Workshop on
“Money, Finance and Banking in East Asia”
Training Centre of the Deutsche Bundesbank, Eltville
5-6 December 2011

Nelson Mark
University of Notre Dame and NBER

Presentation to
“Demographic Patterns and Household Saving in China”
To understand evolution of household saving rate in China over time (1960-2008)

Income and Demographics and Chinese Household Saving

The Data

An OLG Model of Saving

Demographic Patterns and Household Saving in China

Chadwick Curtis, Steven Lugauer and Nelson Mark.

Deutsche Bundesbank Workshop on Money, Finance and Banking in East Asia 12/5-6/2011

Authors: We are from Notre Dame
The Problem

1. To understand evolution of household saving rate in China over time (1960-2008)

2. Income and Demographics and Chinese Household Saving

3. The Data

4. An OLG Model of Saving
Features

- China’s household saving rate is one of the highest in the world and growing. (27 percent in 2008).
- Exhibits large variation over time: (3.9 percent before 1977).
- Funds investment as engine of growth
- Contributes to current account surplus
- Effective strategies for rebalancing growth requires us to understand what drives the saving rate
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Household Saving in China
China’s Rise in the World Economy

Table 2: Share of output. Source PWT7.0

<table>
<thead>
<tr>
<th>Year</th>
<th>USA</th>
<th>Japan</th>
<th>Germany</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>0.57</td>
<td>0.22</td>
<td>0.16</td>
<td>0.05</td>
</tr>
<tr>
<td>1984</td>
<td>0.55</td>
<td>0.22</td>
<td>0.15</td>
<td>0.08</td>
</tr>
<tr>
<td>1990</td>
<td>0.53</td>
<td>0.23</td>
<td>0.14</td>
<td>0.10</td>
</tr>
<tr>
<td>1995</td>
<td>0.51</td>
<td>0.21</td>
<td>0.13</td>
<td>0.15</td>
</tr>
<tr>
<td>2001</td>
<td>0.51</td>
<td>0.18</td>
<td>0.12</td>
<td>0.18</td>
</tr>
<tr>
<td>2005</td>
<td>0.49</td>
<td>0.16</td>
<td>0.10</td>
<td>0.24</td>
</tr>
<tr>
<td>2008</td>
<td>0.46</td>
<td>0.15</td>
<td>0.10</td>
<td>0.29</td>
</tr>
<tr>
<td>2009</td>
<td>0.44</td>
<td>0.14</td>
<td>0.09</td>
<td>0.32</td>
</tr>
</tbody>
</table>
To understand evolution of household saving rate in China over time (1960-2008)

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### Investment Shares

**Table 3: Investment share of GDP**

<table>
<thead>
<tr>
<th>Year</th>
<th>USA</th>
<th>Germany</th>
<th>Japan</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>20.8</td>
<td>24.4</td>
<td>29.1</td>
<td>39.2</td>
</tr>
<tr>
<td>1990</td>
<td>19.8</td>
<td>24.2</td>
<td>30.5</td>
<td>37.3</td>
</tr>
<tr>
<td>1995</td>
<td>17.8</td>
<td>22.8</td>
<td>29.8</td>
<td>40.4</td>
</tr>
<tr>
<td>2000</td>
<td>20.1</td>
<td>21.4</td>
<td>26.8</td>
<td>37.4</td>
</tr>
<tr>
<td>2005</td>
<td>19.3</td>
<td>17.6</td>
<td>23.5</td>
<td>40.1</td>
</tr>
<tr>
<td>2010</td>
<td>17.8</td>
<td>17.7</td>
<td>22.3</td>
<td>45.2</td>
</tr>
</tbody>
</table>

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Household Saving in China
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### The Data

**An OLG Model of Saving**

#### Composition of Gross National Saving

<table>
<thead>
<tr>
<th>Year</th>
<th>Share of GDP Gross Saving</th>
<th>Share of National Saving</th>
<th>Household Saving Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>38</td>
<td>7, 42</td>
<td>51, 17</td>
</tr>
<tr>
<td>2000</td>
<td>37</td>
<td>9, 44</td>
<td>49, 23</td>
</tr>
<tr>
<td>2001</td>
<td>38</td>
<td>11, 46</td>
<td>43, 24</td>
</tr>
<tr>
<td>2002</td>
<td>40</td>
<td>13, 45</td>
<td>43, 23</td>
</tr>
<tr>
<td>2003</td>
<td>44</td>
<td>16, 42</td>
<td>42, 24</td>
</tr>
<tr>
<td>2004</td>
<td>47</td>
<td>10, 50</td>
<td>40, 24</td>
</tr>
<tr>
<td>2005</td>
<td>48</td>
<td>13, 42</td>
<td>45, 23</td>
</tr>
<tr>
<td>2006</td>
<td>50</td>
<td>18, 38</td>
<td>44, 25</td>
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<tr>
<td>2007</td>
<td>52</td>
<td>21, 36</td>
<td>43, 26</td>
</tr>
<tr>
<td>2008</td>
<td>53</td>
<td>21, 35</td>
<td>44, 27</td>
</tr>
</tbody>
</table>

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**Household Saving in China**
Income Growth—Mixed results

- Modigliani and Cao (2004): Saving rate increases with long-term growth rate and with the deviation from long-run growth rate.
- Puzzling? Does life-cycle theory predict lower saving with higher growth to smooth consumption over the life-cycle?
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Demographic Factors—Mixed Evidence

- Saving rate should increase in response to: Decline in youth dependency, expected future increase in old-age dependency, decline in today’s old-age dependency.
  - Horioka and Wan (2006): Mixed results (sometimes significant, other times not. Sometimes slope positive, other times negative.
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China’s Influence on the ROW

Fehr, Joskisch and Kotlikoff (2007)
To understand evolution of household saving rate in China over time (1960-2008)

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The Data

An OLG Model of Saving

Demographics

- China’s demographic landscape has undergone dramatic change
- Exogenous decline in fertility due to enforcement of the one-child policy.

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Household Saving in China
To understand evolution of household saving rate in China over time (1960-2008)

Income and Demographics and Chinese Household Saving

The Data

Decline in Fertility

Table 6: Total Fertility Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>China</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-54</td>
<td>6.1</td>
<td>3.4</td>
</tr>
<tr>
<td>1970-74</td>
<td>4.8</td>
<td>1.8</td>
</tr>
<tr>
<td>1975-79</td>
<td>2.9</td>
<td>1.8</td>
</tr>
<tr>
<td>1990-94</td>
<td>1.8</td>
<td>2.0</td>
</tr>
<tr>
<td>2005-09</td>
<td>1.8</td>
<td>2.1</td>
</tr>
</tbody>
</table>

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Household Saving in China
To understand evolution of household saving rate in China over time (1960-2008)

Income and Demographics and Chinese Household Saving

**The Data**

**An OLG Model of Saving**

**Variation in Dependency Ratios**

Authors: We are from Notre Dame
To understand the evolution of household saving rate in China over time (1960-2008), income and demographics are analyzed. The data is presented using an OLG model of saving. Changing demographic composition is illustrated with a graph showing the saving rate and proportion of the population working over time.
To understand evolution of household saving rate in China over time (1960-2008)

Income and Demographics and Chinese Household Saving

The Data

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Real Wage Growth

Authors: We are from Notre Dame

Household Saving in China
To understand evolution of household saving rate in China over time (1960-2008) - Income and Demographics and Chinese Household Saving

The Data

An OLG Model of Saving

Take-aways from the data

- Household saving should be increasing in
  1. exogenous reductions in family size due to relaxation on budget constraint and fewer children to provide for in old age.
  2. an increase in the proportion of working age people because they are the savers.
  3. lower expected income growth (?)

- Over the sample, demographics and income growth work in opposite directions
  - Pre-reform era: Low income growth (high saving) and relatively large household size (low saving).
  - Post-reform era: High income growth (low saving) and relatively small household size (high saving).

- Try to sort out with a model

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Household Saving in China
Model Features

- **People live 85 years. Those aged 18 to 85 make decisions**
  - Stages of life: Children (age 0 to 17), parents (age 18 to 47), workers (age 18 to 63), adult children (age 45 to 65), and retirees (age 64 to 85).
  - Parental and childrenís consumption enter separately into parental utility, as in Barro and Becker (1989). More spending on children make parents happier (altruistic parents) but also cuts into budget constraint.
- People work and support aging parents from ages 18 to 63
- People retire at 64, live off of accumulated assets and transfers from working aged children until they die at 85. 85 year olds have bequest motive. Bequest spread across adult aged (45 to 65) children
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The various cohorts

Households with children

\[ u_t^i \left( c_{t}, c^i_t \right) = \mu \left( n_t^c \right)^{\eta} \left( \frac{\left( c_{t}^{c,i} \right)^{1-\sigma} - 1}{1-\sigma} \right) + \left( \frac{\left( c_t^i \right)^{1-\sigma} - 1}{1-\sigma} \right), \]

\[ n_t^c c_{t}^{c,i} + c^i_t + a_{t+1}^i = (1-\tau_t) w_t + (1+r_t) a_t^i + B_t^i, \quad i \in [18,47]. \]
Effective Discount Rate for Households with Children

\[ U_t = \sum_{j=0}^{30} \hat{\beta}_j \frac{c_{t+j}^{j+18}}{1 - \sigma} \]

where \( \hat{\beta}_j \) is the effective discount rate, such that

\[ \hat{\beta}_j = \beta^j \left( 1 + \left[ \mu n_{t+j} \left( (\sigma^2 - 2\sigma + 1 - \eta) \right]^{1/\sigma} \right) \]

is decreasing in \( n_{t+j} \) if \( \sigma < 1 - \sqrt{\eta} \) or if \( \sigma > 1 + \sqrt{\eta} \).
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To understand evolution of household saving rate in China over time (1960-2008),

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**The Data**

**An OLG Model of Saving**

**Working empty nest**

- \[ u_t^i (c_t^i) = \left( \frac{(c_t^i)^{1-\sigma} - 1}{1-\sigma} \right), \]

- \[ c_t^i + a_{t+1}^i = (1-\tau_t)w_t + (1+r_t)a_t^i + B_t^i, \quad i \in [48,63], \]

Authors: We are from Notre Dame

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Retirees

\[ u_t^i (c_t^i) = \left( \frac{(c_t^i)^{1-\sigma} - 1}{1-\sigma} \right), \]

\[ c_t^i + a_{t+1}^i = P_t + (1+r_t)a_t^i + B_t^i, \quad i \in [64,84], \]

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Households take wages, interest rates, and demographic variations as exogenous.

Present to households the data on these variables, and see if we can get them to save like they do in the data.
Quantitative Exercise

- Households take wages, interest rates, and demographic variations as exogenous.
- Present to households the data on these variables, and see if we can get them to save like they do in the data.
## Parameterization

### Table 4: Baseline parameterization

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>weight on children</td>
<td>$\mu$</td>
<td>0.65</td>
</tr>
<tr>
<td>concavity for children</td>
<td>$\eta$</td>
<td>0.76</td>
</tr>
<tr>
<td>labor’s share of output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre-reforms</td>
<td></td>
<td>0.60</td>
</tr>
<tr>
<td>post-reforms</td>
<td></td>
<td>0.40</td>
</tr>
<tr>
<td>transfer share</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre-reforms</td>
<td>$\tau$</td>
<td>0.12</td>
</tr>
<tr>
<td>post-reforms</td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>discount rate</td>
<td>$\beta$</td>
<td>0.99</td>
</tr>
<tr>
<td>coef. of relative risk aversion</td>
<td>$\sigma$</td>
<td>1.90</td>
</tr>
<tr>
<td>depreciation rate</td>
<td>$\delta$</td>
<td>0.10</td>
</tr>
</tbody>
</table>

$\mu, \eta$: Manuelli-Seshadri. $\alpha$: Hu-Khan, Hsieh-Klenow. $\tau$: Lee-Xiao
To understand the evolution of household saving rate in China over time (1960-2008), we have used income and demographics data. This is part of our study on Chinese Household Saving.}

**The Data**

An OLG Model of Saving

### Baseline Results

Authors: We are from Notre Dame

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Family Size

Variation of Family Size

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Constant Demographic and Family Composition

Authors: We are from Notre Dame

Household Saving in China
To understand evolution of household saving rate in China over time (1960-2008), we consider income and demographics and Chinese household saving through an OLG (Oligopolistic Labor and Goods) model of saving.

### Old Age Support

**Variations on Old Age Support**

![Graph showing variations on old age support from 1950 to 2020](chart.png)

- **Y-axis**: Variations on Old Age Support
- **X-axis**: Years from 1950 to 2020

Authors: We are from Notre Dame.
To understand evolution of household saving rate in China over time (1960-2008) Income and Demographics and Chinese Household Saving

The Data

An OLG Model of Saving

Variations on Wage Growth

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Household Saving in China
To understand evolution of household saving rate in China over time (1960-2008), we analyze income and demographics and Chinese household saving. We use an OLG model of saving to examine variations on interest rates.

Variations on Interest Rates

Authors: We are from Notre Dame Household Saving in China

Saving by cohort

**Saving Rates by Cohorts, 2009**

Authors: We are from Notre Dame.
Conclude

- It is possible to write down a model of Chinese households and to get them to save a large fraction of income.
- Using a deterministic model, standard life-cycle considerations go a long way in explaining the evolution of household saving in China.
- Family size matters
- Expected growth rate of labor income matters
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