CENTER FOR
ECONOMIC
BEHAVIOR &
INEQUALITY

8. Housing

Adv. Macro: Heterogenous Agent Models

Jeppe Druedahl & Patrick Moran

2023

Danmarks
Grundforskningsfond
Danish National
Research Foundation

Introduction

Housing

- **Previously:** HA models with equilibrium interest rates

Housing

- **Previously:** HA models with equilibrium interest rates
- **Today:** Learn to apply these methods to study housing markets

Housing

- **Previously:** HA models with equilibrium interest rates
- **Today:** Learn to apply these methods to study housing markets
- **Central economic questions:**
  1. How do tax subsidies to housing affect the homeownership rate?
  2. What are the distributional consequences of housing subsidies?
  3. Should these tax subsidies be repealed?

Housing

- **Previously:** HA models with equilibrium interest rates
- **Today:** Learn to apply these methods to study housing markets
- **Central economic questions:**
  1. How do tax subsidies to housing affect the homeownership rate?
  2. What are the distributional consequences of housing subsidies?
  3. Should these tax subsidies be repealed?
- **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

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.

Motivation

Motivation

- Many governments provide substantial tax incentives to homeownership

Motivation

- Many governments provide substantial tax incentives to homeownership
- In the US, the mortgage interest tax deduction (MITD) is a \$90 billion subsidy to homeowners

Motivation

- Many governments provide substantial tax incentives to homeownership
- In the US, the mortgage interest tax deduction (MITD) is a \$90 billion subsidy to homeowners
- This subsidy represents 7% of total personal income tax payments

Motivation

- Many governments provide substantial tax incentives to homeownership
- In the US, the mortgage interest tax deduction (MITD) is a $90 billion subsidy to homeowners
- This subsidy represents 7% of total personal income tax payments
- Ongoing debate about whether this subsidy should be eliminated
  - Propoents: MITD reduces government revenue, is a regressive tax policy, and subsidizes mortgage debt
  - Opponents: argue that repealing MITD would depress homeownership and reduce social welfare

Motivation

- Many governments provide substantial tax incentives to homeownership
- In the US, the mortgage interest tax deduction (MITD) is a $90 billion subsidy to homeowners
- This subsidy represents 7% of total personal income tax payments
- Ongoing debate about whether this subsidy should be eliminated
  - Propoents: MITD reduces government revenue, is a regressive tax policy, and subsidizes mortgage debt
  - Opponents: argue that repealing MITD would depress homeownership and reduce social welfare
- But to what extent would repeal of MITD affect these outcomes?

Motivation

- Many governments provide substantial tax incentives to homeownership
- In the US, the mortgage interest tax deduction (MITD) is a $90 billion subsidy to homeowners
- This subsidy represents 7% of total personal income tax payments
- Ongoing debate about whether this subsidy should be eliminated
  - Propoents: MITD reduces government revenue, is a regressive tax policy, and subsidizes mortgage debt
  - Opponents: argue that repealing MITD would depress homeownership and reduce social welfare
- But to what extent would repeal of MITD affect these outcomes?
- Depends on equilibrium change in the after-tax cost of homeownership

Model

Model

- Households
  - get utility from consumption c and housing services s
  - receive exogenous labor income with wage w
  - can save in deposits d or purchase housing h
  - can borrow using mortgages m

Model

- Households
  - get utility from consumption c and housing services s
  - receive exogenous labor income with wage w
  - can save in deposits d or purchase housing h
  - can borrow using mortgages m
- Multiple overlapping generations
  - Population grows at constant rate $n = 0.01$
  - Total population evolves as $N' = (1 + n)N$

Asset structure

- Houses available in discrete sizes $h \in \{0, h(1), \ldots, h(K)\}$

Asset structure

- Houses available in discrete sizes $h \in \{0, h(1), \ldots, h(K)\}$
- Houses can be purchased at a market price q per unit of housing.

Asset structure

- Houses available in discrete sizes $h \in \{0, h(1), \ldots, h(K)\}$
- Houses can be purchased at a market price q per unit of housing.
- A linear technology exists that transforms one unit of owned housing stock, h', into one unit of shelter services, s.

Asset structure

- Houses available in discrete sizes $h \in \{0, h(1), \ldots, h(K)\}$
- Houses can be purchased at a market price q per unit of housing.
- A linear technology exists that transforms one unit of owned housing stock, h', into one unit of shelter services, s.
- Households can choose to purchase housing services, s, in the rental market.

Asset structure

- Houses available in discrete sizes $h \in \{0, h(1), \ldots, h(K)\}$
- Houses can be purchased at a market price q per unit of housing.
- A linear technology exists that transforms one unit of owned housing stock, h', into one unit of shelter services, s.
- Households can choose to purchase housing services, s, in the rental market.
- Households may rent a small unit of shelter, $\underline{s}$, smaller than the minimum house size that is available for purchase, so $\underline{s} < h(1)$.

Asset structure

- Houses available in discrete sizes $h \in \{0, h(1), \ldots, h(K)\}$
- Houses can be purchased at a market price q per unit of housing.
- A linear technology exists that transforms one unit of owned housing stock, h', into one unit of shelter services, s.
- Households can choose to purchase housing services, s, in the rental market.
- 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, $s \in \{\underline{s}, h(1), \ldots, h(K)\}$.

Asset structure

- The household's choices about the amount of housing services consumed relative to the housing stock owned determine whether the household is a:
  - renter ($h' = 0$)
  - owner-occupier ($h' = s$)
  - landlord ($h' > s$).

Asset structure

- The household's choices about the amount of housing services consumed relative to the housing stock owned determine whether the household is a:
  - renter ($h' = 0$)
  - owner-occupier ($h' = s$)
  - landlord ($h' > s$).
- Landlords lease ($h' - s$) units of shelter to renters at rental rate ρ
  - supply of rental property in the market is endogenously determined.

Asset structure

- The household's choices about the amount of housing services consumed relative to the housing stock owned determine whether the household is a:
  - renter ($h' = 0$)
  - owner-occupier ($h' = s$)
  - landlord ($h' > s$).
- Landlords lease ($h' - s$) units of shelter to renters at rental rate ρ
  - supply of rental property in the market is endogenously determined.
- Mortgage debt limited by $m' \leq (1 - \theta)qh'$

Household optimization problem

- Households enter each period with a stock of owned housing, $h \geq 0$, deposits, $d \geq 0$, and mortgage debt, $m \geq 0$.

Household optimization problem

- Households enter each period with a stock of owned housing, $h \geq 0$, deposits, $d \geq 0$, and mortgage debt, $m \geq 0$.
- Then observes its idiosyncratic wage shock, w, and, given the current prices (q, ρ), solves the problem:

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

Household optimization problem

- Households enter each period with a stock of owned housing, $h \geq 0$, deposits, $d \geq 0$, and mortgage debt, $m \geq 0$.
- Then observes its idiosyncratic wage shock, w, and, given the current prices (q, ρ), solves the problem:

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

- subject to

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

Budget constraint

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

- $\rho(s - h')$ is rental payment/income

Budget constraint

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

- $\rho(s - h')$ is rental payment/income
- $q(h' - h)$ is the house price times change in housing stock

Budget constraint

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

- $\rho(s - h')$ is rental payment/income
- $q(h' - h)$ is the house price times change in housing stock
- Two transaction costs: when sold ($\tau^s qh$) or bought ($\tau^s qh\prime$)

Budget constraint

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

- $\rho(s - h')$ is rental payment/income
- $q(h' - h)$ is the house price times change in housing stock
- Two transaction costs: when sold ($\tau^s qh$) or bought ($\tau^s qh\prime$)
- Income tax $T(w, \tilde{y})$ and property tax $\tau^h qh'$

Budget constraint

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

- $\rho(s - h')$ is rental payment/income
- $q(h' - h)$ is the house price times change in housing stock
- Two transaction costs: when sold ($\tau^s qh$) or bought ($\tau^s qh\prime$)
- Income tax $T(w, \tilde{y})$ and property tax $\tau^h qh'$
- $M(h')$ maintenance expense for homeowners

Budget constraint

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

- $\rho(s - h')$ is rental payment/income
- $q(h' - h)$ is the house price times change in housing stock
- Two transaction costs: when sold ($\tau^s qh$) or bought ($\tau^s qh\prime$)
- Income tax $T(w, \tilde{y})$ and property tax $\tau^h qh'$
- $M(h')$ maintenance expense for homeowners
- ϕ fxed cost incurred by landlords

Other constraints

- Collateral requirement for mortgages

$$m' \leq (1 - \theta) q h'$$

Other constraints

- Collateral requirement for mortgages

$$m' \leq (1-\theta) q h'$$

- And other constraints

$$m' \geq 0$$

$$d' \geq 0$$

$$h' \geq s \text{ if } h' > 0$$

Tax benefits to ownership

- **Goal:** capture the broad features of the US tax system
  - progressive income taxation
  - differential tax treatment of homeowners, landlords, and renters.

Tax benefits to ownership

- **Goal:** capture the broad features of the US tax system
    - progressive income taxation
    - differential tax treatment of homeowners, landlords, and renters.
- Taxable income is $\tilde{y} = y - \psi(j)$, for $j \in \mathit{Rent}, \mathit{Own}, \mathit{Landlord}$

Tax benefits to ownership

- **Goal:** capture the broad features of the US tax system
    - progressive income taxation
    - differential tax treatment of homeowners, landlords, and renters.
- Taxable income is $\tilde{y} = y - \psi(j)$, for $j \in \mathit{Rent}, \mathit{Own}, \mathit{Landlord}$
- Deduction $\psi(j)$ allowed to vary for each group

Tax benefits to ownership

- **Goal:** capture the broad features of the US tax system
    - progressive income taxation
    - differential tax treatment of homeowners, landlords, and renters.
- Taxable income is $\tilde{y} = y - \psi(j)$, for $j \in \mathit{Rent}, \mathit{Own}, \mathit{Landlord}$
- Deduction $\psi(j)$ allowed to vary for each group
    - Homeowners can deduct mortgage interest payments

Tax benefits to ownership

- **Goal:** capture the broad features of the US tax system
  - progressive income taxation
  - differential tax treatment of homeowners, landlords, and renters.
- Taxable income is $\tilde{y} = y - \psi(j)$, for $j \in \mathit{Rent}, \mathit{Own}, \mathit{Landlord}$
- Deduction $\psi(j)$ allowed to vary for each group
  - Homeowners can deduct mortgage interest payments
  - Homeowners can deduct property taxes

$$\psi(\mathit{Own}) = \left[e + \max\left\{ \xi, \tau^m r^m m \left(\frac{s}{h'} \right) + \tau^h q s \right\} \right]$$

Housing Supply

- Residential investment, I, is proportional to the current stock of housing, H

$$I = f(q, \varepsilon)H$$

Housing Supply

- Residential investment, I, is proportional to the current stock of housing, H

$$I = f(q, \varepsilon)H$$

- $f(q, \varepsilon)$ constant elasticity supply function for residential investment

Housing Supply

- Residential investment, I, is proportional to the current stock of housing, H

$$I = f(q, \varepsilon)H$$

- $f(q, \varepsilon)$ constant elasticity supply function for residential investment
- ε is elasticity of residential investment w.r.t house price (q)

Housing Supply

- Residential investment, I, is proportional to the current stock of housing, H

$$I = f(q, \varepsilon)H$$

- $f(q, \varepsilon)$ constant elasticity supply function for residential investment
- ε is elasticity of residential investment w.r.t house price (q)
- A linear technology translates residential investment into housing:

$$H' = H + I$$

Housing Supply

- Residential investment, I, is proportional to the current stock of housing, H

$$I = f(q, \varepsilon)H$$

- $f(q, \varepsilon)$ constant elasticity supply function for residential investment
- ε is elasticity of residential investment w.r.t house price (q)
- A linear technology translates residential investment into housing:

$$H' = H + I$$

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

Stationary Equilibrium

Key definitions

- State variables $x = (w, d, m, h)$ are wage, deposits, mortgage, and housing stock holdings

Stationary Equilibrium

Key definitions

- State variables $x = (w, d, m, h)$ are wage, deposits, mortgage, and housing stock holdings
- Let $\lambda(x)$ indicate the distribution of households with different state variables.

Stationary Equilibrium

Key definitions

- State variables $x = (w, d, m, h)$ are wage, deposits, mortgage, and housing stock holdings
- Let $\lambda(x)$ indicate the distribution of households with different state variables.
- Let $P(x, x')$ defne the transition function, ie the probability that a household with state x will have state $x^{'}$ next period

Stationary Equilibrium

A stationary equilibrium is a collection of

1. value functions $v(x)$
2. household policy functions$c(x), s(x), d\prime(x), m\prime(x), h\prime(x)$
3. probability measure, λ, over the distribution of households
4. price vector $(q*, \rho*)$

Stationary Equilibrium

A stationary equilibrium is a collection of

1. value functions $v(x)$
2. household policy functions$c(x), s(x), d\prime(x), m\prime(x), h\prime(x)$
3. probability measure, λ, over the distribution of households
4. price vector $(q*, \rho*)$

such that:

1. $c(x), s(x), d\prime(x), m\prime(x), h\prime(x)$ are optimal decision rules to the households' decision problem, given prices $q*$ and $\rho*$.

Stationary Equilibrium

A stationary equilibrium is a collection of

1. value functions $v(x)$
2. household policy functions$c(x), s(x), d\prime(x), m\prime(x), h\prime(x)$
3. probability measure, λ, over the distribution of households
4. price vector $(q*, \rho*)$

such that:

1. $c(x), s(x), d\prime(x), m\prime(x), h\prime(x)$ are optimal decision rules to the households' decision problem, given prices $q*$ and $\rho*$.
2. Markets clear:
   - 2.1 Housing market clearing: $\int h\prime(x) d\lambda = H$,
   - 2.2 Rental market clearing: $\int (h\prime(x) - s(x)) d\lambda = 0$

Stationary Equilibrium

A stationary equilibrium is a collection of

1. value functions $v(x)$
2. household policy functions$c(x), s(x), d\prime(x), m\prime(x), h\prime(x)$
3. probability measure, λ, over the distribution of households
4. price vector $(q*, \rho*)$

such that:

1. $c(x), s(x), d\prime(x), m\prime(x), h\prime(x)$ are optimal decision rules to the households' decision problem, given prices $q*$ and $\rho*$.
2. Markets clear:
   - 2.1 Housing market clearing: $\int h\prime(x)d\lambda = H$,
   - 2.2 Rental market clearing: $\int (h\prime(x) - s(x))d\lambda = 0$
3. λ is a stationary distribution: $\lambda(x) = \int P(x, x')d\lambda$

Baseline calibration

Calibration

- Assume the following utility function:

$$U(c, s) = \frac{\left(c^{\alpha} s^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}$$

Calibration

- Assume the following utility function:

$$U(c, s) = \frac{\left(c^{\alpha} s^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}$$

- Two stage parameterization

Calibration

- Assume the following utility function:

$$U(c, s) = \frac{\left(c^{\alpha} s^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}$$

- Two stage parameterization
  - Set exogenous parameter values

Calibration

- Assume the following utility function:

$$U(c,s) = \frac{\left(c^{\alpha} s^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}$$

- Two stage parameterization
  - 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)	Model (4)
Median house value-to-income ratio	2.44	3.32	2.98	2.54
Median loan-to-income ratio	0.58	0.91	0.93	0.78
Median loan-to-value	0.28	0.31	0.37	0.26

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

Distribution of housing consumption

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

	Homeownership Status	
Size	(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

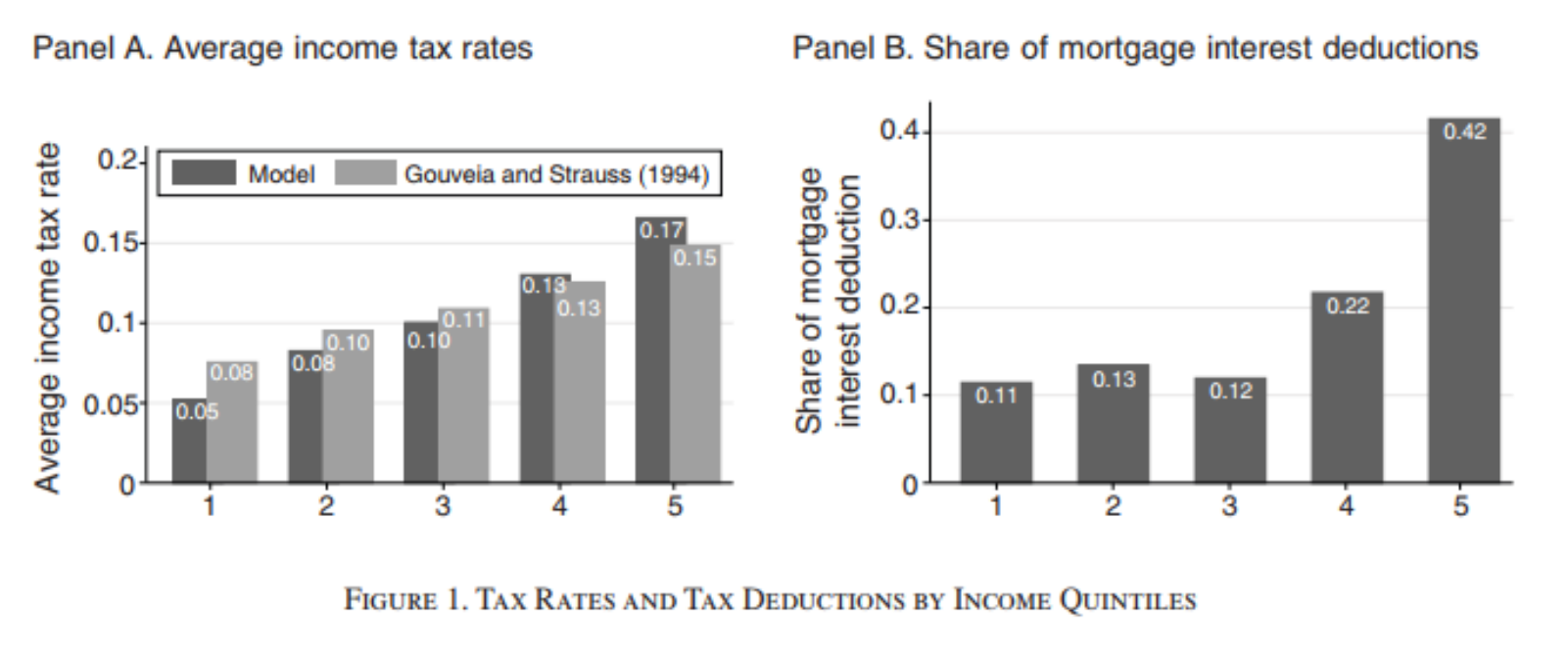

FIGURE 1. TAX RATES AND TAX DEDUCTIONS BY INCOME QUINTILES

- The largest benefits of MITD go to the top quintile

Counterfactual exercises

Counterfactual exercises

- Compare the baseline economy to the new steady-state equilibrium after the mortgage interest deduction is repealed

Counterfactual exercises

- Compare the baseline economy to the new steady-state equilibrium after the mortgage interest deduction is repealed

- Compute the dynamic transition path from the unexpected reform

Counterfactual exercises

- Compare the baseline economy to the new steady-state equilibrium after the mortgage interest deduction is repealed

- Compute the dynamic transition path from the unexpected reform

    - The counterfactual experiment begins with the economy in the baseline steady state where mortgage interest is tax-deductible.

Counterfactual exercises

- Compare the baseline economy to the new steady-state equilibrium after the mortgage interest deduction is repealed

- Compute the dynamic transition path from the unexpected reform

    - The counterfactual experiment begins with the economy in the baseline steady state where mortgage interest is tax-deductible.

    - Starting from this initial steady state, the mortgage interest deduction is unexpectedly and permanently repealed.

Counterfactual exercises

- Compare the baseline economy to the new steady-state equilibrium after the mortgage interest deduction is repealed
- Compute the dynamic transition path from the unexpected reform
  - The counterfactual experiment begins with the economy in the baseline steady state where mortgage interest is tax-deductible.
  - 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.

Counterfactual exercises

- Compare the baseline economy to the new steady-state equilibrium after the mortgage interest deduction is repealed
- Compute the dynamic transition path from the unexpected reform
  - The counterfactual experiment begins with the economy in the baseline steady state where mortgage interest is tax-deductible.
  - 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 housing subsidy

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 $\frac{house\ value}{wage}$	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 housing subsidy: change in housing by quintile

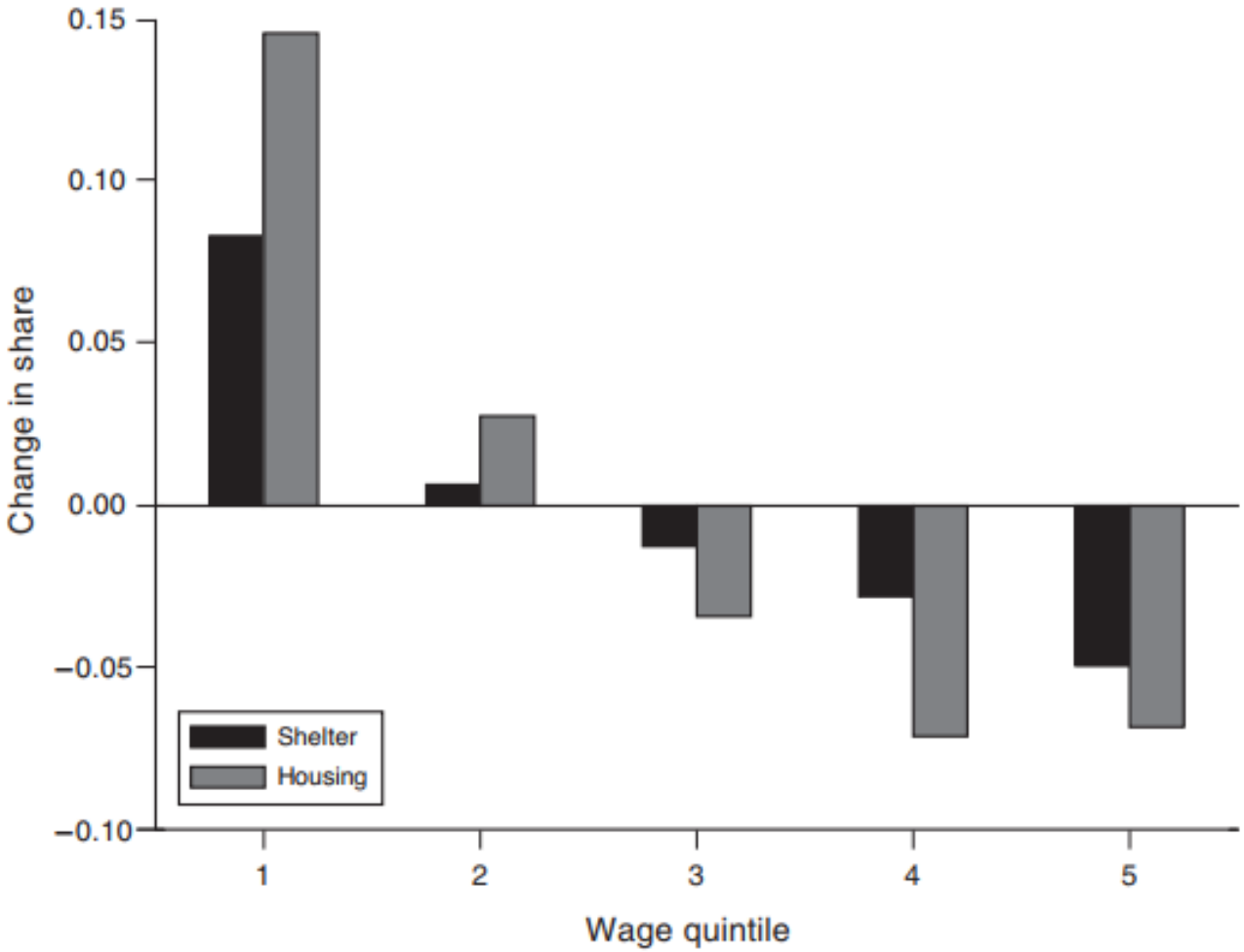

FIGURE 2. PERCENT CHANGE IN THE SHARE OF STEADY-STATE SHELTER CONSUMPTION AND HOUSING OWNERSHIP BY WAGE: ELIMINATION OF MORTGAGE INTEREST DEDUCTION

Transition dynamics

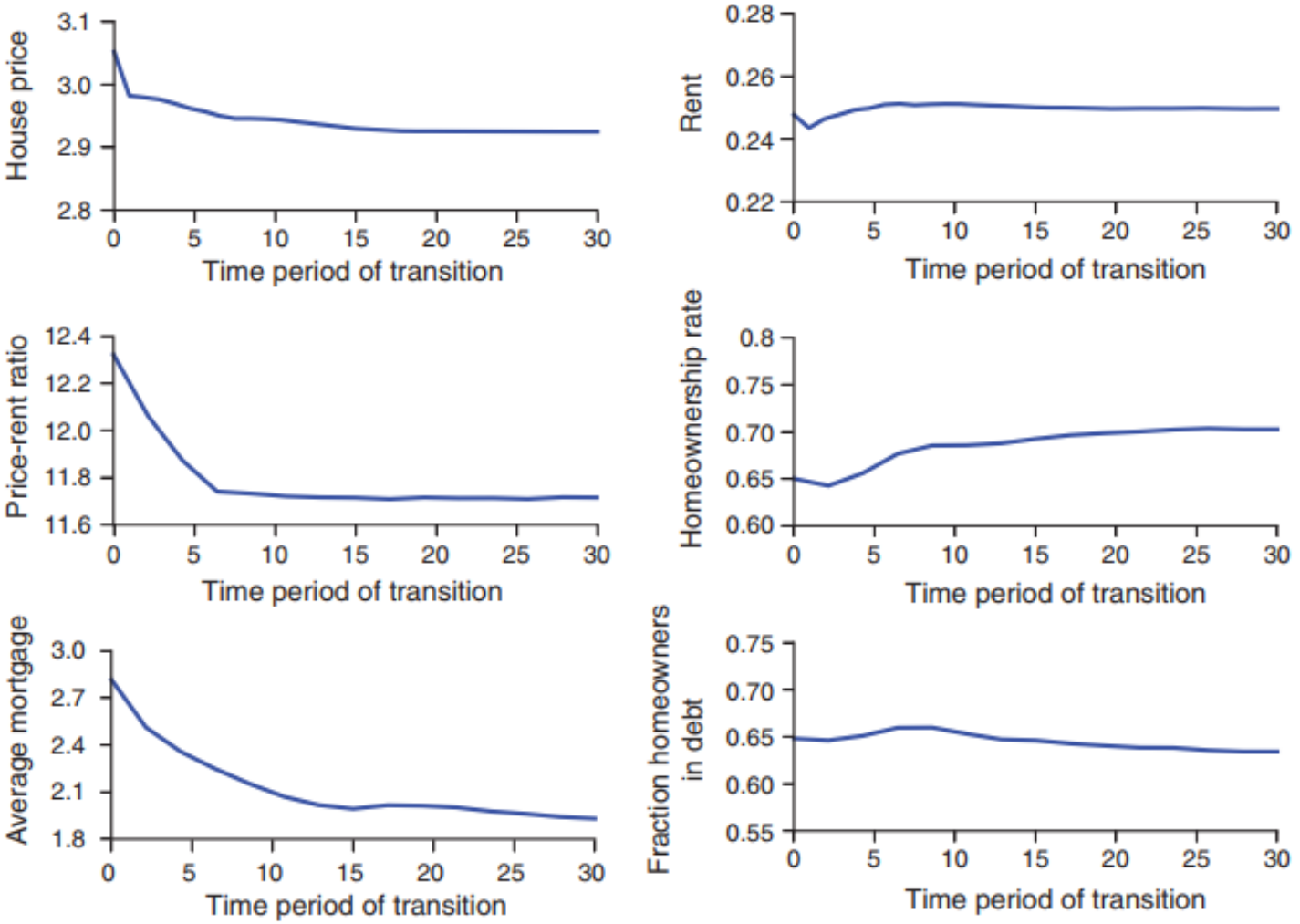

FIGURE 3. TRANSITIONAL DYNAMICS OF THE ECONOMY AFTER UNEXPECTED, PERMANENT ELIMINATION OF THE MORTGAGE INTEREST DEDUCTION AT $t = 1$

Welfare effects

Heterogeneous welfare effects

- How does the policy change affect household wellbeing?

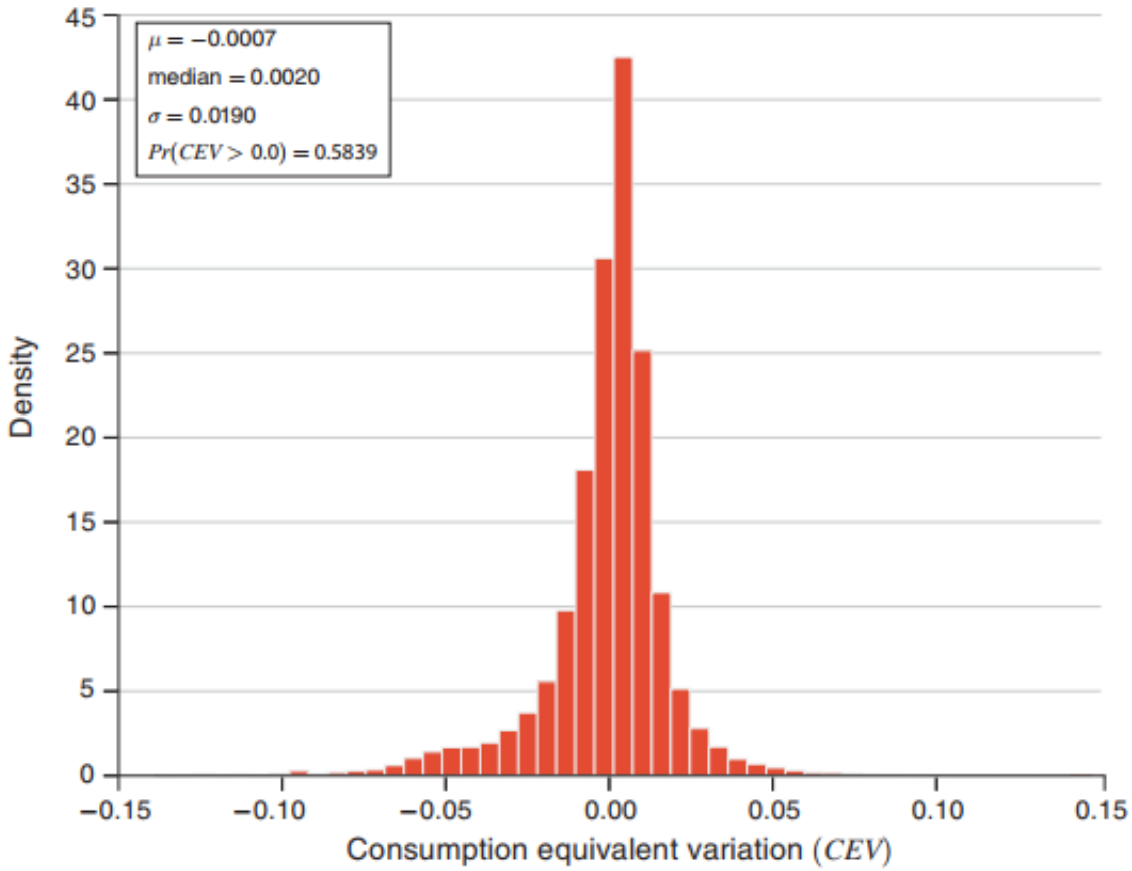

FIGURE 4. HISTOGRAM OF CONSUMPTION EQUIVALENT VARIATION (cev_i)

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

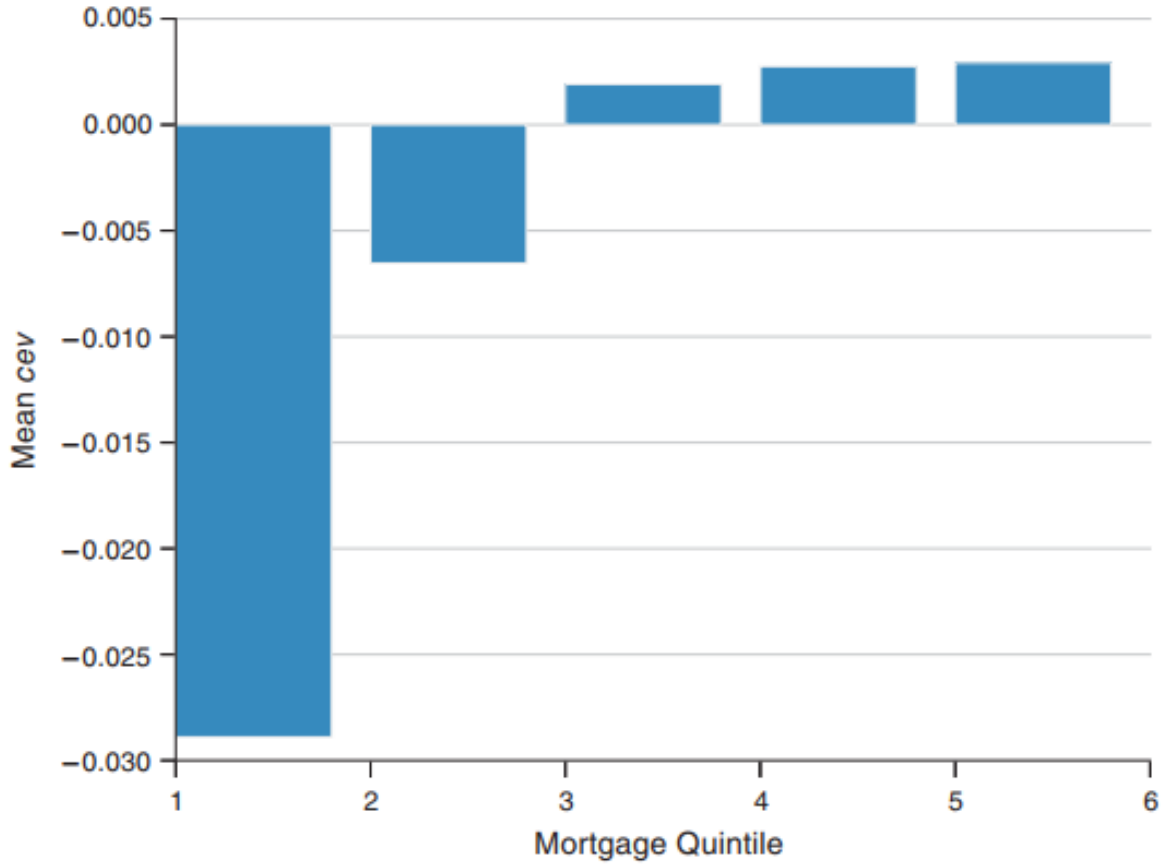

FIGURE 5. MEAN CONSUMPTION EQUIVALENT VARIATION (cev_i) BY INITIAL MORTGAGE QUINTILE

Note: Quintile 1 represents the largest mortgages.

Heterogeneous welfare effects

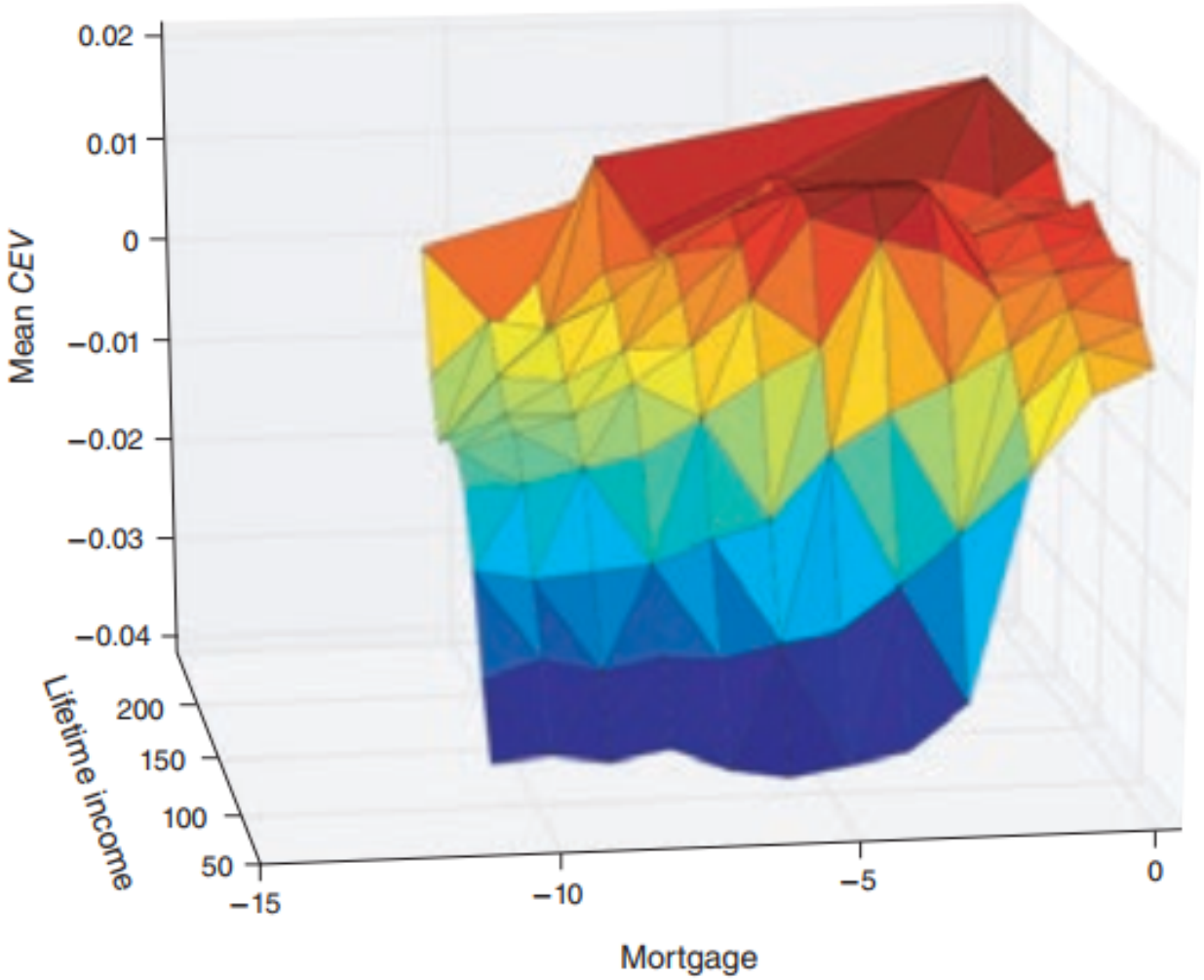

FIGURE 6. MEAN CONSUMPTION EQUIVALENT VARIATION (cev_i) BY INITIAL MORTGAGE AND LIFETIME INCOME

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%
%Δ income tax revenue	0.000	2.596%	1.806%
%Δ property tax revenue	0.000	−7.798%	−7.614%
%Δ 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. %Δ 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
  - reduces aggregate mortgage debt

Conclusion

- Repealing tax subsidies to homeownership:
  - decreases housing consumption by the wealthy
  - lowers house prices
  - increases aggregate homeownership
  - improves overall welfare
  - reduces aggregate mortgage debt

- 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

Summary

Summary

- **Previously:** Learned to compute a stationary equilibrium in an Aiyagari economy

Summary

- **Previously:** Learned to compute a stationary equilibrium in an Aiyagari economy

- **Today:** Learned how to apply these methods to study housing policy

    1. Developed a model with equilibrium house prices and rents

    2. Studied the effect of removing housing subsidies

    3. Considered the differential welfare effects of the policy