CENTER FOR
ECONOMIC
BEHAVIOR &
INEQUALITY

6. Housing

Adv. Macro: Heterogenous Agent Models

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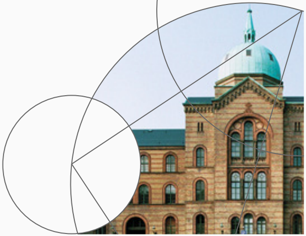
2022



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Introduction

Disclaimer

- Note: The views expressed in this presentation are those of the author and do not represent the views of the Federal Reserve Board or Federal Reserve System.

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- **Plan for today:** Discuss 'Implications of US Tax Policy for House Prices, Rents, and Homeownership' (Sommer & Sullivan, 2018)
  1. Develop a HA model with equilibrium house prices and rents
  2. Calibrate the model to match the US economy
  3. Study the effect of eliminating housing subsidies

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- But to what extent would repeal of MITD affect these outcomes?
- Depends on equilibrium change in the after-tax cost of homeownership

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  - get utility from consumption c and housing services s
  - receive exogenous labor income with wage w
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- Multiple overlapping generations
    - Population grows at constant rate $n = 0.01$
    - Total population evolves as $N' = (1 + n)N$

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- Households may rent a small unit of shelter, $\underline{s}$, smaller than the minimum house size that is available for purchase, so $\underline{s} < h(1)$.
- Renters can rent any of the larger shelter sizes on the housing grid. So that for renters, $s \in \{\underline{s}, h(1), \ldots, h(K)\}$.

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- The household's choices about the amount of housing services consumed relative to the housing stock owned determine whether the household is a:
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- Mortgage debt limited by $m' \leq (1 - \theta)qh'$

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$$v(w, d, m, h) = \max_{c, s, h' d', m'} U(c, s) + \beta \sum_{w' \in \mathcal{W}} \pi\left(w' \mid w\right) v\left(w', d', m', h'\right)$$

subject to

$$\begin{gathered} c + \rho\left(s - h'\right) + d' - m' + q\left(h' - h\right) + I^s \tau^s q h + I^b \tau^b q h' \\ \leq w + (1 + r) d - \left(1 + r^m\right) m - T(w, \tilde{y}) - \tau^h q h' - M\left(h'\right) - \phi I^{h' > s} \end{gathered}$$

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- H responds not only to increases in population but also to the counterfactual tax reforms studied in this paper.

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A stationary equilibrium is a collection of

1. value functions $v(x)$
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3. λ is a stationary distribution: $\lambda(x) = \int P(x, x') d\lambda$

Baseline calibration

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- Assume the following utility function:

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  - Set exogenous parameter values
  - Calibrate remaining parameters to match key moments
    - Homeownership rate
    - Landlord rate
    - Expenditure share on housing
    - Fraction of homeowners with mortgage debt

Exogenous parameters

TABLE 1—EXOGENOUS PARAMETERS

Parameter	Value
Autocorrelation of labor income shocks (ρ_w)	0.90
Standard deviation of labor income shocks (σ_w)	0.20
Risk aversion (σ)	2.50
Down payment requirement (θ)	0.20
Selling cost (τ^s)	0.07
Buying cost (τ^b)	0.025
Risk-free interest rate (r)	0.04
Mortgage interest rate spread (κ)	0.015
Maintenance cost rate (δ^h)	0.015
Payroll tax rate (τ^p)	0.076
Property tax rate (τ^h)	0.01
Mortgage deductibility rate (τ^m)	1.00
Deductibility rate for depreciation of rental property (τ^{LL})	0.023
Population growth rate (n)	0.01

TABLE 2—PROGRESSIVE TAX SYSTEM PARAMETERS

Tax parameter	
Panel A. Marginal rate	Bracket cutoff
$\eta_1 = 10\%$	\$0–\$8,350
$\eta_2 = 15\%$	\$8,350–\$33,950
$\eta_3 = 25\%$	\$33,950–\$82,250
$\eta_4 = 28\%$	\$82,250–\$171,550
$\eta_5 = 33\%$	\$171,550–\$371,950
$\eta_6 = 35\%$	> \$371,950
Panel B. Deduction	Amount
Personal exemption (e)	\$3,650
Standard deduction (ξ)	\$5,700

Internally calibrated Parameters

TABLE 3—PARAMETER VALUES

Parameter	Value
Panel A. Obtained by calibration	
Discount factor (β)	0.985
Consumption share (α)	0.685
Fixed cost for landlords (ϕ)	0.056
Panel B. Estimated by instrumental variables	
Housing supply elasticity (ε)	0.902
	(0.171)

Note: Standard error in parentheses.

TABLE 4—CALIBRATION TARGETS

Moment	Data	Model
Homeownership rate	0.65	0.65
Landlord rate	0.10	0.10
Expenditure share on housing	0.25	0.25
Fraction of homeowners with gross mortgage debt	0.65	0.65

Properties of baseline model

TABLE 5—MOMENTS NOT TARGETED IN ESTIMATION

	Waves of the SCF			
	1998 (1)	2007 (2)	2010 (3)	M
Median house value-to-income ratio	2.44	3.32	2.98	[illegible]
Median loan-to-income ratio	0.58	0.91	0.93	[illegible]
Median loan-to-value	0.28	0.31	0.37	[illegible]

Notes: Columns 1–3 show statistics from Survey of Consumer Finances. Column 4 show
tistics computed from the model.

Distribution of shelter consumption

Table 3: The Distribution of Shelter Consumption for Renters and Homeow

Size	Homeownership Status	
	(1) Renter ($h' = 0$)	(2) Owner ($h' > 0$)
$\underline{s}$	45.1	0.0
$h(1)$	53.5	17.6
$h(2)$	0.5	54.6
$h(3)$	0.01	13.3
$h(4)$	0.00	5.6
$\geq h(5)$	0.9	8.9

Notes: Entries are percentages (%).

Properties of baseline model

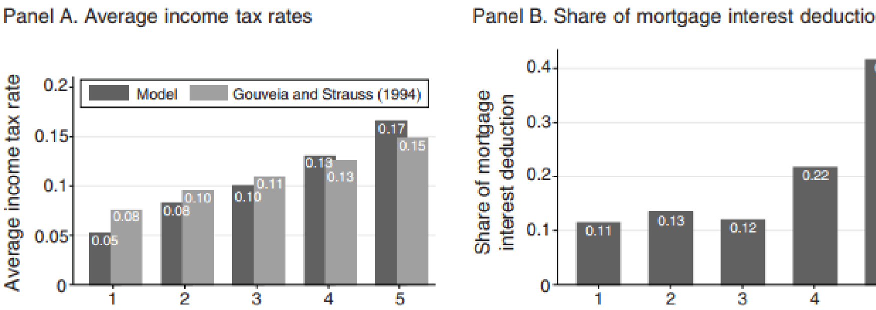

FIGURE 1. TAX RATES AND TAX DEDUCTIONS BY INCOME QUINTILES

- The largest benefits of MITD go to the top quintile

Counterfactual exercises

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  - Starting from this initial steady state, the mortgage interest deduction is unexpectedly and permanently repealed.
  - Compute the perfect foresight transition path that ends at new s.s.
    - All agents correctly forecast the sequence of house prices and rents, and markets clear in each period.

Effect of eliminating MITD

TABLE 6—THE EFFECT OF ELIMINATING THE MORTGAGE INTEREST TAX DEDUCTION

	Baseline (1)	Experiment (2)
House price	3.052	2.925
Rent	0.248	0.249
Price-rent ratio	12.320	11.715
Fraction homeowners	0.650	0.702
Fraction renter	0.350	0.297
Fraction owner-occupier	0.549	0.635
Fraction landlord	0.101	0.068
Median $\frac{\textit{house value}}{\textit{wage}}$	3.815	2.925
Fraction homeowners in debt	0.648	0.634
Average mortgage	2.815	1.931
Consumption equivalent variation (cev^*)	—	0.757%

Notes: Column 2 is the no-mortgage-deduction economy. cev^* is the ex ante consumption equivalent variation.

Eliminating MITD: change in housing by quintile

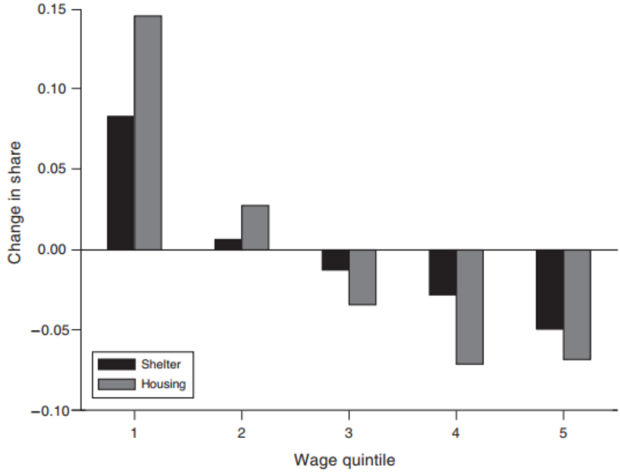

FIGURE 2. PERCENT CHANGE IN THE SHARE OF STEADY-STATE SHELTER CONSUMPTION AND HOUSING OWNERSHIP BY WAGE: ELIMINATION OF MORTGAGE INTEREST DEDUCTION

Transition dynamics

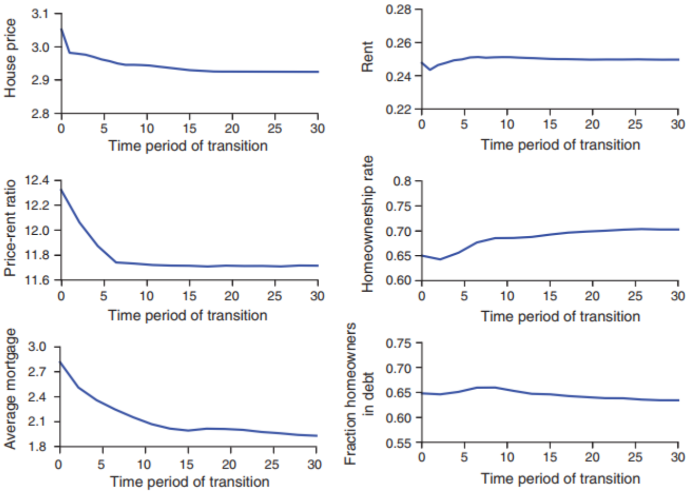

FIGURE 3. TRANSITIONAL DYNAMICS OF THE ECONOMY AFTER UNEXPECTED, PERMANENT ELIMINATION OF THE MORTGAGE INTEREST DEDUCTION AT $t = 1$

Welfare effects

Heterogeneous welfare effects

- How does the policy change affect household wellbeing?

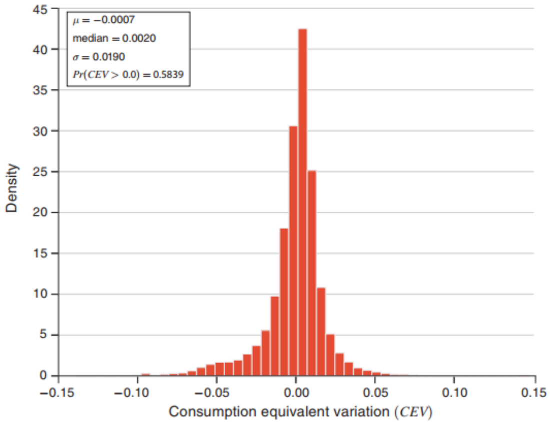

FIGURE 4. HISTOGRAM OF CONSUMPTION EQUIVALENT VARIATION (cev_i)

Heterogeneous welfare effects

TABLE 7—SUMMARY STATISTICS: WELFARE OVER THE TRANSITION

	$\mu(cev_i)$	$\sigma(cev_i)$	Fraction $cev_i > 0$
Initial housing tenure			
Renter	0.004	0.015	0.589
Occupier	0.001	0.015	0.655
Landlord	−0.027	0.027	0.184
All	−0.001	0.019	0.584
Initial mortgage			
Have mortgage	−0.005	0.020	0.547
No mortgage	0.002	0.020	0.663
Initial wage			
Wage top 15%	−0.009	0.029	0.539
Wage at median	0.001	0.015	0.639
Wage bottom 15%	0.001	0.014	0.531

Notes: cev_i refers to the ex post consumption equivalent variation. $\mu(cev_i)$ and $\sigma(cev_i)$ represent the mean and standard deviation.

Heterogeneous welfare effects

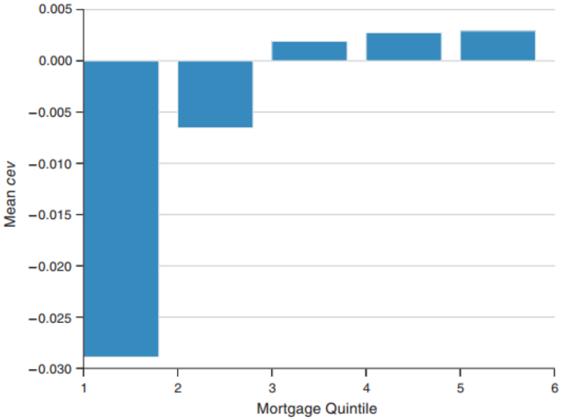

FIGURE 5. MEAN CONSUMPTION EQUIVALENT VARIATION (cev_i) BY INITIAL MORTGAGE QUINTILE

Note: Quintile 1 represents the largest mortgages.

Heterogeneous welfare effects

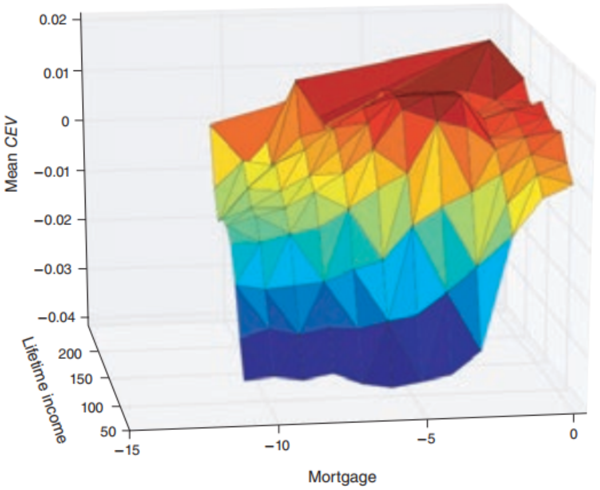

FIGURE 6. MEAN CONSUMPTION EQUIVALENT VARIATION (cev_i) BY INITIAL MORTGAGE AND LIFETIME INCOME

Effect on Taxes

TABLE 8—REVENUE NEUTRAL EXPERIMENT: ELIMINATING THE MORTGAGE INTEREST TAX DEDUCTION

		Eliminate MID	
	Baseline (1)	Experiment (2)	Revenue neutral (3)
House price	3.052	2.925	2.931
Rent	0.248	0.249	0.250
Price-rent ratio	12.320	11.715	11.715
Fraction homeowners	0.650	0.702	0.702
Consumption equivalent variation (cev^*)	—	0.757%	0.786%
$\%\Delta$ income tax revenue	0.000	2.596%	1.806%
$\%\Delta$ property tax revenue	0.000	−7.798%	−7.614%
$\%\Delta$ total tax revenue	0.000	0.598%	0.000%

Notes: Column 2 is the counterfactual no-mortgage-interest deduction economy. Column 3 is the revenue neutral no-mortgage-interest deduction economy. cev^* is the ex ante consumption equivalent variation. $\%\Delta$ indicates percent change relative to baseline model.

Conclusion

- Repealing tax subsidies to homeownership:
    - decreases housing consumption by the wealthy
    - lowers house prices
    - increases aggregate homeownership
    - improves overall welfare
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- Equilibrium effects very important
  - In a partial equilibrium model, the MITD would reduce the user cost of owner-occupied housing
  - But in an equilibrium model, the effect on house prices can undo this benefit for most households

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- **Homework:** finish assignment 1