### Population Age Structure

I. Why is age structure important?
II. How is age structure measures?
III. What determines age structure?

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### I. Importance of age structure

1. Demographic bonus: [Age-earnings profile](#)
2. Lifecycle saving: [C and Y, Taiwan](#)
3. Fiscal policy: [US (Lee and Edwards 2001)](#)

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### II. Measuring Age Structure

1. Age distribution
2. Mean age
3. Dependency ratio or support ratio
Age distribution

1. Age pyramid: Hawaii
2. Age distribution: Hawaii
   \[ f(a,t) = \frac{N(a,t)}{N(t)} \]
3. Mean Age and dependency ratio: Hawaii
   \[ \text{Mean age} = \sum a f(a,t) \]
   \[ \text{DR} = \frac{\text{Dependent pop}}{\text{Working age pop}} \]

III. Determinants of age structure

1. Stable population
2. Over the demographic transition
3. Immigration

Stable Population

- A population which has been subject to constant age-specific birth and death rates for an extended period of time.
- Once stability is achieved:
  - Population growth is constant
  - Age distribution is constant
  - All age groups grow at the same rate
- Stationary population is stable population with n=0
Age Structure for Stable Population

\[ N_{a+1} = B \cdot e^{na} \]
\[ N_a = B \cdot e^{na} \]
\[ N_t = \int_0^a \int_0^b e^{na} da \]
\[ N_{a+1}/N_t = e^{na} \int_0^b e^{na} da \]

Stable Case (cont)

Where:
- \( n \) = population growth rate
- \( B \) = number of births
- \( s \) = proportion surviving from birth to age \( a \)
- \( N \) = population

Age Distributions for Stable Populations

High Mortality Population (early Hawaii)

Low Mortality Population (current US)
Demographic Transition and Age Distribution of the Population

- Age structure is determined both by birth rates and survival rates
- High TFR leads to young age structure
- Effect of $e_0$ varies over the transition
  - Early in transition, increase in $e_0$ leads to even younger population (gains are at young ages)
  - Later in transition, increase in $e_0$ leads to older population (gains are at older ages)

Demographic Transition and 3 Phases of Age Distribution

- Phase I: Percent under 15 rises.
- Phase II: Percent under 15 declines and percent 15-64 rises.
- Phase III: Percent 15-64 declines and percent 65+ rises.
- The swings in age-structure depend on how rapidly fertility and mortality change.

### Steadystate Age Distributions, Alternative Assumptions

<table>
<thead>
<tr>
<th></th>
<th>High Mortality</th>
<th>Low Mortality</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>$n=0$</td>
<td>$n=.02$</td>
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<tr>
<td>Percent under 20</td>
<td>0.35</td>
<td>0.51</td>
</tr>
<tr>
<td>20-64</td>
<td>0.56</td>
<td>0.45</td>
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<td>65+</td>
<td>0.09</td>
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<td>Dependency ratio</td>
<td>0.79</td>
<td>1.21</td>
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<tr>
<td>Mean Age</td>
<td>32.2</td>
<td>24.0</td>
</tr>
</tbody>
</table>
Age Transition
Asia, 1950-2050


Working-Age Population
3 Asian Countries

Aging in 3 Asian Countries
Immigration and aging

- Immigration often reduces average age of population
  - Immigrants tend to be young adults
  - Immigrants have children
- Immigration is not a solution to the aging problem (UN Replacement Migration 2001)