Constructing

The National Transfer Flow Account:

The Economic Lifecycle

East-West Center

**The 38th Summer Seminar
Workshop 1**

Population, Development, and Policy
The Economic Payoffs of
Population Change

May 29, 2007 - June 28, 2007

1. General Guidelines

The economic lifecycle as measured in National Transfer Accounts consists of the age profile of consumption, the age profile of labor income, and the lifecycle deficit – the difference between the two. This guide describes the methods used to estimate the lifecycle profiles of consumption and the lifecycle of labor income. The data that are available will vary from country to country and, consequently, the methods employed will vary.

The following steps apply to estimating the age profile for most NTA variables:

1. Estimate the per capita age-profile for the variable using household survey data or administrative records.
2. Use population data to construct a preliminary aggregate age-profile.
3. Adjust the aggregate profile and the per capita profile to match a control total taken from National Income and Product Accounts or some other source.

The guideline is organized in accordance with these steps.

2. Estimating Per Capita Age Profiles

Age profiles are estimates of per capita values by single year of age. We assume that all consumption within the household and that all public consumption can be assigned to individuals. Likewise, we assume that the value of labor production can be assigned to individuals working in firms or in family enterprise. This assumes away pure public goods, economies of scale, and other important features of consumption and production.

In some instances, data on variables of interest are collected for individuals and per capita profiles can be directly tabulated. This is not usually the case, however. Often statistical techniques or simple rules are used to allocate data reported for households to the individuals residing in the household. Once this is accomplished per capita profiles can be tabulated from the available survey data.

2.1 Private Consumption

The methods described here assume the availability of one or more household surveys which include detailed expenditure data for the household and the number and age of all household members. Ideally the surveys are nationally representative.

Household expenditure surveys usually include all household expenditures or outflows. Although only consumption expenditures are needed to estimate consumption age profiles, other outflows are used to estimate other NTA components. Thus, it is useful to classify all household expenditures or outflows during the year as falling into one of three categories - consumption, transfers, or asset-based reallocations:

Consumption	Transfers	Asset-based Reallocations
Education, health, other.	Tax payments	Residual or saving
Rental value of owner occupied housing	Gifts	Interest payments
Flow of services from durables	...	...

NTA distinguishes three components of consumption: education, health, and other. Education and health are estimated separately because they vary substantially by age.

Several important points should be noted. First, housing consumption for a household residing in a home that it owns is the value of the annual services that home yields typically measured as the amount for which the home could be rented. The purchase of a home is a component of saving and investment. Second, consumer durables should be treated, in principle, in the same way as housing. Consumption is the value of the services from the durables. The purchase of the durable is then classified as saving.

Household expenditure surveys typically report the rental value of owner occupied housing. Whether or not consumption of durables can be measured as a flow rather than a purchase will vary from country to country. If data on durable ownership are not available, the purchase of durables is treated as consumption.

The following items should be classified as transfers and not included in consumption: tax payments, gifts, remittances, donations, and similar items.

The following items are classified as asset-based reallocations and not included in consumption: the purchase of a home; the purchase of consumer durables, if possible; the purchase of stocks, bonds, and other securities; investment in a business or farm; increases in cash holdings; interest payments; land rent. Expenditure surveys will vary in the extent to which these items are reported. Often saving is estimated as a residual, i.e., income plus net transfers less consumption.

Some items require particular attention although they may be unimportant in some countries or data may limit the extent to which they can be treated.

Insurance. Some insurance premiums (whole life insurance) are a form of saving. Consumers pay a premium and their policy accrues value that can be cashed in at a later date or borrowed against. This is saving. Other forms of insurance provide consumers with a way of pooling their risks. Term life insurance and property and casualty insurance are examples of these forms of insurance. Some portion of premiums collected each year are paid to beneficiaries who have experienced the particular event being insured. These payments are transfers. Although they may produce interage reallocations, we assume that premiums are assessed in an actuarially fair way and, hence, produce only intra-age reallocations. The remaining portion of premiums paid by consumers defer administrative costs and profits of insurance companies. This amount represents the cost and value of the risk-pooling services provided by insurance. It is classified as consumption by NIPA and by NTA.

The US NIPA has recently been revised because catastrophic losses, e.g., those produced by Hurricane Katrina, lead to large fluctuations in insurance related components. The new revisions will measure the consumption of insurance services using an estimate of normal profits. Catastrophic losses that lead to actual profits that differ from normal profits are treated as a transfer. More details of the US revision are described in http://www.bea.gov/bea/faq/national/insurance_services_gdp.htm
The key issue for estimating NTA consumption is using household survey data to define consumption in a way that is comparable to NIPA consumption and its components. Household consumption expenditure would include a portion of insurance premium expenditure with that portion determined by the share of insurance in NIPA consumption.

Health. In NIPA private health consumption includes the values of all goods and services that are marketed, i.e., goods and services purchased from either private or public providers. Public health consumption includes only goods and services that are provided as in-kind transfers. Examples are the subsidized portion of public inoculation programs, public sanitation programs, free clinics, family planning programs, etc. Private consumption includes goods and services purchased and reimbursed through public cash transfer programs. Health consumption reimbursed by Medicare and Medicaid in the US and by National Health Insurance in Taiwan are classified as private health consumption in NIPA.

In NTA, however, private health consumption that is reimbursed by the public sector is re-classified as public health consumption.

The allocation of private health consumption is difficult because of the complex ways in which it is financed. Three sources of finance are important in many countries: private out-of-pocket expense, private insurance, and the public sector. Different age allocation methods may be required for each of these components of health consumption. National Health Accounts (NHA), available in some countries, provide a useful breakdown by source of finance. Recent estimates for the US and a detailed discussion of the methodology employed for construction NHA in the US are available at: http://www.cms.hhs.gov/statistics/nhe/definitions-sources-methods/

There are important differences between NHA and NIPA that should be kept in mind. First, NHA document expenditures rather than consumption. Expenditure is a broader measure that does not distinguish consumption from investment and profits. Private health expenditure, for example, includes the profits of insurance companies. Second, public national health expenditure in NHA includes both in-kind and cash transfers. Separate procedures are used to allocate education, health, and housing and other consumption to household members. The methods described are intended as illustrative and should be adapted to the particular circumstances of the country being analyzed and to the particular data that are available. The method of choice is to rely on individual level data for any consumption component, but these are rarely available.

Draft v.2
5/25/07

2.1.1 Allocating Education
Education is typically allocated using a regression model. In Taiwan, for example, the household consumption of

education (CFE_j)

$$CFE_j = \sum \alpha(a) E_j(a) + \sum \beta(a) NE_j(a)$$

Note that this equation is estimated in homogeneous form (without an intercept) insuring that household consumption is fully allocated. The age groups included will vary with the country and its enrollment rates. In Taiwan, the number of enrolled members includes those aged 6 to 29. The number of not enrolled members includes those aged 3-7 and 30+. The number of members not enrolled captures educational spending that is not part of the formal educational system. Education consumption is intrinsically not smooth and the best approach is often to use the unsmoothed age profile to construct final estimates. Some smoothing at older ages may be warranted, however. Smoothing is discussed below.

2.1.2 Allocating Health
The method used to allocate health varies depending on the availability of data.

Expenditure survey includes individual utilization measures. In some cases the expenditure survey may include utilization measures for household members. In this case, a model similar to the model employed for education can be used. For example, household health expenditure can be regressed on the number of members using outpatient services in each age group and the number of members using inpatient services in each age group.

Age profile of utilization from alternative source. In some countries, such as Japan, per capita utilization by age is available from alternative sources.   To simplify discussion suppose that a single utilization measure is available U(a). The regression model estimated is:

$$C_j = \sum_a \beta(a) U(a) M_j(a) + \varepsilon_j \qquad (1)$$

where C is health expenditure in household j, M(a) is the number of household members aged a in household j, and $\beta(a)$, interpreted as the unit cost, is to be estimated. In some cases it may be reasonable to assume that the unit cost is independent of age, but this is probably an unattractive option for health services. Thus, the unit cost may be assumed to be quadratic in age, for example. In this case, the model to be estimated is:

$$C_j = \sum_a \beta_0 U(a) M_j(a) + \sum_a \beta_1 a U(a) M_j(a) + \sum_a \beta_2 a^2 U(a) M_j(a) + \varepsilon_j \qquad (2)$$

As with the education method presented above, the estimated model is used to "predict" health expenditure for persons aged a. In this case, the predicted cost would be:

$$\hat{\beta}_0 U(a) + \hat{\beta}_1 a U(a) + \hat{\beta}_2 a^2 U(a) \qquad (3)$$

The predicted costs are used to allocate the observed health expenditure in each household to individual members. Then the health expenditures are tabulated to construct the per capita profile.

This approach was used to estimate profiles for Japan.

Iterative method.
An approach used in the Philippines with plausible results relies on an iterative approach rather than a regression approach to allocating health expenditures. This approach works by assigning health expenditure equally to each household member and then tabulating the per capita profile. The per capita profile is then used as weights to allocate health expenditure to household members producing a new per capita profile. The procedure can be repeated each time using the newly generated profile to allocate household expenditure. Under some conditions, this approach will converge to the actual underlying profile. Whether it will always do so is unknown at this point. A nice feature of this method is that negative values will not be generated.

Simple regression approach.
One approach, used in Taiwan, relies on a simple regression model. This approach is not recommended unless absolutely nothing else is possible.

The regression approach used for health differs than the model used for education because there is no variable that capture which individuals are receiving health care services. Hence, household health expenditure is regressed on the number of household members in each age group ($M_j(a)$)

$$CFH_j = \sum \beta(a) M_j(a)$$

Again, the model is estimated in homogeneous form (with the intercept suppressed). The age groups can be single year or in broader age groups. For some age groups, out of pocket health spending might be very small and estimated coefficients may be negative. Health spending on these age groups can be constrained to zero.
The regression estimates are used to allocate the health expenditure for each household j to household member i using:

$$CFH_{ij} = CFH_j \beta(x) / \sum \beta(a) M_j(a)$$

where x is the age of the i-th household member.

2.1.3 Allocating Other Household Consumption
Other household consumption is allocated to individuals using an *ad hoc* allocation rule based on an extensive review of the literature on household consumption. Evaluation of other methods, e.g., Engel's method and the Rothbarth method, has shown them to be unreliable and we do not recommend that they be used.

Consumption of individuals living within any household j is assumed to be proportional to an equivalence scale that is equal to 1 for adults aged twenty or older, declines linearly from age 20 to 0.4 at age 4, and is constant at 0.4 for those age 4 or younger.
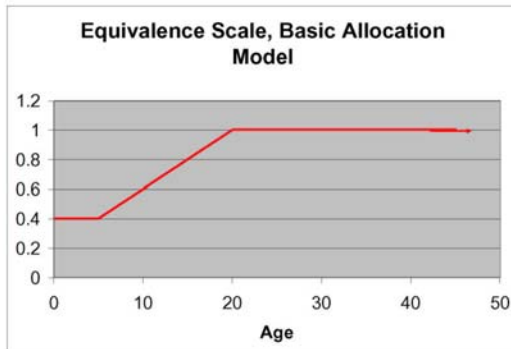
A formula for the scale:

$$a(a) = 1 - 0.6*(4 < a < 20)*((20-a)/16) - 0.6*(a \le 4)$$
$$CFX_{ij} = CFX_j a(x) / \sum a(a) M_j(a)$$

where x is the age of the ith household member.

Additional Issues
Adjustment of private consumption to exclude indirect taxes. Expenditure on consumption goods and services in many countries includes indirect taxes, e.g., the value added tax. In NTA consumption is measured as pre-tax consumption and, hence, an estimate of indirect taxes should be subtracted from reported consumption. If the tax rate is the same for all types of consumption, then consumption can be reduced across the board at the tax rate. In many cases, however, certain forms of consumption, e.g., alcohol or tobacco, are subject to higher taxes and other forms of consumption, e.g., food or health, are subject to lower tax rates.

Sample weights. In all cases sample weights should be used.

Subsidized Consumption. Should private consumption that is heavily or totally subsidized by taxpayers be classified as public consumption. Examples are Medicare and Medicaid in the US and National Health Insurance in Taiwan.

2.2 Public Consumption

Public consumption is the value of consumption of goods and services individuals receive through the public sector. Public consumption is allocated to individuals based on administrative records and, in some instances, survey data. Public consumption distinguishes education, health, and other public consumption.

2.2.1 Public Education Consumption

Public education consumption consists of two parts: formal and informal education consumption. Formal education consumption is government spending on primary, secondary and higher education levels. The informal education consumption refers to expenditure on culture, religious studies and other types of education.

Public formal education consumption by age $E_g^f(a)$ is estimated by summing unit cost per student per level c_l weighted by the number of students by age in each level $e_l(a)$, i.e. $E_g^f(a) = \sum_l e_l(a)c_l$, where l is a school level. Unit cost per student at each level of education c_l is estimated by dividing public spending on education at that level by the reported number of students. Unit cost of education within each level is assumed not to vary by age. The number of students by age in each level $e_l(a)$ available from administrative records or, if necessary, tabulated from a household survey.

In addition to public formal education, public informal education consumption by age $E_g^{nf}(a)$ is estimated by dividing total public informal education consumption by total population by age. Public informal education consumption is not age-targeted, so it is allocated equally to everyone. Public education consumption by age is computed by summing public formal education consumption by age and public informal education consumption by age.

2.2.2 Public Health Care Consumption

Public health care consumption consists of health care purchased by individuals and reimbursed through public programs, health care provided directly to individuals by government clinics and hospitals, and collective services, e.g., health education and preventative programs, that are provided to the public at large.

Health care purchased by individuals and reimbursed through public programs are captured in household expenditure surveys. These age profiles can be estimated using the methods described in the section on private health spending.

Collective health services are allocated on a per capita basis assuming that each individual consumes the same amount of these services.

Allocating health care provided directly by government programs must be allocated using administrative records, e.g., patient information; information about the kinds of health care services being provided (child and maternal health, etc.) Note that health care costs associated with pregnancy and birth are assigned to infants.

2.2.3 Other Public Consumption

Other public consumption consists of public goods and services, such as defense, justice and police, that are not targeted at particular age groups. The per capita age profile is

assumed to be constant, i.e., these goods and services are allocated equally to all members of the population.

2.3 Labor Income

Labor Income (YL)
Earnings (YLE)
Fringe Benefits (YLF)
Self-Employment Income (labor component) (YLS)

Total labor income is estimated from NIPA and the age profile is estimated using an individual or household survey. The methods outlined in this section assume that survey data on employee compensation are available, ideally from a nationally representative survey. Estimating the labor income of the self-employed is difficult for two reasons. First, entrepreneurial income or the "profits" of a family business or farm must be allocated between returns to labor and returns to capital. Second, the return to labor must be allocated among family members who often do not explicitly receive compensation. In some instances, e.g., the Taiwan FIES, household surveys explicitly assign income from a family business to individual members.

Defining labor income
Labor income is defined as all compensation that is a return to work effort; including labor earnings, employer-provided benefits, taxes paid to the government on behalf of employees, and the portion of entrepreneurial income which is a return to labor.

Compensation of employees includes the value of social benefits provided to workers, including payments to retirees. In some cases, these benefits are explicit and can be directly measured. Examples are taxes paid to the government on behalf of employees, contributions by employers to health insurance programs or pensions programs, etc. In other instances estimating the value of employer-provided benefits is more difficult. If employees, including public employees, receive retirement benefits on a pay-as-you-go basis, the imputed value of providing the social benefit to employees should be credited when the benefit is earned, not when it is received. For example, if employees will receive unfunded pension benefits in the future, current compensation should include the imputed value of purchasing an annuity that would provide the future pension. In practice, this is often not possible and the payment of social benefits to current or former workers is counted as current compensation.

Paid leave (vacation and sick leave) is not counted as compensation, and is therefore not included. The value of other activities, such as childrearing and other in-home activities, which do not produce market goods or services, is also excluded from labor income calculations.

Estimating Labor Income Age Profiles
The age profile of employee compensation is estimated using survey data which reports individual earnings. In general, surveys provide information about wages and salaries, but

they may not provide information about employers' social contributions. In the absence of information to the contrary, we assume that employers' social contribution is a constant proportion of wages and salaries.

Labor income is not directly observable or reported in household surveys. Rather household surveys report mixed income, entrepreneurial income, operating surplus from family businesses, or a similar measure. This includes both the return to labor and the return to capital. We assume that two-thirds accrues to labor and one-third to capital. The age profile of the labor income of the self-employed and family workers is estimated using one of three approaches.

Direct tabulation. In some instances, self-employment income is reported for individual household members. In these cases, labor income can be tabulated directly from household surveys. Note that the tabulated values should be self-employment labor income per person, not per worker.

Non-parametric methods. The iterative approach described above for health expenditure can also be employed to allocate self-employment income among household members or preferably among household members who are reported as self-employed or unpaid family workers.

Regression models. Alternative regression models will be discussed and tested during the workshop.

Super Smooth Method Using 'R'

The per capita age profiles are noisy, particularly at ages with relatively few observations, and except as noted below should be smoothed. The following guidelines should be followed:
- The per capita education profile should not be smoothed.
- Basic components should be smoothed, but not aggregations. For example, private health consumption and public health consumption profiles should be smoothed, but the sum of the two should not be smoothed.
- Smoothing should be cautiously applied. The objective is to reduce sampling variance but not eliminate what may be "real" features of the data. For example, public health spending may increase dramatically when individuals reach an age threshold, e.g., 65. This kind of feature of the data should not be smoothed away.

There are three steps to smoothing the per capita profile. The first step is to create a spreadsheet, which contains unsmoothed age profile and the number of observations for each age.

The second step is to use Friedman's SuperSmoother (supsmu function in R) to smooth the per capita profile incorporating the number of observations. Suppose the file name is "thyl" and the variable names for age, labor income and sample weight are age, yl and sample. The following is the R code to use the command "supsmu".

```
yl<- read.csv("thyl.csv",header=T) # Read in data
test <- supsmu(yl$age,yl$yl,yl$sample) # Smooth data
write.csv(test,"smoothed_thyl.csv") # write out data using name "smoothed_thyl"
```

Warning. The LOESS smoothing procedure is found to be unreliable because it does not incorporate sample weights. We recommend that it not be used.

3. Population

Annual population estimates by single-year of age required to construct aggregate flows. Population data are available from the United Nations Population Division beginning in 1950 and projected to 2050. The most recently available estimates are from the 2006 edition of *Population Prospects*. Long-term projections are also available to 2300 from the UN Population Division.

Population estimates may be based on national sources, e.g., population censuses. Age misreporting is a very serious problem in many countries, however, and it is very important to insure that population data has been adjusted to eliminate age heaping and differential under-reporting.

4. Aggregate Controls

The per capita profiles of consumption and labor income are adjusted proportionately to match aggregate controls. To be explicit about the procedure, if *x(a)* is the per capita age profile, *N(a)* is the population, *X* is the aggregate control value, and *X* is the aggregate control, the per capita profiles must be adjusted using:

$$\theta = \sum x(a)N(a)/X \qquad (4)$$

Then, the final per capita profile and aggregate profile are given, respectively, by:

$$\tilde{x}(a) = x(a)/\theta$$
$$\tilde{X}(a) = \tilde{x}(a)N(a). \qquad (5)$$

Aggregate control variables are drawn from the National Income and Product Accounts (NIPA) based primarily on the United Nations 1993 System of National Accounts. With the notable exception of the United States, most countries follow the UN system. Members of the European Union follow the European System of Accounts 1995 which is more detailed but entirely compatible with the 1993 UN system. The UN, the IMF, the World Bank, the OECD, and European Commission all follow the 1993 UN SNA. The IMF is responsible for maintaining Government Financial Statistics as part of the SNA.

Detailed information is provided in http://unstats.un.org/unsd/sna1993/introduction.asp.

4.1 Consumption Macro Control
The macro controls for consumption are based on *Final Uses in GDP*. With adjustments described below total NTA consumption is equal to "Final consumption expenditure", public consumption is equal to "General government final consumption expenditure," and private consumption is equal to "Household final consumption expenditure" plus

"NPISHs' final consumption expenditure." (NPISH is non-profit institutions serving households.)

The macro control for private consumption of health (category 6) and education (category 10) are taken from the classification of private consumption by purpose. All other private final consumption expenditure is combined to serve as the macro control for the NTA variable *other private consumption*.

The macro control for public consumption of health, education, and other public consumption are similarly based on the classification of public consumption by purpose.

The following adjustments are required.

Indirect taxes. GDP is measured using market prices that include indirect taxes, e.g., value added tax. In NTA, consumption is measured using basic prices or prices net of taxes. NTA consumption is calculated by subtracting indirect taxes on consumption.

Reclassification of private health consumption. As described above private health consumption for which households receive reimbursement from national health insurance programs or other public health programs are reclassified as public consumption.

Consumer durables. In UN 1993 SNA the consumption of owner-occupied housing is measured as the value of the flow of services. Other consumer durable consumption is measured by expenditure. If a flow of services approach is adopted, other private consumption must be adjusted by adding the value of the flow of services and subtracting expenditure on non-housing consumer durables.

4.2 Labor Income Macro Controls
Labor income is based on two components of National Income: (1) compensation of employees; and (2) operating surplus of household sector.

Compensation of employees in the National Income account excludes compensation received by non-residents and includes compensation received by nationals living abroad.

The operating surplus of the household sector is primary income earned by unincorporated businesses and includes both the return to labor effort and profits. We assume that two-thirds of the operating surplus is a return to labor. Note that the operating surplus of the household sector may be called entrepreneurial income or mixed income.