a clear advantage in providing personal care and attention. There does not seem to be a viable alternative to time transfers from children to elderly and these are likely to increase substantially as populations age. To the extent that familial support systems encourage efficient investment in the human capital of children, they also offer an advantage. However, any shift away from familial *financial* transfers in favor of capital accumulation is a welcome development and one that should be encouraged.

For countries with late demographic transitions, the first population dividend offers a positive development opportunity during the coming decades. For other countries in both the developed and developing worlds, the first population dividend is beginning to erode. This has led some to conclude that population aging will necessarily undermine development efforts. This view is unduly pessimistic. Intrinsic to population aging is a second demographic dividend. Population aging provides a powerful incentive for capital accumulation. Given early and successful efforts to exploit the second dividend, higher rates of economic growth could be achieved over an extended, if transitory, period. At the end of the day, population aging could lead to wealthier and more prosperous societies.

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Table 1. Demographic Dividend, 1960-2000. Major Regions of the World, High Performing Countries of East Asia.

	Annual Growth Rate (%), 1960-2000		First Dividend (%)	Annual Growth Rate (%), 2000-2050		First Dividend (%)	Cumulated First Dividend Since 1960 (%)	
	Effective labor force	Effective Consumers	1960-2000	Effective labor force	Effective Consumers	2000-50	2000	2050
World	1.99	1.80	0.19	0.89	0.71	0.18	7.7	16.0
More developed regions	0.90	0.71	0.18	-0.56	-0.27	-0.29	7.6	-4.3
Less developed regions	2.42	2.17	0.25	1.19	0.91	0.29	10.3	23.7
Least developed countries	2.42	2.51	-0.09	2.95	2.27	0.67	-3.5	26.2
Africa	2.60	2.66	-0.06	2.74	2.03	0.71	-2.2	29.8
Asia	2.30	2.01	0.29	0.77	0.58	0.19	12.3	21.2
Europe	0.65	0.51	0.14	-1.00	-0.69	-0.32	5.8	-6.9
Latin America and Caribbean	2.62	2.27	0.35	0.91	0.65	0.26	15.0	27.5
Northern America	1.40	1.14	0.25	0.36	0.55	-0.19	10.6	2.5
Oceania	1.90	1.72	0.18	0.89	0.86	0.03	7.4	8.5
China	2.27	1.78	0.49	-0.23	-0.06	-0.18	21.5	13.2
China, Hong Kong SAR	2.70	2.19	0.51	0.09	0.60	-0.50	22.6	0.3
Japan	1.13	0.81	0.32	-1.20	-0.63	-0.57	13.8	-9.4
Republic of Korea	2.49	1.74	0.74	-0.49	-0.04	-0.45	34.7	12.5
Indonesia	2.37	2.08	0.29	0.68	0.44	0.24	12.4	23.6
Malaysia	3.05	2.62	0.43	1.32	0.97	0.34	18.6	36.1
Singapore	3.21	2.41	0.80	-0.50	0.08	-0.58	37.7	9.2
Thailand	2.96	2.30	0.66	0.23	0.27	-0.04	30.2	28.3

Sources: Calculations by authors. See text.

Figure 1. Mean Consumption and Labor Income by Age, Taiwan, 1977 (NT$)

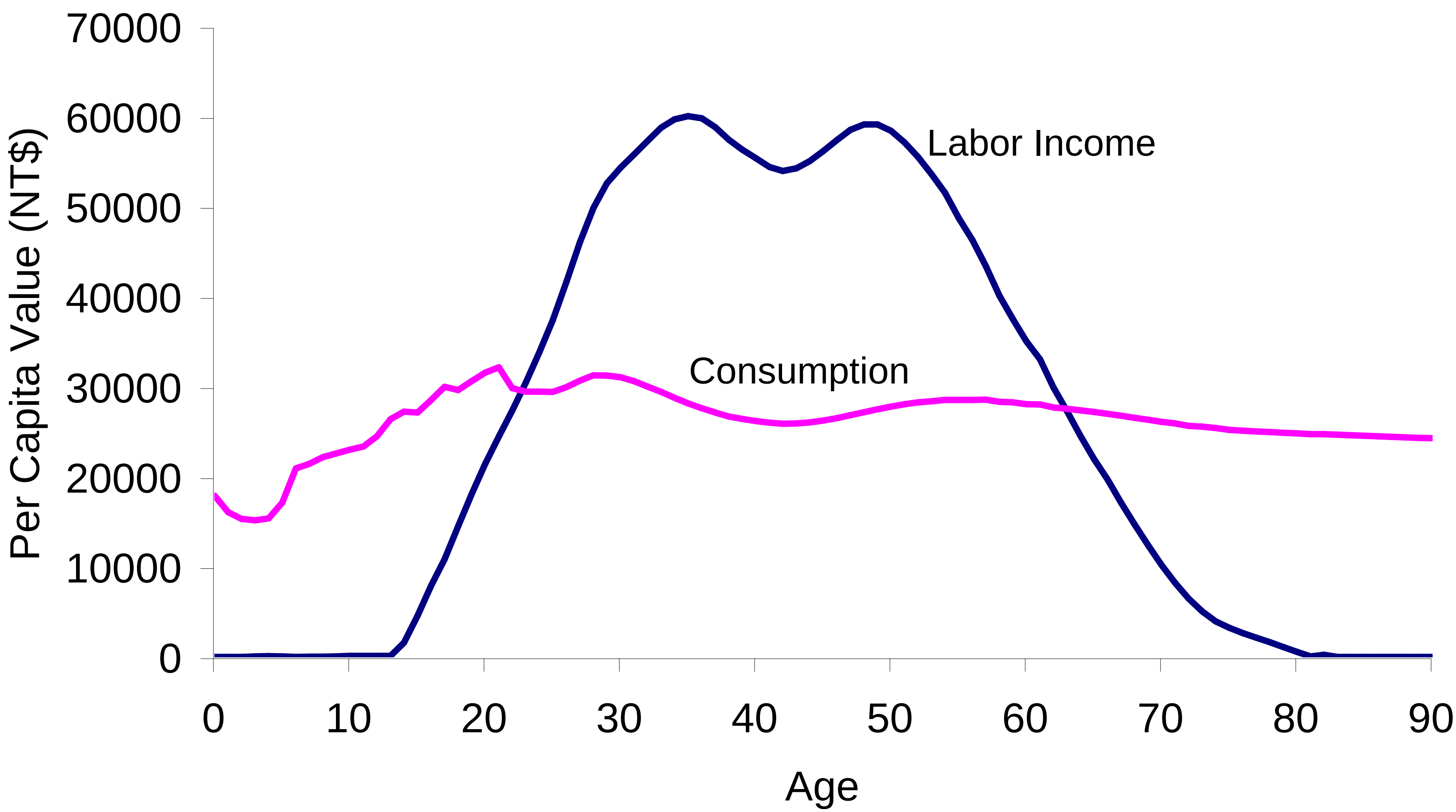
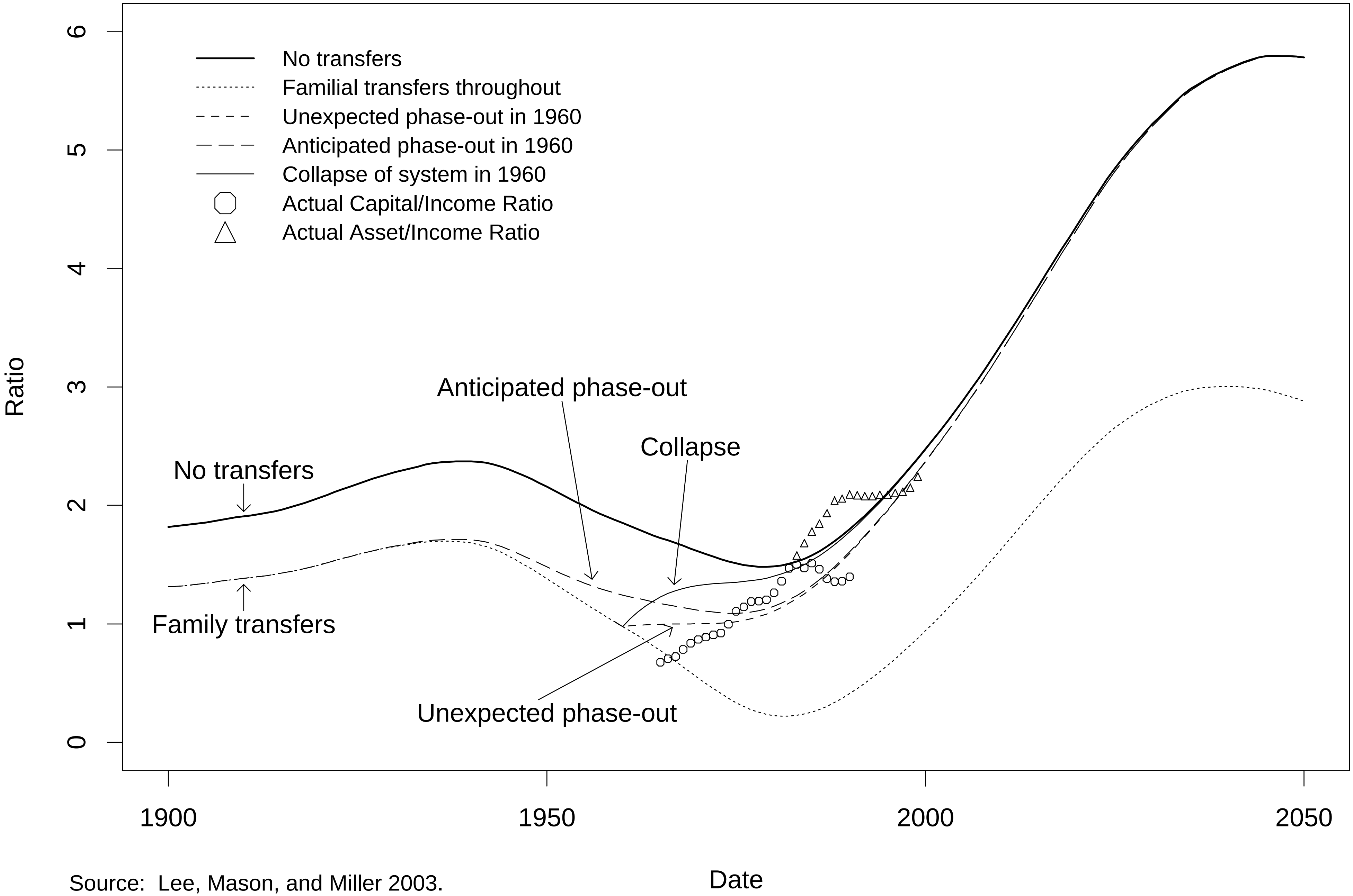
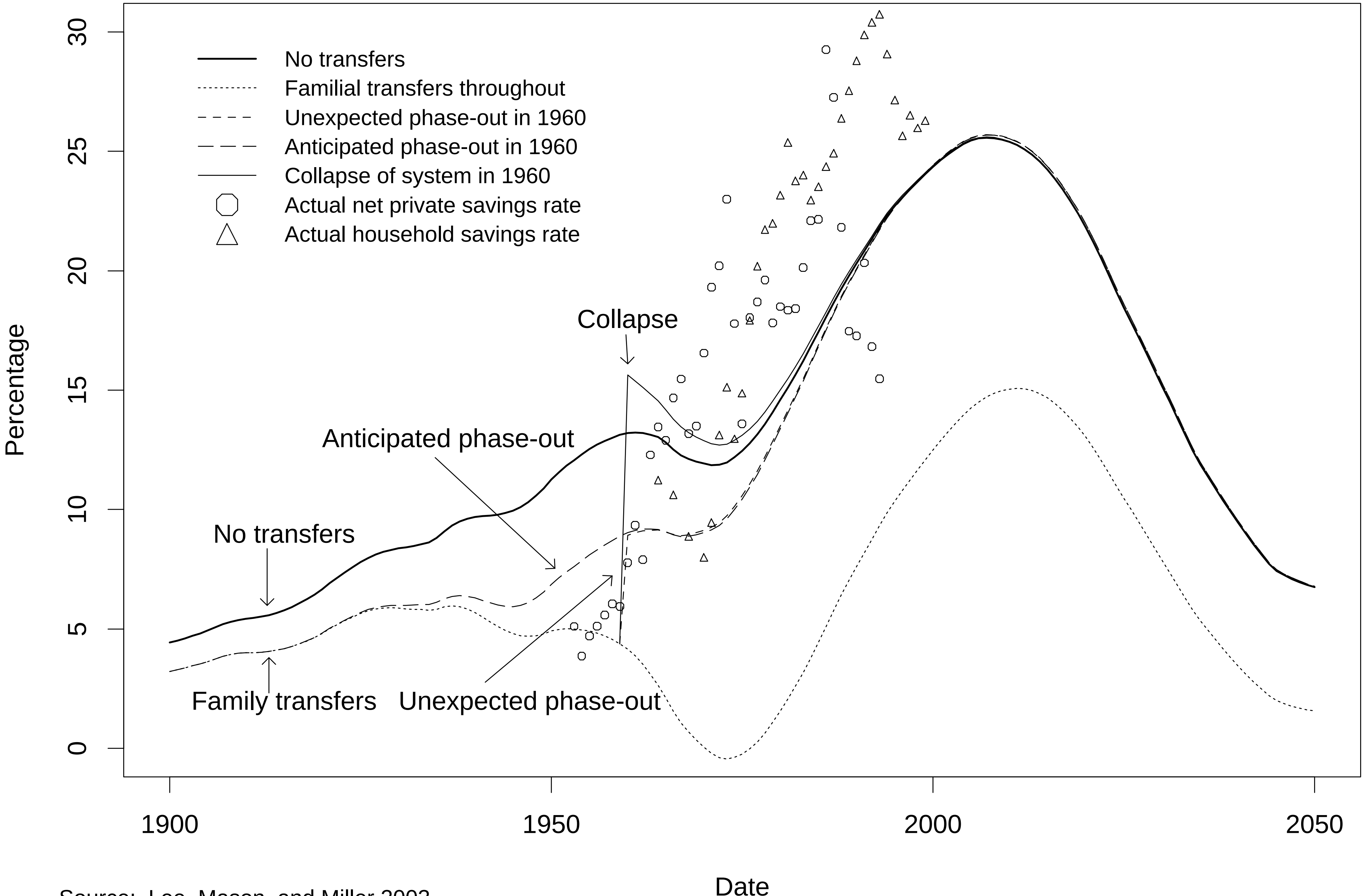


Figure 2: Simulated Asset/Income Ratio for Taiwan, 1900-2050, Under Life Cycle Saving with Different Assumptions About Family Transfers



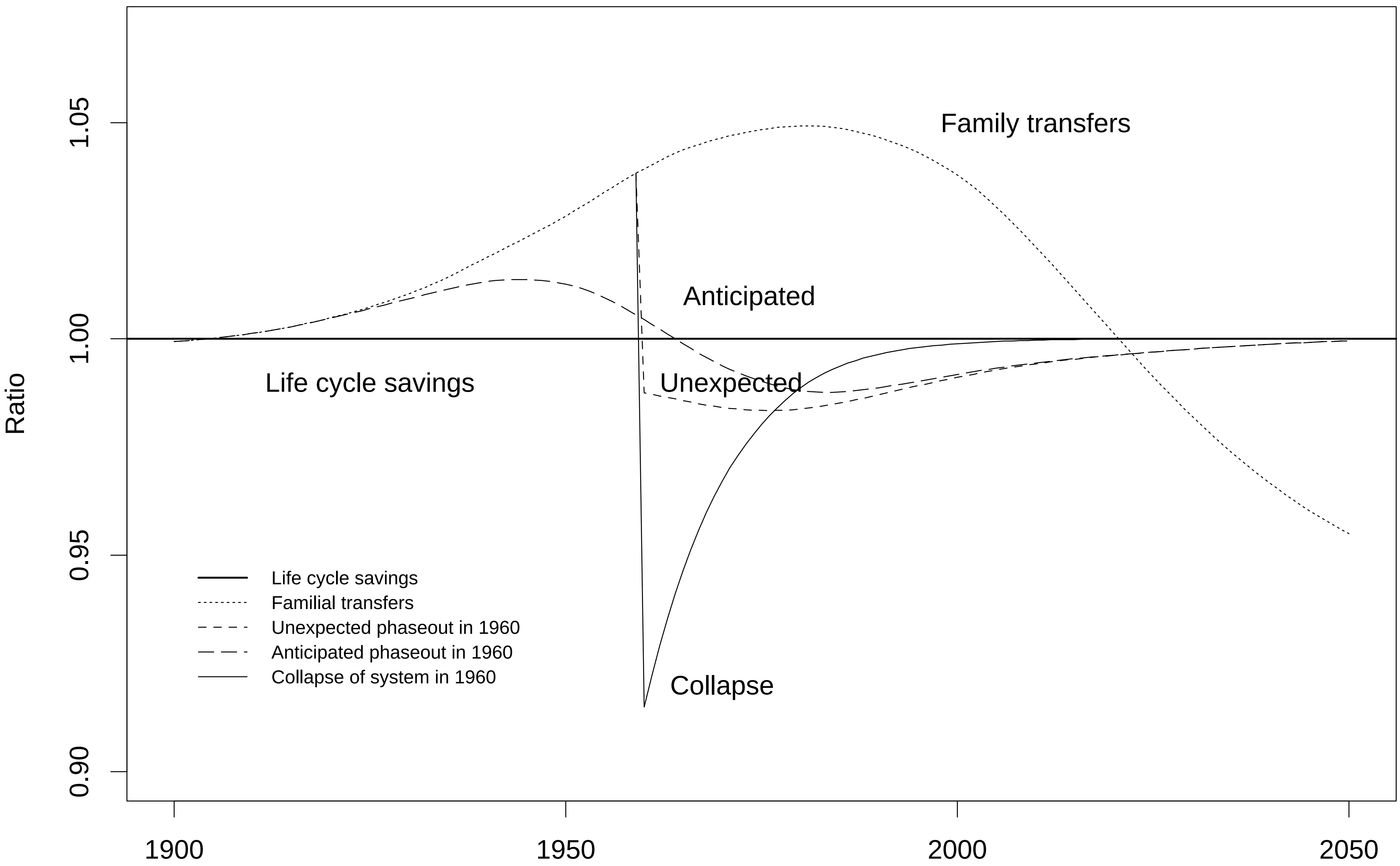
Source: Lee, Mason, and Miller 2003.

Figure 3: Simulated Savings Rate for Taiwan, 1900-2050,
Under Life Cycle Saving with Different Assumptions About Family Transfers



Source: Lee, Mason, and Miller 2003.

Figure 4: Total Consumption Relative to Life Cycle Savings Scenario, Taiwan



Note. Values are ratios of consumption for the indicated scenario to consumption for the lifecycle scenario.