

Housing and Tax-deferred Retirement Accounts

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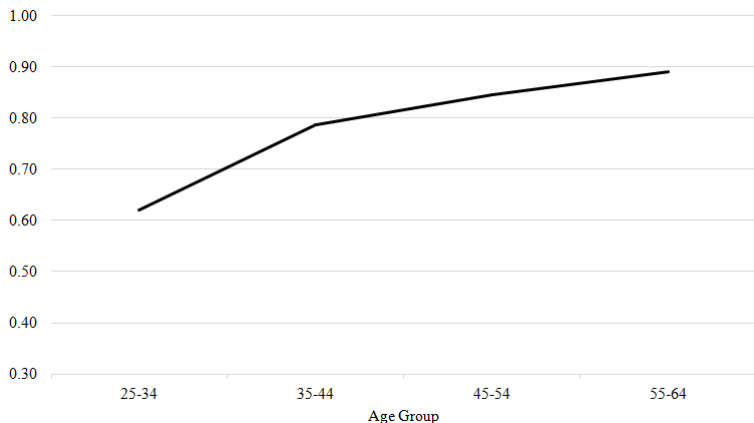
Introduction I

- Assets in tax-deferred accounts (**TDA**) and housing are two major components of household portfolios
- Common types of TDA in the U.S.: defined contribution (DC) pension plans (e.g., 401(k) and 403(b)) and Individual Retirement Accounts (IRA)
- Over 50% of U.S. households have TDA
Assets in TDA: \$8.6T (\$11.9T) in 2007 (2013)
- **Home ownership** in the U.S.: 68% (65%) in 2007 (2013)
- Housing is the single most important asset for a typical household

- Tax benefits of TDA
 - Contributions to TDA are income tax deductible
 - Investment income earned in TDA is tax exempt
 - Subsequent asset withdrawals are taxed as ordinary income
- However, early withdrawals of TDA assets subject to a 10% penalty
- Preferential tax treatments on home ownership:
 - Mortgage interest and property tax are income tax deductible in U.S.
 - Untaxed capital gains (up to a limit) from housing
 - Untaxed service flow from owners-occupied housing
- But buying and selling a house involves high transaction costs and there are down payment constraints in mortgage market

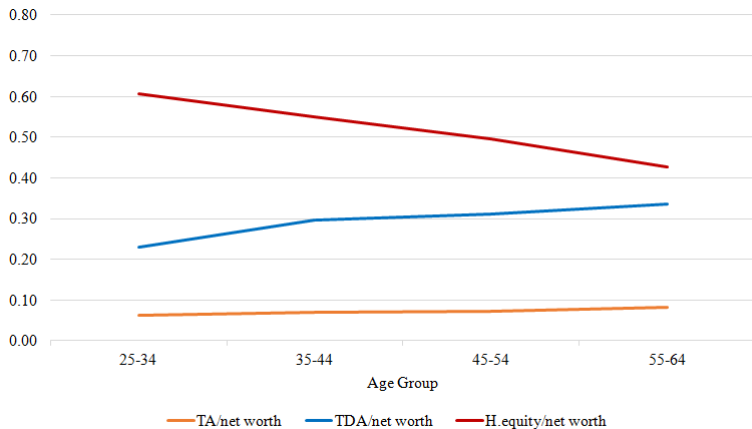
Stylized Facts: Survey of Consumer Finances (SCF) I

Figure : Home ownership for DC participants: average in 2001–2007 SCF



Stylized Facts: Survey of Consumer Finances (SCF) II

Figure : Net worth composition for homeowners: DC participants



- Questions

- Does households' use of TDA affect their housing decisions, or vice versa?
- How do TDA policies and housing-related factors, such as minimum down payment requirement and mortgage interest deductibility, affect the life-cycle patterns of net worth composition?

- Model

- Study the **joint decisions** of housing choice and households' use of TDA
- Evaluate household behavior in counterfactual experiments on TDA-related policies and housing-related factors

Main Findings

- TDA promotes home ownership
 - In the presence of TDA, households contribute to TDA, pay lower down payments (borrow more) and become homeowners earlier
 - Further increase in TDA contribution limit: moderate increase in TDA share of net worth and TA share drops, but little impact on home ownership rate and overall wealth accumulation
- Housing-related factors affect housing decisions and savings in TA more than their use of TDA
 - When mortgage interest payments and property taxes are not income tax deductible, home ownership drops significantly, TA share \uparrow , and TDA share \downarrow
 - An increase in min. down payment ratio has a large impact on young households, but little impact on older households. Overall, home ownership \downarrow and TA share \uparrow)

- TDA literature extensively explores the influence of TDA on
 - Households' savings decisions and whether TDA creates new savings (Engen, et. al. 1996, Poterba et. al. 1996)
 - Wealth distribution (Chernozhukov and Hansen 2004)
 - Macroeconomic impact (Imrohoroglu et. al. 1998, Kitao 2010)
 - Portfolio choice between stocks and bonds (Amromin 2003, Dammon et.al. 2004, Zhou 2009)
- Housing literature focuses on
 - Preferential tax treatments (Gervais 2002, Diaz and Luengo-Prado 2008)
 - Home ownership over life cycle and over time (Chambers et. al. 2009, Halket and Vasudev 2014)
 - Interaction between housing and non-housing consumption (Li and Yao 2007, Yang 2009)
 - Housing and macroeconomy (Iacoviello and Pavan 2013)
 - Portfolio choice between stocks and bonds in the presence of housing (Cocco 2005, Yao and Zhang 2005)

- Existing literature treats housing and TDA separately
- Two papers that study both
 - Amromin, Huang, and Sialm (2007): mortgage prepayment vs. TDA contribution
 - Marekwica, Schaefer, and Sebastian (2013): asset allocation between stocks and bonds
- We show that the interaction between housing and TDA is important
- Our results also suggest an explanation to findings that holdings in 401(k) plans for a substantial share of U.S. households remained low (Munnell 2012, Poterba 2014)

Model: Key Features

- Discrete time life-cycle model with income shock
- Households have access to both TA and TDA
- Long-term mortgage arrangement
- Social security system and progressive income tax system that mimics the U.S. tax codes
- Households make decisions on:
(1) housing tenure choice, (2) house size, (3) down payment, (4) TDA contribution and (5) consumption

- Stochastic lifetime and at most live for J periods
 - s_j : conditional survival probability in period j
- Households' preferences are represented by

$$u(c_j, h_j) = \frac{(c_j^{1-\omega} h_j^\omega)^{1-\gamma}}{1-\gamma} \quad (1)$$

γ : relative risk aversion

ω : preference for housing

- Let W_j be the estate when a household dies in period j . Households also derive utility from leaving estate:

$$u(W_j) = \frac{(W_j)^{1-\gamma}}{1-\gamma} \quad (2)$$

- Households supply labor inelastically to work in first R periods of life
- Household i at age j receives stochastic labor income Y_{ij} such that

$$\ln(Y_{ij}) = y_{ij} = f_{ij} + \eta_j + \varepsilon_{ij} \quad (3)$$

f_{ij} : the deterministic hump-shape age earnings profile

η_j : aggregate shock among all households

ε_{ij} : idiosyncratic persistent shock

- Both η_j and ε_{ij} follow AR(1) processes

$$\eta_{j+1} = \rho_\eta \eta_j + \zeta_{j+1}^\eta, \text{ with i.i.d. } \zeta_{j+1}^\eta \sim N(0, \sigma_\eta^2) \quad (4)$$

$$\varepsilon_{ij+1} = \rho_\varepsilon \varepsilon_{ij} + \zeta_{j+1}^\varepsilon, \text{ with i.i.d. } \zeta_{j+1}^\varepsilon \sim N(0, \sigma_\varepsilon^2) \quad (5)$$

- Aggregate shock and idiosyncratic shock are uncorrelated

- After R working periods, households retire and receive retirement income
- Retirement income is modeled as

$$y_{ij} = \log(\lambda) + f_{iR} + \varepsilon_{iR} \quad (6)$$

where λ is a constant fraction, which differs by education group

- As in Cocco (2005), there is a constant house price growth (g) and house price shocks perfectly correlated with aggregate income shocks
- Housing services can be obtained by renting ($DR=1$) or owning ($DR=0$)
- Differences in house size for rental and owner-occupied housing
- Generally rental housing are smaller units (Gervais 2002)

$$h_j = \begin{cases} \in \{H_1, H_2, H_3\} & \text{if } DR = 1 \\ \in \{H_2, H_3, H_4, H_5\} & \text{if } DR = 0 \end{cases} \quad (7)$$

Housing II

- For $j \leq R$, households can choose to be a renter or an owner
- For $j > R$, homeowners decide whether to stay in the same house, downsize or become a renter. Renters can only rent and choose the size of the rental property
- Renters pay ϕ of the house value as rental cost per period
- Buying a house requires a long-term mortgage with fixed mortgage interest rate (**we track mortgage payments**)
- Households can choose their down payments

$$\theta^D = \begin{cases} \in \{0.1, 0.2, 0.5, 0.75, 1.0\} & \text{if } j \leq R \\ = 1 & \text{if } j > R \end{cases} \quad (8)$$

- Transaction costs: buyer (θ^B) and seller (θ^S)
- Annual maintenance costs (δ) and property tax rate (τ)

Tax-deferred Account (TDA) I

- For period $j \leq R$, households can contribute their pre-tax labor income to TDA, up to a limit (\bar{q} of labor income)
- Withdrawals from TDA are subject to income tax
- Early withdrawals prior to certain age ($R - 4$): penalty rate $pen = 10\%$ in addition to the ordinary income tax incurred
- After certain age ($R + 6$), minimum withdrawal rate applies
- q_j is a household's contributions to (withdrawal from) TDA

Tax-deferred Account (TDA) II

- Employers match employees' contributions
- Only applies up to 6% of an employee's labor income
- The employer's contribution (q_j^E) is

$$q_j^E = \begin{cases} \min(0.333 * q_j, 0.333 * 0.06 * Y_j) & \text{if } j \in [1, R] \text{ and } q_j > 0 \\ 0 & \text{otherwise} \end{cases} \quad (9)$$

- Assets earn a constant rate of return, r , in both TDA and TA. The law of motion of assets in TDA is

$$a_{j+1}^D = \begin{cases} (1+r)(a_j^D + q_j + q_j^E) & \text{if } j \leq R \\ (1+r)(a_j^D + q_j) & \text{if } j > R \end{cases} \quad (10)$$

Taxable Account (TA)

- a_j^T is the financial wealth in the TA plus current labor income. The law of motion of assets in the TA is

$$a_{j+1}^T = (1 + r) [a_j^T - c_j - x_j - q_j - \Gamma_j] + Y_{j+1} \quad (11)$$

- Both TDA and TA are subject to zero borrowing constraint

$$a_j^T \geq Y_j \text{ and } a_j^D \geq 0 \text{ for all } j \quad (12)$$

- Households are randomly endowed with initial wealth a_0^T when they are born
- The estate left by a household is

$$W_j = \begin{cases} a_j^T + a_j^D + (1 - \theta^S) P_j h_{j-1} - LL_{j-1} & \text{if } DR_{j-1} = 0 \\ a_j^T + a_j^D & \text{if } DR_{j-1} = 1 \end{cases} \quad (13)$$

- Income is taxed through a piece-wise linear progressive tax system
- Adjusted gross income (*AGI*) is defined as

$$AGI_j = \begin{cases} r \left(\frac{a_j^T - Y_j}{1+r} \right) + Y_j - q_j - l_j - \tau P_j h & \text{if } DR_j = 0 \\ r \left(\frac{a_j^T - Y_j}{1+r} \right) + Y_j - q_j & \text{if } DR_j = 1 \end{cases} \quad (14)$$

- Households also pay payroll taxes: payroll tax rate (τ_{ss}) and earnings limit subject to payroll tax (Y_{ss})
- The total tax liability of a household is defined as

$$\Gamma_j = \begin{cases} T(AGI_j) + \min(\tau_{ss} * Y_j, \tau_{ss} * Y_{ss}) - pen * q_j & \text{if } q_j < 0 \text{ and } j < (R - 4) \\ T(AGI_j) + \min(\tau_{ss} * Y_j, \tau_{ss} * Y_{ss}) & \text{otherwise} \end{cases} \quad (15)$$

Household Problem

A household's decision problem in recursive form is written as

$$\begin{aligned} & V(j, \eta_j, \varepsilon_j, a_j^T, a_j^D, DR_{j-1}, h_{j-1}, n, \tilde{p}_n, \theta_n^D) \\ = & \max_{c_j, q_j, DR_j, h_j, \theta_n^D} \frac{\left(c_j^{1-\omega} h_j^\omega\right)^{1-\gamma}}{1-\gamma} \\ & + \beta s_{j+1} E_j \left[V(j+1, \eta_{j+1}, \varepsilon_{j+1}, a_{j+1}^T, a_{j+1}^D, DR_j, h_j, n, \tilde{p}_n, \theta_n^D) \right] \\ & + \beta(1-s_{j+1}) \frac{(W_{j+1})^{1-\gamma}}{1-\gamma} \end{aligned} \quad (16)$$

Parametrization I

- All nominal variables are normalized to 2007 values
- Monetary variables are expressed as multiples of median income in period 1 (\$38,000 = 1)
- Housing sizes are {2,4,6,8,10} times of period 1 median income
- We use year 2000 income tax code

Table : Cutoff Points and Marginal Tax Rate

Taxable Income	Normalized Income	Marginal Tax Rate
(\$0, \$52,800]	(0, 1.389]	15%
(\$52,800, \$127,600]	(1.398, 3.357]	28%
(\$127,600, \$194,400]	(3.357, 5.116]	31%
(\$194,400, \$347,200]	(5.116, 9.137]	36%
> \$347,200	9.137 +	39.60%

Table : Summary of Parameter Values I

Parameters	Name	Values	Target / Data Source
Demographics			
J	Lifespan	71	Real age 25–95
R	Last working period	40	Work until age 64
s	Survival probability		Life table 2000
Preferences			
γ	Relative risk aversion	2	
β	Discount factor	0.96	
ω	Preferences on housing	0.2	Li and Yao (2007)
Income			
f	Age earnings profile		Cocco et al. (2005)
ρ_η	Persistence of aggr. income shock	0.748	Cocco (2005)
σ_η	s.d. aggregate income shock	0.019	Cocco (2005)
ρ_ε	Persistence of idio. income shock	0.973	Heathcote et al. (2010)
σ_ε	s.d. idiosyncratic income shock	0.133	Heathcote et al. (2010)
λ_{COL}	Income replacement rate	0.4	Diaz and Luengo-Prado (2008)
λ_{HS}	Income replacement rate	0.6	Diaz and Luengo-Prado (2008)

Table : Summary of Parameter Values II

Parameters	Name	Values	Target / Data Source
Savings			
r	Return on saving	2%	
Housing & mortgage			
N	Mortgage length	30	Chambers et al. (2009)
r_m	Mortgage interest rate	4.7%	
g	House price growth rate	1%	Cocco (2005)
$\sigma_{\bar{p}}$	s.d. house prices	6.2%	Cocco (2005)
θ^S	House trans. cost for seller	6%	
θ^B	House trans. cost for buyer	1.5%	
τ	Property tax rate	1%	
δ	Housing maintenance cost	1.5%	Yao and Zhang (2005)
ϕ	Rental cost of housing	6.5%	
TDA			
\bar{q}	Contributions limit	8%	Joulfaian and Richardson (2001)
pen	Penalty rate	10%	Zhou (2009)
Tax code			
τ_{ss}	Payroll tax rate		Historical OASDI tax rate
Y_{ss}	Earnings limit for payroll		Historical earnings limit

Figure : Home ownership rate for DC participants

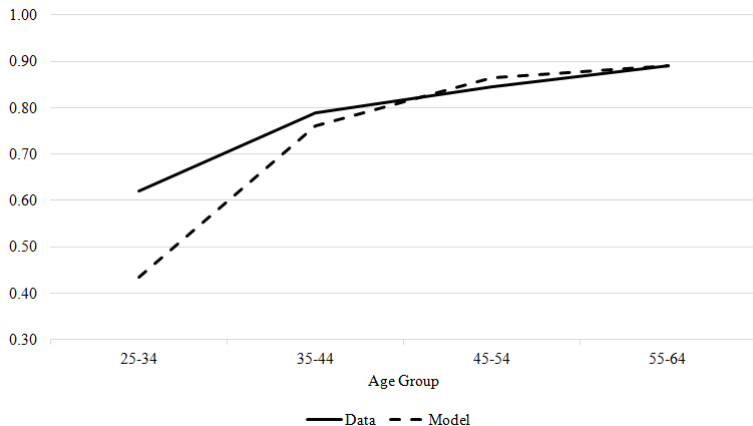
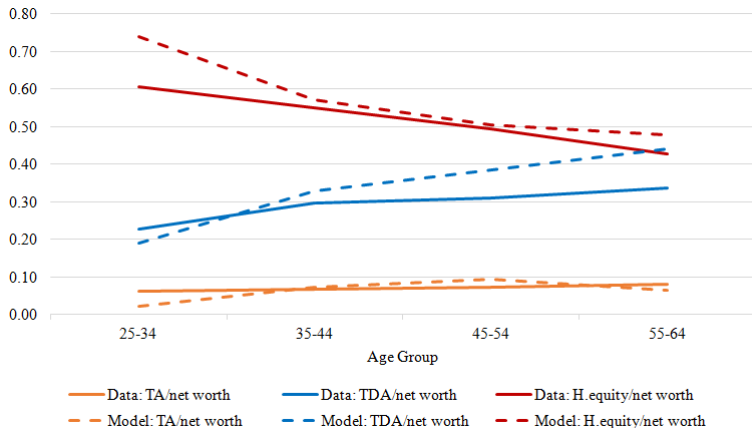


Figure : Net worth composition for homeowners



List of Experiments

- TDA policies
 - Eliminating TDA
 - Higher TDA contribution limit
 - No employer matching
- Housing-related factors
 - Increasing min. down payment
 - Increasing rental costs
 - No tax benefits for home ownership

Eliminate TDA

- Values for the benchmark model are normalized to 1

	Age Group				Overall
	25-34	35-44	45-54	55-64	
Net worth	0.468	0.758	0.878	0.872	0.818
TDA/net worth
TA/net worth	7.981	8.355	3.270	4.969	7.781
% of home ownership	0.380	0.564	0.746	0.900	0.685
Median income of owners	1.122	1.261	1.085	1.020	1.114
Home equity/net worth	1.169	1.376	1.478	1.410	1.363
Home equity/home value	1.504	2.414	1.520	1.053	1.765

Increase TDA contribution limit from 8% to 12%

- Values for the benchmark model are normalized to 1

	Age Group				Overall
	25-34	35-44	45-54	55-64	
Net worth	1.016	1.009	1.020	1.026	1.009
TDA/net worth	1.103	1.045	1.093	1.113	1.087
TA/net worth	0.835	0.838	0.786	0.634	0.752
% of home ownership	0.999	1.001	1.004	0.999	1.001
Median income of homeowner	0.999	0.999	1.000	1.000	1.000
Home equity/net worth	0.996	1.001	0.978	0.959	0.985
Home equity/home value	1.006	1.003	0.994	0.981	0.996

Eliminate employer matching

- Values for the benchmark model are normalized to 1

	Age Group				Overall
	25-34	35-44	45-54	55-64	
Net worth	0.921	0.926	0.936	0.934	0.946
TDA/net worth	0.426	0.755	0.770	0.814	0.742
TA/net worth	1.950	1.014	1.105	1.226	1.194
% of home ownership	1.031	1.010	1.010	1.006	1.012
Median income of homeowner	0.993	0.996	0.990	0.999	0.995
Home equity/net worth	1.151	1.132	1.131	1.119	1.127
Home equity/home value	1.023	1.016	1.031	1.039	1.026

Increase min. down payment from 10% to 20%

- Values for the benchmark model are normalized to 1

	Age Group				Overall
	25-34	35-44	45-54	55-64	
Net worth	0.885	0.997	0.995	0.995	0.998
TDA/net worth	1.117	0.938	0.967	0.985	0.981
TA/net worth	1.378	1.212	1.081	1.073	1.157
% of home ownership	0.728	0.924	0.982	0.998	0.932
Median income of owners	1.070	1.032	1.009	1.000	1.023
Home equity/net worth	1.044	1.037	1.011	1.002	1.007
Home equity/home value	1.339	1.094	0.997	0.957	1.062

Increase rental costs from 6.5% to 7%

- Values for the benchmark model are normalized to 1

	Age Group				Overall
	25-34	35-44	45-54	55-64	
Net worth	1.161	1.063	1.034	1.025	1.062
TDA/net worth	0.883	0.967	0.976	0.984	0.957
TA/net worth	0.848	0.915	0.955	0.970	0.930
% of home ownership	1.169	1.059	1.036	1.030	1.061
Median income of homeowner	0.966	0.975	0.975	0.995	0.981
Home equity/net worth	1.016	1.017	1.014	1.012	1.024
Home equity/home value	1.011	1.034	1.023	1.028	1.005

No tax benefits for home ownership

- Values for the benchmark model are normalized to 1

	Age Group				Overall
	25-34	35-44	45-54	55-64	
Net worth	0.728	0.892	0.946	0.971	0.922
TDA/net worth	1.175	0.863	0.901	0.957	0.956
TA/net worth	1.488	1.304	0.990	1.230	1.191
% of home ownership	0.600	0.756	0.864	0.918	0.810
Median income of owners	1.006	1.020	1.028	1.014	1.031
Home equity/net worth	1.054	1.131	1.107	1.040	1.065
Home equity/home value	1.138	1.248	1.394	1.053	1.450

Conclusion

- Quantitative life-cycle model to study the interaction between housing decisions and households' use of TDA
 - Earnings risk and housing price shocks
- Model explains the variation in household net worth composition over life-cycle
- TDA promotes home ownership and mortgage debt
- Home ownership rate and net worth composition adjust to TDA policies and housing-related factors