

November 31, 2002

**Saving, Wealth, and the Transition from Transfers to Individual Responsibility:
The cases of Taiwan and the United States**

Ronald Lee
Demography and Economics
University of California
2232 Piedmont Ave
Berkeley, CA 94720
E-mail: rlee@demog.berkeley.edu

Andrew Mason
Department of Economics
University of Hawaii at Manoa, and
Population and Health Studies
East-West Center
E-mail: amason@hawaii.edu

Timothy Miller
Demography
University of California
2232 Piedmont Ave
Berkeley, CA 94720
E-mail: tmiller@demog.berkeley.edu

Lee and Miller's research for this paper was funded by NIA grant R37 AG11761. Mason's support for this paper was provided by a grant from the Rockefeller Foundation.

In both Third World countries and industrial nations the elderly receive substantial transfers from the working age population through familial support or public pensions. However, in many Third World countries commitment to familial transfers is weakening and is being replaced by private saving for retirement. Likewise, in industrial nations the commitment to pay-as-you-go (PAYGO) public pensions is changing, and at least partial privatization is under consideration in many places. The expectation of future net transfers can be viewed as a form of wealth, namely transfer wealth. Transfer wealth is one component of total wealth, broadly construed, and physical capital is the other. Individuals can also hold wealth in the form of credit, but aggregated over a closed economy debt and credit cancel. Under the life cycle savings theory, we would expect transfer wealth to substitute for capital in portfolios, and the erosion of upward transfer programs, by reducing transfer wealth, might plausibly lead to increased saving rates and to an increase in capital per person.

While transfer systems are changing, populations are aging in both Third World and industrial nations. Population aging in itself may lead to an increase in wealth per capita because of compositional effects. Young adults have low levels of wealth whereas older workers and young elderly need to hold large amounts of wealth to finance their consumption during retirement. The declines in fertility and mortality, which lead to population aging, also may induce changes in saving behavior and the age-profile of wealth. Anticipated declines in mortality at older ages will cause workers to save more at every age to provide for a longer period of retirement. Reductions in the number of surviving children, if not offset completely by increased expenditures per child, will reduce consumption and increase saving during the childrearing years and allow for increased consumption and lower saving after children are no longer being supported.

The aging-induced increase in wealth may take the form of greater transfer wealth or greater capital. Given sufficiently comprehensive transfer programs, population aging will lead

only to an increase in transfer wealth. Otherwise, population aging will lead to at least some increase in capital. When concurrently populations are aging and transfer systems are in decline, the effect on the household demand for capital may be particularly great.

When capital grows more rapidly than total income, aggregate saving rates must exceed long-run steady-state levels. Thus, a transition away from transfer systems and population aging lead both to greater wealth and to a surge in aggregate saving. Unusually high rates of saving occur when the demographic transition and the shift away from transfer systems are especially rapid. Once the transitions are complete, aggregate saving returns to lower levels.

In principle, older people could adjust to a reduction in expected transfers or a longer life expectancy by working longer as well as by saving more. In practice, trends in age at retirement have been strongly downward in industrial countries over the past century (Costa, 1998), although there has been a slight reversal of this trend in the US in the 1990s. To the extent that the declines in retirement age have been induced by the incentives embedded in defined benefit public pension programs (Gruber and Wise, 1999), they may be reversed by pension reform. In our analysis, however, we take labor supply by age as given. Thus, we do not take into account the possibility that the age of retirement will rise nor that further declines may occur.

The causal chain linking population aging and transfer systems to saving rates and capital accumulation are complex. Thus, in this paper, we use simulations to explore the interaction of changing transfer patterns with population aging as these affect saving rates and capital formation. We will compare the simulated experience of Taiwan, where familial transfers are still important but eroding, and that of the United States, where partial privatization of Social Security has been proposed. Simulations assume that behavior is consistent with the life cycle savings theory.

We formulate a set of decision rules based on life cycle saving theory, which determine saving and consumption at each age, depending on current assets, expected net transfers, expected

household demographic trajectory including fertility, survival, and children leaving home, and expectations about interest rates and future earnings. These rules are identical for the US and Taiwan. However, they are applied in different contexts, and these contexts are subject to change. First, there is demographic change, as fertility fluctuates and declines, mortality declines, and the population consequently ages. Second, there is institutional change, as the familial transfer system or public pension program is phased out. Third, there is economic change as interest rates and productivity growth rates vary according to their historical values. We do not attempt to take into account the general equilibrium effects on wages and interest rates in this paper.

Although our focus is on wealth, the analysis is also relevant to the extensive literature on saving, and within this literature, cross-national empirical studies. Many of these studies are based at least loosely on life cycle saving theory or on cruder discussions of the effects of old and young dependency rates (see Mason, 1987 and 1988 for a survey of the literature; see Williamson and Higgins, 2001 for a recent example). Surprisingly, none of these studies addresses the role of transfer systems in supporting the elderly, although transfer systems should be a prime influence on savings behavior. This paper is also a first step towards incorporating transfer systems and their changes into a study of saving rates, and we hope that this line of inquiry might eventually point toward useful ways to incorporate information about transfer systems in empirical cross-national studies.

Changing Forms of Old Age Support

Because transfer systems are social constructs, they can change as quickly as laws or customs. In many Asian countries the commitment to familial support of the elderly is waning. In Japan, South Korea, and Taiwan, the percentage of elderly living with their children has declined substantially in recent years (Feeney and Mason, 2001). In Japan, in 1950, 65% of women of

childbearing age expected to rely on their children in old age. By 1990, only 18% expected to turn to their children for support in the future (Ogawa and Retherford, 1993).

In a number of industrial nations the commitment of workers to their Pay-As-You-Go (PAYGO) pension programs also appears to be weakening. In the US many young workers doubt that they will receive benefits from Social Security when they retire. There is public discussion of partially privatizing the system or of changing its taxes and benefits in serious ways.¹ Public pension programs throughout the world have come under pressure for reform for three major economic reasons: they yield a rate of return lower than funded systems;² as the population ages, they are increasingly costly for the working-age population, unlike funded systems;³ and they displace savings and capital. Some countries have turned to systems of private retirement accounts as in Chile. Other countries, including Taiwan, are instituting public pension programs that are only partially funded (see Hu, et al., 2000), but we do not consider the implications of adopting new transfer systems below.

The institutional form of individual saving also varies. Farmers and small businessmen may save by investing directly in productive enterprises. Workers may save directly through a variety of financial instruments or by participating in funded company-sponsored pension programs. Funded public pensions have the same effect. Some countries, Singapore and Malaysia, for example, have now institutionalized such individual "life cycle saving" through large mandatory saving/retirement programs.

¹ PAYGO pension systems in some countries, such as Sweden and Italy, have been restructured to mimic defined contribution programs while remaining PAYGO. The restructuring reduces the generosity of benefits in the future, and therefore reduces transfer wealth, but these restructured programs are still unfunded PAYGO programs which create transfer wealth.

² This is true in steady state so long as the rate of growth of GDP is less than the rate of return on capital (the Samuelson-Aaron condition), which is typically true by a wide margin. See Samuelson (1958) and Aaron (1966).

³ If returns to capital fall as capital labor ratios rise, then population aging will also require greater savings with funded systems. In a closed economy, returns to capital would be expected to fall in this way.

How Transfer Systems Influence Life Cycle Saving and Wealth: A Heuristic View

Over the adult life cycle, the desired age profile of consumption differs from the desired profile of labor earnings, mostly because of the widespread preference for reducing labor time and effort in old age. To realize the desired age-time shapes of consumption requires that wealth in some form be accumulated during the working years and then used as a source of consumption in old age.

Call the implied age-time path of wealth holdings over the life cycle $W(x)$, and the average value of wealth in the population W . This wealth can be held either in the form of property or capital, $K(x)$, or in the form of transfer wealth, $T(x)$, or as a net credit. Averaged over the population-age distribution, we have $W = K + T$; average net credit is zero because borrowing and lending will cancel out in aggregate.⁴ Transfer wealth is defined as the present value of the expected survival weighted future benefits to be received minus the expected contributions to be made (e.g. to elderly parents, or in taxes to a PAYGO pension program). People first assess their transfer wealth based on their personal situation and the relevant rules or customs, and then plan their saving and investment so as to accumulate the necessary $K(x)$ so that they meet their overall demand for wealth.

So what happens when there is a change in transfer system and therefore in the expectations about $T(x)$? If a transfer system is phased out, then in the long run, after a transitional period, we would expect that people would save at a higher rate so that the capital stock per person would rise by an amount equal to the missing transfer wealth (subject to the reservations expressed in a later section). However, it is far from clear what will happen during the transitional phase in which the transfer system is being phased out.

There are several considerations in assessing these effects. First, of course, is the increased need for capital to replace the lost transfer wealth. Depending on the details of the

transition, some or all will find themselves with insufficient wealth, because they had previously been counting on transfers that are no longer expected to materialize. Those who are behind will have to save in excess of the normal life cycle saving amount at each subsequent age, and aggregate saving may also exceed the normal life cycle rate. We call this “super saving.” Super saving would be more likely when obligations are not honored and the transition to a new system is unexpected. Those closer to old age would have to save at a very high rate, while those already old would not have the assets from which to dissave.

A second effect tends to offset this first, leading to higher consumption at each age. Compared to the market, a transfer system for old-age support is a bad deal, with a rate of return on “contributions” equal only to population growth rate plus productivity growth rate in steady state, usually a few percentage points below the rate of return available in the market. In the US, for example, the present value of participation in Social Security is roughly -\$17,000 at age 21, evaluated relative to a market rate of 6%. If the system were abolished, the life cycle budget constraint of a 21-year-old would shift outwards by this \$17,000, other things equal. Consequently, at any age they could consume more and under life cycle savings would indeed plan to consume more. But since the stream of labor earnings is unaffected (to a first approximation), this will mean that savings rates will be less than the former contribution rates, and less than they would otherwise be. There would be similar consequences when a familial transfer system is dissolved. Because a higher rate of return can be earned through the market, less income needs to be set aside to provide for old age.

A third effect arises from the need to pay off the implicit debt of a transfer system, during the transitional stage. When the collapse of a transfer system is brought about by the collapse of a system of government there is a possibility that benefits will fall far short of prior commitments.

⁴ In an open economy net credit balances are possible. Taylor and Williamson (1994) argue that changes in the demand for intergenerational transfers has influenced international capital flows.

In most real world transitions from public sector PAYGO pension plans to individual accounts, however, prior obligations are more fully honored (e.g. in Chile or in proposed plans for the US). Even here, however, reform measures may increase tax rates or reduce benefits by changing the age of retirement, for example (Fox and Palmer 2001). If prior obligations are honored to any extent, there is an implicit debt which survives the demise of the system, and which must be repaid. When a family system declines, adult children will presumably continue to support their elderly parents if these parents do not have other viable options. During the transitional phase, a young worker has to continue to pay into the transfer system by supporting elderly parents or by paying payroll taxes, with no expectation of receiving full transfers in return. This will, of course, reduce the resources available for non-elder household consumption below their previous level, and therefore lead to reduced savings. The implicit debt of a transfer system is identically equal to the transfer wealth—it is just the other side of the coin.

These complicated effects will interact with the changing demography. In addition there are potentially important labor force responses and general equilibrium effects in closed economies. Changes in the capital stock would influence the interest rate and earnings, which would in turn alter saving and consumption behavior. Our simulations do not currently incorporate either labor force responses or general equilibrium effects.

For a formal and complete description of the model, we refer readers to an appendix available on the web (<http://www.ceda.berkeley.edu/papers/rlee/>).) 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 capital held by residents and the domestic interest rate equals the world interest rate. The labor supply is determined as the product of 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 productivity of workers varies by age and changes over time governed by exogenous labor-augmenting technological change. Domestic output is determined using a standard neo-classical production function with domestic capital and augmented labor as arguments. 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 and their eventual retirement. Because household size and age distribution changes over the life cycle, we assume that it is consumption per equivalent adult consumer that is smoothed, rather than household consumption itself.⁵ The consumption path is also influenced by time preference, the rate of interest, and attitudes towards uncertainty.

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). 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.

Given the complexities of this approach, perhaps it is not surprising that many analysts find the theory implausible, and that empirical studies often reject it (Carroll and Summers, 1991). Indeed, many people live on a month-to-month basis with no saving or a relatively small amount to buffer against uncertainties in their income streams and in their emergency consumption needs. Although many people do not life cycle save in the spirit detailed above,

⁵ We employ a very simple weighting scheme: children count 0.5 and adults 1.0. Lee et al. 2001b considers the impact of varying weights for children and the elderly on saving and wealth.

doubtless many others do. This is particularly true in the US where employer-provided private pensions have institutionalized such saving for a substantial number of employees--around 30% in any given year-- and a greater proportion over the life cycle. Such saving is also institutionalized in some countries such as Singapore and would be under proposed plans to partially privatize Social Security in the US.

There are, of course, other reasons to save as well. One, the precautionary motive, has already been mentioned. Another is the wish to leave a bequest to one's children. A third is uncertainty about time of death, leading some people to over-save to protect against the risk of outliving their savings. In this case, on average people die leaving unintended bequests to their children. This is consistent with life cycle savings, provided it is not assumed (as in our model) that people plan, in effect, to exhaust their savings at the instant of death by purchase of annuities that spread the uncertainty of time at death across their generation.

Simulating Life Cycle Wealth and Saving During Demographic Change

We begin with simulations of saving and wealth in the absence of transfers in Taiwan and the United States.⁶ These results provide a benchmark for comparison with alternative transfer systems. In all simulations, we use available data on age-earnings profiles, productivity growth rates, interest rates, and demographic rates and make assumptions for the remaining years. We abstract from immigration to Taiwan and US. For both countries we assume that the total fertility rate stabilizes at 2.1 births per woman in Taiwan and 1.9 births per woman in the US. Life expectancy at birth stabilizes at 78.8 years in 2036 in Taiwan, while in the US life expectancy is assumed to rise throughout the projection reaching 83.3 years in 2050. This allows us to assess the implications of continued increases in life expectancy and aging.

⁶ Results for Taiwan are described in detail in Lee, Mason and Miller, 2000, 2001a and b.

The simulated path for the ratio of capital to income under the pure life cycle model, labeled “no transfers,” is presented in Figure 1 for Taiwan and in Figure 2 for the US. In both countries, the dominant trend is an increase in the capital/income ratio. This change reflects the effect of longer life expectancy on the demand for wealth for retirement at the household level, and the effect of 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. The US ratio continues to increase reflecting the assumption of a rising life expectancy. In both countries, the trend towards greater wealth was interrupted for three to four decades in the middle of the 20th century. The cause was similar in both places: a major increase in the number of children due to the baby boom in the US and a rapid decline in infant and child mortality in Taiwan. But with the drop in fertility to low levels in the mid-1960s in the US and the early 1980s in Taiwan, the influences of rising life expectancy and aging reasserted themselves.

The saving rates that correspond to the capital/income series are presented in Figure 3 (Taiwan) and Figure 4 (US), again labeled as “no transfers”. In both countries, simulated saving rates increase from low levels during the late 19th and early 20th Century. Both experience downturns followed by large and dramatic increases in saving rates with peaks early in the 21st Century. These peaks occur because saving rates are particularly high at older working ages where populations are concentrated. The upswing in saving is more pronounced in Taiwan because of its more rapid fertility decline and consequent larger swings in age structure (Lee, Mason, and Miller 2001b).

Saving declines dramatically in Taiwan as population growth becomes concentrated among the low-saving elderly and as life expectancy stabilizes. In the US saving rates also drop but remain above the level found in Taiwan. The reason is that life expectancy is continuing to rise increasing the demand for life cycle wealth.

One might think that population aging in Taiwan or the US would cause a reduction in capital 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. Less saving is required for capital widening. The capital-income ratio continues to rise as shown in Figures 1 and 2 and capital per person rises correspondingly.⁷

Anyone with a passing knowledge of either US or Taiwan saving would note important differences between actual saving rates and the simulated no transfer, life cycle saving rates presented in Figures 3 and 4. 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.

Although the erosion of the family support system in East Asia has been gradual, 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.

In the case of US Social Security, we incorporate the historic trajectories of payroll tax and benefit levels, and for the future we adopt explicit scenarios for taxes and benefits. Where appropriate, we incorporate the legislated increase in the Normal Retirement Age from 65 to 67 over the next two decades. We treat the system as including OASI (Old Age and Survivors Insurance) but not DI (Disability Insurance) or HI (Hospital Insurance or Medicare). All changes in taxes and benefits are treated as unexpected, except in so far as changes are legislated far in advance as with the increase in normal retirement age. In one scenario, the Social Security system is continued indefinitely into the future. Payroll taxes are left at their current level until the trust fund is exhausted in 2033, and then the taxes are raised each year as necessary to meet the next year's costs of benefits. In the "collapse" scenario the social security program is terminated immediately with neither taxes collected nor benefits paid thereafter.

In another scenario, the system begins to phase in personal saving accounts along the lines suggested by the most radical privatization plan in the report of the 1994-96 Advisory Council on Social Security. Simplifying a bit for clarity, all current obligations are met to retirees and are met to workers to the extent that they have completed their earning span measured in the same manner as described for Taiwan. Future benefits are reduced to 50% of their current level. Taxes are also cut, and maintained flat until the trust fund is exhausted; then they are raised to meet costs as described above. The proposal includes specific plans for personal savings accounts, but those are simply absorbed into our general life cycle saving scheme.

⁷ Capital per person is equal to per capita earnings times $w/(1-rw)$ where w is the ratio of capital to income and r is the rate of interest.

Both these transfer systems for old-age support provide 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 we assume that people save over their working years so as to accumulate the assets needed to achieve their optimal consumption paths. In the case of the US, only 40% of the income of the elderly comes from Social Security. The rest comes from private pensions (which are generally funded, and which should be counted as saving), private saving, and from other assets. 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 pure life cycle model, with no transfers, this demand for wealth is also the demand for capital.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 capital measures the transfer wealth generated by the transfer 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 to the existing adult population.

For the US in the year 2000, the implicit debt (discounting at 3%) generated by Social Security (OASI) amounts to 1.7 times GDP or 17 trillion dollars, which is 46% of the total

⁸ The capital includes domestic capital and foreign capital owned by residents.

demand for wealth. This can be compared to a calculation by Feldstein (1997:9) who gives an estimate for implicit debt that is slightly lower than ours, after adjustment for the five-year difference in reference year. 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 in Latin America for *circa* 1990 calculated by Jorge Bravo (2001). Among those with higher ratios were the following: 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 Figures 1 and 2, the family transfer system in Taiwan and the public transfer system in the US significantly reduce, but do not eliminate, the demand for life cycle capital. As noted above, the US system is designed to provide only partial support. The gap between the capital-income ratio with and without transfer systems, representing the transfer wealth and implicit debt, widens substantially over time in both countries. 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. In the US implicit debt relative to income is projected to increase from a ratio of 1.7 in 2000 to 2.5 in 2050 in the absence of

reform. It will become increasingly costly and difficult to phase out the family support system in Taiwan and to reform the PAYGO social security program in the US 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 the capital stock. This is a fundamental result.

Now let's turn to the transitional phase itself. If the system collapses, then wealth immediately increases in a discontinuous fashion from its previous path (Figures 1 and 2). Aggregate saving rates immediately shoot up by 10 to 15 percentage points (Figures 3 and 4). This is the "super saving" discussed earlier, 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 Taiwan scenarios in which family obligations are honored, the capital-reducing effects of the transfer system are prolonged, so that capital 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.

In the more realistic phase-down of US Social Security, capital and saving rates increase relative to the status quo, but remain below the "no transfer" level because the reform scenario maintains transfers at 50% of their current level.

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 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 1). 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 the US, the actual capital-output ratios (Figure 2) have been consistently about twice the level needed for life cycle purposes given the current PAYGO system. Through the mid-1980s the personal saving rate has been somewhat similar to the “no-transfer” simulation. But just as the simulated saving rates rise to dramatically high levels in all scenarios, personal saving rates have dropped to dramatically low levels – only 1% of disposable income (BEA, 2001). However, this is by a measure that is deeply flawed for our purposes. The run-up in the stock market, which is not captured by personal saving rates, has greatly increased personal wealth during this period, evidently increasing consumption and reducing measured saving. Periods of steep increases in housing prices similarly invalidate standard measures of saving. These measurement problems aside, however, fluctuations in the simulated saving rate do not correspond to variations in saving rates.

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 and Miller 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

⁹ See Holzmann 1996, for example, for an analysis of the effect of pension reform on saving in Chile.

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.

Reservations About This Approach

According to the assumptions of our simulation, ending a transfer system for the elderly will inevitably lead to a substantial increase in saving rates and in capital accumulation. But in the real world, this might not happen. *First*, systems like public pensions exist in part because many people are thought to be improvident or myopic. If mandatory public programs are reduced, many may fail to increase their saving during their working years. Although need-based poverty programs may provide a floor, consumption in old age would decline.

Second, the phase out of one transfer program, e.g., public pensions, may lead to greater transfers from alternative programs, e.g., public welfare. Similarly, people may respond to the phase-out of public pension programs or family transfers by altering their private transfers – reducing bequests to their children, for example. This would neutralize the effect on savings and capital accumulation (Barro, 1974). To the extent that elderly do not make transfers to their children, or if they do, make them for exchange purposes (that is, in exchange for attention and assistance from their children), then the Barro argument would not apply. There is an extensive but inconclusive literature on these issues (see for example McGarry and Schoeni, 1997). It appears safe to say that some people would alter their private transfer behavior to offset the changes in public transfers, while others would not. For these reasons, our simulations probably over-state the size of the effects of change in transfer system. Nonetheless, there should be some tendency towards the changes we have simulated.

Third, individuals may respond to declining support systems by delaying retirement or increasing hours worked. The labor supply response is a substitute for increased saving so that on

this count our simulations over-state the effect of changing support systems on saving and wealth. Fourth, general equilibrium effects may also play an important role. For a small economy, e.g., Taiwan the assumption that a rise in saving rates will have no effect on interest rates is plausible, but for the US economy interest rates might be depressed by an increase in lifecycle wealth. In the lifecycle model employed here a decline in interest rate leads to lower savings but the empirical evidence on this point is mixed (Lee, Mason, and Miller 2001b).

There are many considerations, other than the effect on saving and capital, in deciding whether a phase-out of transfer programs would be a good idea. The transition is costly and requires that some generations consume less than they would have otherwise. Family support systems also involve caregiving and coresidence, and there is much more to these arrangements than their purely financial aspect. Transfer systems, particularly public ones, also are intended to perform an intragenerational redistributive function: the replacement rates are higher for low-income participants than for high income ones. (It is possible that differences in mortality largely undo this redistributive effect.) The public pensions are annuities, which spread the risk of length of life; private annuity markets are afflicted by adverse selection and do not function well. These programs also force people to provide for their old age at a minimal level at least, and therefore have a forced-saving aspect. They have very low administrative costs. The question whether to privatize old-age support systems is highly complex, and we take no position on this question here.

Conclusions

- Under pure life cycle saving, the demographic transition – increased life expectancy and fertility decline – leads to a large surge followed by a substantial decline in aggregate saving. During the surge in saving, capital grows more rapidly than income, but even when saving rates decline capital remains at a permanently high level relative to income. Population aging

contributes to a permanent increase in capital because older workers and young retirees hold large amounts of capital. This is evident in simulations for both Taiwan and the US.

- With a transfer system in place to provide even partial old-age support, the effects of demography on saving and capital are muted - both saving rates and capital follow a substantially lower path.
- Transfer systems for old-age support generate large transfer wealth and corresponding implicit debts in the US Social Security system and in the family transfer system of Taiwan. In our simulations, these are between 1 and 4 times annual GDP. If obligations are honored, these implicit debts must be repaid during a transition toward individual responsibility for old-age support through saving, prolonging the effects of the transfer system past the system's dissolution.
- Population aging dramatically increases the implicit debt in a transfer system, making a change of system more costly and difficult. An early change to a funded system, while still costly, harnesses the power of population aging to drive capital accumulation.
- Eliminating or reducing reliance on transfers leads to more rapid increase in wealth and larger swings in saving rates. Collapse produces the most radical and rapid swings. Transitions that are fully anticipated and honor obligations generate more gradual and drawn out transitions.

If transfer systems are phased out, certain of their redistributive effects might be lost, and new risks would be traded for old ones. We have not attempted any kind of assessment of the welfare gains or losses from a change in system. We are not recommending such changes, but rather noting that they are occurring and seeking to understand their effects.

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Appendix

Additional details of the basic model can be found in the appendices to Lee, Mason and Miller (2001b) which are posted at <http://www.ceda.berkeley.edu/papers/rlee/>. Here we first describe the open economy macro model. Then we describe a few elements of the model for the static case of pure life cycle saving; the dynamic life cycle saving model; and, in both the static and dynamic models, the incorporation of intergenerational transfers.

Supply of Domestic Capital and the Interest Rate

We assume perfect international capital mobility. Hence, the supply of capital to domestic firms is infinitely elastic at the world interest rate, r^w .

To the extent that capital owned by households exceeds the demand for capital by domestic firms, households hold capital abroad.

Supply of Labor and Earnings

The labor market is closed to immigration. The labor supply is the number of workers measured in productivity units. Productivity varies with age and over time. Hence, the labor supply at time t is:

$$L_t = e^{\lambda t} \sum_{a=0}^{\omega} l_a N_{at}$$

The term l_a incorporates age-variation both in productivity and in labor force activity. Given the competitive markets assumed above, workers are paid their marginal product. Thus, the earnings (from labor) by an individual aged a in year t is:

$$w_{at} = e^{\lambda t} l_a w$$

Firms

We assume that firms are profit maximizing and that the economy is perfectly competitive. Output (Y) is produced using two factors of production – capital (K) and augmented labor (L). Total production of any firm or the economy is determined by a Cobb-Douglas production function:

$$Y = BK^\beta L^{1-\beta}$$

The cost of capital is equal to the interest rate (r) plus the rate of depreciation (δ) and the cost of labor is the wage (w). The profit of firms is given by:

$$\text{Profit} = Y - (r + \delta)K - wL$$

In equilibrium, profit-maximizing firms equate the marginal cost and marginal product of capital. Hence,

$$\begin{aligned} r^w + \delta &= \beta Y/K \\ w &= (1 - \beta) Y/L \end{aligned}$$

Steady State (Static) Life Cycle Saving

When a household is formed, the heads seek to maximize lifetime utility V . Let x be the age of the head of household. Then V is given by:

$$V = \int_z^{\omega} e^{-\rho x} u[C(x), H(x)] dx$$

where z is the age of forming a household, ω is oldest age with non-zero survival probability; $C(x)$ is total household consumption; $H(x)$ is the expected (survival weighted) total household size measured in equivalent adult consumer units (EAC), and ρ is the subjective discount rate. Note that $H(x)$ reflects fertility, survival, and the age at which children leave home.

The instantaneous household utility function μ in V is specified as:

$$u[H(x), C(x)] = H(x) \left(\left(\left[\frac{C(x)}{H(x)} \right]^{1-\gamma} - 1 \right) / (1-\gamma) \right)$$

where γ is the inverse of the intertemporal elasticity of substitution.

Life cycle utility is maximized subject to the constraint that the present value of expected future lifetime earnings of householders, and their children while co-resident ($PV[Y_1, z]$, evaluated when the heads are age z), plus the present value of expected future lifetime net transfers, $PV[T, z]$, equals the present value of expected future household consumption. These expectations are survival weighted. The maximization yields the following planned age-time path for household consumption, where r is the market rate of interest:

$$C(x) = \frac{H(x) e^{(r-\rho)x/\gamma}}{\int_z^{\omega} e^{-ra} H(a) e^{(r-\rho)a/\gamma} da} \{PV[Y_1, z] + PV[T, z]\}$$

It follows that the life cycle trajectory of consumption per EAC rises at the rate $(r-\rho)/\gamma$.

For Taiwan, we assume the intertemporal elasticity of substitution ($1/\gamma$) to be .6, based on an estimate by Ogaki et al. (1996), which appears to be the only estimate available. Studies relevant for the US include the following. Ogaki et al. (1996) estimate .64 for the US (p.57). Attanasio, Banks, Meghir and Weber (1997) estimate a value of .64 with a standard error of .33, for US micro data. Auerbach and Kotlikoff choose .25, after discussing a wide range of estimates (p.51). Deaton (1992) reports favorably an estimate of Attanasio and Weber using English micro data for the coefficient of consumption growth on the interest rate, which was .735. This should estimate the intertemporal elasticity of substitution (page 73). Deaton asserts that econometric studies of the growth of aggregate consumption in relation to the expected interest rate, based on the representative individual assumption, are nonsensical. The Attanasio and Weber paper avoids this pitfall, but not the Ogaki et al. estimate we use for Taiwan. We conclude that a value of .64 seems reasonable for the US, but we should consider a range of possibilities.

We assume that labor supply decisions over the life cycle are exogenous. Thus, the cross-sectional age-earnings profile is given, although the profile shifts over time governed by labor-augmenting technological change. This is for simplicity and convenience only. There is every reason to believe that labor supply decisions are affected by transfer arrangements, and there is a

substantial literature on the subject for industrial nations. We also assume that the rules governing net transfers are exogenous whether those transfers are private transfers between parents and children or public transfers from members of one age group to members of another.

Life Cycle Saving with Changing Demography, Economy, and Policy

The extension to a context of economic and demographic change is based on rules for formulating expectations as circumstances change, and then on reoptimization at each age, taking as the new initial conditions the asset position resulting from earlier decisions.

A dynamic approach is necessary to consider the affect on saving of unanticipated changes in public transfer policy or socially governed rules regarding private transfers. Moreover, actual changes in productivity and interest rates from year to year during the historical periods will differ from those anticipated by optimizing households. Individuals may also fail to anticipate correctly actual changes in demographic rates, although in the simulations presented in this paper we assume that individuals correctly anticipate the trends in mortality and fertility.

Despite the presence of these uncertainties, we assume that every decision is made under complete certainty about the future (except that survival is a probability, albeit a fully insured one). Thus, consumers behave as though they live in a certain world despite the fact that they are repeatedly surprised as the future unfolds. This is an inconsistency on our part. It would be preferable to model decision-making under uncertainty more completely, but that would substantially increase the complexity.

Actors form their life cycle plans based on their expectation of future productivity growth rates, interest rates, and transfer policies which turn out to be incorrect. Each year, they must form new life cycle plans since their current circumstances are different than what they had foreseen.

The dynamic version of the age-time path of consumption is listed below. It differs from the static version in that optimization occurs at all ages $x \geq z$ rather than solely at age $x = z$ and that these optimizations are based on expectations about future interest rates $[r^*(t+a)]$ and productivity growth rates [which are reflected in Y_l^* and T^*]. Consumption is optimized at age x in year t looking forward a years ($a \geq 0$) into the future when the household head will be aged $x+a$ in year $t+a$. In the dynamic equation, the value of future lifetime wealth must include expected future earnings and expected future net transfers (as in the static model) but also current capital owned by households that reflects the accumulation of past savings. Capital $[W(x,t)]$ is defined so that cohort capital is maintained. That is, there are lateral, not vertical, bequests – capital saved by last year's households aged $x-1$ is shared among this year's surviving heads aged x . Orphaned children are assumed to be adopted into households by heads of the same age as their deceased parents. The dynamic consumption path is:

$$C(x+a, t+a) = \frac{H(x+a, t+a) e^{(r^*(t+a)-\rho)a/\gamma}}{\int_0^{\omega-x} e^{-r^*(t+g)g} H(x+g, t+g) e^{(r^*(t+g)-\rho)g/\gamma} dg} \{PV[Y_l^*, x, t] + PV[T^*, x, t] + W(x, t)\}$$

In the special case in which household expectations about interest rates and productivity rates turn out to be correct, households would have no need to re-evaluate their age-time path of consumption. Households would only need to make one optimization decision at age z . Then the dynamic equation simply reduces to the static equation.

The Determination of Transfers

Transfers take two forms in our model. Private transfers are between family members, more specifically transfers from adult offspring to their elderly parents. (Transfers from adults to their dependent children are incorporated directly into the household consumption as explained above.) Public transfers also flow only upward (through Social Security), but without regard to family connections, from workers to older individuals. In both cases, the rules governing transfers are exogenously determined. Public transfers are governed by statute. Private transfers are governed by social practice or norms.

$PV[T^*, x, t]$ are typically negative for x near the start of the working years, for reasons discussed in the text: transfer systems yield a rate of return that is inferior to the market rate, as a rule. However, at older ages, it becomes positive because people are closer to retirement when benefits will be claimed, and an increasing share of their lifetime contributions are sunk costs, which no longer enter the calculation.

We will not write down mathematical expressions for the transfer system rules; the descriptions should suffice. Public transfers are based on the case of US Social Security. We simply assume the historic trajectories of payroll tax and benefit levels, and for the future we adopt explicit scenarios for taxes and benefits, incorporating the legislated increase in the Normal Retirement Age from 65 to 67. We make differing assumptions about the degree of foresight of future changes, and about the degree to which past obligations incurred by the system are honored, as described in the text. For private or familial transfers, we assume in essence that elders live with their surviving adult offspring and consume an amount equivalent to the adults in those households. Because adults have more than one child on average, we assume that they split their time during the year. It makes no difference whether we treat this as a financial transfer to a separate household of the elder, or we treat the elder as joining the child's household. In our actual calculations, we assume separate coresidence for accounting convenience. This governs planning by both the young and the old.

Figure 1: Simulated Capital/Income Ratio for Taiwan, 1900-2050, Under Life Cycle Saving with Different Assumptions About Family Transfers

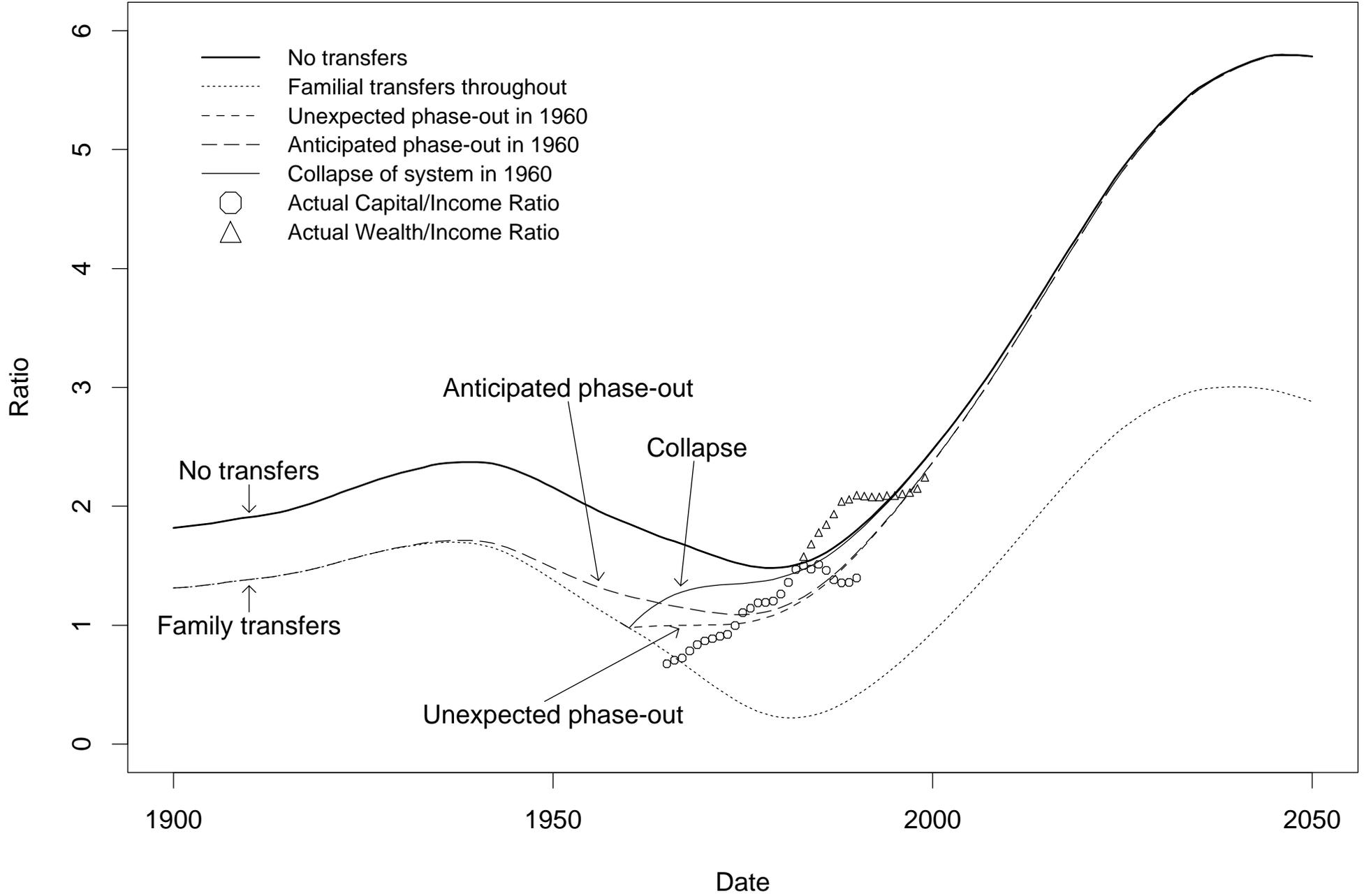


Figure 2. Simulated Capital/Income Ratio for the US, 1800-2100, Under Life Cycle Saving with Different Assumptions About Social Security Transfers

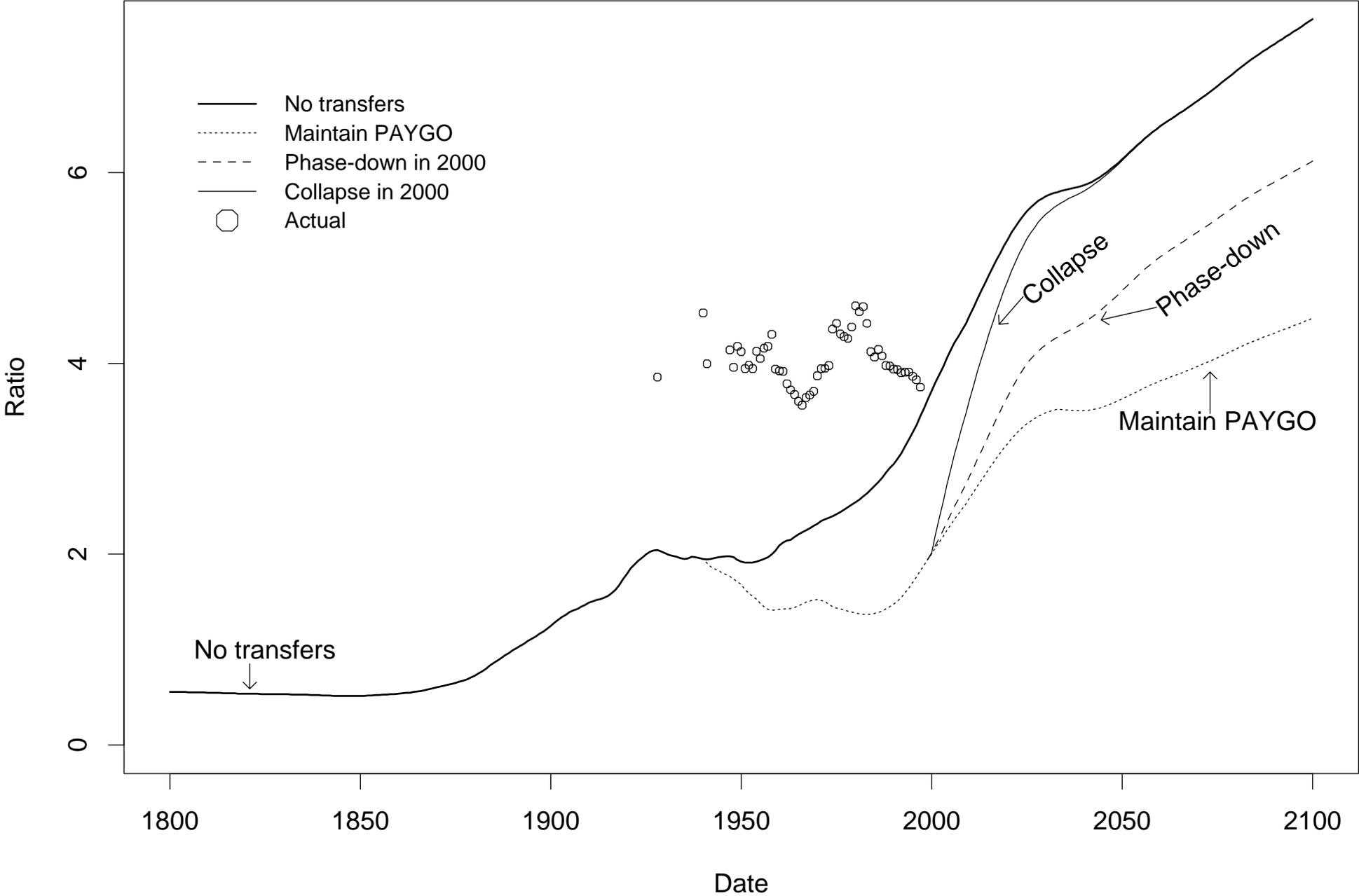


Figure 3: Simulated Savings Rate for Taiwan, 1900-2050, Under Life Cycle Saving with Different Assumptions About Family Transfers

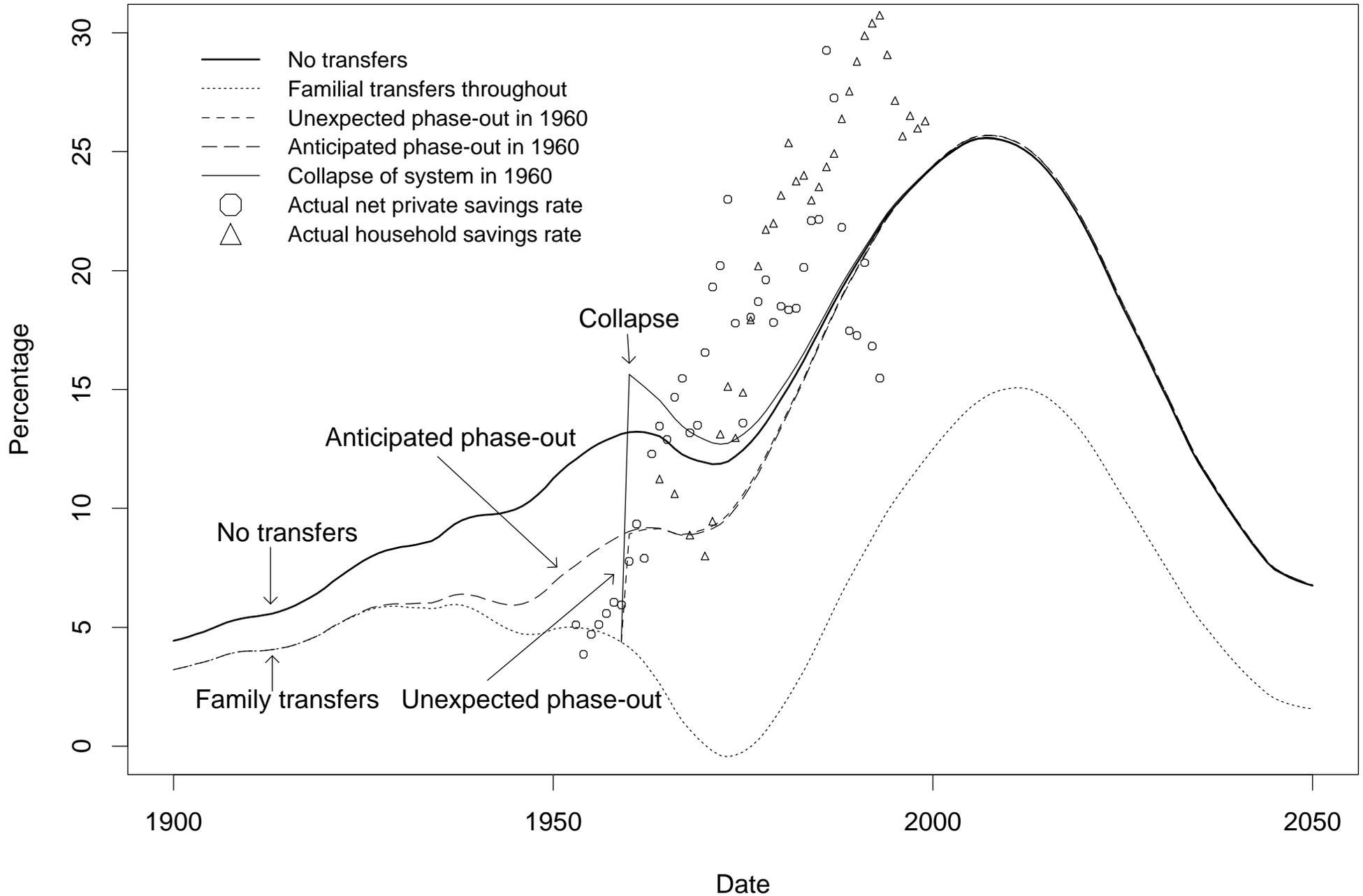


Figure 4. Simulated Savings Rate for the US, 1800-2100, Under Life Cycle Saving with Different Assumptions About Social Security Transfers

