Distributional Effect of Land Taxation

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Land Taxation

- Land taxation is a tax imposed on the value of land, excluding buildings, personal property, or other improvements
- Since Henry George, land value taxation has been popular due to its non-distortive nature
- Since land simply exists, taxing its rent would not harm any productive incentives

Land Taxation

- However, the impact of land taxation extends beyond simply collecting a non-distortive tax on existing land
- Under the no-arbitrage condition, a declining after-tax return lowers the value of the land itself
- The **general equilibrium effect** of declining land value through the asset market has been rarely explored

Land as an asset

- In the **U.S.**, approximately 25% of a household's net worth can be attributed to **residential land value** (Davis and Heathcote (2007))
- This "asset stock" from land can **crowd out** savings in the form of production capital when there is a precautionary or life-cycle saving motive
- If land value in the economy is reduced through land taxation, it would promote saving in the form of production capital, increasing aggregate production and wages

Pecuniary Externality

- While taxing capital—typically serving a redistributive purpose—reduces long-run capital stock and production, land taxation may **enhance both long-run production and redistribution**

- Additional capital accumulation can improve welfare through a **pecuniary externality** from increased wages even during the transition in a heterogeneous agent model, as poor households primarily rely on wages (Dávila, Hong, Krusell, and Ríos-Rull, 2012)

- Then, why is it so rare?

Implementation of Land Taxation

- Pure land value tax - Estonia
- Mixed with Property Tax - Denmark, Hungary, some states in U.S., Austrailia
- Average property tax takes only 1.09% of GDP on average in OECD countries

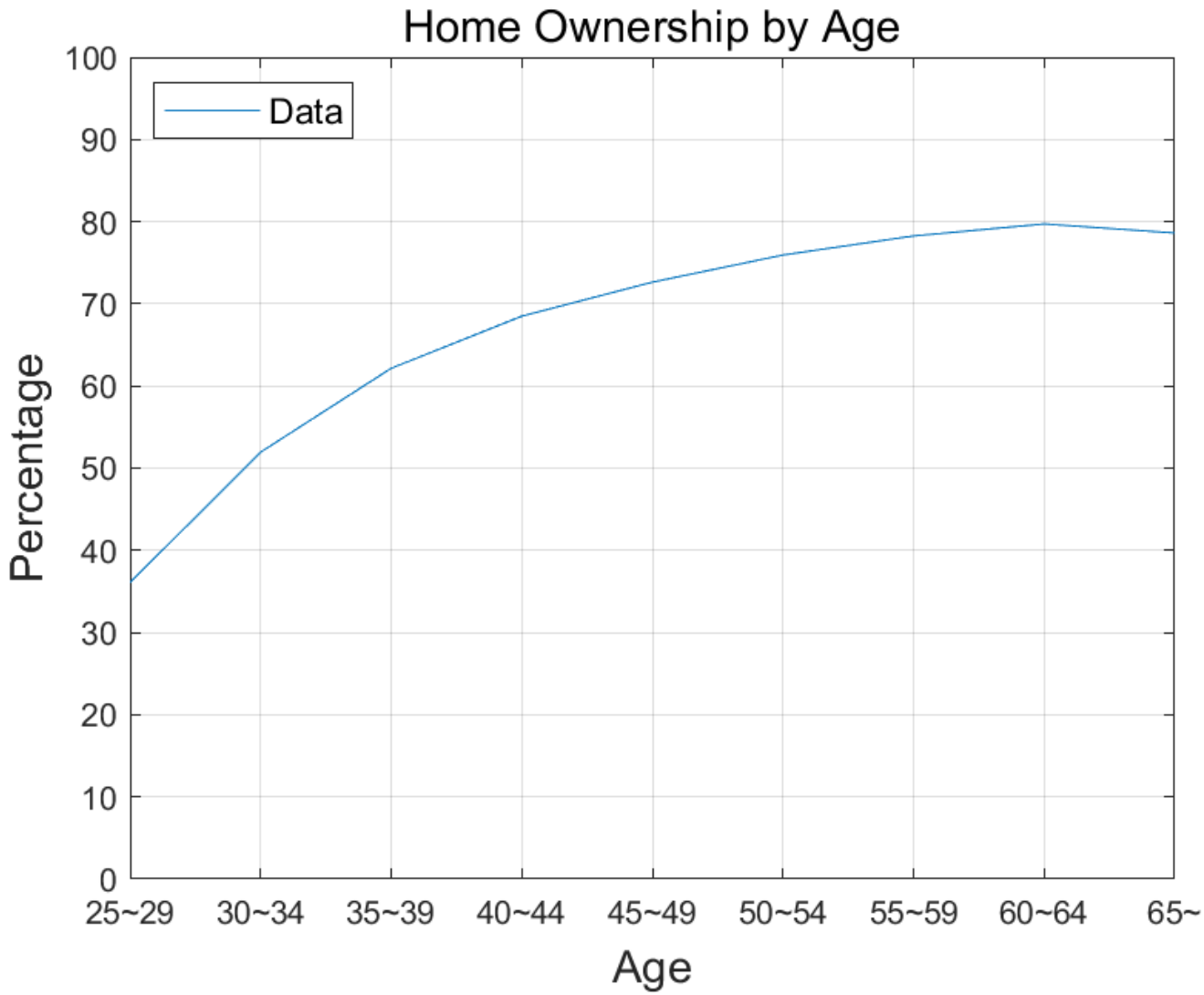
Asset Composition

- Land taxation causes an initial house price crash, **harming homeowners**. Additionally, homeownership rates and housing share of the net worth vary significantly across age and wealth groups
- While low-wealth non-homeowners are unaffected by the price crash, low-wealth homeowners—who typically have a larger share of their wealth in housing—are significantly worse off
- As a result, the welfare effect of land taxation during the transition is ultimately a quantitative question

Effect of Land Taxation

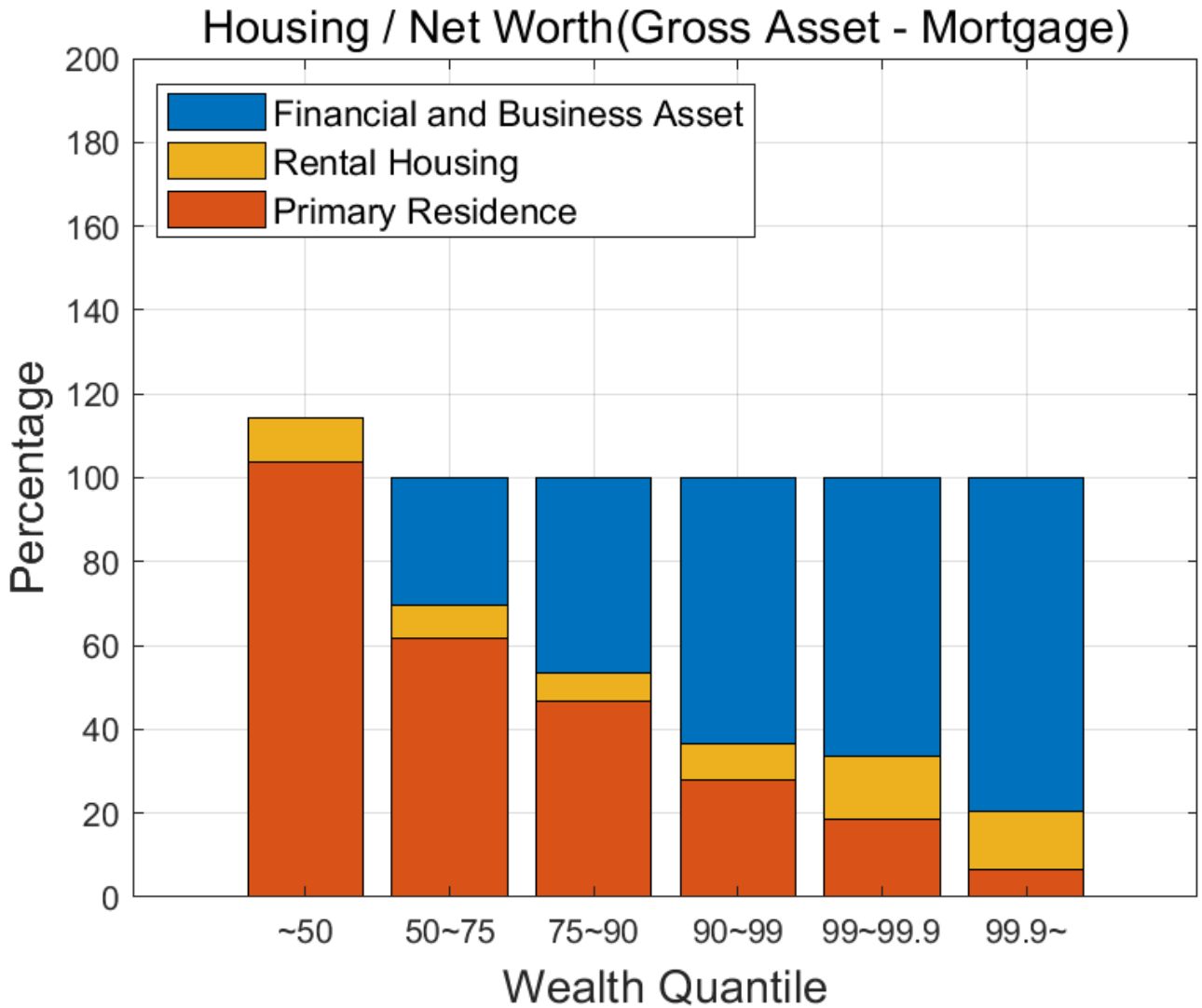
Pros	Cons
Promote additional capital accumulation with a tax on wealth	Large initial asset shock through housing price crash
Additional redistributional effect through increased wage	Large share of housing in wealth-poor homeowners' asset

Home Ownership Rate by Age



Source: CPS/Housing Vacancy Survey, average from 1982 to 2023

Housing Share by Wealth Quantile



Source: Piketty, Saez, and Zucman (2018) microdata, average from 1980 to 2019

Objective

- Analyze the general equilibrium effects of land taxation using a heterogeneous-agent overlapping generations model that incorporates land, capital, and a realistic asset composition
- Examine how aggregate macroeconomic variables evolve along the transition path in response to land taxation
- Identify the welfare effects across different age groups and wealth quantiles

Summary of Results

- With a land taxation policy that halves land value and replaces the labor tax, steady-state production and wages increase by 13.1%.
- The welfare Effect, measured as consumption-equivalent variation (ΔCEV), is $+14.26\%$ in the steady state and $+2.77\%$ including transition
- The policy cannot secure a majority vote from the living population, as most homeowners are worse off under the taxation (35.7% approval)

Literature Review

- Capital accumulation through land taxation is not a new idea, but its implementation remains very limited
- Feldstein (1977) - Fixed saving rate
- Edenhofer et al. (2015) - Perpetual youth model, no heterogeneity, no quantitative results

Literature Review

- The broader literature on housing and property taxation lacks some elements of this paper
- Gervais (2002), Nakajima (2020) - Housing comes purely from capital, so housing price is numeraire
- Fleototto et al. (2016), Sommer and Sullivan (2018) - Have housing price dynamics, but exclude production capital

Model

Household Preference

- Analyze the welfare effect of land taxation under circumstances that replicate the asset composition observed in the data.
- The main target is housing asset holdings across households, considering life-cycle dynamics and asset inequality.
- When housing is a necessity good (i.e., when the utility for housing services is more concave), we can replicate the decreasing housing asset share among wealthier households.

$$U(c,h) = (1-w_h)\frac{c^{1-\sigma_c}}{1-\sigma_c} + w_h\frac{h^{1-\sigma_h}}{1-\sigma_h}$$

Households

- Each household can invest in three types of assets, $\{O', R', S'\}$: primary residence, rental housing, and financial assets, and receive a stochastic return

- When a household owns a home, her consumption of housing service is equal to the amount of O'

$$V_o(a, z, j) = \max_{c, O', R', S'} \{U(c, O') + \beta * \gamma(j) * E[V(a', z', j+1)|z, O', R', S']\}$$

- If not, the household becomes a renter, and her housing service consumption is determined by the rent she pays

$$V_r(a, z, j) = \max_{c, h, S'} \{U(c, h) + \beta * \gamma(j) * E[V(a', z', j+1)|z, S']\}$$

Households

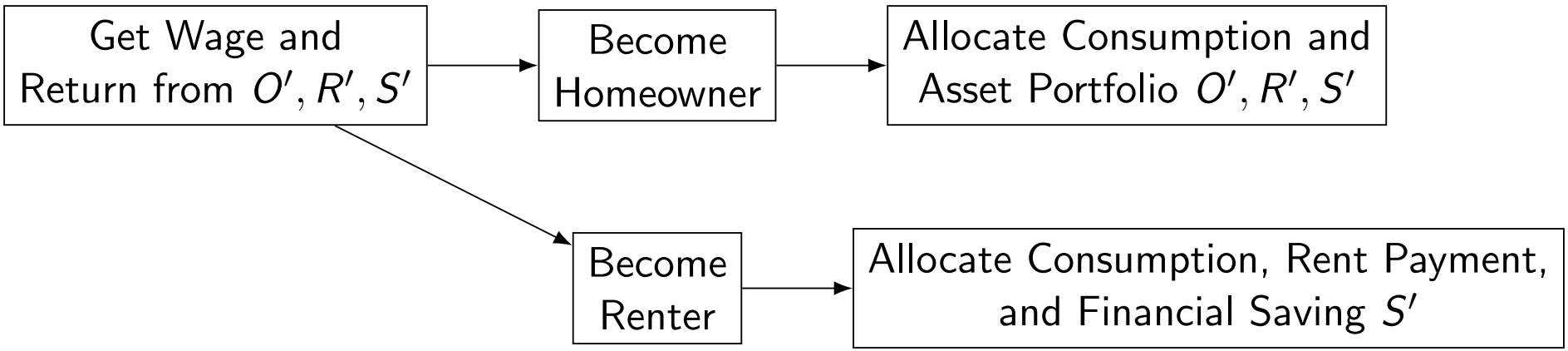
- Households receive wages based on labor productivity, which depends on an idiosyncratic component and age, and they retire at age 65
- The life cycle and income risk construct the asset accumulation motive in the model
- Due to the borrowing limit (80% LTV), wealth-poor households who are young or have experienced negative income shocks become renters

$$S' \geq -0.8(O' + R')$$

Other Elements

- Each household pays social security contributions before retirement and receives a constant pension after retirement
- Households face age-dependent mortality risk and can pass away at any age based on their survival probability
- All households receive a random bequest based on their labor productivity at age 55

Timeline


Get Wage and
Return from O', R', S'
Become
Homeowner
Allocate Consumption and
Asset Portfolio O', R', S'
Become
Renter
Allocate Consumption, Rent Payment,
and Financial Saving S'

Households

- A household chooses whether to become a homeowner or a renter. When she becomes a homeowner:

$$V_o(a,z,j) = \max_{c,O',R',S'} \{U(c,O') + \beta * \gamma(j) * E[V(a',z',j+1)|z,O',R',S']\}$$

$$\begin{aligned} s.t. \quad & c + P_h(O' + R') + S' = a + (1 - \tau_n - SSC)w * e^z * \eta_j + p * 1_{\{j>65\}} \\ & a' = (P_h' - \tau_L(P_h - A_h)) * O' + (P_h' - \tau_L(P_h - A_h) + (1 - \tau_k')\frac{rent'}{P_h})R' \\ & - \delta_O * O' - (1 - \tau_k')\delta_R * R' + (1 + (1 - \tau_k')(r' + ms * 1_{\{S'<0\}}))S' \\ & + P_h(\epsilon_O O' + \epsilon_R R') + Q_{z'} * 1_{\{j=54\}} \\ & O' \geq 0, R' \geq 0, S' \geq -0.8(O' + R') \end{aligned}$$

Households

- When she becomes a renter:

$$V_r(a,z,j) = \max_{c,h,S'}\{U(c,h) + \beta * \gamma(j) * E[V(a',z',j+1)|z,S']\}$$

$$\begin{aligned} s.t. \quad & c + rent * h + S' = a + (1-\tau_n - SSC)w * e^z * \eta_j + p_{\{j>65\}} \\ & a' = (1 + (1-\tau_k')r')S' + Q_{z'} * 1_{\{j=54\}} \\ & S' \geq 0 \end{aligned}$$

$$V(a,z,j) = max\{V_o(a,z,j), V_r(a,z,j)\}$$

Goods Production

- The goods production firm maximizes static profit:

$$max_{Y,K_g,N_g}\, Y - w * N_g - (r + \delta_k)K_g$$
$$s.t. \quad Y = {K_g}^{\alpha} {N_g}^{1-\alpha}$$

Housing Production

- The housing production firm maximizes static profit:

$$max_{K_h, Land} \quad P_h * Y_h - K_h - P_L * Land$$
$$s.t. \quad Y_h = min(\frac{K_h}{A_h}, Land)$$

- At the beginning of each period, all houses disintegrate into land and capital and are sold to the housing production firm

- When sold to the housing production firm, the volume of the house changes randomly with $1 + \epsilon_O, 1 + \epsilon_R$

- After purchasing capital and land, the housing production firm constructs houses and sells them to households

Stationary General Equilibrium

Given the price vector $\{w, r, rent, P_h, P_L\}$, tax rates $\{\tau_n, \tau_k, \tau_p\}$, survival probability, and bequest profile $F(Q_z)$, the optimal policy, transition probability $P((a, z, j), B)$, and stationary distribution $\Psi(a, z, j)$ satisfies the following conditions

1. All policy functions are optimal given price, tax, and bequest profile
2. Competitive input markets
3. Capital, Labor market clear

$$\int S'(a, z, j) d\Psi = K_g \quad \int l(z, j) d\Psi = N_g$$

4. Goods market clear
5. Government spending clear
6. Pension and social security clear
7. Housing market clear

$$\int O'(a, z, j) + R'(a, z, j) d\Psi = P_h * Y_h = K_h + P_L * Land$$

Stationary General Equilibrium

8. Rental market clear

$$\frac{\int R'(a,z,j)d\Psi}{P_h} = \frac{\int h(a,z,j)d\Psi}{rent}$$

9. Distributional consistency

$$\int_B d\Psi = \int P((a,z,j),B)d\Psi \quad for \quad \forall B \in B(X)$$

10. Bequest consistency

$$\int_{a\in A} dF(Q_z) = \frac{\int_{a\in A, j\geq 2}(1-\gamma(j-1))d\Psi(z)}{\int_{j\geq 2}(1-\gamma(j-1))d\Psi(z)} \quad for \quad \forall z, A$$

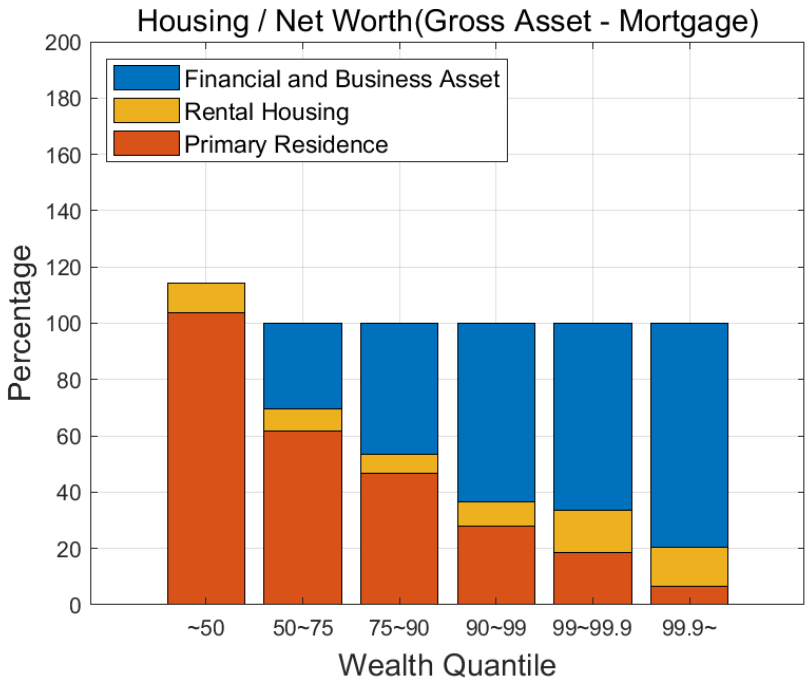
Calibration - Household Parameters

Parameter	Value	Target
Risk Aversion for goods σ_c	2	Davila, Hong, et al (2012)
Risk Aversion for housing σ_h	3.33	Own housing share by net worth quantiles
Weight on housing service w_h	0.2152	Housing asset share in total asset = 0.5
Discount factor β	0.9702	financial asset return = 0.04
Capital Depreciation rate δ_k	0.08	
AR(1) process ρ_z, σ_η	0.96, 0.25	Bottom 99% earning inequality, wealth inequality
Top earning grids y_1, y_2, y_3	[15.7, 60.63, 305.18]	Top 1%, 0.1%, 0.01% earning
Top risk π_d	0.05	Wealth inequality
Survival Probability $\gamma(j)$		US Life Table 2023
Age-Dependent Earning η_j		US Median Wage by age, 0 if $j > 65$

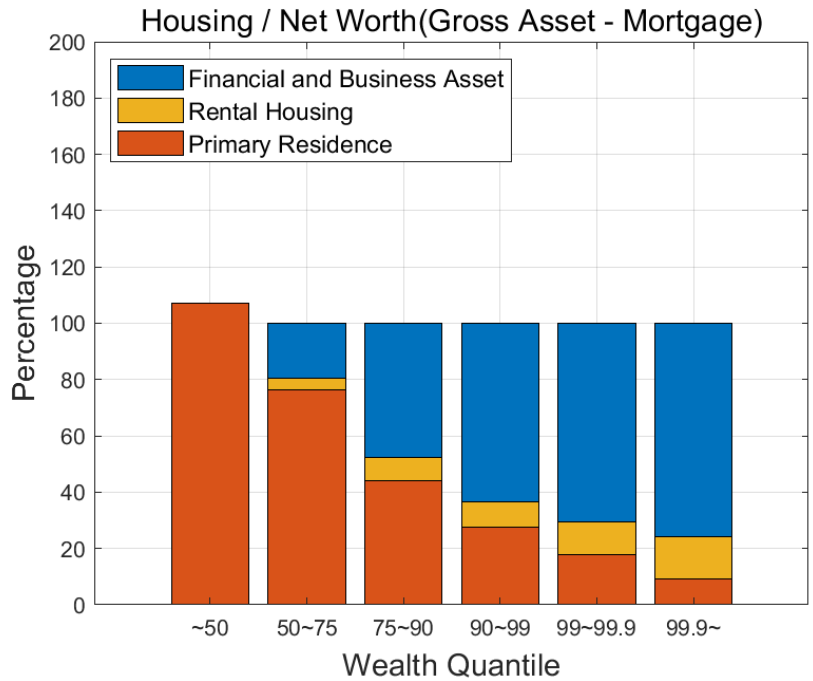
Calibration - Production and Asset Market

Parameter	Value	Target
Capital Share in Goods α	0.36	
Housing Capital Requirement A_h	4.7356	Half of house value = land value
Own Housing Cost δ_O	0.1593	Homeownership rate = 0.65
Rental Housing cost δ_R	0.1421	Nominal housing depreciation = 0.015, Sommer and Sullivan (2018)
Own Home Volatility σ_{ϵ_O}	0.1	Case and Shiller(1989), Chang et al.(2016)
Rental Home Volatility σ_{ϵ_R}	0.1	Case and Shiller(1989), Chang et al.(2016)
$corr(\epsilon_O, \epsilon_R)$	0.3265	Aggregate housing index volatility
Mortgage Spread ms	0.015	Sommer and Sullivan (2018)
Initial Tax Rate for Labor, Capital $\{\tau_n, \tau_k\}$	[0.196, 0.196]	Average federal + state tax rate
Social Security Rate SSC	0.062	Social security contribution rate of employees

Proportion of Primary Residence

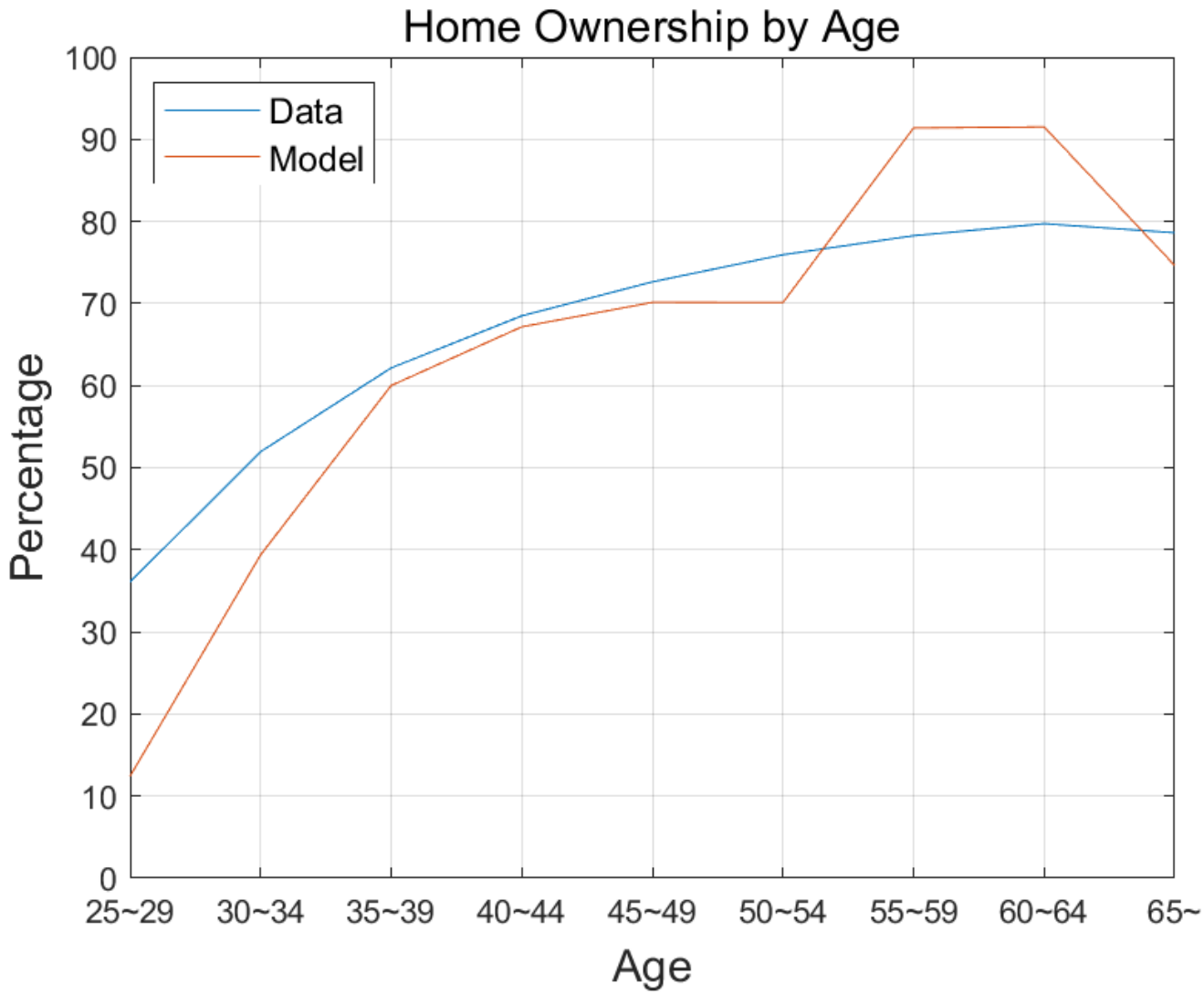


Data



Model

Home Ownership by Age



Home ownership rate

Inequality Matching

Data from Piketty, Saez, and Zucman (2018), average from year 1980 - 2019, Earning is for *Earning* > 0, Wealth is for all households

Model is with universal tax rate 19.6% (Average tax rate in 2005)

- Earning Inequality

	∼50	50∼75	75∼90	90∼99	99∼99.9	99.9∼	Gini
Data	15.05%	24.24%	24.61%	25.97%	6.8%	3.3%	0.52
Model	16.56%	20.48%	21.21%	28.31%	8.4%	5.04%	0.53

- Wealth Inequality

	∼50	50∼75	75∼90	90∼99	99∼99.9	99.9∼	Gini
Data	4.45%	12.49%	20%	34.4%	15.26%	13.34%	0.76
Model	4.32%	16.11%	24.98%	36.66%	11.1%	6.83%	0.72

Matching Other Moments

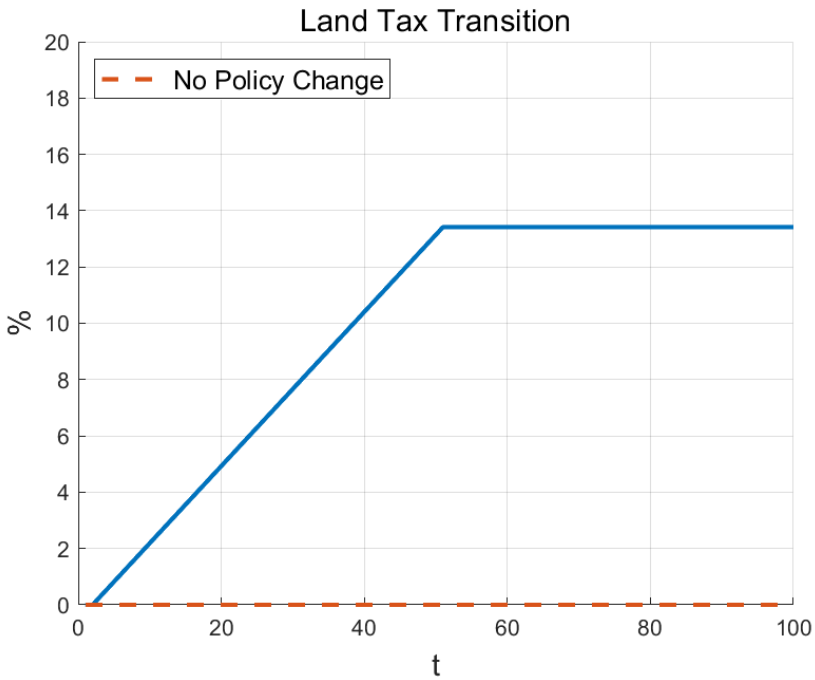
Target	Data	Model
Rental rate	6%	5.8%
Rental Housing Share	20% (PSZ, year 2005)	17.3%
Consumption Shelter Service Share	PCE 17%, CPI-U 31%	24%

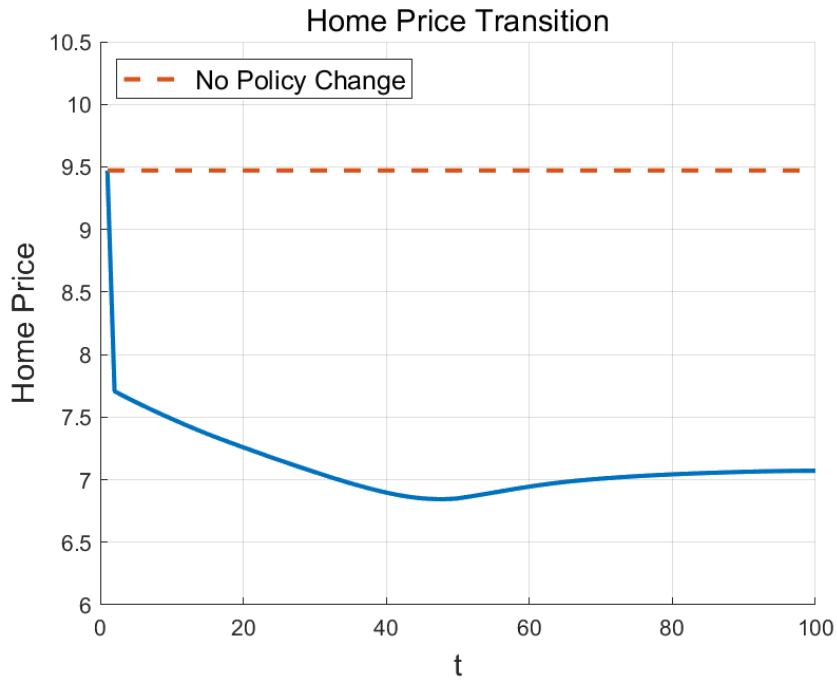
Policy Simulation

- Start with a 19.6% tax on labor and asset income, and gradually increase the land value tax over 50 years until it reaches a level that halves the land price

- With increased land tax, decrease labor tax

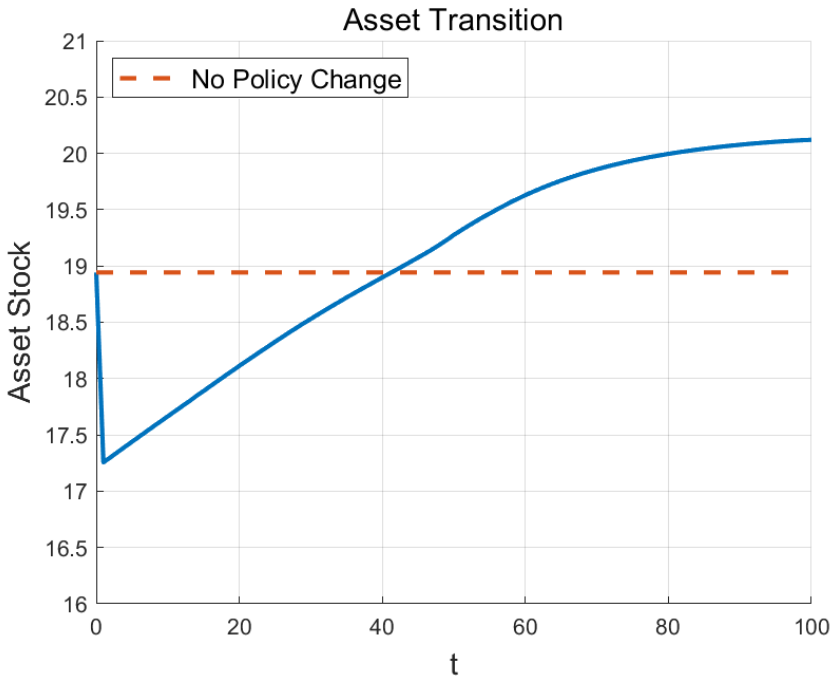
Transition Dynamics

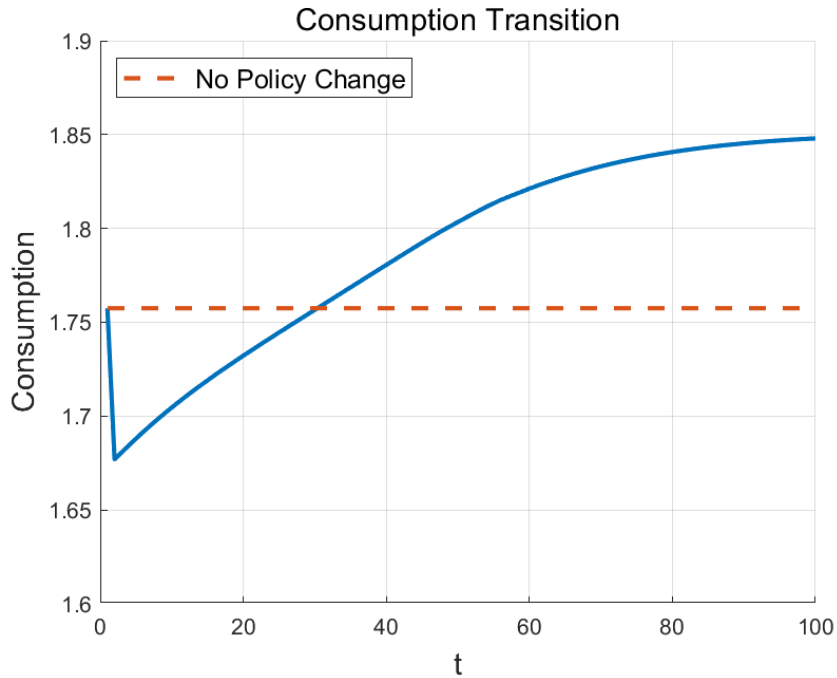




- As land taxation increases, land prices crash instantly due to perfect foresight

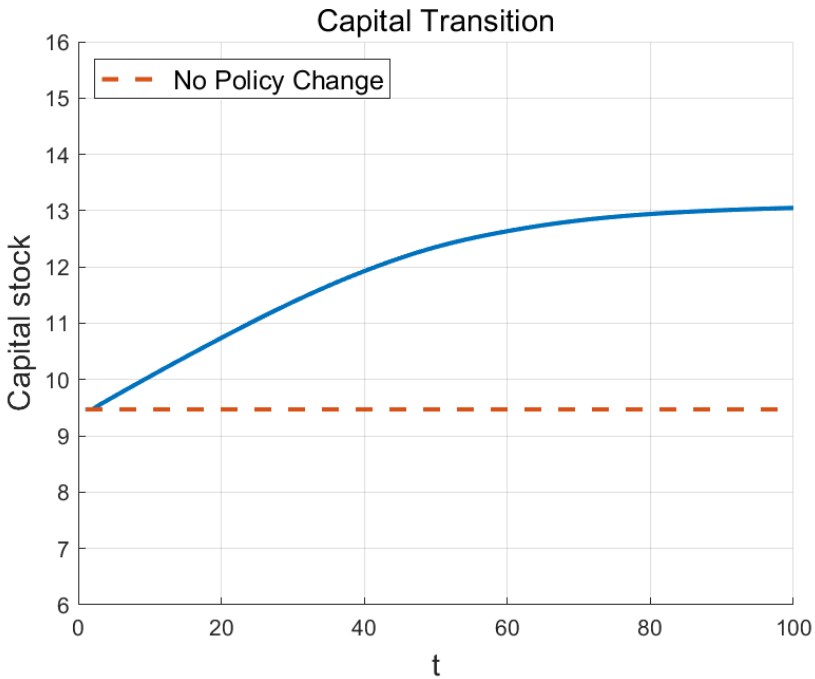
Transition Dynamics

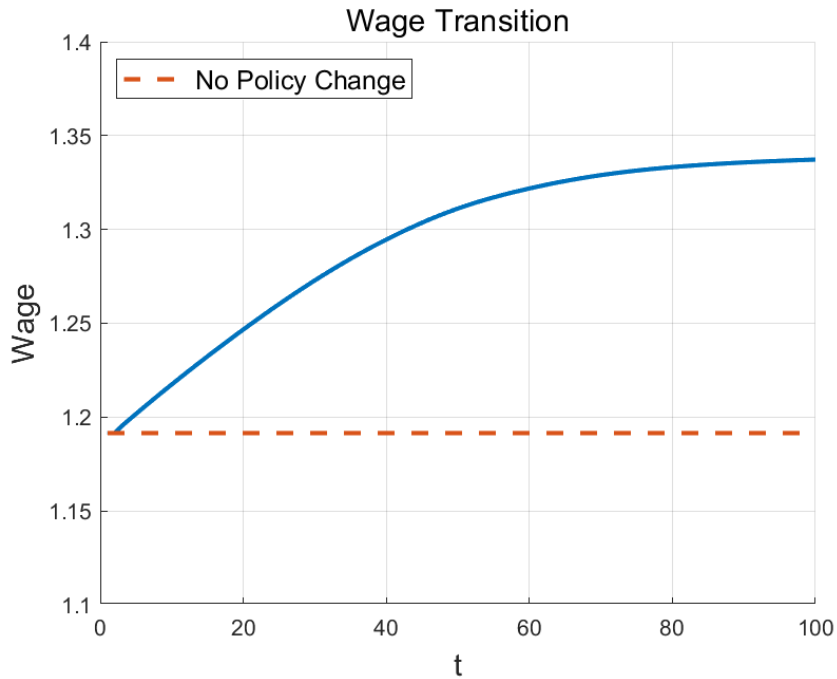




- In response to a decrease in asset values, households reduce consumption and increase savings to restore their buffer stock of assets

Transition Dynamics





- Additional household savings flow into production capital, increasing production and wages

Welfare Effect

	Aggregate Effect	Distributional Effect	Total Effect
Steady State ΔCEV	$+\Delta 5.26\%$	$+\Delta 9\%$	$+\Delta 14.26\%$
Transition ΔCEV	$-\Delta 2.26\%$	$+\Delta 5.03\%$	$+\Delta 2.77\%$

- Total Effect - Equivalent consumption change that generates the same average lifetime utility
- Aggregate Effect - Equivalent consumption change measured by preserving the relative levels of goods and housing consumption

$$\sum_{j=1}^{T}\sum_{t=0}^{T-j}\int \beta^t U(\Delta^{AG} c_{j,t}^{NR}, h_{j,t}^{NR}) d\mu_{j,t}^{NR} = \sum_{j=1}^{T}\sum_{t=0}^{T-j}\int \beta^t U(\frac{C_t^R}{C_t^{NR}} c_{j,t}^{NR}, h_{j,t}^{NR}) d\mu_{j,t}^{NR}$$

- Distributional Effect - The difference between the total effect and the aggregate effect

Welfare Effect

	Equilibrium Effect	Asset Shock Effect	Total Effect
Transition ΔCEV	$+\Delta 5.96\%$	$-\Delta 3.18\%$	$+\Delta 2.77\%$

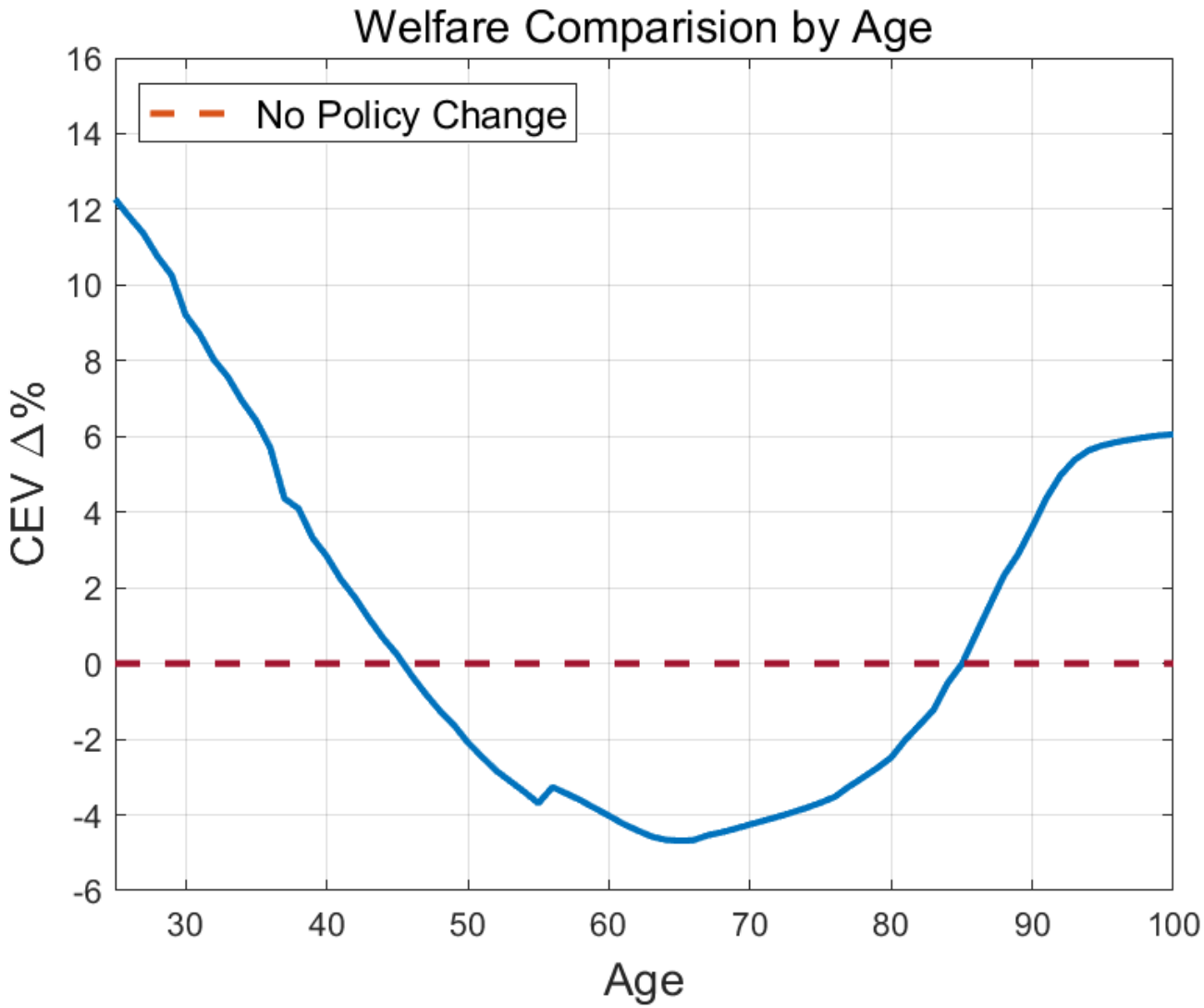
- Equilibrium Effect - Assuming that only macroeconomic variables change during the transition and individual assets do not experience a crash

$$\sum_{j=1}^{T}\sum_{t=0}^{T-j}\int \beta^t U(\Delta^{EQ} c_{j,t}^{NR}, h_{j,t}^{NR}) d\mu_{j,t}^{NR} = \int V^R(a,z,j) d\mu^{NR}$$

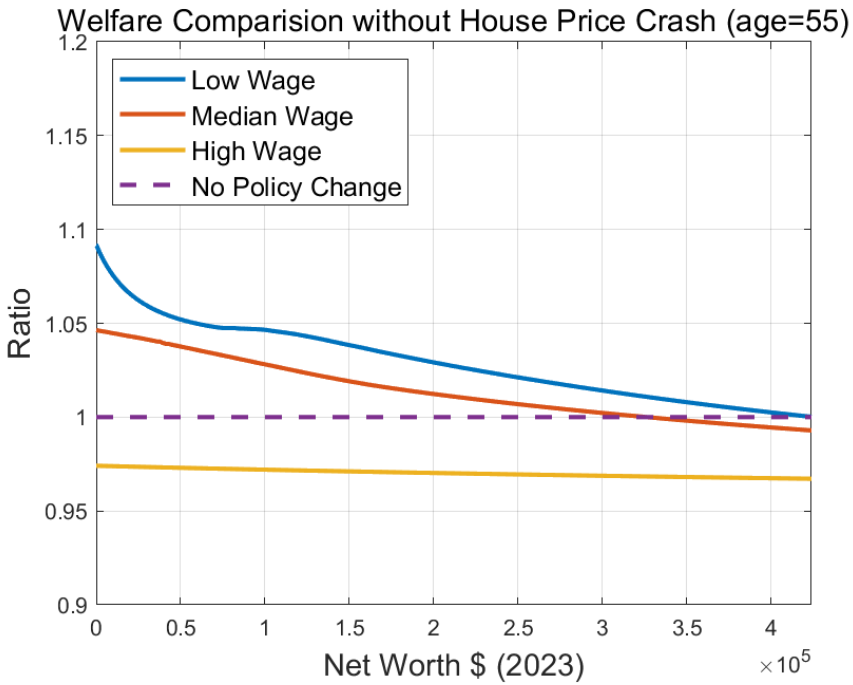
- Asset Shock Effect - Welfare effect of initial housing price crash

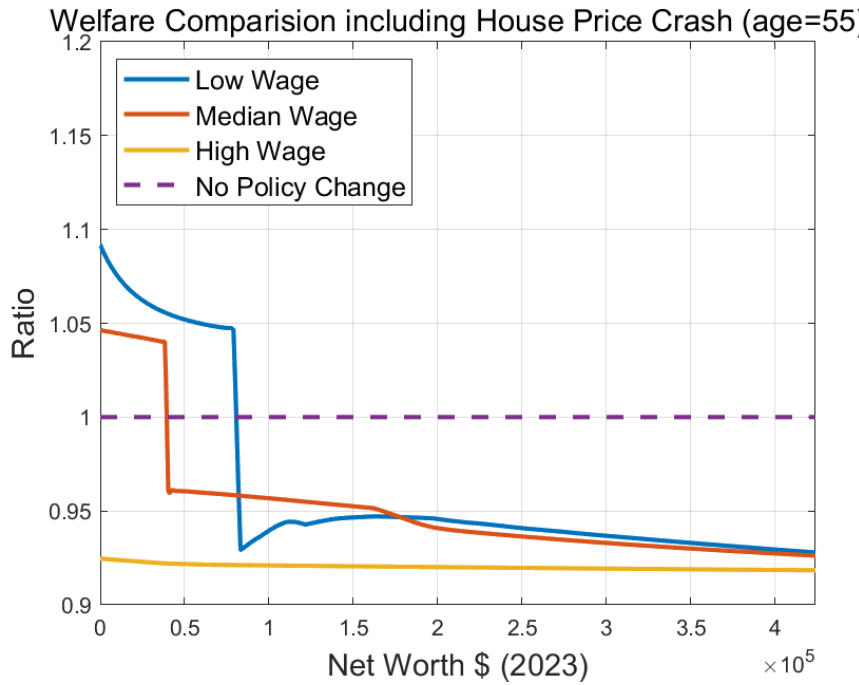
$$\sum_{j=1}^{T}\sum_{t=0}^{T-j}\int \beta^t U(\Delta^{AS}\Delta^{EQ} c_{j,t}^{NR}, h_{j,t}^{NR}) d\mu_{j,t}^{NR} = \int V^R(a,z,j) d\mu^{R}$$

Welfare Comparison by Ages



Welfare Comparison by Wealth





Political Outcome

- We can compare the welfare effects of introducing land taxation with the status quo for each household
- As we can see from the welfare figure, homeowners are significantly worse off due to the decline in housing prices
- If we define those who benefit from the introduction of land taxation as 'approving,' the policy fails to secure a majority vote, with only 35.7% approval

Conclusion

- Reducing land value through taxation can promote long-run capital accumulation and economic growth
- After considering asset composition and life cycle, average welfare is still better off on average, both including the transition path and steady state
- Despite its positive impact on average welfare, homeowners are generally worse off under the policy, and it fails to secure a majority vote

Thank You!