

# Manual on National Transfer Accounts: Lifecycle Account

Andrew Mason

University of Hawaii at Manoa and East-West Center

Training Workshop on Measuring and Analyzing the Generational  
Economy with National Transfer Accounts, United Nations  
Population Division, Bangkok, Thailand, 17-20 September, 2012



# Outline of Presentation

Introduction

Constructing aggregate controls

Estimating the age shapes

Finalizing age profiles

Comparing, summarizing, and applying the account

# Outline of Presentation

Introduction

Constructing aggregate controls

Estimating the age shapes

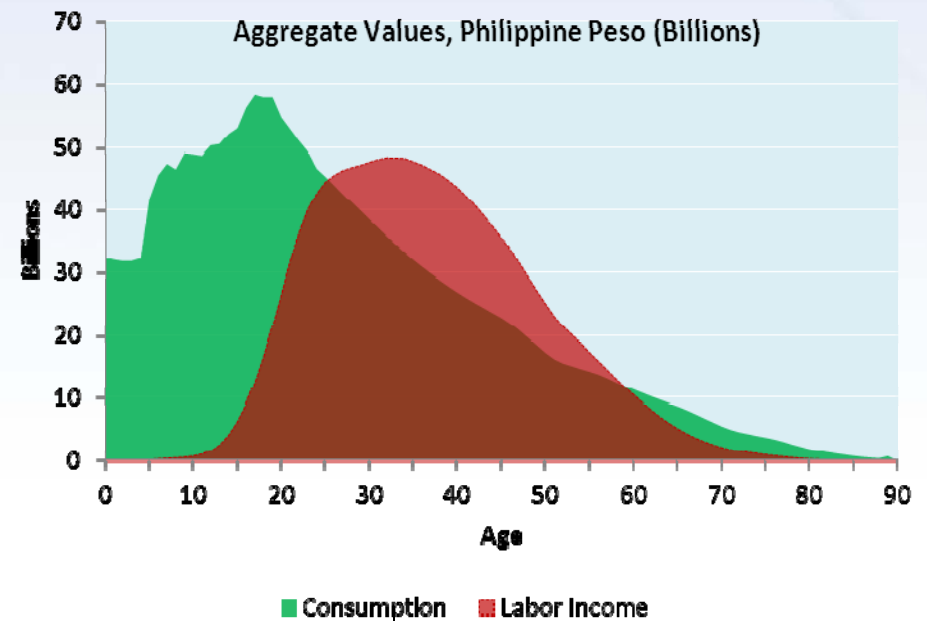
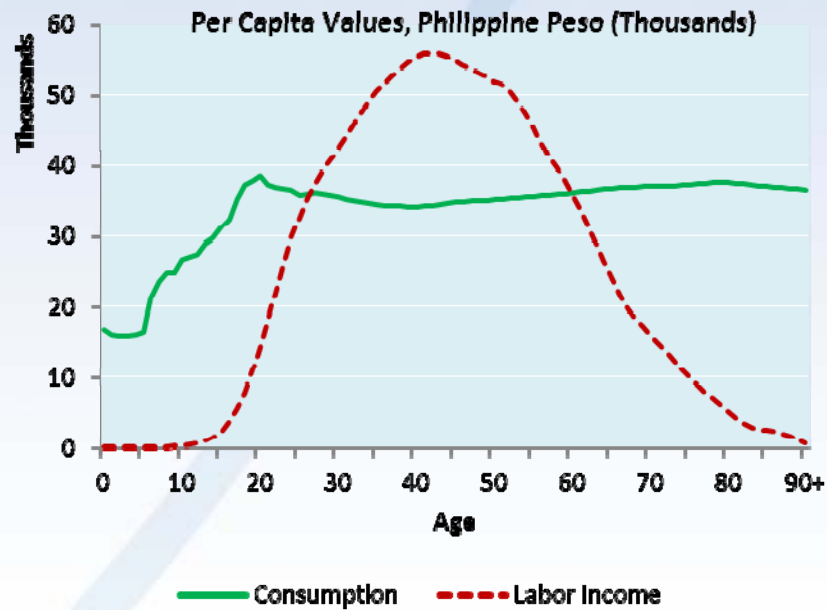
Finalizing age profiles

Comparing, summarizing, and applying the account

# Primary Objective

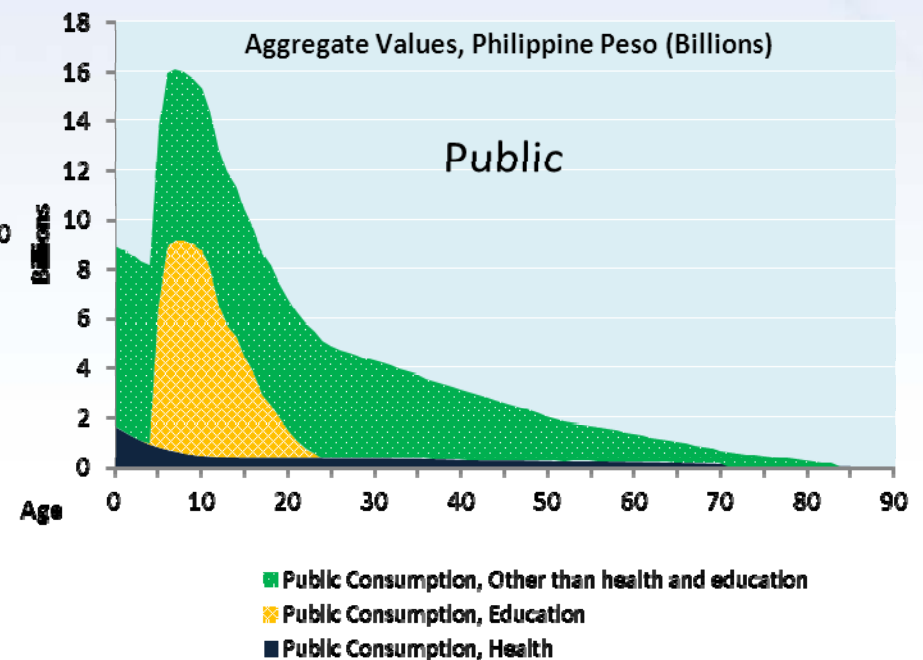
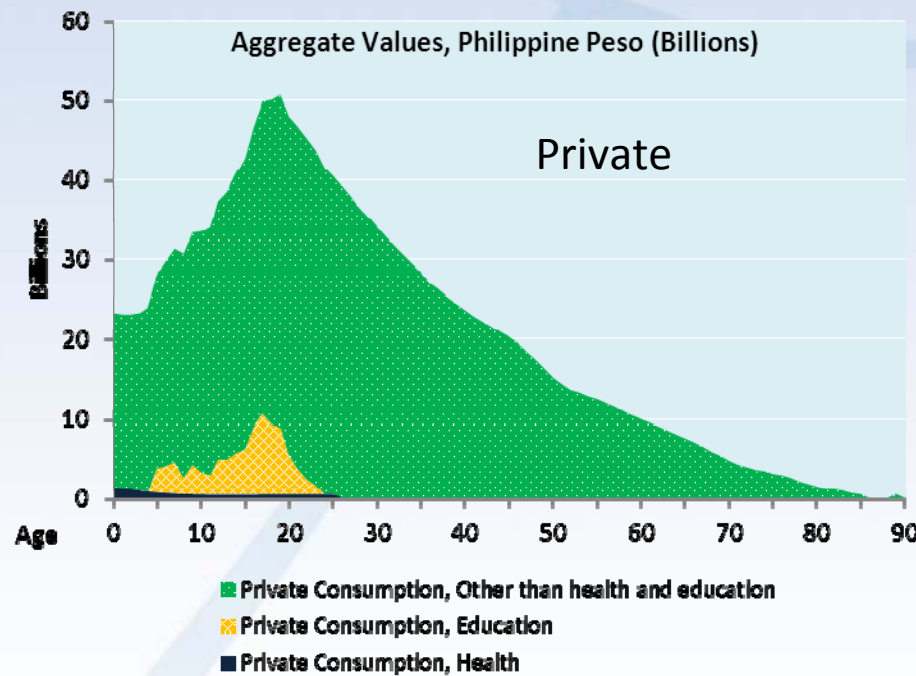
- Learn methods for constructing the lifecycle account
  - Consumption at each age
  - Labor income at each age
  - Lifecycle deficit or difference between the two
- Consumption
  - Sector: public versus private
  - Purpose: education, health, and consumption other than education or health
- Labor income
  - Earnings of employees including benefits
  - Labor income of self-employed including unpaid family workers

# Economic Lifecycle



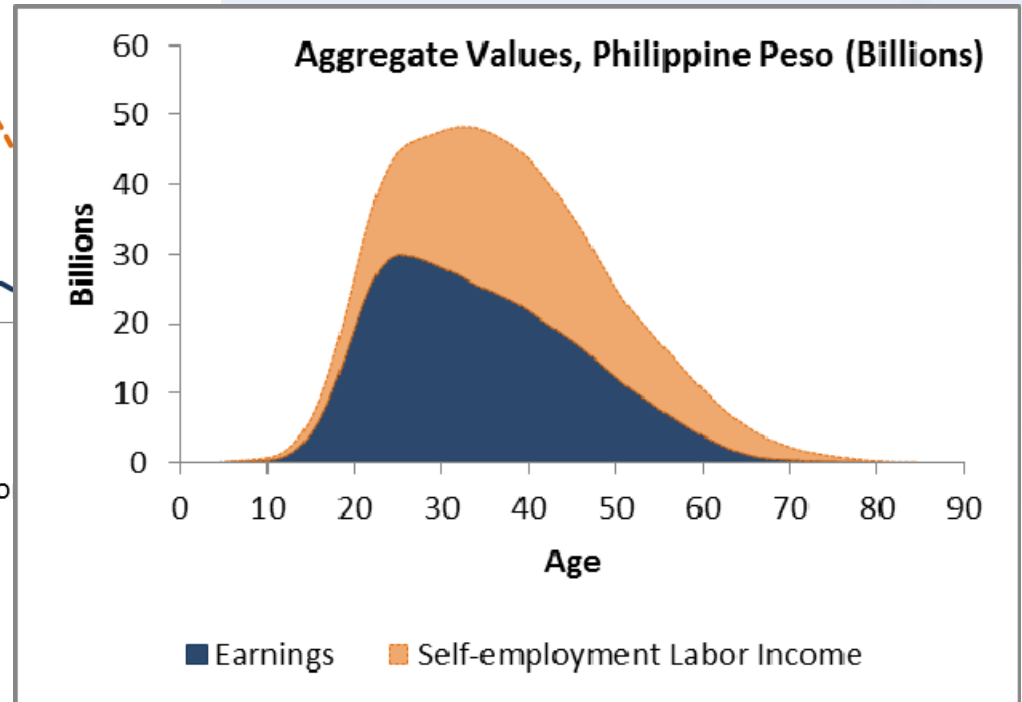
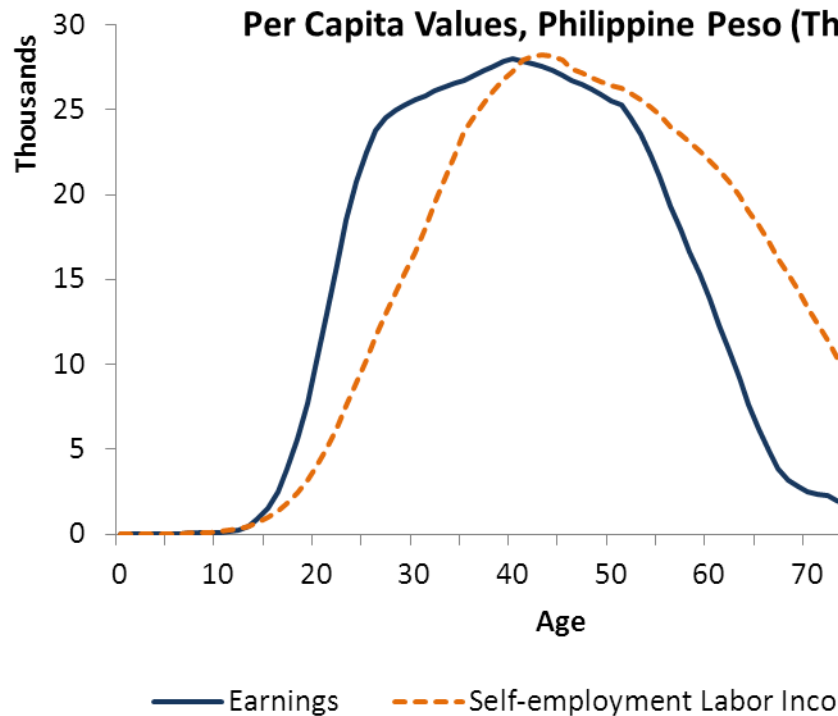
Source: Chapter 2.

# Consumption Components



Source: Chapter 2.

# Labor Income Components



Source: Chapter 2.

# Lifecycle Account, Per Capita Values

Table 4.1 Consumption and labor income for selected ages, Nigeria, 2004.

	Selected ages					
	0	1	15	40	65	90+
<i>Per capita values (Naira)</i>						
Lifecycle Deficit	28,141	28,077	62,418	-45,281	22,785	77,674
Consumption	28,141	28,077	63,102	88,404	89,692	78,431
Public Consumption	5,015	5,015	6,297	5,347	5,553	5,563
Public Consumption, Education	0	0	1,153	104	0	0
Public Consumption, Health	237	237	366	465	775	785
Public Consumption, Other	4,778	4,778	4,778	4,778	4,778	4,778
Private Consumption	23,126	23,061	56,805	83,056	84,139	72,868
Private Consumption, Education	0	0	7,952	268	0	0
Private Consumption, Health	5,221	5,156	7,581	13,491	13,115	10,483
Private Consumption, Other	17,905	17,905	41,271	69,296	71,023	62,385
Labor Income	0	0	684	133,685	66,907	757
Earnings	0	0	231	30,727	15,438	0
Self-employment Labor Income	0	0	453	102,958	51,468	757



# Lifecycle Account, Aggregate Values

Table 4.1 Consumption and labor income for selected ages, Nigeria, 2004.

	Selected ages					
	0	1	15	40	65	90+
<i>Aggregate values (Naira billions)</i>						
Lifecycle Deficit	145	139	202	-55	9	2
Consumption	145	139	204	107	36	2
Public Consumption	26	25	20	6	2	0
Public Consumption, Education	0	0	4	0	0	0
Public Consumption, Health	1	1	1	1	0	0
Public Consumption, Other	25	24	15	6	2	0
Private Consumption	119	114	184	100	34	2
Private Consumption, Education	0	0	26	0	0	0
Private Consumption, Health	27	25	25	16	5	0
Private Consumption, Other	92	88	133	84	28	1
Labor Income	0	0	2	162	27	0
Earnings	0	0	1	37	6	0
Self-employment Labor Income	0	0	1	124	21	0

# Steps for Constructing Account

- Estimate aggregate controls
- Estimate age patterns using survey data and administrative data
- Finalize profiles
  - Smoothing
  - Adjusting to macro controls
  - Calculating lifecycle deficit
  - Evaluating
  - Documenting and archiving

# Outline of Presentation

Introduction

Constructing aggregate controls

Estimating the age shapes

Finalizing age profiles

Comparing, summarizing, and applying the account

# Aggregate Control: Consumption

- Based on *final consumption expenditure* from SNA (Use of Disposable Income Account).
  - Public is consumption of general government
  - Private is consumption of households and NPISHs (non-profit institutions serving households)
- Purpose is based on classification of private consumption from SNA
  - Health (category 6)
  - Education (category 10)
  - Other is the residual

# Three adjustments to consumption

- Taxes on products and production
  - SNA consumption includes taxes on products, e.g., value added tax; NTA consumption is value before taxes
  - Consumption taxes must be subtracted from SNA consumption
- Reclassification of private health consumption
  - Private health consumption that is reimbursed by the government is reclassified as public consumption
- Consumer durables
  - In NTA, durables are measured as the value of services from the durable, not as expenditure on durables

Table 4.2. Aggregate controls for consumption in NTA. Illustrative values.

	A	B	C	D	E	F
	Final consumption expenditure	Taxes on products	Pre-tax consump tion	Reclassi- fication of health consumption	Consumer durable: consumption less expenditure	NTA consumption
Consumption	10,000		9,300	-	100	9,400
Consumption, public	3,000		3,000	300		3,300
Consumption, public, education	600		600			600
Consumption, public, health	800		800	300		1,100
Consumption, public, other	1,600		1,600			1,600
Consumption, private	7,000		6,300	(300)	100	6,100
Consumption, private, education	800	200	600			600
Consumption, private, health	1,200		1,200	-300		900
Consumption, private, other	5,000	500	4,500		100	4,600

A. Reported in System of National Accounts, Use of Disposable Income Accounts.

B. Reported in System of National Accounts, Allocation of Primary Income Account. See Chapter 5 for additional details.

C. Equal to A - B.

D. Private consumption of health reimbursed by National Health Insurance schemes reclassified as public rather than private.

E. Consumption of consumer durables is recalculated as flow of service rather than expenditure on consumer durables.

F. Equal to C+D+E.

# Aggregate controls: Labor income

- Labor income includes
  - Wages and salaries payable in cash or in kind
  - Social contributions payable by employer
  - Imputed value of accrued pensions
  - Share of mixed income that is return to labor
  - Taxes on products and production attributed to labor
- Labor income excludes
  - Value of childrearing and other in-home activities which do not produce markets goods and service

**Table 4.3 Aggregate labor income, components and adjustments. Illustrative values.**

<b>Variable</b>	<b>Value</b>	<b>Source</b>
<b>A. Compensation of employees</b>	<b>15,000</b>	<b>System of National Accounts, Allocation of Primary Income Account</b>
<b>B. Mixed income, net</b>	<b>3,000</b>	<b>System of National Accounts, Allocation of Primary Income Account</b>
<b>C. Return to labor</b>	<b>2,000</b>	<b>2/3 of mixed income (B)</b>
<b>D. Return to capital</b>	<b>1,000</b>	<b>1/3 of mixed income (B)</b>
<b>E. Taxes on production imputed to labor</b>	<b>100</b>	<b>System of National Accounts, Allocation of Primary Income Account; see Chapter 5 for additional details.</b>
<b>F. Labor income</b>	<b>17,100</b>	<b>Sum of compensation (A), return to labor from mixed income (C), and taxes on production imputed to labor (E).</b>



# Outline of Presentation

Introduction

Constructing aggregate controls

Estimating the age shapes

Finalizing age profiles

Comparing, summarizing, and applying the account

# Selecting and preparing data

- Detailed guidelines in Chapter 3
- Public consumption
  - All levels of government
  - Budgets versus expenditure
  - Consumption versus investment
  - Identifying beneficiaries by age
  - Accounting for age variation in average benefit for education and health
- Private consumption and labor income profiles
  - Household surveys of expenditure and consumption
  - Coverage: Civilians only? Students? Military? Institutionalized population?
  - Proper classification of items
    - Interest expense
    - Gifts
    - Insurance
    - Homes and consumer durables
    - Employer provided pensions

# Public Education Consumption: Formal and informal

- Estimate unit cost of formal education: Cost per student for each level of schooling, such as primary, secondary, and tertiary.
- Calculate public school enrollment rate for each level and age: Number enrolled at each school level and age divided by the population at the corresponding age.
- Calculate per capita spending on each level at each age: product of the unit cost and the public school enrollment rate.
- Compute per capita spending on education: Sum per capita spending at each level and age across education levels.
- Informal education is allocated equally to each member of the population. Per capita value does not vary by age.

Andrew Mason, September 17, 2012



# Calculation of unit cost illustrated

**Table 4.4 Calculation of unit costs for education sector, illustrative values.**

	Primary	Secondary	Tertiary	Source
<b>Public spending for public schools (billions)</b>	50	100	75	Administrative records
<b>Enrollment in public schools (millions)</b>	25	40	10	Administrative records or household surveys
<b>Unit cost (spending per student)</b>	2,000	2,500	7,500	Calculated as spending divided by enrollment

**Table 4.5 Calculation of public consumption of primary school education, illustrative values.**

<b>Age</b>	<b>Public primary school enrollment (millions)</b>	<b>Population (millions)</b>	<b>Public school enrollment rate</b>	<b>Consumption of public primary school per person</b>
5	1.20	4.00	0.30	600
6	3.18	4.08	0.78	1,560
7	3.26	4.12	0.79	1,580
8	3.29	4.16	0.79	1,580
9	3.32	4.20	0.79	1,580
10	3.35	4.25	0.79	1,580
11	3.39	4.29	0.79	1,580
12	2.38	4.33	0.55	1,100
13	0.87	4.37	0.20	400
<b>Total</b>	<b>24.25</b>	<b>40</b>	<b>--</b>	<b>--</b>
<b>Note: Unit cost is 2,000.</b>				

# Publicly-funded Health Consumption

- Health care provided directly by government
  - Administrative records on health care costs and utilization by age
  - Proxies such as in-patient and out-patient utilization of services by age, weighted to reflect differences in average costs of in-patient and out-patient services
- Health care purchase by individuals and reimbursed
  - Estimated from household expenditure survey as described below
- Collective health services
  - Allocated equally to each person. Per capita value does not vary by age.

# Public Consumption Other than Health and Education

- Public individual consumption
  - Some programs are allocated by age if they are important and estimates can be constructed. Example is publicly provided child care.
  - Remaining programs are allocated equally to each person.
- Public collective consumption
  - Allocated equally to each person.

# Overview of Private Consumption

- All consumption is assigned to individuals, i.e., no public goods or economies of scale.
- Private consumption distinguished by three purposes:
  - Private education consumption
  - Private health consumption
  - Private consumption other than education and health
- Using household survey and allocation rules
  - Household consumption calculated for each household
  - Household consumption is allocated among household members using allocation rules
  - Household consumption is tabulated to obtain per capita consumption by age



# Private Consumption Allocation Rules

- Private education
  - Education spending by the household is regressed (homogeneous form) on:
    - Number of enrolled members of each age
    - Non-enrolled members of each age
  - Regression coefficients are used as weights to allocate observed spending to each member based on age and enrollment status
  - Results are tabulated to yield per capita consumption by age of member.

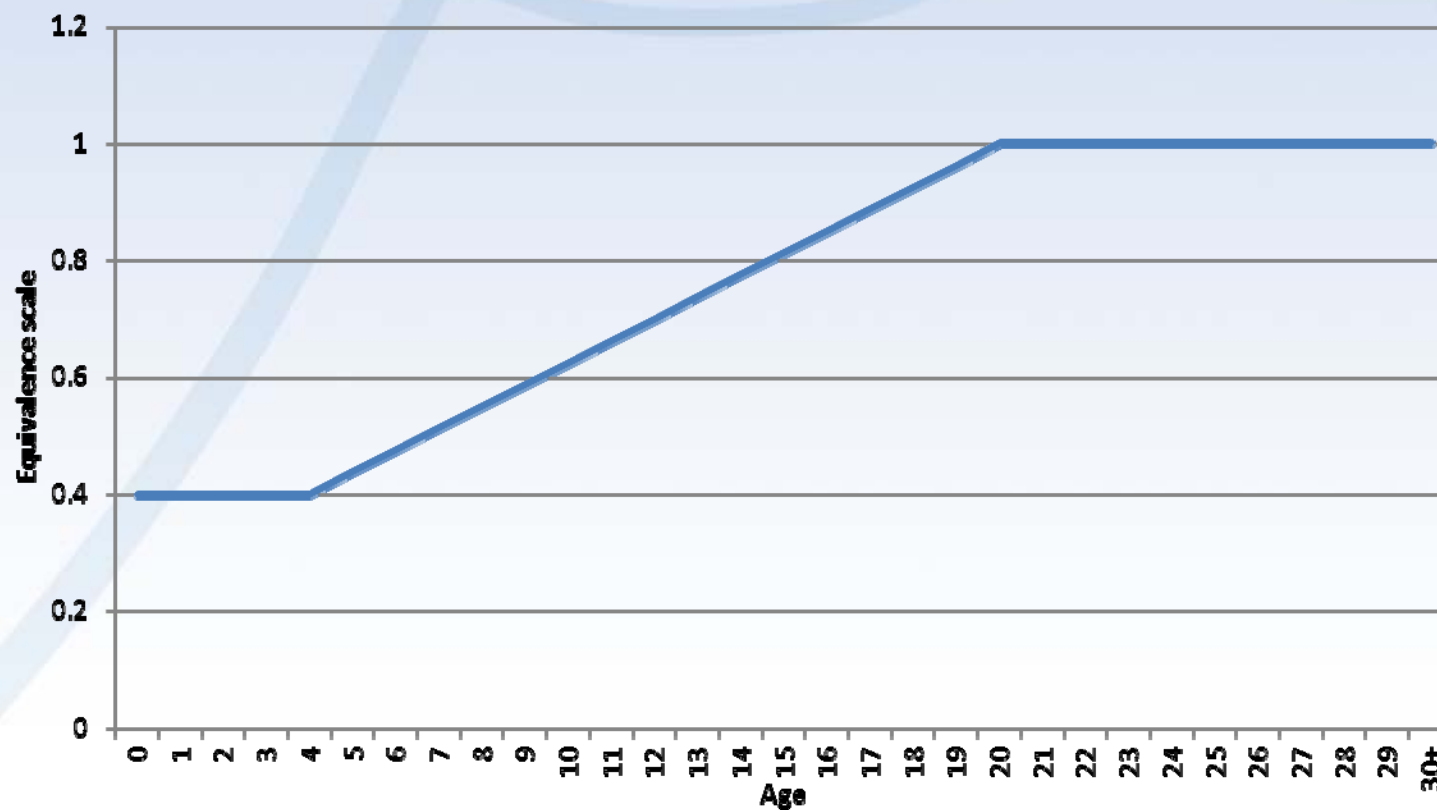
# Private Consumption Allocation Rules

- Health
  - Profiles are difficult to estimate
  - Utilization measures (inpatient and outpatient, for example) can be used in a regression model similar to education
  - Last resort: Regression of health care spending on number of members of each age.
    - Iterative method
    - Least-squares, homogeneous form

# Private Consumption Allocation Rules

- Consumption other than education and health
  - More complex methods, e.g., Rothbarth or Engel's method are not robust and are not used.
  - Equivalence scale is used
    - *Ad hoc* but based on review of literature
    - Same scale used across all countries
    - 0.4 for children 4 and younger; increases linearly from age 4 to age 20; 1 for those 20 and older.

**Figure 2.2 Equivalence scale for allocating private consumption other than education and health.**



# Age Profile of Labor Income

- Separate age profiles estimated for two components
  - Compensation of employees
  - Return to labor from mixed income
- Age profile of compensation
  - Surveys report separately by individual
  - Include all employer provided benefits including social contributions by employer
  - Social contributions by employer may be captured in adjustment to macro control but only if they are proportional
  - Tabulate by age
- Age profile of mixed income
  - Allocated to household members who report themselves as self-employed or as unpaid family workers
  - Allocation weights are based on mean compensation or earnings of employees.

# Outline of Presentation

Introduction

Constructing aggregate controls

Estimating the age shapes

Finalizing age profiles

Comparing, summarizing, and applying the account

# Smoothing and Upper Age Interval

- Smoothing guidelines
  - Only smooth lowest level variables, not aggregations
  - Avoid smoothing real variation that arises for a number of reasons
  - Set upper age interval when variance at upper ages become too great
  - Be mindful of cross-variable effects
- Recommendation of software and method details provided in the manual appendix

# Adjusting to Aggregate Controls

- In all cases where aggregate controls are available, age profiles are scaled (proportionately adjusted) to match aggregate values.
- For lifecycle account, aggregate controls are in principle available for all components.



# Lifecycle deficit/surplus

- Calculated as consumption less labor income
- Final estimates of consumption and labor income are used after any smoothing.

# Evaluation

- Check list provided
  - Completeness
  - Consistency
  - External validity
- Note that many of these checks will be automated using a spreadsheet that can be downloaded. Under development.

# Documenting and archiving

- Good documentation is essential
  - All data sources fully referenced
  - Include data accessed and version number for any data that is downloaded
  - Can analysis be replicated?
- Archiving
  - Proper storage and backup is essential
  - NTA database available to members of NTA network

# Outline of Presentation

Introduction

Constructing aggregate controls

Estimating the age shapes

Finalizing age profiles

Comparing, summarizing, and applying the account

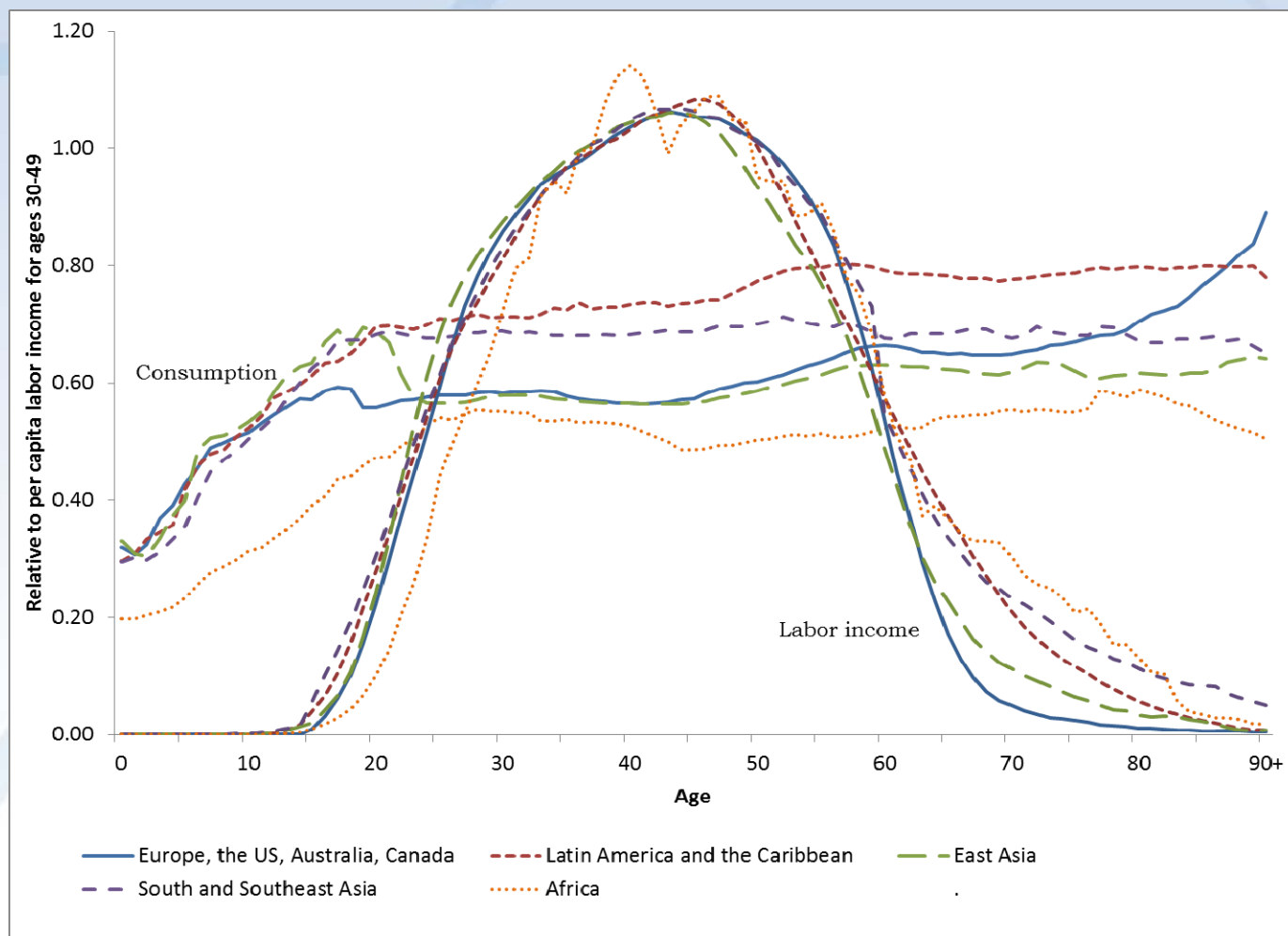
# Summarizing and comparing

- Normalizing profiles
- Synthetic cohort values
- Timing and mean ages
- Support ratio
- Lifecycle wealth

# Normalizing profiles

- Purpose of normalization is to facilitate comparisons of countries with large differences in per capita values.
- Normalized values are calculated by dividing by average labor income of persons 30-49.
- Age range was chosen so that denominator is unaffected by decisions about schooling or retirement.
- Note, however, that female labor patterns will affect the denominator.

**Figure 2.4 Normalized per capita consumption and labor income by age, Regions of the world.**



Source: Lee and Mason (2011) and [www.ntaccounts.org](http://www.ntaccounts.org) accessed July 20, 2012.

# Synthetic cohort values

- Value over an age range assuming that age-specific flows remain constant at values observed in the cross-section
- Examples
  - Total fertility rate and life expectancy
  - Synthetic cohort values of human capital spending



# Calculating Synthetic Cohort Values

Value for persons who survive from age  $a_0$  to  $a_1$

$$\sum_{x=a_0}^{a_1} v(x)$$

Expected value as of age  $a_0$

$$\sum_{x=a_0}^{a_1} v(x) \left( L(x) / l(a_0) \right)$$

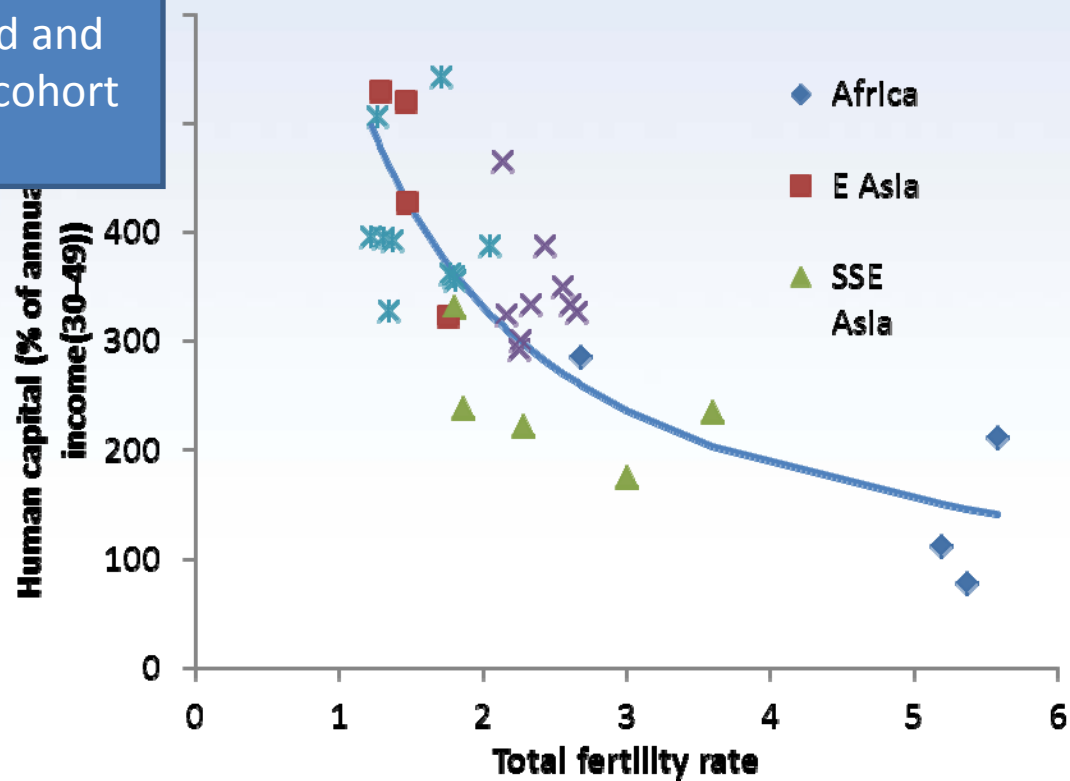
$L(x)$  – years lived at age  $x$

$l(a_0)$  – population of exact age  $a_0$

$v(x)$  – economic flow

Figure 1.4 Human capital and TFR, selected countries

Human capital values are normalized and synthetic cohort values.



Source: Updated from Lee and Mason (2010).

Andrew Mason, September 2012

# Mean ages of flows

- Value weighted average age of any age flow

Mean age of per capita profile	$\mu(v) = \sum_{x=0}^{\omega} xL(x)v(x) / \sum_{x=0}^{\omega} L(x)v(x)$
Mean age of aggregate profile	$A(v) = \sum_{x=0}^{\omega} xN(x)v(x) / \sum_{x=0}^{\omega} N(x)v(x)$
Mean age of aggregate profile, steady state	$A(v) = \sum_{x=0}^{\omega} x(1+n)^{-x} L(x)v(x) / \sum_{x=0}^{\omega} (1+n)^{-x} L(x)v(x)$

$x$  – age (0.5, 1.5, 2.5, ...)

$L(x)$  – years lived at age  $x$

$v(x)$  – economic flow

$N(x)$  – population age  $x$

$n$  – population growth rate

# Support Ratio

$$\text{support ratio} = \frac{\text{Effective number of producers}}{\text{Effective number of consumers}}$$

$$= \frac{\text{equivalence scale for producers} \times \text{number of producers}}{\text{equivalence scale for consumers} \times \text{number of consumers}}$$

$$\text{equivalence scale for producers} = \frac{yl(x)}{yl(30-49)}$$

$$\text{equivalence scale for consumers} = \frac{c(x)}{c(30-49)}$$

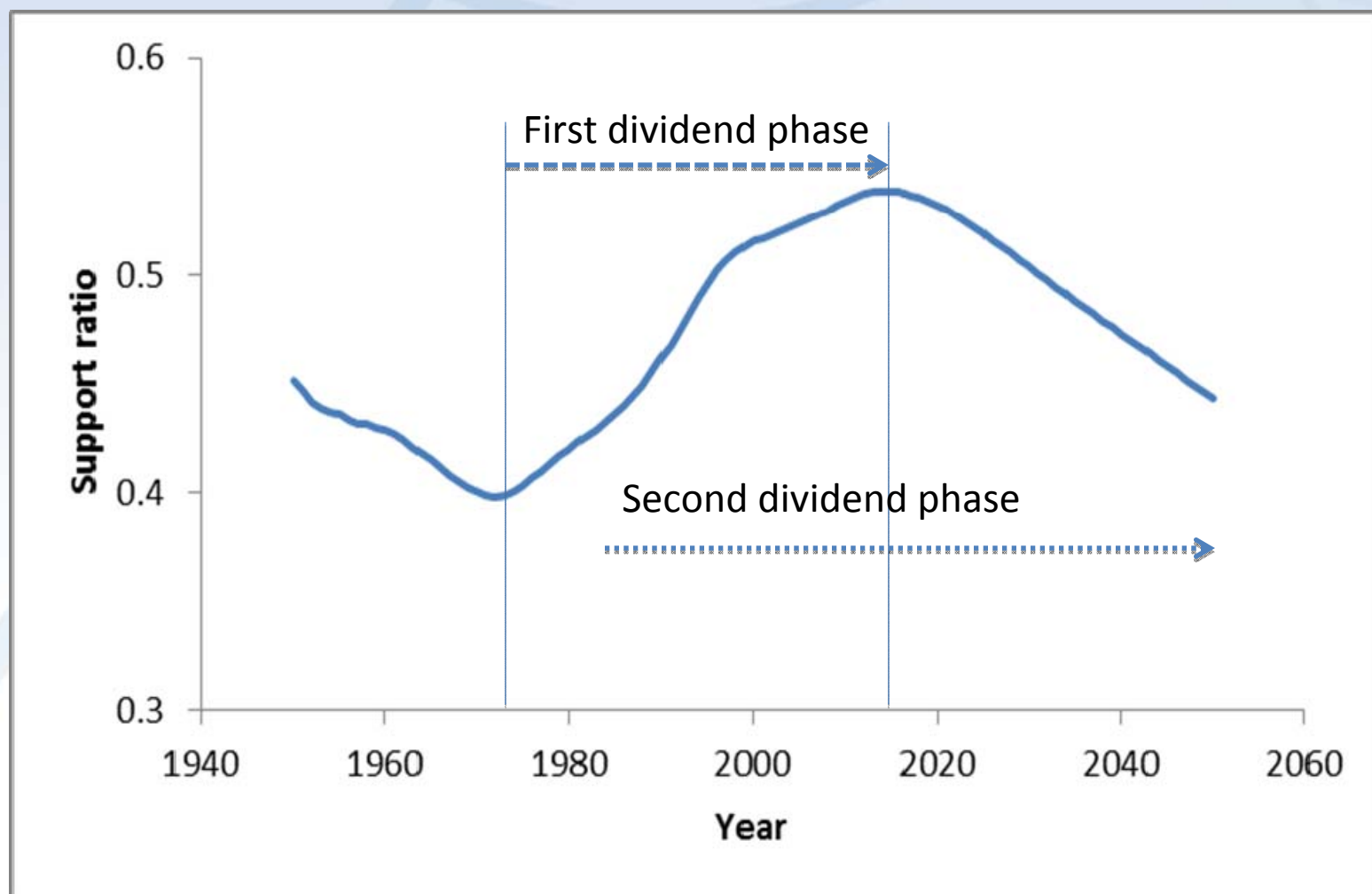
persons 30-49 are counted as one effective producer and consumer;  
all others measured relative to them.

# Illustrative calculation for China

**Table 4.6 Calculation of support ratio for China.**

Variable	Total	Selected ages					
		0	1	20	40	60	80
Per capita consumption, 2002		2422	2298	5435	3980	4434	4043
Per capita labor income, 2002		0	0	2580	10644	3897	803
Consumption equivalence scale		0.615	0.584	1.381	1.011	1.127	1.027
Production equivalence scale		0.000	0.000	0.262	1.082	0.396	0.082
Population (thousands), 2025	1,395,256	13292	13348	16228	21422	19693	4657
Effective consumers (thousands), 2025	1,398,872	8179	7796	22413	21665	22185	4784
Effective producers (thousands), 2025	726,007	0	0	4256	23180	7802	380
Support ratio, 2025	0.519						

# Figure 1.3 Support ratio for China, 1950-2050.



Source: See UN (2012) Manual on National Transfer Accounts.

# Lifecycle wealth

- Lifecycle wealth is the current wealth required to fund the anticipated gap between consumption and labor income over the remaining lifetime of a cohort.
- Value depends on the discount rate, the anticipated path of consumption and labor income, and the proportion or number surviving to each age.

# Lifecycle Wealth Formula

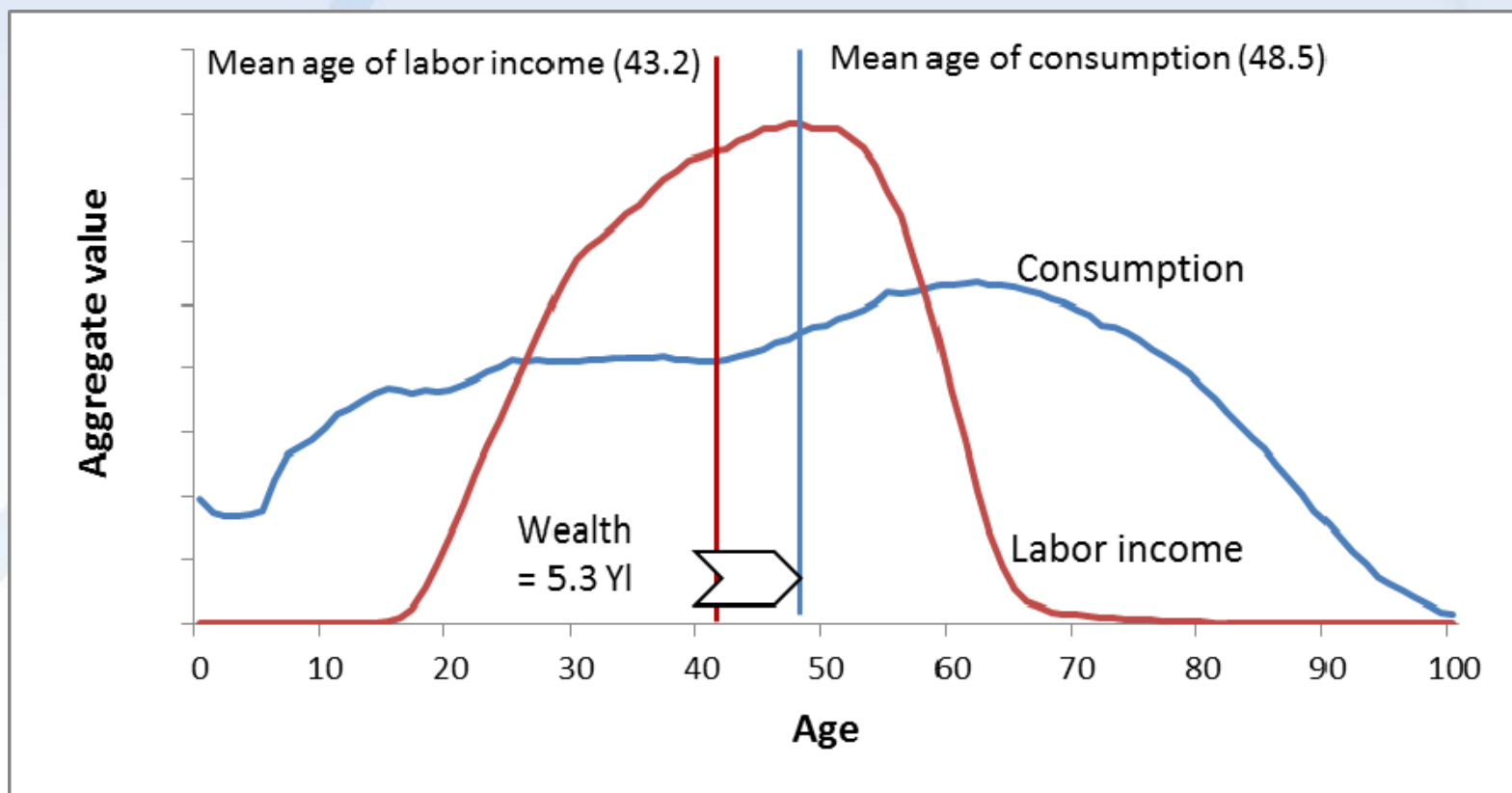
For all persons age $x$ in year $t$	$W(x, t) = \sum_{z=0}^{\omega-x} (1+d)^{-z} \tilde{N}(x+z, t+z) (\tilde{c}(x+z, t+z) - \tilde{y}_l(x+z, t+z))$
Per person age $x$ in year $t$	$w(x, t) = W(x, t) / N(x, t)$
<p>Notes: tilde indicates anticipated values. Calculated using observed NTA values and an assumed rate of growth. Anticipated population calculated using survival rates from a period life table or projected survival rates. Total wealth for the country is calculated by summing across all ages <math>x</math>.</p>	



# Golden Rule Lifecycle Wealth

For all persons	$W_{GR} = (A_c - A_{y_l}) Y_l$
Per person	$w_{GR} = (A_c - A_{y_l}) y_l$
Notes: Mean ages are defined and method of calculating are provided above. $Y_l$ is total labor income; $y_l$ is per capita labor income.	

# Figure 1.10 Lifecycle wealth, golden rule, Germany



# Conclusions

- Economic lifecycle quantifies
  - Individuals at each age use resources to meet their material needs (consumption)
  - Individuals acquire economic resources through their labor (labor income)
  - Lifecycle deficit – the gap that must be funded through transfers and asset-based flows
- Economic lifecycle can be used in many important ways to understand the macro economic implications of population age structure.
- Estimating the reallocation system provides important additional information about the generational economy.