

Skill-Biased Technological Change and Homeownership

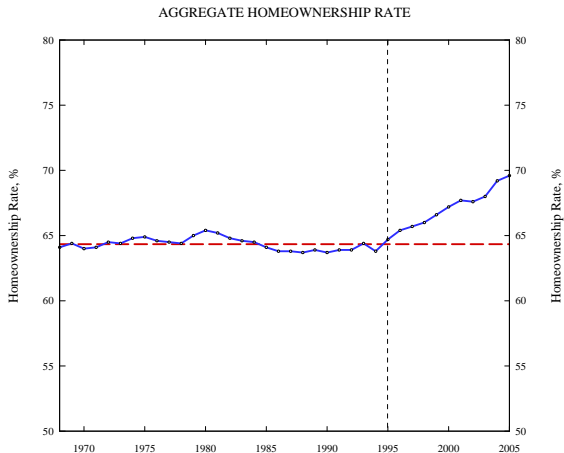
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QSPS 2012

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



Homeownership Rates by Age

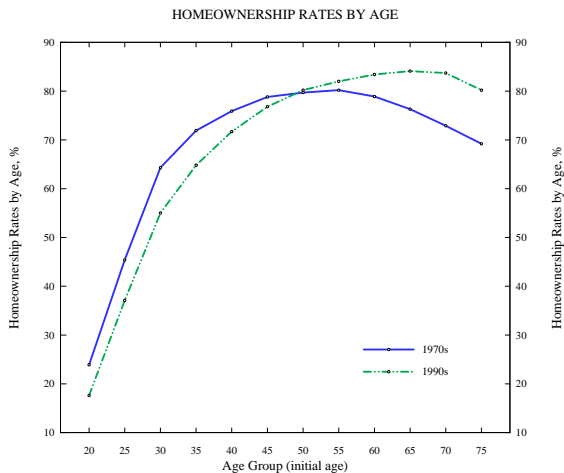
Homeownership Rates by Age

Age Group	1970s	1990s	1970s-1990s
20-24	23.9	17.6	-6.3
25-29	45.4	37.1	-8.3
30-34	64.3	55.0	-9.3
35-39	71.9	64.8	-7.1
40-44	75.9	71.7	-4.2
45-49	78.8	76.8	-2.0
50-54	79.7	80.0	0.3
55-59	80.2	82.0	1.8
60-64	78.9	83.4	4.5
65-69	76.3	84.1	7.8
70-74	72.9	83.7	10.8
75-79	69.2	80.1	10.9

* 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



A Contributing Factor...

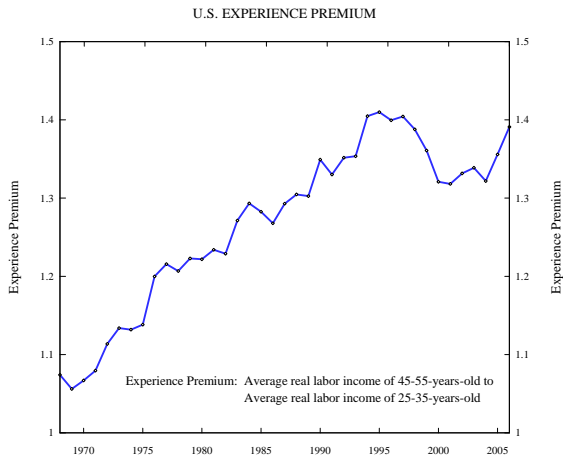
- ▶ Question: Why has Life Cycle Profile of Homeownership Steepened?
- ▶ Our Answer: Skill-Biased Technological Change (SBTC) - an important factor.
- ▶ Period coincides with significant changes in wage inequality and returns to skill.
- ▶ In particular, returns to skill increased, associated with the '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. ”

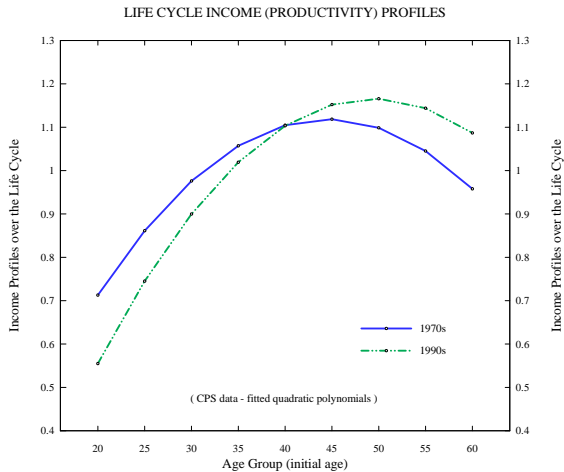
*Violante, Giovanni L. - "Skill-Biased Technical Change"
The New Palgrave Dictionary of Economics, 2nd Edition*

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

Experience Premium



Income Profiles



Mechanism

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

Wage of Young (Inexperienced) ↓

Wage of Old (Experienced) ↑

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

Aghion, Howitt, Violante (2002), Hornstein, Krusell, Violante (2004),
Weinberg (2005)

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
 - Segal and Sullivan (1998), Garriga, Gavin, Schlagenhaut (2006), Li (2005)

- ▶ 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 Schlagenhaut (2009)

- ▶ Modelling: SBTC and Experience
 - Guvenen and Kuruscu (2009,2010), Jeon, Kim and Manovskii (2008)

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 l
 - Agents retire at age $1 < l_r < l$
 - 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.

$$x = a$$

$$c + x' + qd_r = y(e, i) + (1 + r)(x + tr)$$

$$a \geq 0$$

- ▶ No unsecured borrowing

Household Problem

- ▶ Owner's Problem:

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

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: χ

- 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

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

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 :

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

- The technology parameter, γ , captures the skill-biased demand shifts

Firm Problem

- ▶ Competitive Factor Prices in Labor Market:

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

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

$$\text{where } L = \gamma U + (1 - \gamma)H$$

- ▶ Relative price of skill : $\frac{w_h}{w_u} = \frac{1 - \gamma}{\gamma}$
- ▶ Skill-Biased Technological Change : \downarrow in γ

Parameters

- ▶ Utility : $u(c, \varphi d) = \frac{(c^\lambda (d)^{1-\lambda})^{1-\sigma}}{1-\sigma} \quad (\sigma = 2)$
- ▶ 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.
- ▶ Income Shocks : The process estimated by Storesletten, Telmer, Yaron (2004)
 - Persistence : $\rho = 0.95$
 - 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

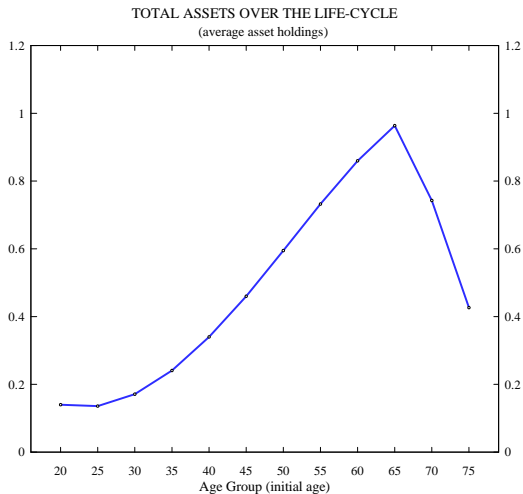
Parameters

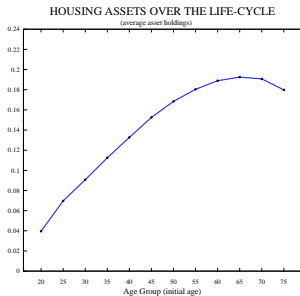
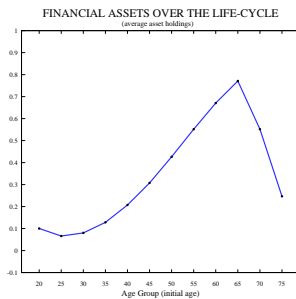
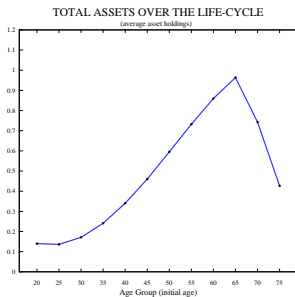
- ▶ Demand for “Raw Labor” / Demand for “Skills” :
 - Before SBTC : $\gamma = 0.5$ (normalized)
 - After SBTC : γ is calibrated to match experience premium after SBTC
- ▶ “Raw Labor”, u : calibrated to match a 4.4% increase in household income due to improved female labor market outcomes.
(Fisher and Gervais 2010)

Calibration Targets and Corresponding Parameters

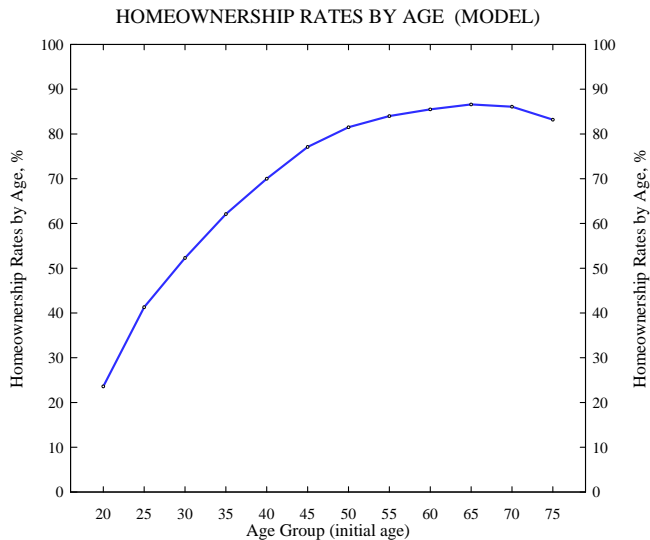
	Parameter	Target	Source
Technology	α	$\frac{(r+\delta_k)K}{Y} = 0.32$	NIPA 1947-2008
Technology	$\delta_{d,o}, \delta_{d,r}$	$\frac{I_d}{Y} = 0.047, \frac{\delta_{d,r}}{\delta_{d,o}} = 1.15$	NIPA 1947-2008
Technology	δ_k	$\frac{I_k}{Y} = 0.19$	NIPA 1947-2008
Preferences	β	$\frac{K}{Y} = 1.65$	NIPA 1947-2008
Preferences	λ	$\frac{D_o+D_r}{Y} = 1.08$	NIPA 1947-2008
Min house	\underline{d}	64% Agg. Ownership	CPS 1976-1978
Initial assets	$X_1 \sim U(0, \bar{X})$	24% Young Ownership	CPS 1976-1978
LifeCycle Prof.	h_i	70's Product. Profile	CPS 1970-1979

Before SBTC...

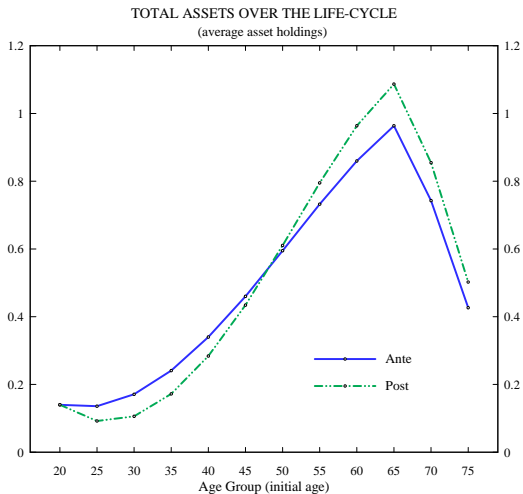




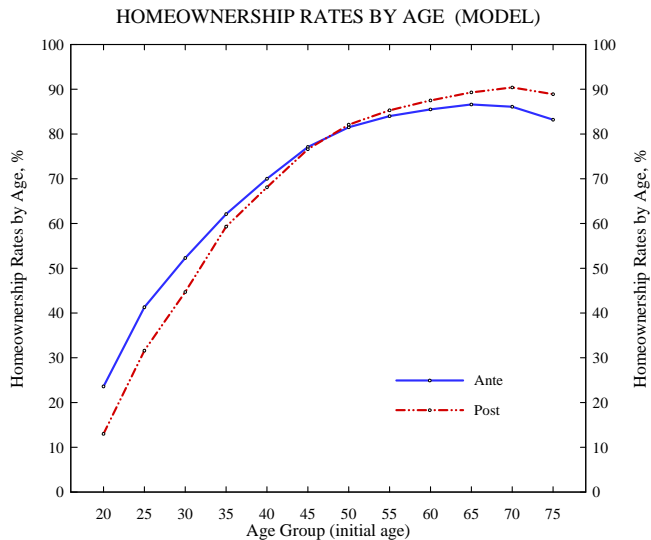
Before SBTC...



After SBTC...



After SBTC...



HOMEOWNERSHIP RATES BY AGE

Age Group	Data			Model		
	1970s	1990s	1970s-1990s	1970s	1990s	1970s-1990s
20-24	23.9	17.6	-6.3	23.6	13.0	-10.6
25-29	45.4	37.1	-8.3	41.3	31.6	-9.7
30-34	64.3	55.0	-9.3	52.3	44.7	-7.6
35-39	71.9	64.8	-7.1	62.1	59.3	-2.8
40-44	75.9	71.7	-4.2	70.0	68.1	-1.9
45-49	78.8	76.8	-2.0	77.1	76.6	-0.6
50-54	79.7	80.0	+0.3	81.5	82.1	+0.6
55-59	80.2	82.0	+1.8	84.0	85.3	+1.3
60-64	78.9	83.4	+4.5	85.5	87.5	+1.9
65-69	76.3	84.1	+7.8	86.6	89.3	+2.7
70-74	72.9	83.7	+10.8	86.1	90.4	+4.3
75-79	69.2	80.1	+10.9	83.2	88.9	+5.6

HOMEOWNERSHIP RATES FOR YOUNG AND OLD

Age Group	Data			Model		
	1970s	1990s	1970s-1990s	1970s	1990s	1970s-1990s
20-44	54.5	47.4	-7.1	48.3	41.5	-6.8
45-59	79.5	79.4	-0.1	80.7	81.1	+0.4
60-79	75.1	83.0	+7.9	85.5	88.8	+3.4

The model explains

- 96% of the decrease for the young
- 42% of the increase for the old

