Skill-Biased Technological Change and Homeownership

Alexis Anagnostopoulos   Orhan Erem Atesagaoglu
Eva Carceles-Poveda

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Housing Market

- Housing and the Macroeconomy

- The August 2007 subprime crisis has raised more attention to:
  (i) Homeownership
  (ii) House Prices
  (iii) Mortgage Markets

- Motivated by the recent facts, the literature has mostly focused on a specific period: housing boom-bust.
Homeownership Rate

AGGREGATE HOMEOWNERSHIP RATE

Homeownership Rate, %

50 55 60 65 70 75 80

Homeownership Rate, %

65 66 67 68 69 70 71 72

Homeownership Rate, %

65 66 67 68 69 70 71 72
# Homeownership Rates by Age

<table>
<thead>
<tr>
<th>Age Group</th>
<th>1970s</th>
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*1970s - stands for the period of 1976 to 1978, (CPS Data)*

*1990s - stands for the period of 1994 to 1997, (CPS Data)*
Homeownership Rates by Age

![Homeownership Rates by Age](image-url)
A Contributing Factor...

- Question: Why has Life Cycle Profile of Homeownership Steepened?

- Our Answer: Skill-Biased Technological Change (SBTC) - an important factor.

- Period coincides with significant changes in wage inequality and returns to skill.

- In particular, returns to skill increased, associated with the 'latent' SBTC.

  “SBTC is a shift in the production technology that favors skilled (more educated, more experienced, more able) labor over unskilled labor by increasing its relative productivity and, therefore, its relative demand.”

  Violante, Giovanni L. - "Skill-Biased Technical Change"

  *The New Palgrave Dictionary of Economics, 2nd Edition*

- SBTC increases the relative price of experience, an important dimension of skill.
Experience Premium

Experience Premium: Average real labor income of 45-55-years-old to Average real labor income of 25-35-years-old
Income Profiles

LIFE CYCLE INCOME (PRODUCTIVITY) PROFILES

Income Profiles over the Life Cycle

Age Group (initial age)

0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3

1970s 1990s

(CPS data - fitted quadratic polynomials)
Mechanism

- Skills accumulated with labor market experience
- Old agents are more skilled w.r.t. young agents
- SBTC $\rightarrow$ increase in the relative price of skill

Wage of Young (Inexperienced) $\downarrow$

Wage of Old (Experienced) $\uparrow$

- Why? “General Purpose Technological Change” and
  “Technology-Experience Complementarity in Adoption”

Mechanism

▶ The increase in returns to experience generates a steepening in life-cycle earnings profiles, widening the wage gap between young and old ages.

▶ This makes it increasingly hard for young households to accumulate substantial savings early in the life-cycle, in line with consumption smoothing.

▶ Accordingly, it takes more time for young agents to become homeowners, given frictions in (i) financial markets (downpayment requirement) (ii) housing markets (owned houses are larger, indivisible).

▶ Older agents who were not able to own a house before may now become homeowners, given higher returns to experience and depending on what has happened to average wealth level at those old ages.
Related Literature

▶ Data: Housing and Ownership

▶ Data: Inequality Facts
  - Heathcote, Perri and Violante (2010)

▶ Modelling: Housing and Ownership
  - Gervais (2002), Nakajima (2010), Diaz and Luengo-Prado (2008),
  - Fang Yang (2009), Chambers, Garriga and Schlagenhauf (2009)

▶ Modelling: SBTC and Experience
Related Literature : Most Related Paper

▶ Fisher and Gervais (2011) :

▶ Fisher and Gervais (2011) - conjecture :
  - increase in idiosyncratic risk
  - decrease in marriage rates

▶ Fisher and Gervais (2011) :
  - Their story is complementary to ours.
  - But note that they do not aim to explain the steeping of homeownership profiles across ages.
Setup: Environment

- Discrete-time OLG model with (i) housing (ii) incomplete markets
- Skill accumulated (exogenously) over the life cycle with experience
- Agents: Households - Firms - Financial Institutions - Government
- Two consumption goods: (i) housing services (ii) non-housing goods
- Two assets: (i) financial assets (ii) houses
- Households - Demographics:
  - Agents are born at age 1
  - Agents could live up to age $I$
  - Agents retire at age $1 < l_r < I$
  - Agents face a positive probability of dying, $1 - \psi_i$
  - Population grows at a rate $g_n$
Household Problem

- State Variable: \( s = (i, e, x) \)

- All agents face the same problem: “owning” vs “renting”:
  \[
  V(s) = \max \left\{ V_o(s), V_r(s) \right\}
  \]

- Renter’s Problem:
  \[
  V_r(s) = \max_{c \geq 0, d_r \geq 0, a, x'} \left\{ u(c, d_r) + \beta \psi_i EV(s') \right\}
  \]
  \[
  s.t.
  \]
  \[
  x = a
  \]
  \[
  c + x' + q d_r = y(e, i) + (1 + r)(x + tr)
  \]
  \[
  a \geq 0
  \]

- No unsecured borrowing
Household Problem

- Owner’s Problem:

\[ V_o(s) = \max_{c \geq 0, d_o \geq d, a, x'} \left\{ u(c, d_o) + \beta \psi_i EV(s') \right\} \]

\[ s.t. \]

\[ x = d_o + a \]

\[ c + x' = y(e, i) + (1 + r)(a + tr) + (1 - \delta_{d,o})d_o \]

\[ a \geq -(1 - \chi)d_o \]

- The only available form of credit: ‘collateralized credit’
  
  - Minimum down payment requirement: \( \chi \)
  
  - For homeowners, financial assets must satisfy:

\[ a \geq -(1 - \chi)d_o \]
Household Labor Income

- Household - Labor Endowment:
  - Agents provide two distinct productive services
    * “raw labor”: fixed over the life-cycle, \( u \)
    * “skill” : accumulated with labor market experience, \( h_i \)
  - Raw labor and skill earn separate wages in the labor market, \( w_u, w_h \)
  - Each agent faces stochastic productivity shocks, \( e \)
  - Labor Income: \( e(w_u u + w_h h_i) \)

Household Labor Income

\[
y(e, i) = \begin{cases} 
(1 - \tau_s)e(w_u u + w_h h_i) & \text{if } age \leq l_r \\
 b & \text{if } age > l_r 
\end{cases}
\]
Firm Problem

- **Financial Institutions**:
  - Real Estate Sector: borrow financial assets from households
    - use the financial assets to buy housing assets
    - rent the housing assets at a price of $q$
    - use the rental income to pay back the debt
  - The problem of the intermediary:

    $$\max_{D_r} \left\{ qD_r + (1 - \delta_{d,r})D_r - (1 + r)D_r \right\}$$

  - Rental Price: $q = r + \delta_{d,r}$

- **Firms - Production Technology**:

  $$y = AF(K, U, H) = A(K)^\alpha \left( \gamma U + (1 - \gamma)H \right)^{1-\alpha}$$

  - The technology parameter, $\gamma$, captures the skill-biased demand shifts
Firm Problem

▶ Competitive Factor Prices in Labor Market:

\[ w_u = \gamma(1 - \alpha)A \frac{K}{L} \]

\[ w_h = (1 - \gamma)(1 - \alpha)A \frac{K}{L} \]

where \( L = \gamma U + (1 - \gamma)H \)

▶ Relative price of skill: \( \frac{w_h}{w_u} = \frac{1 - \gamma}{\gamma} \)

▶ Skill-Biased Technological Change: ↓ in \( \gamma \)
Parameters

- Utility: \( u(c, \varphi d) = \frac{(c^\lambda (d)^{1-\lambda})^{1-\sigma}}{1-\sigma} \) (\( \sigma = 2 \))

- Population growth rate: \( g_n = 1.2\% \)

- Mortality rates: Life Tables for 1977 and 1997

- Mandatory retirement: \( I_r = 65 \)

- Maximum life span: \( I = 80 \)

- Social security tax: 5.4\% - to match 33\% replacement ratio
  (Nakajima 2010)

- Macro Aggregates:
  - Capital share in non-housing GDP: \( \alpha = 0.32 \)
  - Calibrate \( (\delta_k, \delta_{do}, \delta_{dr}, \beta, \lambda) \) to match:
    \[
    \frac{K}{Y} = 1.65, \quad \frac{D_r + D_o}{Y} = 1.08, \quad \frac{I_k}{Y} = 0.19, \quad \frac{I_d}{Y} = 0.047, \quad \frac{\delta_{dr}}{\delta_{do}} = 1.15
    \]
Parameters

- Downpayment requirement: \( \chi = 20\% \)

- Minimum housing size: calibrated to match aggregate homeownership rate.

- Initial assets: Part of bequests distributed uniformly to young cohorts.
  \[ x_1 \sim U(0, \bar{x}) \]  
  The parameter \( \bar{x} \) is chosen to match the 23.9% ownership rate of 20 – 24 old.

  - Persistance: \( \rho = 0.95 \)
  - Innovations: \( \sigma_\epsilon = 0.17 \) (standard deviation)
  - The process is discretized with 5 states using Tauchen-Hussey (1991)

- “Skill Accumulation”, \( h_i \): calibrated to match the 1970s income profile
Parameters

- Demand for “Raw Labor” / Demand for “Skills”:
  - Before SBTC: $\gamma = 0.5$ (normalized)
  - After SBTC: $\gamma$ is calibrated to match experience premium after SBTC

- “Raw Labor”, $u$: calibrated to match a 4.4% increase in household income due to improved female labor market outcomes.
  
  (Fisher and Gervais 2010)
Calibration Targets and Corresponding Parameters

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<thead>
<tr>
<th>Parameter</th>
<th>Target</th>
<th>Source</th>
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<tbody>
<tr>
<td>Technology</td>
<td>$\alpha$</td>
<td>$\frac{(r+\delta_k)K}{Y} = 0.32$</td>
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<tr>
<td>Technology</td>
<td>$\delta_{d,o}$, $\delta_{d,r}$</td>
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<tr>
<td>Min house</td>
<td>$d$</td>
<td>64% Agg. Ownership</td>
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<td>Initial assets</td>
<td>$X_1 \sim U \left(0, \bar{X}\right)$</td>
<td>24% Young Ownership</td>
</tr>
<tr>
<td>LifeCycle Prof.</td>
<td>$h_i$</td>
<td>70’s Product. Profile</td>
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Before SBTC…

TOTAL ASSETS OVER THE LIFE-CYCLE
(average asset holdings)

Age Group (initial age)

20 25 30 35 40 45 50 55 60 65 70 75

0
0.2
0.4
0.6
0.8
1
1.2

0
0.2
0.4
0.6
0.8
1
1.2
Before SBTC…

**Homeownership Rates by Age, %**

![Graph showing homeownership rates by age](chart.png)
After SBTC...
After SBTC...

**HOMEOWNERSHIP RATES BY AGE (MODEL)**

Homeownership Rates by Age, %

Age Group (initial age)

Homeownership Rates by Age, %
HOMEOWNERSHIP RATES BY AGE

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### Homeownership Rates for Young and Old

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The model explains

- 96% of the decrease for the young
- 42% of the increase for the old
TOTAL ASSETS OVER THE LIFE-CYCLE
(average asset holdings)
FINANCIAL ASSETS OVER THE LIFE-CYCLE
(average asset holdings)
HOUSING ASSETS OVER THE LIFE-CYCLE (OWNED)

(average asset holdings)

Age Group (initial age)

Ante

Post