Generational Economics in a Changing World

Ronald Lee (Corresponding Author)
Departments of 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
2424 Maile Way, Saunders 542
Honolulu, HI 96821
E-mail: amason@hawaii.edu

Key words: population aging, demographic transition, intergenerational transfers, national transfer accounts, old age support, public transfers, private transfers, family

Research for this paper was funded by parallel grants from the National Institutes of Health to Lee, NIA R37 AG025247 and to Mason, R01 AG025488, as well as by grants from MEXT.ACADEMIC FRONTIER (2006-2010) and UNFPA (RAS5P203) to NUPRI in Japan. We are grateful for help from Gretchen Donehower and Amal Harrati, and grateful to all the country research teams in the NTA project for the use of their data. The researchers are identified and more detailed information is available for many countries in working papers on the NTA website: www.ntaccounts.org. We are also grateful to Tim Dyson and David Reher for their comments on an earlier draft.

Abstract

Human hunter-gatherers evolved a life strategy that involved extensive sharing of food and support within and across generations, social behaviors that coevolved with the cognitive and emotional mental apparatus needed to sustain such sophisticated sociality. Adults at all ages produced surplus food which was transferred downwards to children, to support their prolonged period of nutritional dependency, until around age 20. Over a long period of economic development, and a shorter period of demographic transition, generational relations interacted with the changing environment, including changing population age distributions, life cycle behavior, technologies, and institutional arrangements.

Similar patterns may have held during land abundant subsistence agriculture, but in intensive agriculture, perhaps due to their property rights in land, the elderly became net consumers in a stage of partial retirement, when they were sustained in part by food transfers from their adult children. At the same time, assets in general became more important – land, buildings, property of all sorts. These assets provided an alternative means for the elderly to support themselves in retirement. These trends continued as agriculture gave way to industry, with retirement earlier and more complete. The growth of a public sector reinforced the pattern of downward transfers with public education and health care for children. However, as states industrialized and the welfare state grew, transfers to the elderly for pensions and health care became increasingly important, with a fiscal effect exacerbated by population aging. At the same time, the growth of capital and financial institutions provided new forms of asset accumulation along with private pensions. These two trends reduced the role of the family in providing for the elderly. Our evolved sociality and ethic of sharing and fairness is now expressed through welfare state redistributive programs, and continuing and intensifying public and private investment in children. But now population aging, interacting with the public programs for the elderly, has led to a reversal in the direction of resource flows across age, from downward (old to young) to upward (young to old). We are currently able both to invest in the young and care for the newly dependent elderly. However, the old age dependency ratio is projected to double or triple in coming decades in the rich industrial countries. The public costs of the elderly may increasingly compete with investments in children through the public sector budget constraint. It remains to be seen whether the elderly, in the context of new public policies, will opt to work until substantially older ages, and whether the rapid growth of health care expenditures will be restrained.

Introduction

Across the developed world, generous welfare state programs for the elderly together with projected doublings or more in the proportion old, have led to political struggles which sometimes pit younger generations against the elderly (e.g. for US, see New York Times, 2009). It may be helpful to put the current situation in historical and institutional context, which is the goal of this paper. We will begin by considering research on hunter gatherer groups, and then turn to results of the National Transfer Accounts project, a large international collaborative effort.

Human hunter-gatherer offspring have an exceptionally long period of immaturity and nutritional dependency, lasting until around age 20, judging by studies of contemporary groups (Kaplan, 1994; Hill and Hurtado, 2009; Howell, in press). Adults at all ages up to 70 or so produced more calories than they consumed on average, contributing their surplus to provision the young.[1] Humans had shorter birth intervals and longer dependency than did other large primates (Hawkes et al, 2005; Hrdy, 2009; Sears and Mace, 2005). A mother and her mate would have had difficulty provisioning their offspring on their own, and it was common for others in the sharing group, including postreproductive grandparents and nonkin, systematically to assist families with high dependency ratios, even with little prospect of later repayment (Gurven 2004; Hill and Hurtado 2009; Hrdy 2009). There was thus a strong downward flow of resources from older to younger members in hunter-gatherer groups.

Hunter-gatherers also shared food with other adults, often non-kin, behaviors that coevolved with the cognitive and emotional mental apparatus needed to sustain such sophisticated sociality. Such sharing was essential because individual hunters were successful on only a fraction of days, and because it was common for hunters to be disabled by injury or disease for weeks or months (Hill and Hurtado 2009). Long term net benefits also accrued to those who were permanently disadvantaged, such as men who were less able hunters. Thus food transfers between and within age groups and generations were an integral part of the evolved human life history. Hunter-gatherers lived in a web of social relations that included transfers of food on a daily basis. Viewed in this light, many features of today's welfare state appear less anomalous, although the anonymity of today's arrangements is new.

The demographic transition began many thousands of years after hunting and gathering was displaced by agriculture as the dominant form of production technology and social organization. The demographic transition eventually led to a much reduced proportion of children in the population, and a very much increased proportion of elderly. Given the intergenerational transfer patterns of hunter gatherers that we just described, one would expect that population aging would have relaxed the social budget constraint, as the ratio of adults to children soared. But a funny thing happened along the way: societies invented retirement, older people became increasingly dependent on younger adults, and the economic consequences of population aging are now viewed with alarm.

This paper will explore the interaction of the transition's changing population age distributions with the changing organization of the economic life cycle and with differing institutional arrangements. We draw on estimates by twenty three country teams (members of each country team are researchers in that country) participating in the National Transfer Accounts project. The researchers are identified and more detailed information is available for many countries in working papers on the NTA website: www.ntaccounts.org. We will see that the direction of intergenerational transfers in the population has shifted from downward to upward, at least in a few leading rich nations. This sea change has resulted in part from the changing economic role of the elderly, which is closely tied to the rise of the welfare state and the increasing importance of assets, and in part from the population aging brought by the demographic transition. Despite the change in the net direction of resource flows, investment in the health and education per child has risen relative to incomes, in association with fertility decline. The degree to which these changes have occurred varies across levels of economic development, broad regions of the world, and the idiosyncratic institutions of particular countries. It is well known, however, that the systems of public transfers to the elderly as currently structured will not be fiscally sustainable as populations age strongly in the first half of the 21st century. Structural reforms will occur and in some cases have already been made, and the upshot is likely to be a reversal in the trend toward earlier retirement and related changes.

Theoretical Background

There is a great deal of theory that is relevant for interpreting patterns of intergenerational transfers, and here we will just briefly mention a few that appear particularly relevant. Most fundamental is evolutionary theory, particularly life history theory, which considers the coevolution of the long period of juvenile dependency, large brain, food acquisition strategy, short birth intervals, and long life including a long postreproductive life span during which elders provide support and food transfers for the young. Food sharing and other cooperation in social groups including non-kin was part of this evolving pattern (Kaplan 1994; Kaplan and Robson 2002; Hawkes et al 2005; Chu and Lee 2003; Lee 2008). The interaction of our evolved capacities and predispositions with different cultures and institutions has generated a variety of individual and social behaviors that often bear little or no relation to the forces of natural selection that originally gave rise to them. Importantly, evolutionary theory also suggests that parents have limited altruism towards offspring, since reproductive fitness depends both on the success of those offspring already born (the objects of parental altruism) and on parental survival and future reproduction and care. Selection will act through both of these outcomes. It will generally not be optimal for parents to give or risk all for the sake of existing offspring.

In economic theory the degree of parental altruism is expressed by the weight with which children's utility or consumption enters into parental utility, and consequently parents tradeoff their own consumption against that of their children, much as in evolutionary theory. Parental altruism in this sense has been very important in the work of Becker and his collaborators (Becker and Barro 1988), Willis (1994), and others. Once technological progress raises the rate of return to education, the limited altruism of parents can lead them to invest less than the optimal amount in their children's education. More

investment could raise the future earnings of children sufficiently that they could pay back the increment to their parents and still come out ahead, but in the absence of mechanisms guaranteeing the repayment of parents, these investments don't occur and the society is stuck in a low level trap. Becker and Murphy (1988) suggest that this inefficiency in familial investment in human capital is the rationale for the state initiating public education, paid for by taxing the working age population. They further suggest that the state may then initiate a pay-as-you-go pension program which, by taxing the well-educated children and transferring the funds to the elders as pensions, in effect compels repayment to the parents for their earlier tax cost of public education. Building on these ideas, it is possible to construct a theory of the interaction of fertility and transfers including transfers to the elderly, with changing institutional structures and technology (Willis, 1987, 1994).

Central to these and other works is the idea that parents choose a preferred balance of own lifetime consumption and the lifetime consumption of their children. If the public sector disrupts this chosen balance through overly generous pension payments, for example, older parents may reverse the public policy by making larger private transfers to their children, perhaps as bequests at death or as help with the mortgage on a house, or grandchildren's education (Brazil). Similarly, private expenditures on education will be reduced when public education is introduced, although if parents judge public education to be inadequate they may complement it with heavy private investments (East Asia). Thus we expect a substitution of public and private transfers.

Samuelson (1958) made a seminal theoretical contribution and established the framework for subsequent work on transfers, pensions, and overlapping generation models. But he largely ignored children, focusing on the differences between unfunded pensions and credit markets as institutions facilitating old age support, which limits the use of his insights in the present context.

We will keep these theories in mind, but for the most part not discuss our results explicitly in relation to them.

Age Profiles of Labor Income and Consumption

Our starting point is estimated age profiles of labor income and consumption. These estimates are averages across males and females in the population at a given age. For labor income, individuals are counted whether they generate income or not. Income includes pretax wages and salaries, fringe benefits paid by the employer, income accruing to unpaid family labor, and two thirds of "mixed" or self employment income (one third is assumed to accrue to property or capital). Estimates derive from surveys, and the levels of the estimated profiles are adjusted so that, taken together with the population age distribution, they are consistent with the totals given in National Income and Product Accounts (NIPA). For further details, see Lee, Lee and Mason 2008 and Mason et al 2009. For hunter-gatherer populations, labor income is estimated as average food calories acquired at each age, drawing on estimates by anthropologists (for details see Kaplan 1994 and Howell in press).

The age profile of consumption is again an average of male and female consumption at each given age, and includes both private consumption and in-kind government transfers, most notably for public education, health care, and long term care. In household surveys, private expenditures on health and on education may be reported for individual household members, or may be available only for the household as a whole, in which case they can often be reliably allocated by age. Other private expenditures for each household are allocated to individual household members using Equivalent Adult Consumer weights which start at 0.4 for those age 4 and younger and rise to 1.0 for age 20 and above. The individual estimates are then tabulated to estimate the age profile of other private consumption. Estimated private expenditures on health, on education, and on other consumption are adjusted to be consistent with NIPA. For details see Lee et al 2008 and Mason, Lee et al. (2009). For hunter gatherers, total food production is calculated separated for each sharing group (which could be a collection of households, or a larger group). It is then allocated to the individuals in the sharing group in proportion to standard caloric need tabulations by age, sex, and sometimes body weight and level of physical activity (Kaplan 1994). Howell in press uses a variant of this approach.[2]

To ease comparison, we have formed an unweighted average of the Kaplan and Howell hunter-gatherer age profiles, which in any case are very similar. We have also made an unweighted average of the profiles for four of the lowest income countries in our NTA collection, Kenya, Indonesia, Philippines and India. Finally, we have formed an average of four of the richest countries in NTA: Japan, the US, Sweden and Finland. In order to make the shapes of the age schedules comparable, we adjust the level by dividing by the average level of labor income across the ages 30 to 49, chosen to be affected neither by educational enrollment nor by early retirement.[3] The resulting age profiles are plotted in Figure 1.

First, we note the close similarity of the hunter-gatherer consumption age schedule and that of the poor countries. Although there are some differences, such as the decline in consumption at older ages in the hunter-gatherer profile but not in the poor country profile, these may well be due to differences in the methods and assumptions used to estimate these. For example, the caloric need tables indicate a decline in old age whereas the equivalent adult consumer weights we use assume no change in adulthood. The slightly lower consumption schedule for hunter-gatherers, relative to the labor income schedule, reflects the higher fertility and younger age distribution among the Amazon Basin hunter-gatherers. The less favorable support ratio leads to lower consumption for all. In addition, hunter-gatherers have little or no non-labor income, and non-labor income in these estimated profiles is zero by construction.

The strongest contrast is between the consumption schedule for hunter-gatherers and poor countries, on the one hand, and the rich countries on the other. We note the strikingly higher level of child consumption up to the late teen years in the rich countries, reflecting primarily the heavy investment in education in these countries. We also note that in the rich countries, the level of consumption increases with age in the adult years, and is highest at the very highest ages. This increase is in large part due to the heavy expenditures on health care for the elderly, which rise with age, and which are largely

funded by the public sector. At the highest ages, above 80, the rapid increase reflects the costs of long term care. But publicly funded health care and long term care are not the whole story. In the US, at least, private consumption also rises with age until around age 60. It seems likely that this increase in private consumption with age reflects the separate living arrangements of the elderly in the rich countries, and perhaps more fundamentally reflects a decline in intergenerational sharing, in contrast to the poor and hunter-gatherer groups where consumption is shared across the ages within co-residential or sharing groups. These separate living arrangements are in turn fostered by the shift towards public transfers to the elderly.

The labor income schedules also reveal interesting differences. The relative contributions of teen agers are much greater in the hunting and gathering groups. It appears that the age schedule is similar in shape to the other groups but displaced three or four years to the left, indicating an earlier start. The poor countries also show greater labor contributions by children than in the rich countries, but by a surprisingly small amount. We believe this smaller difference reflects low wages among young agricultural workers and the great importance of the nonagricultural labor force which generally has much higher incomes and which has higher enrollment rates and therefore starts work later than in the agricultural areas. Preliminary estimates for some African countries suggest that rates of employment and labor income may be very low for young adults who are not in school in urban settings, as well.

We also note that labor income peaks around age 40 in the poor countries, at around 50 in the rich countries, and is quite flat among hunter-gatherers from 40 to 60. Labor income drops precipitously in the rich countries, particularly in the early 60s, reflecting retirement facilitated by pensions and motivated by the incentives for early retirement built into their structures (Gruber and Wise 1999) and an increase in the demand for leisure (Costa 1998). In poor countries, we also see an initial rapid decline but then labor income continues well into the later years. This pattern may be due to averaging together incomes of those in the urban areas and modern sector with those in the rural areas where older people continue to work. Finally, we note the striking pattern for hunter-gatherers, who continue to work productively into old age. The data for the Amazon Basin groups include almost no one beyond age 70, but Howell reports that the !Kung continue to produce about what they consume up to around age 80 (Howell in press, Figure 5.6). All the age profiles presented here are cross-sectional rather than longitudinal, and it is possible that this may affect some of their features, particularly in populations experiencing rapid economic growth.

The net effect of these differences in the age schedules of consumption and labor income can be seen clearly by plotting consumption minus labor income, which we call the “life cycle deficit”, or LCD. This is done for the three populations in Figure 2. The positive values indicate that more is consumed than is produced at those ages, hence the deficit is positive. The LCD is smaller for young hunter-gatherers due to their earlier productivity and the absence of market inputs for education, training and health care. In all three populations, adults have a negative LCD, that is they produce more than they consume and reallocate the surplus to others. What is most noticeable, however, is that in the rich

and poor countries, this adult LCD begins to move toward zero after age 45, and turns positive around age 60, whereas in the hunter-gatherer groups the LCD remains quite strongly negative until end of observation at age 70 (after which it drops to zero in the !Kung data). This is driven in part by the reduction in labor income at older ages and in part by the increase in old age consumption. In addition, consumption in rich countries is funded by asset income to a greater extent which has shifted the consumption curve up relative to labor income. We also see that the LCDs in both childhood and old age have increased strongly over time/development. These changes in the economic lifecycle are central to understanding how intergenerational flows have evolved over the development process.

Before turning to this issue a number of features of these estimates require discussion. The level of the LCD curve is governed by a social budget constraint - total outflows cannot exceed total inflows. Were labor income the only inflow and consumption the only outflow, the population weighted sum of the LCD curve would necessarily equal zero and the level of the LCD curve in Figure 2 would depend only on population age structure. This is assumed to be the case in the construction of the profiles for hunter-gatherer populations. For contemporary economies, however, other economic mechanisms can be used to fund lifecycle deficits. First, the lifecycle deficit can be funded by relying on assets – using asset income or dis-saving. Second, the LCD can be funded relying on net transfers from abroad, e.g., remittances and foreign aid. The higher level of the LCD profiles for poor and rich countries as compared with hunter-gatherer populations, reflect the increased reliance on assets by almost every contemporary population and by reliance on net foreign transfers by many poor populations.[4]

Often in this paper we will refer to the "life cycle", which suggests longitudinal patterns, but in fact all the estimates we present are cross-sectional, referring to different ages in the same calendar year. For a number of our countries we do have long series of these cross sectional estimates from which longitudinal life cycles can be constructed, but we will not discuss these data here.

Probably the most serious shortcoming of the estimates is that they do not include the value of time spent in home production, other than standard measures of unpaid family labor and self employment income. This means that we count consumption of market-provided education, health care, and long term care, whether publicly or privately funded, but do not count the value of similar services provided privately by the family. Nor do we count the value of non-market time spent rearing children, preparing meals, cleaning and other domestic tasks. Where data permit, it would be very useful to include time in our accounts, but our project resources have already been stretched to the limit in preparing the current version of the accounts. For an example of accounts including time, see the case of Thailand (Phananiramai 2008), early estimates for the US (Lee and Lapkoff 1988), a study of Mayan subsistence agriculturalists (Lee and Kramer 2002) and a reanalysis of Caine's data for a poor village in Bangladesh (Roberston, Lee and Kramer, 2008).

Lifecycle wealth and the Direction and Scale of Generational Flows

We have begun our analysis by considering the economic lifecycle because intergenerational transfers and other generational flows are the counterpart of the lifecycle. The purely cross-sectional perspective we have employed to this point is incomplete, however. It tells us how resources are being allocated between different generations at a point in time, but further analysis is needed to understand how features of the economic lifecycle influence the allocation of resources across successive generations. This requires a generational perspective and for that reason we introduce two important concepts: lifecycle wealth and one of its components – transfer wealth.

To understand these concepts consider first the relationship between the old-age lifecycle deficit and the demand for lifecycle wealth. In the absence of intergenerational transfers, individuals would have to accumulate assets during their working years on which they would rely during retirement. Per capita assets would rise with age and then at some point begin to decline. For the population as a whole the demand for per capita assets would depend on the asset profile that corresponds to the lifecycle deficit and the age distribution of the population.

The one-to-one relationship between the lifecycle deficit and the demand for assets is readily extended to include reliance on intergenerational transfers to fund the lifecycle deficit. During working years individuals contribute to a public transfer system and in retirement receive benefits. From the perspective of the individual, the transfer system is a form of wealth equal to the present value of benefits to be received in the future less payments to be made. Transfer wealth increases as an individual passes through the working years and then declines as he or she proceeds through retirement drawing down lifetime benefits.

Transfer wealth is different from assets in a very important way. Assets are created through investment, raising the productive potential of an economy. Transfer wealth is purely a social obligation. There is no physical counterpart to transfer wealth, only a commitment to fulfill a social contract. For current retirees the obligation falls on those who are currently contributing. But for the current population, taken in its entirety, transfer wealth is an obligation born by future generations. The counterpart of transfer wealth is implicit debt passed on to our descendants.

Now let's consider the lifecycle deficit during childhood. By relying on transfers to fund the lifecycle deficit of children we create an obligation on the part of the current population to provide resources to support current children and future generations (during their childhood). The present value of net transfers to future generations by the current population is equal to downward transfer wealth. Total transfer wealth is equal to the sum of downward transfer wealth – a negative value – and upward transfer wealth – a positive value. Depending on the relative magnitudes of these two values transfer wealth is either positive or negative and future generations are gaining or losing from existing transfer systems.

Lifecycle wealth is the combined value of asset and transfer wealth. To explore the relationship between the economic lifecycle and lifecycle wealth we will switch our focus to take into account the population age distribution so that we can view the scale and direction of flows in the aggregate population and economy. To do this, we multiply the population age distribution by the age profiles to calculate the aggregate consumption and labor income by age, and their difference, the aggregate LCD (in contrast to the per capita profiles in Figures 1 and 2). The information contained in these aggregate age profiles can be summarized using arrow diagrams which indicate the direction and distance across age of transfers and asset operations, and their volume or relative importance.

We will illustrate the construction of these arrow diagrams for Indonesia in 2002. Indonesia is one of the lowest income countries in our collection, but in 2002 it was well along in the fertility transition with a TFR of about 2.6, and had 8.3% of its population age 65 and over. Panel A of Figure 3 plots the per capita age profiles of consumption and labor income. Panel B plots the population age distribution in 2002. Panel C plots the age profiles for aggregate consumption and labor income that result from multiplying the per capita age profiles time the population age distribution. The simple sums across ages of these aggregate profiles shown in Panel C equal total consumption and total labor income as reported in the National Income and Product Accounts (NIPA) for Indonesia in 2002, by construction.

In Panel C we can see at what age each unit of consumption is consumed, and from this information we can calculate the age at which the average unit is consumed, and similarly for labor income. The average age of consumption is calculated by multiplying each age (e.g. 23) times aggregate consumption at that age and then summing these products over all ages. This sum is then divided by the total amount of consumption at all ages.[5] The results of these mean age calculations for Indonesia are indicated by vertical lines in Panel C. It is evident that these average ages abstract from a great deal of interesting information, reducing it to a single number, but we will see these average ages are nonetheless useful and informative.

We can then compare the average age of consumption, A_c, to the average age of labor income, A_{yl}. If every individual simply consumed 100% of her labor income at each age, then we would have $c(x) = y_l(x)$, $C(x) = Y_l(x)$, and therefore $A_c = A_{yl}$: the average ages would be identical. The same would be true if the aggregate deficit at young ages ($C(x)>Y_l(x)$) were exactly offset by the deficit in old age. But neither of these situations is likely to occur. If $A_c > A_{yl}$ it means that the average unit of output is shifted upwards from the lower age at which it was earned to the higher age at which it was consumed, and if $A_c < A_{yl}$ then the average direction of shifting is downwards, from older to younger. If only a small amount of income is shifted, then there will be only a small effect on the average age of consumption, and the average ages will still be close together.

In the case of Indonesia, we see in Panel C that $A_c < A_{yl}$. Indeed, the average age of consumption is 6.8 years younger than the average age of labor income. The arrow

therefore points to the left toward younger ages in the negative direction. The width of the arrow, equal to per capita consumption normalized by dividing by average labor income ages 30-49, is equal to 0.61, that is per capita consumption is about 60% of the average labor income of a prime age adult. The area of the arrow is -6.8*.61 = -4.2. The interpretation is that over his/her remaining life, the average Indonesian in 2002 expects to consume less than he/she produces by an amount equal to 4.2 years worth of labor income (in survival weighted present value). It is in this sense that the average person holds negative transfer wealth. The reason is that on average, labor income will be used to support children's consumption in the future to a greater extent than the labor income of others or own assets will be used to support future consumption in old age.

The area of the arrow measures the demand for lifecycle wealth per capita (relative to average labor income) needed to achieve the consumption profile given the labor income profile, under steady state conditions with a discount rate equal to the growth rate of population plus the productivity growth rate. This was first shown by Willis 1988, and further developed in Lee 1994a.

The area of the arrow lumps together transfer wealth and asset wealth. In this paper we will largely ignore assets and concentrate on transfers and transfer wealth. Since actual populations and economies are unstable and non-steady state, and since discount rates are generally different than the population growth rate plus productivity growth rate, the area of the arrow only approximates the demand for lifecycle wealth.[6]

The width of the arrow is per capita consumption divided by labor income. This may differ considerably from country to country. In China, with a low value of 0.44, a very high proportion of income is saved, so consumption is low relative to labor income, and the arrow is thin. In countries with low saving rates, high support ratios reflecting favorable population age distributions, high remittance income, or high asset income including from extractive industries, consumption may be considerably greater than labor income, so the arrow is fat. The highest values are found in Mexico (0.77) and the United States (0.71).

Figure 4 plots arrows for 23 countries plus two hunter-gatherer groups. We might expect the arrows to cluster in regional patterns, in part because the demography shares features within regions, and in part because regionally similar cultures shape the life cycle. The countries are grouped into four broad regions: Europe/US; East Asia; Latin America; and South and Southeast Asia. These regions are arranged in order of per capita GDP, with the highest first. Within each region, the member countries are also ordered by per capita GDP, except for the hunter-gatherer groups. The unweighted averages for the regions are shaded gray.

With this background, we can turn to Figure 4 which plots arrows for 23 countries plus two hunter-gatherer groups. We might expect the arrows to cluster in regional patterns, in part because the demography shares features within regions, and in part because regionally similar cultures shape the life cycle. The countries are grouped into four broad regions: Europe/US; East Asia; Latin America; and South and Southeast Asia. These

regions are arranged in order of per capita GDP, with the highest first. Within each region, the member countries are also ordered by per capita GDP, except for the hunter-gatherer groups. The un-weighted averages for the regions are shaded gray.

Two features of the chart are visually striking. First, we see that the arrows for the hunter gatherer groups[7] and the poorer countries at the bottom of the chart all point to the left and are long, indicating strongly downward net transfers from older to younger in these populations. The length of the arrows tends to decline as we move up the figure, ending with short arrows at the top, some pointing slightly down and some slightly up, indicating that net transfers are no longer strongly from older to younger. The regional average arrows also follow this pattern, with the arrow for the average European/US region pointing very slightly to the right, indicating net transfers to the elderly. Second, we see that the stack of arrows, broad at the base, is tilted to the right. The richer countries toward the top are also older, so both ends of the arrows are also older and farther to the right. The mean age of making and receiving transfers is older in older populations.

For five countries the arrows point to the right: Germany, Austria, Japan, Slovenia, and Hungary. For another three countries the arrows are only very slightly to the left, by less than a year: Sweden, Finland, Spain. We note that there are nine countries in our data set in which more than 15% of the population is 65 or over, and that all five of our upward arrows come from this group, as do all three of our short downward arrows. The US, which is the richest country, has only about 12% of its population 65+ and has a downward pointing arrow, similar to Uruguay—which, although relatively poor, has the same proportion 65+ as does the US. Kenya, with the youngest population, also has the most downward pointing arrow. This suggests that the population age distribution has an important influence on the length and direction of the arrows, a possibility we will investigate below.

Our leading goal here is to deepen our understanding of these cross-sectional patterns and apparent historical changes, and their relation to the demographic transition and the population aging it eventually brings about. The direction of flows results in part from the population age distribution, since higher proportions of the young or the old tilt the aggregate flows toward that age group. Thus population aging makes arrows less downward or more upward. However, the shapes of the age profiles of consumption and labor income also play an important role. These shapes are influenced by individual incentives, culture and institutional contexts, and most particularly by the growth of the public sector and its transfer programs.

We may begin our exploration by probing the role of population age distribution in shaping the pattern we observed in Figure 4. To do this, we calculate the unweighted average population age distribution for all 23 countries in our current set, and recompute all the average ages and per capita flows using this same age distribution for all populations.[8] The results are shown in Figure 5, which looks very different than Figure 4. All arrows are now downwards. We see that most of the variation across countries has disappeared, but not all. Austria stands out for its short downward arrow, as does Uruguay. Among the regions, now Latin America has the shortest arrow, while the

arrows for Europe/US and the lowest income region, South and Southeast Asia, are nearly identical. This shows clearly that population age distribution has a huge effect on the direction of transfers. Nonetheless, it is not the whole story, and in addition the arrows summarize and thus obscure other important changes and differences.

These data are cross-sectional and not historical. Nonetheless, they suggest that over past millennia, the direction of income flows has been strongly downwards from older to younger, probably in all societies. Once we realize the key role that population aging has played in shortening the arrows and even reversing them, it follows that in the pretransitional and therefore young populations of the past, income would have been reallocated downwards across age for any plausible shape of the per capita age profiles. The young population age distributions of the times would have placed so much weight on the necessarily heavy dependence of the children that downward transfers would have dominated any upward flows that may have occurred.

Over almost all of human history, income has been reallocated from adults to the young to support the costs of the long period of maturation and dependency. Fairly recently, probably starting during the last half century, there has been a sea change with the direction of net flows shifting from downward to upward. This does not mean that we now invest less in our children; in fact we now invest more per individual child relative to our labor income, with heavy expenditures on education in particular (Lee and Mason 2009). But it does underline the heavy cost of supporting our growing proportions of increasingly costly elderly, a cost that is likely to grow greatly in the coming decades as populations age.

The Roles of Private and Public Transfers

We have seen the extent to which individuals are able to consume more than their labor income, particularly in childhood and old age. But how exactly is this accomplished? The many mechanisms can be classed under the headings of transfers or asset operations. Asset operations include saving and investing during the working ages and dissaving while living on asset income and asset sales in old age. They also include borrowing money to pay for higher education, or to buy a house or a car, paying interest on the loan, and eventually repaying the principle. All borrowing and lending, paying and receiving interest or dividends, and similar operations come under this heading, including operations involving foreigners and foreign governments. These asset operations are included in NTA, but will not be discussed here. Instead we will emphasize transfers. These include private or familial transfers, both intrahousehold and interhousehold, and public transfers, both in-kind and monetary. Remittances to or from other countries are private interhousehold transfers.

NTA includes explicit measures of both public and private transfers. Public transfers received are estimated using the in-kind transfers that have already been included in the measure of consumption, plus cash transfers to individuals such as public pensions, family allowances, public assistance and unemployment insurance, plus a prorated share of expenditures on public goods such as the military, publicly funded research, social infrastructure, and so on. Public transfers made are based on various kinds of taxes paid

by age. Private transfers are interhousehold and intrahousehold. Interhousehold transfers are reported on some surveys, and are here assumed to go to the head of the household who redistributes them through transfers to other members. Remittances from abroad are also interhousehold transfers. Intrahousehold transfers are measured as if a tax were levied within the household on all labor income in excess of consumption, and transfers are assumed to be made to those who consume more than they produce. Transfers in this way are allowed without passing through the head of household. The household assets, such as consumer durables or a home, are assumed to be owned by the head, and the services imputed to these assets are then transferred to household members in the usual way and counted as transfers from the head. It is important to note that our estimates do not include bequests at death.[9]

Estimates of public and private transfers are not yet available for all the 23 countries of the previous figures. Figure 6 shows arrows for private *inter vivos* transfers for those countries with the data, and empty spaces otherwise. The tails and heads are placed on the average age of making a private transfer and receiving a private transfer. The width of the arrow is now the per capita value of private transfers, divided by average labor income.

The figure shows that in every region, private transfers are strongly downwards. Nonetheless, there are some important differences in length and thickness of these arrows. East Asia has the shortest arrows. Although they make strong private transfers per child for health and education, fertility is low, and Taiwan and Korea make strong transfers to the elderly as well through the family support system for the elderly which offsets the effect of the child transfers. Latin America and Southeast Asia have the longest arrows reflecting their higher fertility and younger populations with fewer elderly, so that transfers to children dominate. Aside form Thailand, these countries do not have strong familial transfers to the elderly.

Europe and the US have strangely thin arrows. In part, this is because they have very low fertility and few children, so transfers to children are reduced.[10] But in addition, these countries have very strong welfare states with good public education and, except for the US, good publicly provided health care for children. Private expenditures on children for health and education are very limited. At the same time, private transfers to the elderly are nonexistent, and in fact the elderly make net private inter vivos transfers to younger generations on average. All this tends to make the arrows longer and thinner.

Figure 7 shows similar arrows, but this time for the standard population age distribution. We note that Brazil has by far the strongest downward private transfers of any country, as measured by the size of the transfer wealth (area of the arrow). There are some other differences from the own population arrows, but no qualitative differences, so we will not dwell on these.

The finding that private transfers are uniformly downwards from older to younger ages is important. In Caldwell's (1976) classic article on the demographic transition, he wrote: "The key issue here, and, I will argue, the fundamental issue in demographic transition, is

the *direction and magnitude of intergenerational wealth flows* or the net balance of the two flows--one from parents to children and the other from children to parents--over the period from when people become parents until they die.... In all primitive societies and nearly all traditional societies the net flow is from child to parent." (p.140). If we take this statement at face value, then Figures 6 and 7 contradict it for rich and poor countries alike. Private transfers, the ones relevant for private fertility decisions, are uniformly downward from older to younger on average. The figures confirm earlier similar findings by Lee, 1994b and 2000 and Stecklov 1999. When we interpret the statement more broadly to include other benefits that adults may derive from their children, such as insurance and physical security, then it is more difficult to bring quantitative evidence to bear (see Caldwell 2005 for an updated statement of his views).

In pretransitional agricultural societies, private transfers dwarf public transfers in importance, but the situation changes as countries become richer and more industrial and urban. Figure 8 exhibits the arrows for public transfers. Towards the bottom of the chart, the arrows are long and point left or downwards to younger ages, and are short and mostly point to the right at the top in the richer countries. Evidently, at least in an accounting sense, the public sector plays a bigger role in the reversal of the direction of transfer flows than does the private. The countries and regions show very divergent patterns. Net public transfers for Europe are upwards, with the strong public pension programs and health care for the elderly dominating public education and family allowances, and with the already old populations of Europe. The US, however, is an exception to this pattern with a downward arrow, the only one in the region, due in part to its younger age structure. The East Asian regional arrows generally point to the young (left), but Japan with its old population and important public transfers to the elderly looks much like the European countries. Aside from Japan, these countries do not have strong public pension programs and spending on health care is less than in Europe and the US. Taiwan and S. Korea have relatively large familial transfers to the elderly. The upward arrow for Latin America is striking and surprising, because these populations are still young, except for Uruguay. However, the Latin American countries in our sample mostly have strong welfare state programs including very strong public pension programs. South East Asia has by far the strongest downward public flow, reflecting their higher fertility and lack of public pension programs.

Age standardization (see Figure 9) has the interesting effect of strengthening the upward direction of public transfers in Latin America and reversing it in the US and the Europe/US region, since the former becomes older and the latter younger thereby. The positive public transfer wealth in Latin America is expected to displace some of the capital that would otherwise have been saved by workers to provide for retirement in old age. Given the actual age distributions of the US and Europe, the same is true there. Indeed, this is one of the concerns about the public pensions of the rich countries.

One important question is whether there is substitution between public and private transfers. Do public transfers crowd out private? For example, it is hard to believe that private spending on education and health care would not be greater if there were no public programs providing them. We also expect that without public pensions, elders

would more frequently coreside with their adult children and receive support from them. But it is also possible that the alternative to public pensions would be private ones, or continuing labor effort by the elderly.

While these arguments may seem plausible, it is also true that national cultures may differ considerably in the importance of spending on children and support for the elderly. Thus the relative level of consumption by the elderly varies substantially from country to country, and the same is true for human capital investments in children (health and education, see Lee and Mason 2009).

A simple scatter plot of private transfer wealth versus public transfer wealth, using a standard population age distribution, reveals a negative relationship but not a strong or striking one (see Figure 10). The regression coefficient is -.4, indicating that each unit increase of public transfer wealth is associated with .4 units less of negative private transfer wealth, consistent with a crowding out or substitution story. Three of the countries are special cases. China, which is far above the regression line, has unusually low consumption relative to labor income due to her exceptionally high saving rate. This leads to both private and public transfer wealth falling closer to zero. Mexico, and to a lesser degree the Philippines, have high remittance income and so they have more negative private transfer wealth than would be expected given their labor income. Without these special countries in the regression the slope rises to nearly -.5 and R^2 improves to nearly .3, but this sort of selective exclusion exercise is dangerous.

We note that Brazil has by far the greatest positive public transfer wealth and by far the most negative private transfer wealth, and perhaps this is not a coincidence.

A Closer Look at the Composition of Public Transfers

The final two figures, 11 and 12, present arrow diagrams for different components of public transfers: education, health, pensions, other in-cash, and other in-kind. The first three are self explanatory. Other in-cash includes such items as family allowances and need-based cash transfers. Other in-kind could include some need based transfers such as food, but the bulk of it is public good type expenditures that cannot be allocated to any particular individual or age group, such as military spending, social infrastructure, research, and so on. We treat these as going equally to each individual, but the transfer is made by tax payers who differ from the average age. The main interest is in education, health care, and pensions. We note that for purposes of these figures, we have placed all the tails of the arrows on the average age of paying all taxes in each country, although in many cases there are special taxes for some programs such as pensions or education. Thus for a given country, the tails of all arrows are located at the same age.

In Figure 11, it is striking that pensions are so stingy in the US, the richest country in the figure, and are so generous in Brazil, the second poorest country in the figure. To remove any effect of the different age structures Figure 12 uses the standard for all countries. Here there is little change for the US, but Brazil's pension program now dominates all others in the figure. Both countries are anomalous in this regard. Most poor countries

have small pension programs and most rich countries have generous ones, with or without age distribution standardized.

The two figures also reveal that only countries in the Europe/US region, plus Japan, have substantial public health care expenditures. Even relatively rich Taiwan and S. Korea have weak public expenditures on health. Brazil and Costa Rica stand out among the poorer countries.

For education, Figure 12 shows Sweden with greater expenditures and a younger mean age of receiving education, perhaps reflecting strong public childcare expenditures. Taiwan and S. Korea both have relatively weak spending on education, but these countries substantially augment public spending with complementary private expenditures for tutoring, cram schools, and other complements to public education (see Lee and Mason 2009).

The average age of paying taxes is particularly high in the US in Figure 12, and similarly high in the Philippines. This reflects the high labor income earned in old age in these countries.

Conclusions and Discussion

In every population we have studied, net *familial* transfers are strongly downward from older to younger, which is consistent with evolutionary theory, and inconsistent with simple versions of wealth flow theory. Even the Asian countries with strong familial old age support, such as Taiwan, S. Korea, China and Thailand, have downward familial transfers overall. Parental net transfers to children over the life cycle are also the net cost of children, and they enter into fertility decisions in complicated ways (Becker and Lewis 1973; Willis 1988; Willis 1994). In societies in which the elderly are supported by public unfunded pension and health systems, costs of this support drive a wedge between the public and private cost or benefit of children, and might contribute to the low fertility of today's industrial nations – might, but we offer no evidence on this point here (Lee 1990).

There has been a fundamental change in the direction of net intergenerational transfers from downward to upward, with most of the change driven by population aging in the later part of the most advanced demographic transitions. Changes in the shape of the economic life cycle also contributed: old age consumption rose relative to consumption at other adult ages. At the same time, expenditures per child were raised by increasing per child human capital investment in a smaller number of children per couple. It seems likely that the growing role of the welfare state played an important role in promoting these changes. In particular, heavy public transfers to the elderly have become common, even in some low income Latin American countries, and these have apparently largely replaced familial support for the elderly. We say "apparently" because we do not have strong evidence here of the substitution of public for private transfers. The case of Brazil, with the most generous public transfers to the elderly and the most strongly downward private transfers, is certainly suggestive. However, we do not see net familial support of the elderly in the poorest countries in our collection where there are no appreciable public

transfers for the elderly. Income earned by assets of the elderly, such as land and livestock, probably plays an important role in these situations. In rich industrial countries, the demand for leisure at the end of life has risen with income. In the lower income countries, individuals are more likely to continue to work, and this prolonged work also diminishes the need for family transfers to the elderly.

It is clear that current public transfers to the elderly in rich industrial countries will not be sustainable as populations age over the next few decades. Patterns of work, consumption, and intergenerational transfers through both public and private sectors will surely change. Already there are important moves to restructure public pension programs and to contain costs in public health care programs. In some rich countries, labor supply of the elderly has begun to rise, at least slightly. However, it seems unlikely that these changes will prevent more reversals in the direction of flows as rich industrial nations age rapidly. Some less developed Latin American countries have adopted the public transfer programs of Europe, and will experience the resulting fiscal pressures, and perhaps similar reversals of flows. Asian countries other than Japan have so far gone a different route, with strong private, but weak public, support of the elderly. Once sustainability problems are resolved, the direction of flows is not in itself an issue. However, rising public expenditures on the elderly may compete with public investment in children, and for countries with declining numbers of workers to support increasing numbers of elderly, underinvestment in children would be a very bad outcome. More generally, policy makers should makers should consider levels and trends in the intergenerational and inter-age distribution of consumption, rather than leaving these to be shaped as an incidental by product of institutions and policies designed long ago for other purposes.

References

Becker, Gary S. and Robert Barro (1988) "A Reformulation of the Economic Theory of Fertility," *Quarterly Journal of Economics* v.103 n.1 (February) pp.1-25.

Becker, G., & Lewis, H. G. (1973). On the interaction between the quantity and quality of children. 816 *Journal of Political Economy*, 84(2 pt. 2), S279–S288.

Becker, Gary S. and Kevin M. Murphy (1988) "The Family and the State," *Journal of Law and Economics*, April, pp. 1-18.

Caldwell, John C. (1976), "Toward a Restatement of Demographic Transition Theory", *Population and Development Review*, reprinted as Chapter 4 of John Caldwell (1982) *Theory of Fertility Decline* (Academic Press) 113-180.

Caldwell, John C. (2005) "On Net Intergenerational Wealth Flows: An Update" *Population and Development Review* 31(4):721-740.

Chu, C.Y. and Ronald Lee (2006) "The co-evolution of intergenerational transfers and longevity: an optimal life history approach. *Theoretical Population Biology.* Volume 69. Issue 2. March 2006. Pp. 193-201.

Costa, Dora (1998) *The Evolution of Retirement* (Chicago: University of Chicago Press).

Gruber, Jonathan and David A. Wise (1999) *Social security and retirement around the world*, an NBER Conference Report. Chicago: University of Chicago Press.

Gurven M (2004) To give or not to give: An evolutionary ecology of human food transfers. *Behav and Brain Sci* 27:543–583.

Hawkes K, Blurton Jones N (2005) "Human age structures, paleodemography, and the grandmother hypothesis" in *Grandmotherhood: The Evolutionary Significance of the Second Half of Female Life*, eds Voland E, Chasiotis A, Schiefenho¨ vel W (Rutgers Univ Press, New Brunswick, NJ), pp 118–140.

Hrdy, Sarah (2009) *Mothers and Others: The Evolutionary Origins of Mutual Understanding* (Harvard University Press).

Nancy Howell (in press) *Life Histories of the Dobe !Kung*, Berkeley, Univ. of California Press.

Kaplan, Hillard (1994), 'Evolutionary and Wealth Flows Theories of Fertility: Empirical Tests and New Models', *Population and Development Review* v.20 n.4 (December) pp. 753-791.

Lee, Ronald, Sang-Hyop Lee, and Andrew Mason (2008) "Charting the Economic Life Cycle," in *Population Aging, Human Capital Accumulation, and Productivity Growth*, Alexia Prskawetz, David E. Bloom, and Wolfgang Lutz, eds., a

supplement to *Population and Development Review* vol. 33. (New York: Population Council).

Lee, Ronald and Andrew Mason (2009: published on-line) “Fertility, Human Capital, and Economic Growth over the Demographic Transition,” *European Journal of Population.*

Lee, Ronald and Shelley Lapkoff (1988) "Intergenerational Flows of Time and Goods, and Consequences of Slowing Population Growth," *Journal of Political Economy*, v.96, n.3 (June 1988) pp. 618-651.

Lee, Ronald D. (1994), 'The Formal Demography of Population Aging, Transfers, and the Economic Life Cycle', in Linda Martin and Samuel Preston, eds.; *The Demography of Aging* (National Academy Press, 1994) pp. 8-49.

Lee, Ronald (1994) "Fertility, Mortality and Intergenerational Transfers: Comparisons Across Steady States," in John Ermisch and Naohiro Ogawa, eds., *The Family, the Market and the State in Ageing Societies* (Oxford University Press, 1994), pp.135-157.

Lee, Ronald (2000) “A Cross-Cultural Perspective on Intergenerational Transfers and the Economic Life Cycle,” in Andrew Mason and Georges Tapinos, eds., *Sharing the Wealth: Demographic Change and Economic Transfers between Generations* (Oxford University Press, Oxford), pp.17-56.

Lee, Ronald D. 'Population Policy and Externalities to Childbearing', *Annals of the American Academy of Political and Social Science*, special issue edited by Samuel Preston *World Population: Approaching the Year 2000* (July 1990), pp. 17-32.

Lee, Ronald (2008) “Sociality, Selection and Survival: simulated evolution of mortality with intergenerational transfers and food sharing.” *PNAS.* published May 5, 2008, 10.1073/pnas.0710234105 (Social Sciences).

Lee, Ronald and Karen Kramer (2002) “Children’s Economic Roles in the Context of the Maya Family Life Cycle: Cain, Caldwell, and Chayanov Revisited,” *Population and Development Review*, 28 (3):475-499 (September 2002).

Mace R, Sear R (2005) Are humans cooperative breeders? *Grandmotherhood: The Evolutionary Significance of the Second Half of Female Life*, eds Voland E, Chasiotis A, Schiefenhovel W (Rutgers Univ Press, New Brunswick, NJ), pp 143–159.

Mason, A., Ronald Lee, et al. 2009. Population Aging and Intergenerational Transfers: Introducing Age into National Accounts. in D. Wise (ed.) *Developments in the Economics of Aging.* Chicago, NBER and University of Chicago Press.

New York Times (2009) “Politics and the Age Gap” in Week in Review, p.1.

Phananiramai, Mathana (2008) “Incorporating Time into the National Transfer Accounts” NTA Working Paper (January 29)

Robinson, Rachel Sullivan, Ronald Lee and Karen Kramer (2008) "Counting Women's Labor: A Reanlysis of Children's Net Production in Mead Cain's Bangladeshi Village" *Population Studies,* 62:1, 25-38.

Samuelson, Paul (1958), 'An Exact Consumption-Loan Model of Interest With or Without the Social Contrivance of Money', *Journal of Political Economy*, vol. 66, no. 6 (December), pp. 467-482.

Stecklov, Guy (1999) “Evaluating the Economic Returns to Childbearing in Cote D’Ivoire” *Population Studies* 53(1) pp.1-17.

Willis, Robert (1988), 'Life Cycles, Institutions and Population Growth: A Theory of the Equilibrium Interest Rate in an Overlapping-generations Model', in Ronald Lee, W. Brian Arthur and Gerry Rodgers eds., *Economics of Changing Age Distributions in Developed Countries* (Oxford University Press), pp. 106-138.

Robert Willis (1994) “Economic Analysis of Fertility: Micro-Foundations and Aggregate Implications,” in Kerstin Lindahl Kiessling and Hans Landberg, *Population and Economic Development and the Environment* (Oxford University Press), pp.139-172.

Figure 1. The Economic Life Cycle of Hunter-Gatherers, Poor Agricultural Populations, and Rich Industrial Populations

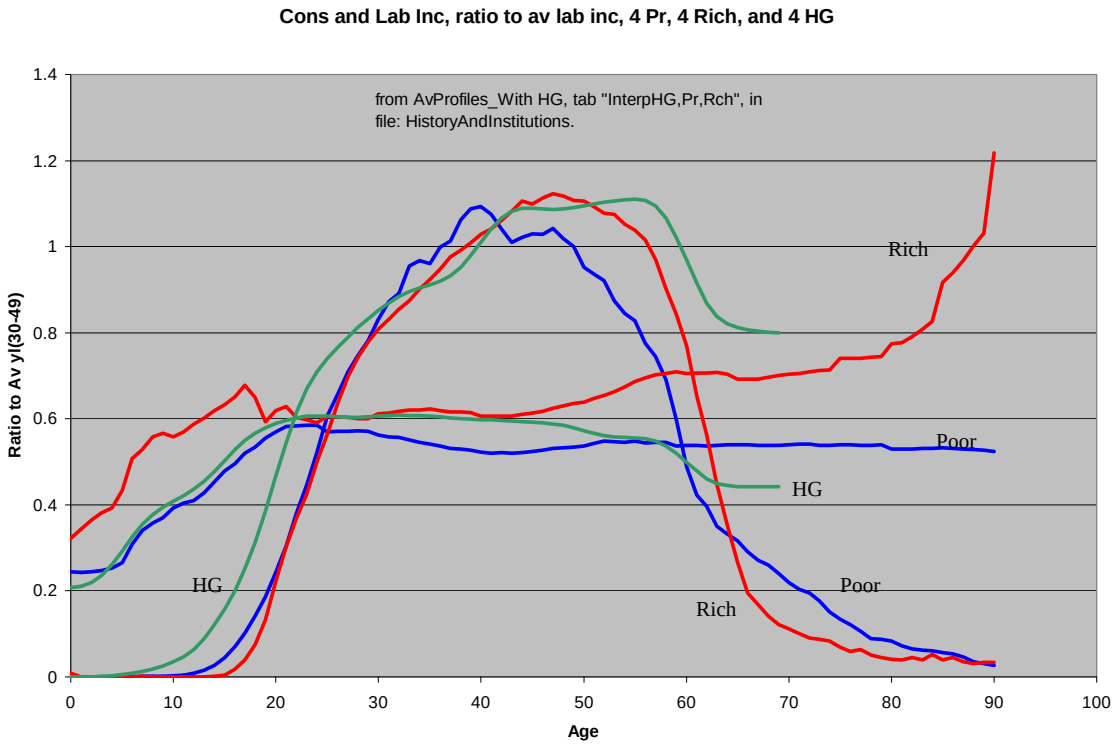


Figure 2. The Life Cycle Deficit (Consumption minus Labor Income) of Hunter-Gatherers, Poor Agricultural Populations, and Rich Industrial Populations

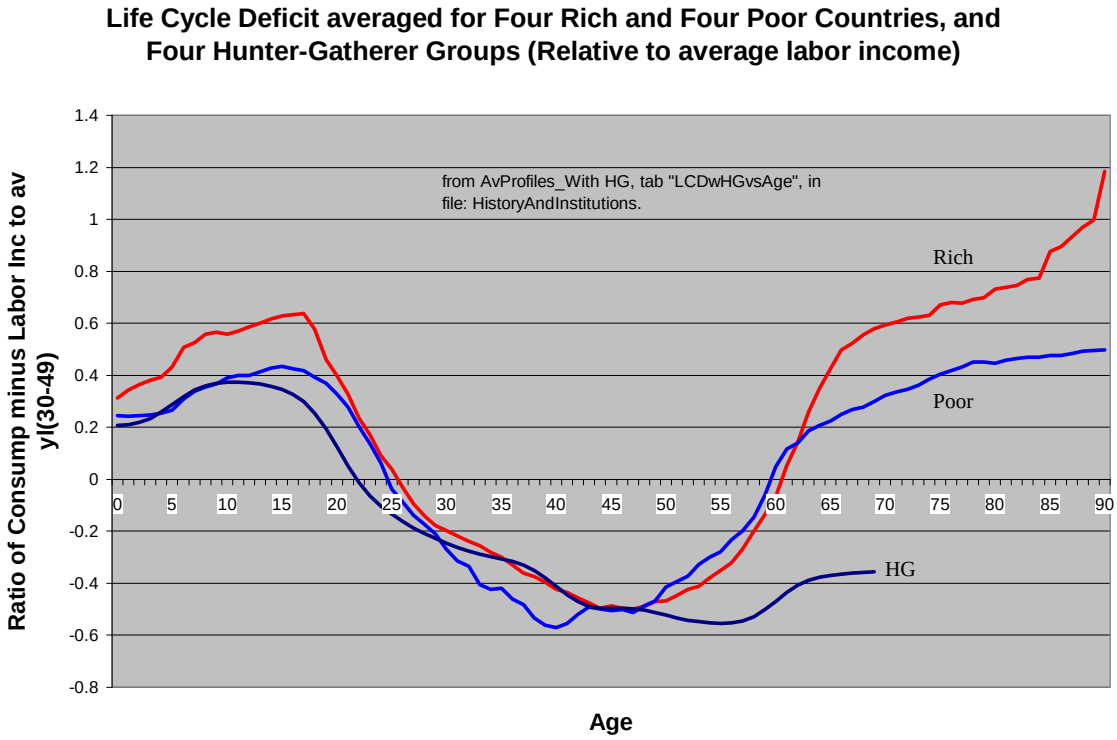
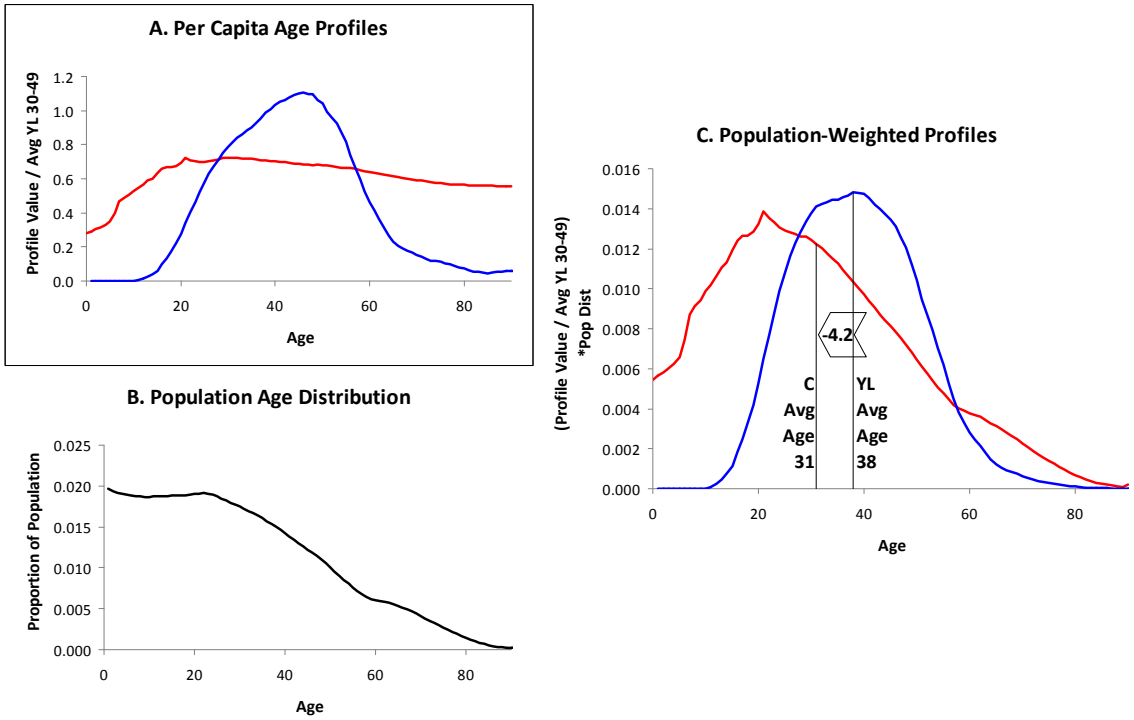


Figure 3. Illustration of Arrow Diagram Construction for Indonesia (2002)



Note: The per capita age profiles in Panel A are multiplied the proportional population age distribution in Panel C to get the population-weighted age profiles shown in Panel C. The average ages of these two profiles are calculated by multiplying them at each age by that age, summing, and dividing by the sum of the original profile across age. The height of the arrow is the per capita consumption divided by average labor income at ages 30-49, which is .61. The area of the arrow is the product of its length, 6.8 years, times the height of the arrow, .61, or -4.2 years. The area is negative because the arrow points to the left, that is A_c-A_{yl}<0. The interpretation is that in order to achieve the per capita consumption by age shown in the first panel, given labor income by age, the average member of the population must hold debt equal to 4.2 years of average annual labor income (for workers age 30-49).

Figure 4. Arrow Diagrams Showing Average Ages of Consumption and Labor Income in Various Populations and Per Capita Flows

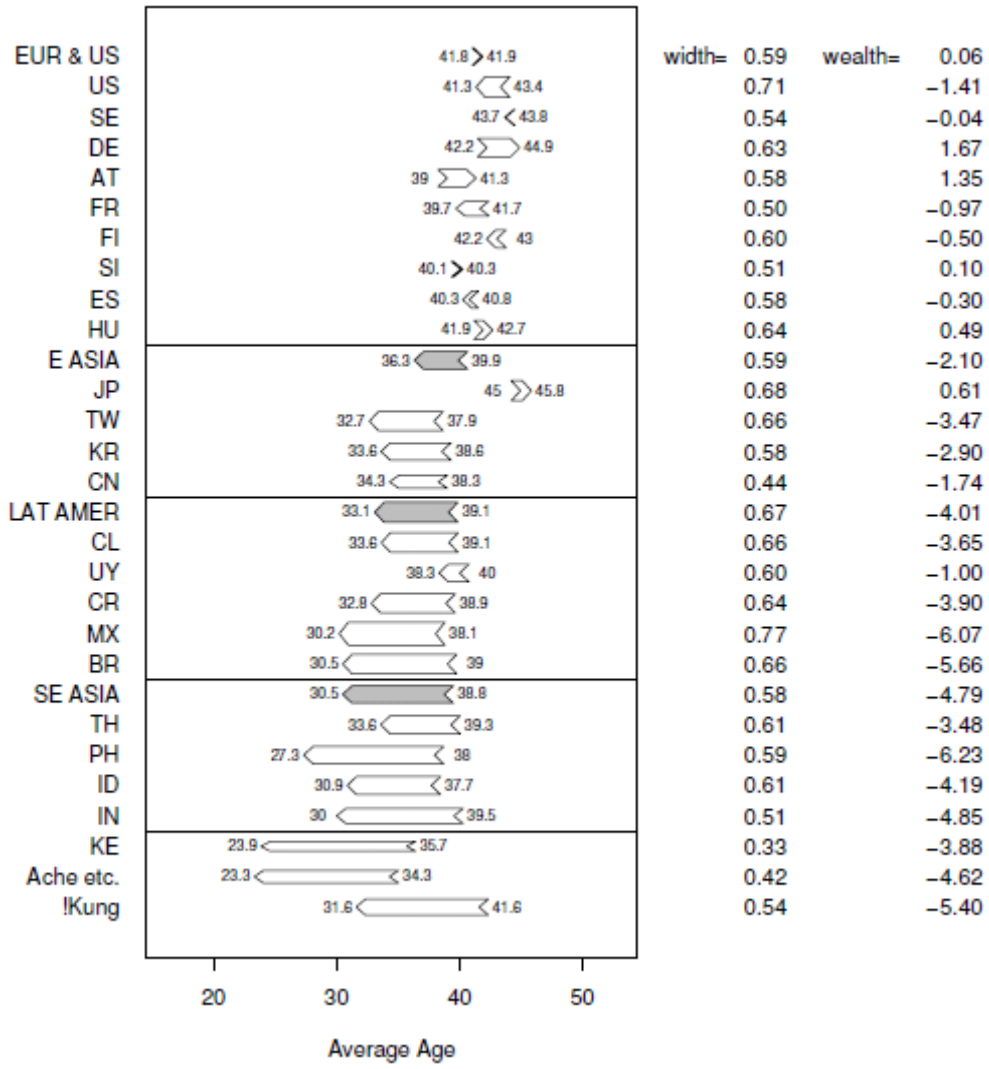


Figure 5. Arrow Diagrams Showing Average Ages of Consumption and Labor Income in Various Populations and Per Capita Flows, Using a Fixed Population Age Distribution (average of all the countries)

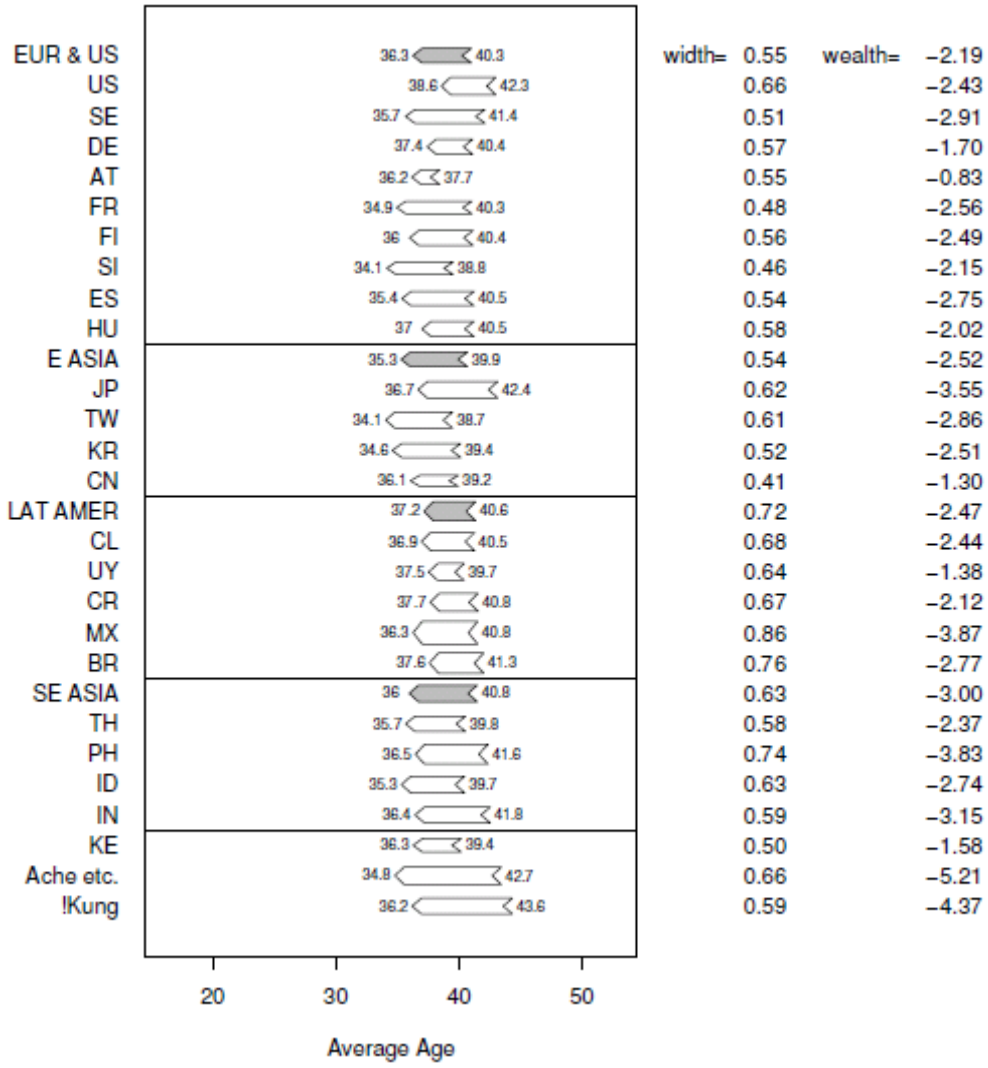
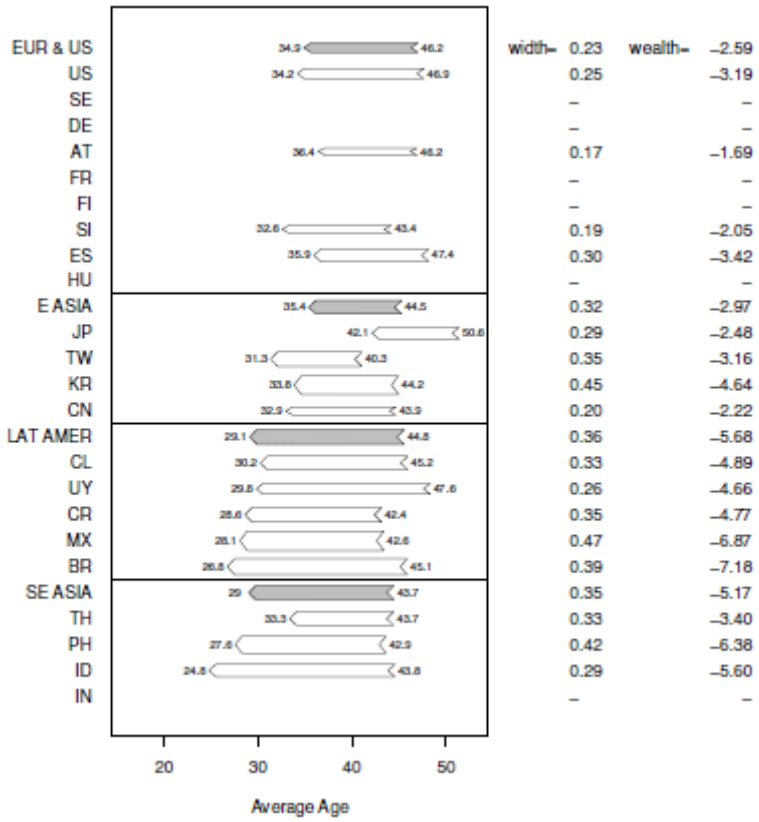


Figure 6. Arrow Diagrams Showing Average Ages of Private Transfers Received and Given and Per Capita Private Transfer Flows



	width=		wealth=
EUR & US	0.23		–2.59
US	0.25		–3.19
SE	–		–
DE	–		–
AT	0.17		–1.69
FR	–		–
FI	–		–
SI	0.19		–2.05
ES	0.30		–3.42
HU	–		–
E ASIA	0.32		–2.97
JP	0.29		–2.48
TW	0.35		–3.16
KR	0.45		–4.64
CN	0.20		–2.22
LAT AMER	0.36		–5.68
CL	0.33		–4.89
UY	0.26		–4.66
CR	0.35		–4.77
MX	0.47		–6.87
BR	0.39		–7.18
SE ASIA	0.35		–5.17
TH	0.33		–3.40
PH	0.42		–6.38
ID	0.29		–5.60
IN	–		–

Figure 7. Arrow Diagrams Showing Average Ages of Private Transfers Received and Given and Per Capita Private Transfer Flows, Using a Standard Population Age Distribution (average of all the countries)

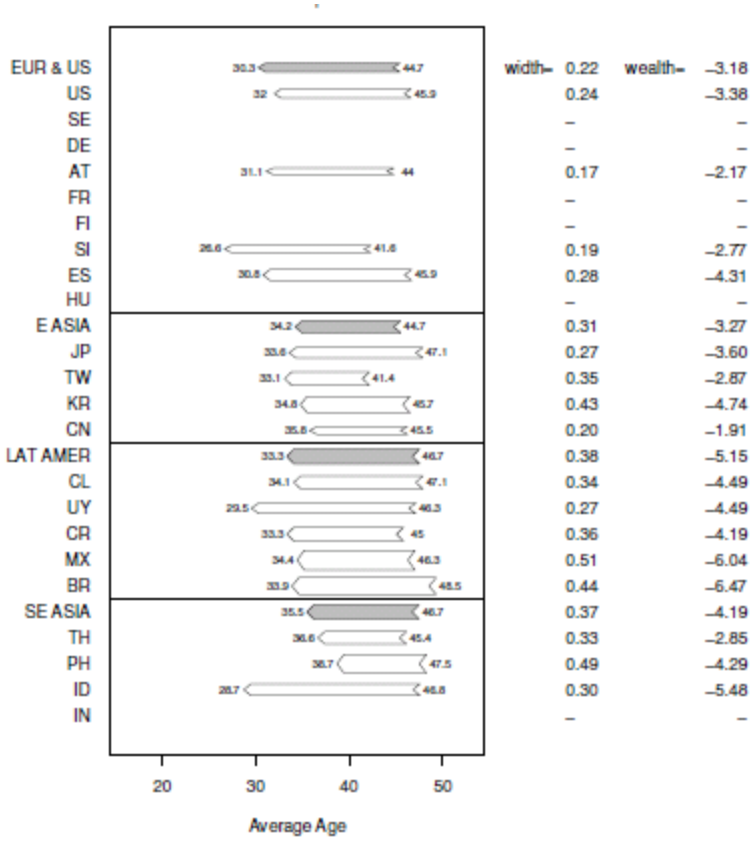
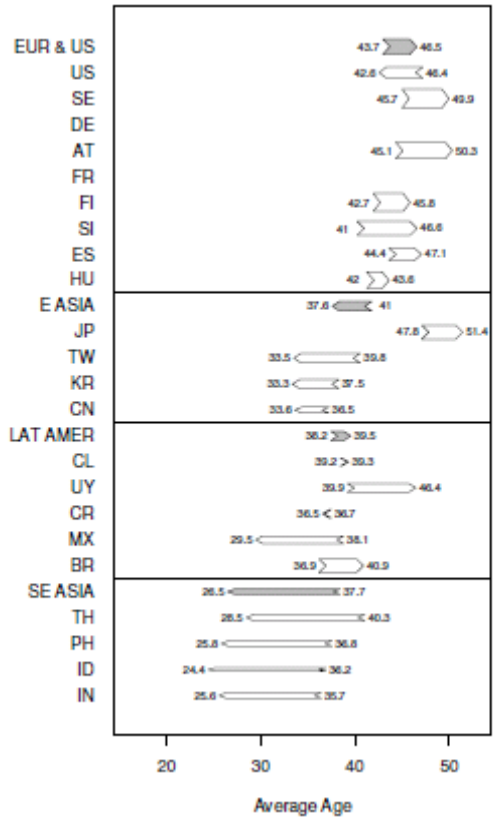
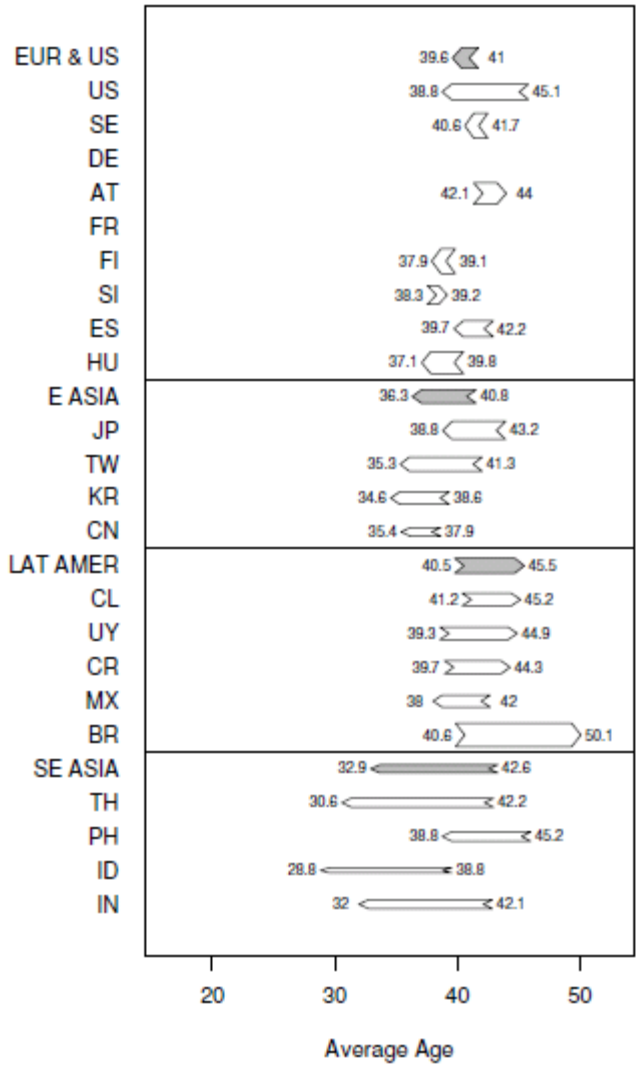


Figure 8. Arrow Diagrams Showing Average Ages of Public Transfers Received and Taxes Paid and Per Capita Public Transfer Flows



	width–	wealth–
EUR & US	0.33	0.94
US	0.24	–0.93
SE	0.42	1.77
DE	–	–
AT	0.35	1.85
FR	–	–
FI	0.39	1.24
SI	0.30	1.70
ES	0.26	0.69
HU	0.36	0.57
E ASIA	0.20	–0.69
JP	0.30	1.09
TW	0.21	–1.34
KR	0.19	–0.80
CN	0.13	–0.37
LAT AMER	0.20	0.28
CL	0.17	0.03
UY	0.19	1.22
CR	0.18	–0.04
MX	0.17	–1.43
BR	0.29	1.16
SE ASIA	0.11	–1.28
TH	0.13	–1.56
PH	0.12	–1.27
ID	0.08	–0.93
IN	0.12	–1.24

Figure 9. Arrow Diagrams Showing Average Ages of Public Transfers Received and Taxes Paid and Per Capita Public Transfer Flows, Using a Standard Population Age Distribution (average of all the countries)



	width=	wealth=
EUR & US	0.31	−0.42
US	0.23	−1.44
SE	0.38	−0.43
DE	–	–
AT	0.32	0.61
FR	–	–
FI	0.37	−0.43
SI	0.28	0.26
ES	0.24	−0.58
HU	0.34	−0.89
E ASIA	0.20	−0.88
JP	0.27	−1.17
TW	0.21	−1.26
KR	0.19	−0.75
CN	0.13	−0.32
LAT AMER	0.22	1.08
CL	0.19	0.75
UY	0.19	1.03
CR	0.20	0.90
MX	0.18	−0.72
BR	0.35	3.29
SE ASIA	0.12	−1.16
TH	0.13	−1.53
PH	0.14	−0.90
ID	0.08	−0.78
IN	0.13	−1.32

Figure 10. Forms of Transfer Wealth in Standard Pops: Tf vs Tg

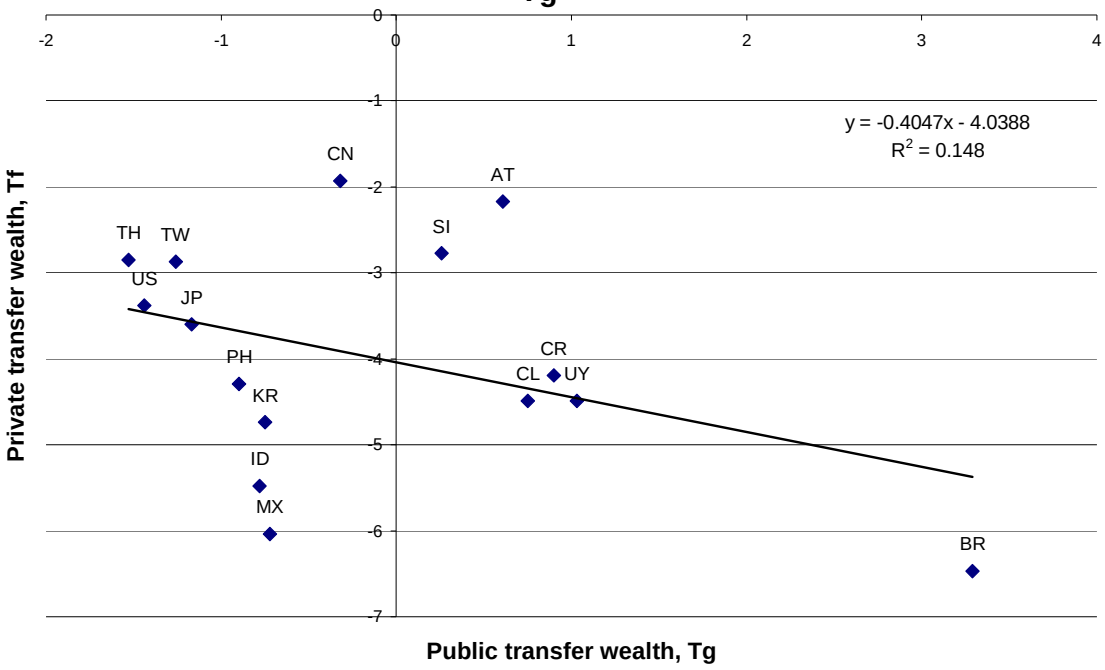
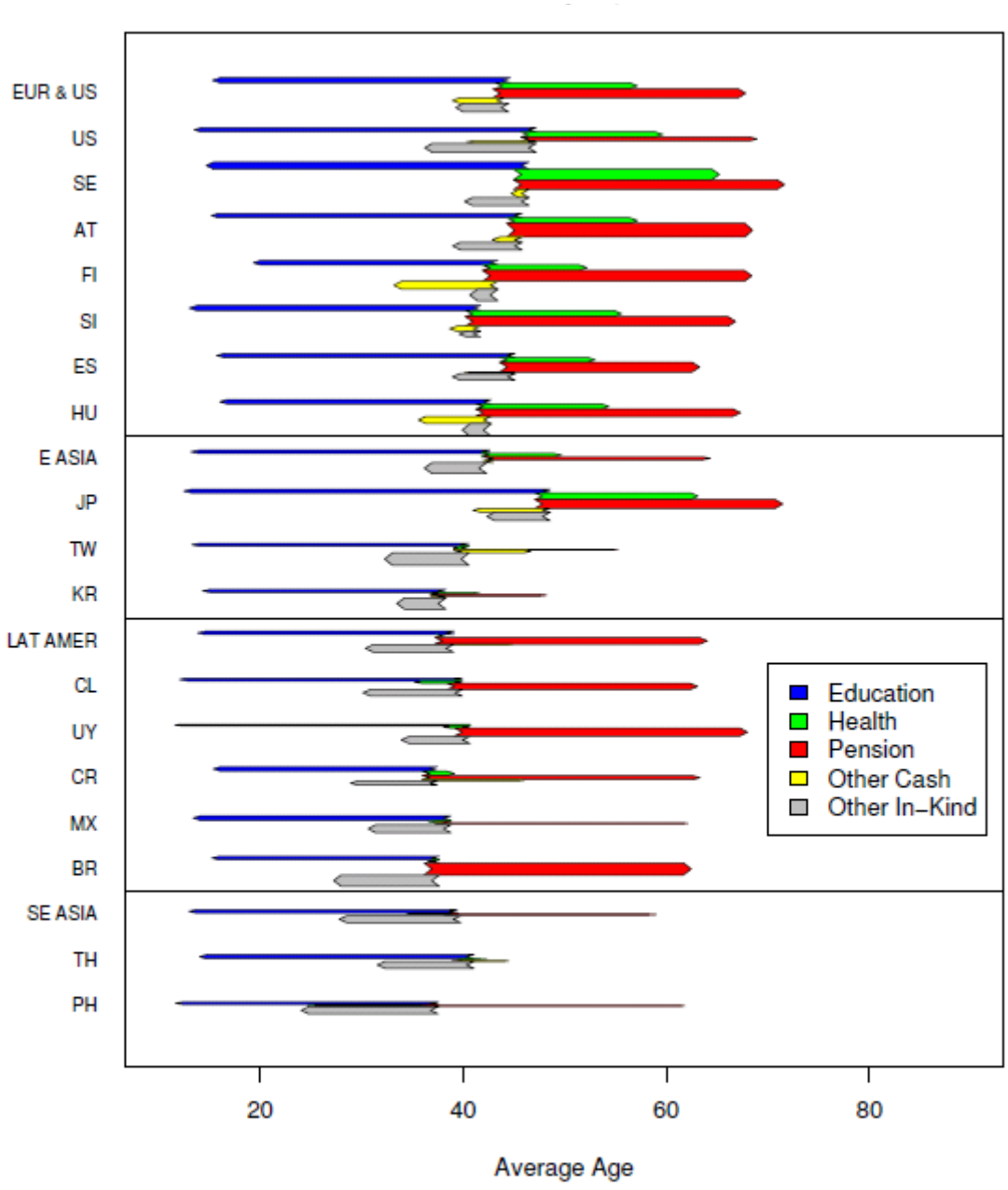
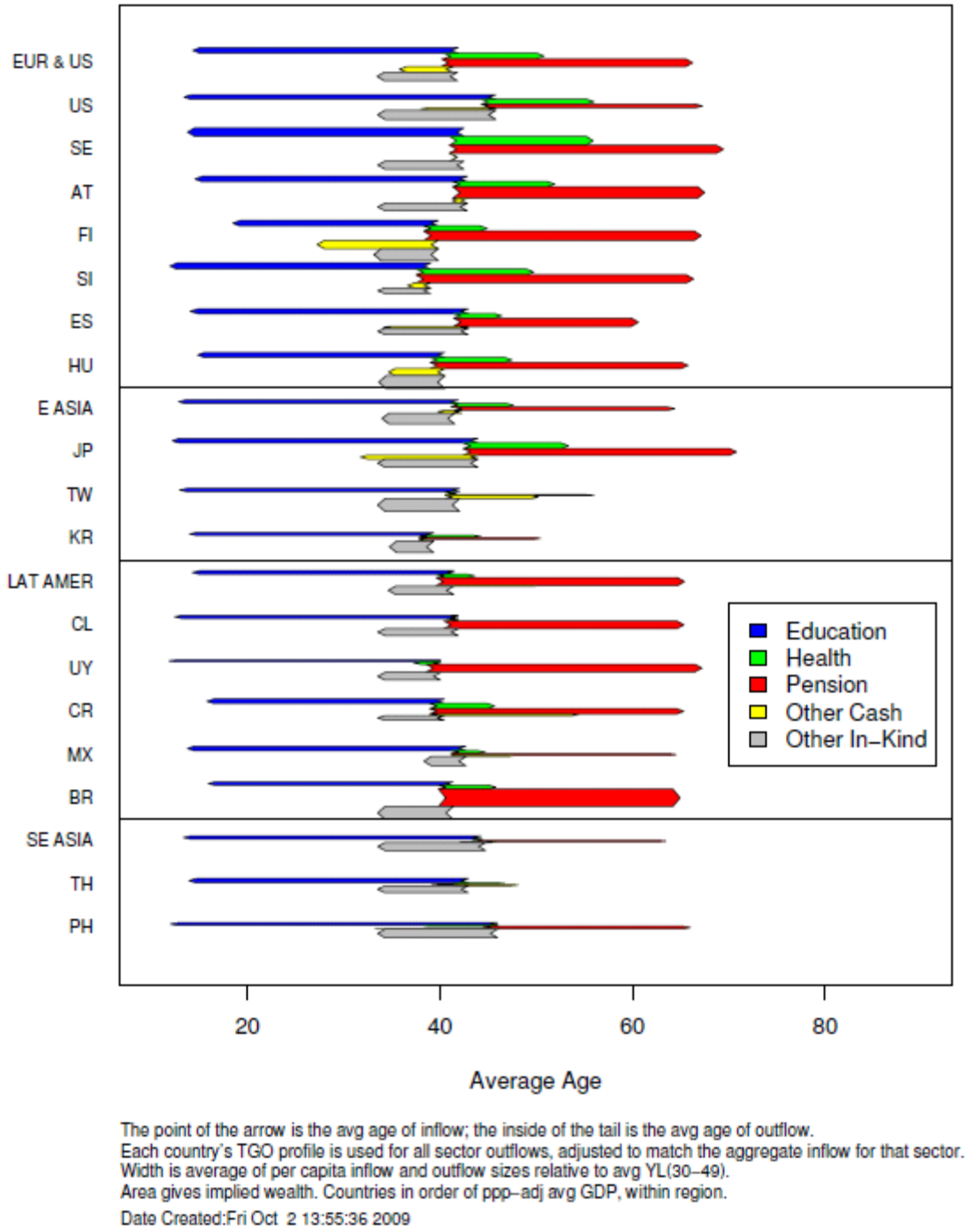


Figure 11. Arrow Diagram Showing Components of Public Transfers, with Average Ages and Per Capita Amounts relative to labor income



The point of the arrow is the avg age of inflow; the inside of the tail is the avg age of outflow.
Each country's TGO profile is used for all sector outflows, adjusted to match the aggregate inflow for that sector.
Width is per capita inflow relative to avg YL(30–49).
Area gives implied wealth. Countries in order of ppp–adj avg GDP, within region.
Date Created:Fri Oct 2 13:55:36 2009

Figure 12. Arrow Diagram Showing Components of Public Transfers, with Average Ages and Per Capita Amounts relative to labor income, Using a Standard Population Age Distribution (average of all the countries)



The point of the arrow is the avg age of inflow; the inside of the tail is the avg age of outflow.
Each country's TGO profile is used for all sector outflows, adjusted to match the aggregate inflow for that sector.
Width is average of per capita inflow and outflow sizes relative to avg YL(30–49).
Area gives implied wealth. Countries in order of ppp–adj avg GDP, within region.
Date Created:Fri Oct 2 13:55:36 2009

Endnotes

[1] Individual elderly might experience a brief period of dependency before death, but up to age 70 or so the average individual (males and females combined) produces a surplus. In Howell's data for the !Kung, after age 70 individuals on average require a small amount of nutritional assistance, but their net cost is very low. Very few individuals survive to these advanced ages in any case.

[2] Note that these caloric needs weights are somewhat different than the equivalent adult consumer weights used by NTA, which will lead to some differences in estimated age profiles.

[3] However, it is possible that the level of fertility is associated with level of female labor supply, and therefore with the shape of the labor income curve, so this age range is not without its own problem.

[4] Of the 23 contemporary populations studied here, only China is funding its lifecycle deficit entirely out of labor income. Mexico and the Philippines are two examples of countries relying heavily on net foreign transfers (remittances) to fund their lifecycle deficit.

[5] Let c(x) be the per capita consumption at age x, and let N(x) be the total population at age x. Then aggregate consumption at age x is c(x)N(x). The average age of consumption, A_c, is given by $A_c = \sum_0^\omega xN(x)c(x) \Big/ \sum_0^\omega N(x)c(x)$. The average age of labor income is calculated similarly. Per capita consumption over all ages is given by $c = C/N = \sum_0^\omega N(x)c(x) \Big/ \sum_0^\omega N(x)$

[6] Calculations we have done elsewhere have shown that the approximation is quite good under the assumption that the discount rate is 3% per year and that individuals expect the age profiles of labor income and consumption to be rising at 1% per year. We did not try other assumptions.

[7] The arrow for the !Kung is located farther right than the arrow for the Ache, Piro and Macheguenga. This is because fertility is considerably lower for the !Kung and consequently the !Kung population is older.

[8] For the per capita flows, we adjusted the level but not shape of the consumption age profile until the ratio of aggregate consumption to aggregate labor income in this hypothetical simulated economy is the same as it was in the actual economy. The length and direction of the arrows are unaffected by this adjustment; only the width of the arrow and its area are affected.

[9] We have estimates of bequests for a few countries, based on the assumption (known to be false) that mortality is independent of asset holdings. We plan to estimate bequests more systematically in the future. Note that only the results plotted in Figures 6, 7, and 10, all involving private transfers, would be affected by inclusion of bequests.

[10] At lower levels of fertility there is higher investment per child in education and health care. However, total consumption expenditures for children are distinctly lower in populations with lower fertility, because general other consumption is not as responsive to lower fertility.