Manual on National Transfer Accounts: Lifecycle Account

Andrew Mason
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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

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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

Per Capita Values, Philippine Peso (Thousands)

Aggregate Values, Philippine Peso (Billions)

Source: Chapter 2.

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Consumption Components

Source: Chapter 2.

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Labor Income Components

Per Capita Values, Philippine Peso (Thousands)

Aggregate Values, Philippine Peso (Billions)

Source: Chapter 2.

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## Lifecycle Account, Per Capita Values

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

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

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# Lifecycle Account, Aggregate Values

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

<table>
<thead>
<tr>
<th></th>
<th>Selected ages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Aggregate values (Naira billions)</strong></td>
<td></td>
</tr>
<tr>
<td>Lifecycle Deficit</td>
<td>145</td>
</tr>
<tr>
<td>Consumption</td>
<td>145</td>
</tr>
<tr>
<td>Public Consumption</td>
<td>26</td>
</tr>
<tr>
<td>Public Consumption, Education</td>
<td>0</td>
</tr>
<tr>
<td>Public Consumption, Health</td>
<td>1</td>
</tr>
<tr>
<td>Public Consumption, Other</td>
<td>25</td>
</tr>
<tr>
<td>Private Consumption</td>
<td>119</td>
</tr>
<tr>
<td>Private Consumption, Education</td>
<td>0</td>
</tr>
<tr>
<td>Private Consumption, Health</td>
<td>27</td>
</tr>
<tr>
<td>Private Consumption, Other</td>
<td>92</td>
</tr>
<tr>
<td>Labor Income</td>
<td>0</td>
</tr>
<tr>
<td>Earnings</td>
<td>0</td>
</tr>
<tr>
<td>Self-employment Labor Income</td>
<td>0</td>
</tr>
</tbody>
</table>

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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

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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

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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

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<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Final</td>
<td>Taxes</td>
<td>Pre-tax</td>
<td>Reclassification</td>
<td>Consumer</td>
<td>NTA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>consumption expenditure</td>
<td>products</td>
<td>consumption</td>
<td>of health consumption</td>
<td>durable: consumption less expenditure</td>
<td>consumption</td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>10,000</td>
<td>9,300</td>
<td>-</td>
<td>100</td>
<td>9,400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption, public</td>
<td>3,000</td>
<td>3,000</td>
<td>300</td>
<td></td>
<td>3,300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption, public, education</td>
<td>600</td>
<td>600</td>
<td></td>
<td>600</td>
<td>1,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption, public, health</td>
<td>800</td>
<td>800</td>
<td>300</td>
<td></td>
<td>600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption, public, other</td>
<td>1,600</td>
<td>1,600</td>
<td></td>
<td></td>
<td>1,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption, private</td>
<td>7,000</td>
<td>6,300</td>
<td>(300)</td>
<td>100</td>
<td>6,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption, private, education</td>
<td>800</td>
<td>200</td>
<td>600</td>
<td></td>
<td>600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption, private, health</td>
<td>1,200</td>
<td>1,200</td>
<td>-300</td>
<td></td>
<td>900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption, private, other</td>
<td>5,000</td>
<td>500</td>
<td>4,500</td>
<td></td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Table 4.4 Calculation of unit costs for education sector, illustrative values.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public spending for public schools (billions)</strong></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

| **Enrollment in public schools (millions)** | Primary | Secondary | Tertiary | Source |
|---------------------------------------------------------------|
| 25 | 40 | 10 | Administrative records or household surveys |

| **Unit cost (spending per student)** | Primary | Secondary | Tertiary | Source |
|---------------------------------------------------------------|
| 2,000 | 2,500 | 7,500 | Calculated as spending divided by enrollment |

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

Note: Unit cost is 2,000.
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

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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.

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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

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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.


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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

<table>
<thead>
<tr>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value for persons who survive from age $a_0$ to $a_1$</td>
<td>$\sum_{x=a_0}^{a_1} v(x)$</td>
</tr>
<tr>
<td>Expected value as of age $a_0$</td>
<td>$\sum_{x=a_0}^{a_1} v(x) \left( \frac{L(x)}{l(a_0)} \right)$</td>
</tr>
</tbody>
</table>

$L(x)$ – years lived at age $x$

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

$v(x)$ – economic flow
Human capital values are normalized and synthetic cohort values.

Source: Updated from Lee and Mason (2010).

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Mean ages of flows

- Value weighted average age of any age flow

<table>
<thead>
<tr>
<th></th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age of per capita profile</td>
<td>$\mu(v) = \frac{\sum_{x=0}^{\omega} xL(x)v(x)}{\sum_{x=0}^{\omega} L(x)v(x)}$</td>
</tr>
<tr>
<td>Mean age of aggregate profile</td>
<td>$A(v) = \frac{\sum_{x=0}^{\omega} xN(x)v(x)}{\sum_{x=0}^{\omega} N(x)v(x)}$</td>
</tr>
<tr>
<td>Mean age of aggregate profile, steady state</td>
<td>$A(v) = \frac{\sum_{x=0}^{\omega} x(1+n)^{-x} L(x)v(x)}{\sum_{x=0}^{\omega} (1+n)^{-x} L(x)v(x)}$</td>
</tr>
</tbody>
</table>

$x$ – 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

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

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

equivalence scale for producers \(= \frac{y_l(x)}{y_l(30-49)}\)

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>
<thead>
<tr>
<th>Variable</th>
<th>Selected ages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Per capita consumption, 2002</td>
<td>2422</td>
</tr>
<tr>
<td>Per capita labor income, 2002</td>
<td>0</td>
</tr>
<tr>
<td>Consumption equivalence scale</td>
<td>0.615</td>
</tr>
<tr>
<td>Production equivalence scale</td>
<td>0.000</td>
</tr>
<tr>
<td>Population (thousands), 2025</td>
<td>1,395,256</td>
</tr>
<tr>
<td>Effective consumers (thousands), 2025</td>
<td>1,398,872</td>
</tr>
<tr>
<td>Effective producers (thousands), 2025</td>
<td>726,007</td>
</tr>
<tr>
<td>Support ratio, 2025</td>
<td>0.519</td>
</tr>
</tbody>
</table>

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Figure 1.3 Support ratio for China, 1950-2050.

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**

\[
W(x,t) = \sum_{z=0}^{x-1} (1+d)^{-z} \tilde{N}(x+z,t+z)\left(\tilde{c}(x+z,t+z) - \tilde{y}_i(x+z,t+z)\right)
\]

**Per person age x in year t**

\[
w(x,t) = \frac{W(x,t)}{N(x,t)}
\]

**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 x.
Golden Rule Lifecycle Wealth

<table>
<thead>
<tr>
<th>For all persons</th>
<th>$W_{GR} = \left( A_c - A_{y_l} \right) Y_l$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per person</td>
<td>$w_{GR} = \left( A_c - A_{y_l} \right) y'_l$</td>
</tr>
</tbody>
</table>

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.

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