# Equilibrium Evictions

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[1] Disclaimer: The views expressed in this paper are those of the authors and they do not necessarily reflect the views of the Federal Reserve Bank of Kansas City or the Federal Reserve System.

# Housing Rentals and Evictions

- About 35% of U.S. households rent rather than own their homes (CPS 2018-2019)
- Renters have few liquid assets - about \$1000 for median renter and \$250 for those with low income (SCF 2019)
- Among low income, more than 70% are hand-to-mouth (defined as liquid wealth less than half of bi-weekly income in Kaplan, Violante, and Weidner (2014)) (SCF)
- Rental Burden: Rent is nearly 50% of income for lowest quartile of renters, 30% for second quartile (SCF)
- In a typical year, between $2-3\%$ of renters are evicted (Eviction Lab)
- Job loss doubles probability that a renter gets evicted (Desmond and Gershenson, 2016)
- Rent is similar between poor and nonpoor neighborhoods, while property values are substantially higher in nonpoor neighborhoods (Desmond and Wilmers, 2019)
- Autor, Palmer, and Pathak (2014) estimate significant housing externalities.

AllData

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  - Directed search framework with costly vacancy creation
  - Up front quality investment in each unit
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    - Supply and quality of housing independent of a person's ability to pay rent (i.e. employment status when searching)
- Competitive search equilibrium generically unable to implement planner's allocation due to two-sided lack of commitment.
    - Unemployed tenants cannot pay rent $r$, landlords bear fixed costs
    - Landlord keeps unemployed tenant if rent upon re-employment is high enough ($r' > \underline{r}$)
    - Tenant is able/willing to pay at most $\overline{r} > r'$ upon reemployment (either due to budget constraint or ability to search for a different rental)
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- Calibrate model with constant rent contracts:
  - Evictions occur in calibrated equilibrium and landlords under supply/invest in rental units for low income people $\longrightarrow$ higher rent-to-quality for low income people (as in data).
  - Eviction restrictions can raise welfare, but a full ban is a bad idea except during crises (first months of Covid)
  - Rental support for unemployed > eviction restrictions. *Can even be Pareto improving w/ externalities.*

# Population and Preferences

- Discrete time, unit measure of households (hhs) that discount future at $\beta$
- HHs can be of two types $i \in \{H, L\}$ with $\mu_i$ of each type
- Hhs can be housed $j = h$ or unhoused $j = u$
- Hhs can be employed $e = 1$ or unemployed $e = 0$ generating income $y_{i,e}$
  - If $e = 1$, create $y_i$ units of good with $y_H > y_L > \alpha$. If $e = 0$, $y_i = \alpha$
- Hhs differ in job finding and separation rates: ▸ Process
  - those currently unemployed find jobs at rate $p_{i,e=0}$
  - those currently employed separate at rate $1 - p_{i,e=1}$
  - $p_{H,e} \geq p_{L,e}$ so that $H-$types find jobs faster, separate slower, and have higher lifetime income than $L-$types
  - In data, avg duration of unemployment is 1 month for type $H$ and 6 months for $L$
- Preferences: hhs have linear utility over non-housing consumption above subsistence and housing given by $C - \alpha + \mathcal{U}^j$
  - $C \geq \alpha$ is non-housing consumption and $\alpha$ is subsistence consumption
  - $\mathcal{U}^h = q\mathcal{E}(Q)$ where $q$ is own rental quality, $Q$ is total quality of housing
  - $\mathcal{U}^u = 0$ is unhoused utility
  - Positive externality $\mathcal{E}'(Q) > 0$ captures that people like to be surrounded by high-quality housing in their neighborhood. ▸ Externality

## Matching and Housing Technologies

- Unhoused $j = u$ in $t$ can become housed $j = h$ in $t + 1$ depending on the number of vacant units created $V$ and the number of unhoused hhs $U$
- Constant returns to scale matching technology $M(U, V)$ where:
    - Tightness: $\theta = \frac{U}{V}$ so a "tight" rental market has many unhoused searching for few rental units
    - Finding rate: $\phi(\theta) = \frac{M(U,V)}{U} = M(1, \theta^{-1})$ with $\phi'(\theta) < 0$: hard to find a rental unit in a tight market
    - Filling rate: $\psi(\theta) = \frac{M(U,V)}{V} = M(\theta, 1)$ with $\psi'(\theta) > 0$: easy to fill a rental unit in a tight market
- Flow cost of person occupying a rental unit is $f_i$, measured in utils (type dependence to match data) ▸ Cost
- Creating a vacancy costs $\kappa$ and the unit's quality requires one-time investment $c(q - f_i)$ after the match occurs, both measured in utils
    - Assume $c'(x) \geq 0, c''(x) \geq 0$ $c(0) = 0$, and $c'(0) = 0$
    - This assumption assures that quality is cheap enough that planner would always post some vacancies with positive surplus (i.e. $q - f_i > 0$)
- Housed become unhoused with exogenous probability $\sigma$ and rental quality depreciates fully ▸ Timing

# Characterization of Planner's Problem

The "first best" stationary allocation in the absence of commitment problems which internalizes the neighborhood externality (subject to the matching technology) :

- No evictions (with commitment don't dissolve positive surplus matches).
- No dependence of quality $q_H^{sp} > q_L^{sp}$ and tightness $\theta_L^{sp} > \theta_H^{sp}$ on employment status $e$.
- Without cost differences (i.e. if $f_H = f_L$), $q_H^{sp} = q_L^{sp}$ and $\theta_L^{sp} = \theta_H^{sp}$ (i.e. purely egalitarian). Planner's Allocation

# Constant Rent Contracts

- Motivated by the data: renters have limited ability to repay missed rent or post large upfront collateral. ▸ HTM

- We approximate this with hand-to-mouth renters with subsistence consumption: $C \geq \alpha \longleftrightarrow r_i \leq y_i - \alpha$

- Landlords post contracts $(r_{i,e}, q_{i,e})$ to which unhoused people direct their search to a submarket with tightness $\theta_{i,e}$

- We assume landlords can choose to evict in the period following a non-payment

- Recall planner's allocation: no evictions, $\theta_i$ and $q_i$ independent of employment status $e$ depends on $i$ only due to $f_i$.

- Constant rent equilibrium is generically inefficient, as is extended model with transferable utility and lack of renter commitment because least rent required for landlord to keep unemployed $L-$type tenant $(\underline{r})$ is typically more than most $(\overline{r})$ renter willing to pay upon re-employment before resuming search (see Appendix).

## Renter Values

A renter in a house of quality $q$ with constant rent $r$ has the following values:

$$
\begin{aligned}
R_{i,1}(r,q) &= y_i - \alpha - r + q\mathcal{E}(Q) + \beta(1-\sigma)\Big[p_{i,1}R_{i,1}(r,q) + (1-p_{i,1})R_{i,0}(r,q)\Big], \\
R_{i,0}(r,q) &= q\mathcal{E}(Q) \\
&+ \beta\Big[(1-\sigma)(1-\epsilon)\big(p_{i,0}R_{i,1}(r,q) + (1-p_{i,0})R_{i,0}(r,q)\big) \\
&+ (1-(1-\sigma)(1-\epsilon))\big(p_{i,0}V^*_{i,1} + (1-p_{i,0})V^*_{i,0}\big)\Big]
\end{aligned}
$$

- If endogenously evicted $\epsilon = 1$ or exogenously separated, person becomes unhoused and searches next period obtaining $V^*_{i,e}$

# Landlord Values

A landlord who has a renter with constant rent $r$ and housing quality $q$ has the following values:

$$L_{i,1}(r,q) = r - f_i + \beta(1-\sigma)\Big[p_{i,1}L_{i,1}(r,q) + (1-p_{i,1})L_{i,0}(r,q)\Big], \quad (1)$$

$$L_{i,0}(r,q) = \max_{\epsilon\in\{0,1\}} -f_i + \beta(1-\sigma)(1-\epsilon)\Big[p_{i,0}L_{i,1}(r,q) + (1-p_{i,0})L_{i,0}(r,q)\Big] \quad (2)$$

- Employed renters pay $r$ and can't be evicted
- Unemployed renters pay 0 and may be evicted
- Eviction occurs ($\epsilon = 1$) if expected discounted profits are negative since posting a new vacancy has zero net profit for landlord, i.e.:

$$p_{i,0}L_{i,1}(r,q) + (1-p_{i,0})L_{i,0}(r,q) < 0 \iff$$
$$p_{i,0}\underbrace{\left[L_{i,1}(r,q) - L_{i,0}(r,q)\right]}_{>0} + \underbrace{L_{i,0}(r,q)}_{<0} < 0 \quad (3)$$

More likely for $L-$type since lower job finding rate $p_{L,0} = 0.17 < p_{H,0} = 0.89$

Evictions Occur Even With Variable Contracts

# Search Equilibrium

- The equilibrium allocations maximize hh utility subject to landlord participation:

$$\begin{aligned} V^*_{i,e} &= y_{i,e} - \alpha \\ &+ \max_{r \le y_i - \alpha, q, \theta} \beta \Big[ \phi(\theta) \Big( p_{i,e} R_{i,1}(r,q) + (1-p_{i,e}) R_{i,0}(r,q) \Big) \\ &+ (1-\phi(\theta)) \Big( p_{i,e} V^*_{i,1} + (1-p_{i,e}) V^*_{i,0} \Big) \Big] \end{aligned} \tag{4}$$

s.t.

$$\kappa \le \beta \psi(\theta) \Big[ p_{i,e} L_{i,1}(r,q) + (1-p_{i,e}) L_{i,0}(r,q) - c(q - f_i) \Big] \tag{5}$$

- Definition: A *steady state competitive search equilibrium* is
  - rents $r_{i,e}$ on units of quality $q_{i,e}$
  - vacancy posting for those contracts with tightness $\theta_{i,e}$
  - eviction choices $\epsilon_{i,0}$
  - fractions of the population over employment and housing states $\mu^j_{i,e}$
- Conditional Block Recursive: $(r_{i,e}, q_{i,e}, \theta_{i,e}, \epsilon_{i,0})$ depend only on $\mu^j_{i,e}$ through $Q$.

Law Of Motion

# Quantitative Experiments: Parameterization

We use $M(U,V) = \frac{U \cdot V}{\left(U^{\nu}+V^{\nu}\right)^{\frac{1}{\nu}}}$, $\mathcal{E}(Q) = e^{\eta Q}$, and $c(x) = e^{c_0 x} - 1$.

**Table: Calibration Outside of Model**

| Parameters | Value |
|---|---|
| $\beta$ | $0.96^{1/12}$ |
| $f_H$ | 0.62 |
| $f_L$ | 0.37 |
| $\sigma$ | 1/36 |
| $p_{L,1,1}$ | 0.57 |
| $p_{L,0,1}$ | 0.17 |
| $p_{H,1,1}$ | 0.96 |
| $p_{H,0,1}$ | 0.89 |
| $y_H$ | 4 |
| $y_L$ | 2 |
| $\alpha$ | 1 |
| $\mu_L$ | 0.1 |
| $\mu_H$ | 0.9 |

**Table: Calibration Within Model**

| parameter | value | moment | data value | model value |
|---|---|---|---|---|
| $\eta$ | 0.285 | spillover semi-elasticity (Autor, et al.) | 0.5 | 0.454 |
| $\nu$ | 0.389 | match elasticity (Genesove and Han) | 0.8 | 0.714 |
| $\kappa$ | 0.037 | eviction rate (Eviction Lab) | 0.5 | 0.533 |
| $c_0$ | 7.729 | $r_H/y_H$ (SCF) | 1/3 | 0.265 |
| | | r/q slope (RHFS) | 0.45 | 0.610 |

- Job finding $p_{H,0,1} > p_{L,0,1}$ and $y_H > y_L$ imply higher lifetime income for type $H$

# Properties of Decentralized Equilibrium

- Type $H$ renters pay higher rent, enjoy higher quality, and have higher rental finding rates than type $L$ CE Allocation
- Type $L$ have higher rent-to-quality $(r_{i,e}/q_{i,e})$ and higher rental burdens $(r_{i,e}/y_i)$ than type $H$
- Type $H$ are not evicted while type $L$ are evicted following missed payment due to unemployment; landlords don't want to bear costs $\kappa$ and $c(q - f_i)$ as well as filling rate $\psi(\theta)$ for type $H$ since job finding rate $p_{H,0,1} = 0.89$
- Unemployed type $L$ are shut out of the market due to low job finding rate $p_{L,0,1} = 0.17$
- Type $L$ have a binding subsistence consumption constraint (i.e. $r_L = y_L - \alpha$) while type $H$ do not
- Housing externality improves welfare of $H-$type more than $L-$type Externality Comparison
- Decentralized outcomes are very different from the more egalitarian allocation of the planner's problem where type $L$ effectively receives the type $H$ allocation (i.e. ex-ante insurance). Comparison of CE and SPE
- 18.3% CE loss relative to planner's problem; three-quarters due to two-sided commitment problem, one-quarter due to externality.

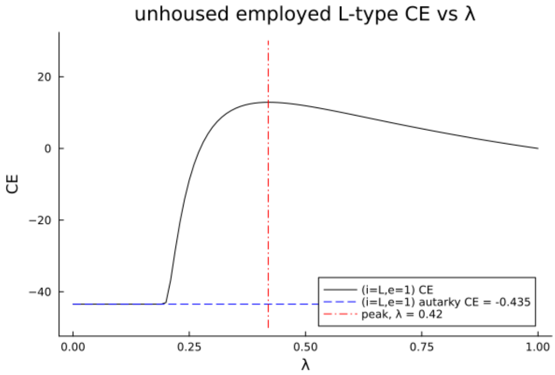
# Optimal Eviction Policy

- Introduce eviction restriction: landlord who wants to evict allowed to do so with probability $\lambda \in [0, 1]$
  - Prior experiment $\lambda = 1$
  - Eviction moratorium $\lambda = 0$ (moratorium policy mitigates landlord commitment friction)

- A policy maker who sets $\lambda$ trades off two forces: Quality vs Tightness
  - Social surplus from maintaining a match $\rightarrow$ benefit of low $\lambda$
  - Lower landlord profits (hence lower quality and/or vacancies) if they can't evict an unemployed person $\rightarrow$ cost of low $\lambda$

- Impact of Subsistence Consumption:
  - Increasing $y_i$ or decreasing $\alpha$ allows for higher rent when tenant is employed
  - Allows enough "front loading" of profits for landlord, making eviction restrictions more attractive for policy makers. Relax Constraint

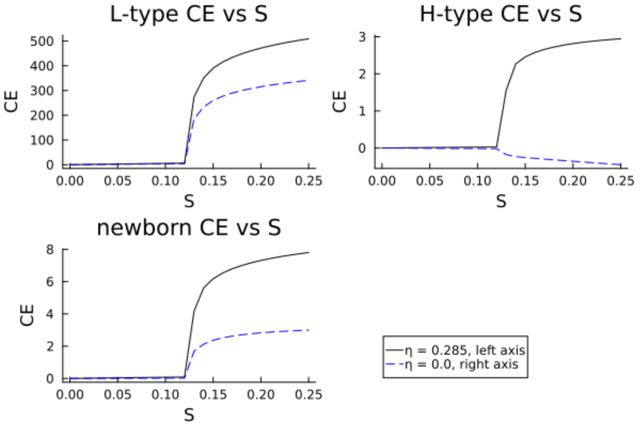
# Optimal Eviction Policy: Unhoused Value




- Black line: $V^*_{L,1}$ evaluated at equilibrium $(q_{L,1}, \theta_{L,1})$ computed for given $\lambda \in [0,1]$. Peak at $\lambda = 0.42$ (red line).
- Blue line: unhoused value $y/(1 - p_{L,1}\beta)$ with zero finding rate for all type $L$ ( $\phi(\theta_{L,1}) = 0$) starting at $\lambda = 0.21$
- Some restrictions on eviction are optimal since eviction destroys matches with positive social surplus but a moratorium means all type $L$ cannot find rental units

# Rental Support May Pareto Improve Laissez-Faire

Consider a tax on employed $H-$types that finances a partial rental payment to landlords of unemployed $L-$types. Welfare effects as subsidy increases:




Rental support can eliminate evictions (support at 0.13) without hurting $L-$type supply. With externality, welfare increasing in subsidy for all types.

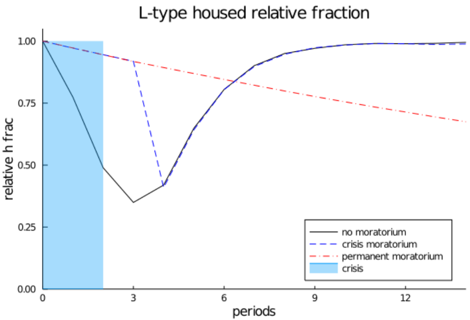
# Decentralized Equilibrium with Aggregate Uncertainty

- Add exogenous aggregate state $s$ representing baseline state $s = g$ and a crisis state $s = b$
- Baseline state $s = g$ is extremely persistent while crisis expected to last for four months on average (i.e. Markov transition sets $Pr(s' = g|s = b) = 0.25$)
- Baseline state has employment transitions $p_{i,e}(g)$ as in 2018-2019 while crisis state has higher separation and lower finding rates (estimated during March-June of 2020).
  - In contractions, $L$-type finding rates fall in half (unhoused duration rises by 115 days) while $H$-type fall by only 4% (unhoused duration rises by 2 days).
- Consider state-dependent eviction moratoria (i.e. $\lambda(s) \in \{0, 1\}$ with $s \in \{g, b\}$)
- Given conditional (on $Q$) block recursivity, use Krusell-Smith forecast of future $Q$ necessary to find equilibrium rental postings.

Agg Problem

# Housing Outcomes in Crisis Depend on Policy

**Figure: Aggregate Uncertainty Experiment**




- No-moratorium policy: all $L-$type evicted when unemployment shock hits
- Permanent moratorium substantially reduces $L-$type housing supply in long run
- Crisis moratorium during crisis keeps substantially more $L$-type workers housed throughout the crisis and maintains original long-run housed share. Agg Outcome
  - Again Pareto improvement due to externality around 2%.

# Conclusion

- Rentals comprise 35% of total housing in the United States, especially amongst lower income households, and between $2-3\%$ of renting households are evicted in a typical year
- We provide general equilibrium insights:
  - Identify market failures
    - Two-sided lack of commitment leads to inefficient separations through evictions
    - Externalities in housing quality increase welfare inequality
  - Calibrate model to stylized facts in rental markets about rent-to-quality ratios and tightness
  - Rent-to-quality is higher for low-quality units because of non-payment risk, expected profits equalized
- Main takeaway: tradeoff between protecting positive-surplus matches ex-post and incentivizing supply ex-ante
  - Supply concerns similar to Hopenhayn and Rogerson (1993)
  - Rent support can eliminate evictions without hurting supply, can even be Pareto improving relative to Laissez-Faire

# Planner's Objective

Planner's Objective:

$$W\left(Q, (\mu_{i,e}^{j})_{i\in\{H,L\},e\in\{0,1\}}^{j\in\{u,h\}}\right) = \max_{(q_{i,e},\theta_{i,e})_{i,e\in\{H,L\}\times\{0,1\}}} Q\mathcal{E}(Q) \tag{6}$$

$$+ \sum_{i\in\{H,L\}} \left[\mu_{i,1}^{h}\cdot(y_i-\alpha-f)+\mu_{i,0}^{h}\cdot(-f)+\mu_{i,1}^{u}\cdot(y_i-\alpha)+\mu_{i,0}^{u}\cdot(0)\right]$$

$$- \sum_{i\in\{H,L\},e\in\{0,1\}} \left[\kappa + c(q_{i,e})\psi(\theta_{i,e})\right]\theta_{i,e}^{-1}\cdot\mu_{i,e}^{u}$$

$$+ \beta\cdot W\left(Q', (\mu_{i,e'}^{j\prime})_{i\in\{H,L\},e'\in\{0,1\}}^{j\in\{u,h\}}\right)$$

- Total quality of occupied housing is

$$Q_i = \int_{f+b}^{\infty} q dG_i(q)$$

  where $G_i(q)$ is the CDF of $i$ types over housing qualities.
- Measures of each type over housing and employment is $\mu_{i,e}^{j}$.
- Choose quality for newly created housing, $q_{i,e}$.
- Choose number of each vacant house created, $\theta_{i,e}^{-1}\cdot\mu_{i,e}^{u}$.

BackSPvCE

# Laws of Motion

$$
\begin{aligned}
Q_i' &= (1-\sigma)\cdot Q_i + \sum_{e\in\{0,1\}} \mu^u_{i,e}\cdot\phi\left(\theta_{i,e}\right)\cdot q_{i,e} && (7)\\
\mu^{h\prime}_{i,1} &= p_{i,1}\left[\mu^h_{i,1}(1-\sigma)+\mu^u_{i,1}\phi(\theta_{i,1})\right] + p_{i,0}\left[\mu^h_{i,0}(1-\sigma)+\mu^u_{i,0}\phi(\theta_{i,0})\right] && (8)\\
\mu^{h\prime}_{i,0} &= (1-p_{i,1})\left[\mu^h_{i,1}(1-\sigma)+\mu^u_{i,1}\phi(\theta_{i,1})\right] && (9)\\
&+ (1-p_{i,0})\left[\mu^h_{i,0}(1-\sigma)+\mu^u_{i,0}\phi(\theta_{i,0})\right]\\
\mu^{u\prime}_{i,1} &= p_{i,1}\left[\mu^h_{i,1}\sigma+\mu^u_{i,1}\left(1-\phi(\theta_{i,1})\right)\right] && (10)\\
&+ p_{i,0}\left[\mu^h_{i,0}\sigma+\mu^u_{i,0}\left(1-\phi(\theta_{i,0})\right)\right]\\
\mu^{u\prime}_{i,0} &= (1-p_{i,1})\left[\mu^h_{i,1}\sigma+\mu^u_{i,1}\left(1-\phi(\theta_{i,1})\right)\right] && (11)\\
&+ (1-p_{i,0})\left[\mu^h_{i,0}\sigma+\mu^u_{i,0}\left(1-\phi(\theta_{i,0})\right)\right]
\end{aligned}
$$

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## Contracting Problem, Matched with Employed Renter

Let

- $L_{i,e=1}$ denote landlord value function matched with an employed renter,
- $V$ promised utility to an employed renter,
- $v'_e$ the future promised utility if renter in state $e$,
- and $V^*_{i,e}$ is equilibrium value of starting next period unhoused.

Contracting Problem:

- Choose current rent, $r$, and future renter values $v'_e$, to maximize landlord profits subject to renter participation (promise keeping constraint).

$$L_{i,1}(V,q) = \max_{r,v'_e} r - f + \beta(1-\sigma)\Big[p_{i,1}L_{i,1}(v'_1,q) + (1-p_{i,1})L_{i,0}(v'_0,q)\Big] \tag{12}$$

s.t

$$q - r + \beta\Big[(1-\sigma)\Big(p_{i,1}v'_1 + (1-p_{i,1})v'_0\Big) + \sigma\Big(p_{i,1}V^*_{i,1} + (1-p_{i,1})V^*_{i,0}\Big)\Big] \geq V \tag{13}$$

# Equilibrium Results

**Table: Calibrated Equilibrium**

| Policies | Baseline | No-Spillovers ($\eta = 0$) |
|---|---|---|
| $(r_{H,1}, q_{H,1})$ | (1.062,2.309) | (0.87,2.188) |
| $(r_{H,0}, q_{H,0})$ | (1.062,2.307) | (0.87,2.186) |
| $(r_{L,1}, q_{L,1})$ | (1.0,1.327) | (1.0,1.348) |
| $(r_{L,0}, q_{L,0})$ | $\emptyset$ | $\emptyset$ |
| $\epsilon_{H,0}(r_{H,1}, q_{H,1})$ | 0 | 0 |
| $\epsilon_{H,0}(r_{H,0}, q_{H,0})$ | 0 | 0 |
| $\epsilon_{L,0}(r_{L,1}, q_{L,1})$ | 1 | 1 |
| $\epsilon_{L,0}(r_{L,0}, q_{L,0})$ | $\emptyset$ | $\emptyset$ |
| $\epsilon_{i,1}(r_{i,e}, q_{i,e})$ | 0 | 0 |
| $(\theta_{H,1}, \phi(\theta_{H,1}))$ | (0.044,0.511) | (0.08,0.441) |
| $(\theta_{H,0}, \phi(\theta_{H,0}))$ | (0.042,0.518) | (0.08,0.442) |
| $(\theta_{L,1}, \phi(\theta_{L,1}))$ | (0.383,0.26) | (0.414,0.252) |
| $(\theta_{L,0}, \phi(\theta_{L,0}))$ | $(\emptyset, 0)$ | $(\emptyset, 0)$ |
| newborn $\text{CE}_L$ | | -24.8% |
| newborn $\text{CE}_H$ | | -28.1% |

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# Inefficiency of CE

**Table: Allocations in Planner's and Competitive Equilibrium**

| Variable | Planner | Competitive Equilibrium |
|---|---|---|
| $Q$ | 2.30 | 1.988 |
| $(q_{H,1}, \theta_{H,1}, \phi(\theta_{H,1}))$ | (2.44,0.03,0.58) | (2.31,0.04,0.51) |
| $(q_{H,0}, \theta_{H,0}, \phi(\theta_{H,0}))$ | (2.44,0.03,0.58) | (2.31,0.04,0.52) |
| $(q_{L,1}, \theta_{L,1}, \phi(\theta_{L,1})))$ | (2.19,0.03,0.57) | (1.33,0.38,0.26) |
| $(q_{L,0}, \theta_{L,0}, \phi(\theta_{L,0}))$ | (2.19,0.03,0.57) | $(0,\infty,0)$ |
| $L$-type frac housed | 0.953 | 0.124 |
| $H$-type frac housed | 0.954 | 0.948 |

**Table: Aggregate Welfare Loss From Competitive Equilibrium Relative to Planner**

| Allocation | CE Aggregate Welfare |
|---|---|
| Planner $Q$ | -13.8% |
| Baseline $Q$ | -18.3% |

$$\text{Baseline } Q = \frac{W^{base}_{\mathcal{E}(Q)} - W^{sp}_{\mathcal{E}(Q^{sp})}}{W^{sp}_{\mathcal{E}(Q^{sp})}}, \ \text{Planner } Q = \frac{W^{base}_{\mathcal{E}(Q^{sp})} - W^{sp}_{\mathcal{E}(Q^{sp})}}{W^{sp}_{\mathcal{E}(Q^{sp})}}.$$

Planner's Problem Back to Properties Specifics

# Equilibrium Results - Aggregate Uncertainty

| Parameters | Values |
|---|---|
| Covid 19 Calibration | |
| $(p_{L,0,1}(G), p_{H,0,1}(G))$ | (0.17,0.89) |
| $(p_{L,1,1}(G), p_{H,1,1}(G))$ | (0.57,0.96) |
| $(p_{L,0,1}(B), p_{H,0,1}(B))$ | (0.09,0.80) |
| $(p_{L,1,1}(B), p_{H,1,1}(B))$ | (0.45,0.91) |
| $Pr(s' = G \mid s = G)$ | 0.9992 |
| $Pr(s' = G \mid s = B)$ | 0.25 |

# Equilibrium Results - Aggregate Uncertainty

| | No Moratoria | | Crisis Moratoria | | Full Moratoria | |
|---|---|---|---|---|---|---|
| | $s = G$ | $s = B$ | $s = G$ | $s = B$ | $s = G$ | $s = B$ |
| $(r_{H,1}, q_{H,1})$ | (1.07,2.31) | (1.07,2.31) | (1.07,2.31) | (1.07,2.31) | (1.04,2.30) | (1.07,2.31) |
| $(r_{H,0}, q_{H,0})$ | (1.07,2.31) | (1.07,2.31) | (1.07,2.31) | (1.07,2.31) | (1.07,2.31) | (1.07,2.31) |
| $(r_{L,1}, q_{L,1})$ | (1.0,1.32) | (1.0,1.19) | (1.0,1.32) | $\emptyset$ | $\emptyset$ | $\emptyset$ |
| $(r_{L,0}, q_{L,0})$ | $\emptyset$ | $\emptyset$ | $\emptyset$ | $\emptyset$ | $\emptyset$ | $\emptyset$ |
| $\phi(\theta_{H,1})$ | 0.53 | 0.51 | 0.53 | 0.51 | 0.50 | 0.51 |
| $\phi(\theta_{H,0})$ | 0.52 | 0.49 | 0.52 | 0.49 | 0.52 | 0.49 |
| $\phi(\theta_{L,1})$ | 0.26 | 0.13 | 0.26 | 0.0 | 0.0 | 0.0 |
| $\phi(\theta_{L,0})$ | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| $Q$ | 1.99 | 1.98 | 1.99 | 1.99 | 1.96 | 1.96 |

**Table: Aggregate Welfare Comparison**

| | Crisis Moratoria | Full Moratoria |
|---|---|---|
| $CE_L$ | 1.8% | -43.6% |
| $CE_H$ | 2.1% | -0.1% |

backOutcomes

## Laws of Motion for Individual States

Given $(r_{i,e}, q_{i,e}, \theta_{i,e})$, the laws of motion for individuals over different states are given by

$$\mu^{h\prime}_{i,1} = p_{i,1}\Big[(1-\sigma)\mu^h_{i,1} + \phi(\theta_{i,1})\mu^u_{i,1}\Big] + p_{i,0}\Big[(1-\sigma)\mu^h_{i,0} + \phi(\theta_{i,0})\mu^u_{i,0}\Big] \quad (14)$$

$$\mu^{h\prime}_{i,0} = (1-p_{i,1})\Big[(1-\sigma)\mu^h_{i,1} + \phi(\theta_{i,1})\mu^u_{i,1}\Big] + (1-p_{i,0})\Big[(1-\sigma)\mu^h_{i,0} + \phi(\theta_{i,0})\mu^u_{i,0}\Big] \quad (15)$$

$$\mu^{u\prime}_{i,1} = p_{i,1}\Big[\sigma\mu^h_{i,1} + \big(1-\phi(\theta_{i,1})\big)\mu^u_{i,1}\Big] + p_{i,0}\Big[\sigma\mu^h_{i,0} + \big(1-\phi(\theta_{i,0})\big)\mu^u_{i,0}\Big] \quad (16)$$

$$\mu^{u\prime}_{i,0} = (1-p_{i,1})\Big[\sigma\mu^h_{i,1} + \big(1-\phi(\theta_{i,1})\big)\mu^u_{i,1}\Big] + (1-p_{i,0})\Big[\sigma\mu^h_{i,0} + \big(1-\phi(\theta_{i,0})\big)\mu^u_{i,0}\Big] \quad (17)$$

backEQM

## Eviction with Variable Rates and TSLC

Lowest rent $\underline{r}$ landlord needs to keep from evicting renter:

$$p_{i,0,1}L_{i,1}(\underline{r},q)+p_{i,0,0}L_{i,0}(\underline{r},q)=0 \tag{18}$$

Which gives:

$$\underline{r}=\left(\frac{1-\beta(1-\sigma)(p_{i,1,1}-p_{i,0,1})}{p_{i,0,1}}\right)f_i \tag{19}$$

Now imagine employed renter can work overtime with disutility $1/\varphi_0$, so value becomes

$$\begin{aligned} R_{i,1}(r,q) \quad = \quad & \max_{h^+\geq 0,h^++y_i-\alpha-r} h^+ - \frac{1}{\varphi_0}h^+ + y_i-\alpha-r+q\mathcal{E}(Q) \\ & +\beta(1-\sigma)\left[p_{i,1,1}R_{i,1}(r,q)+p_{i,1,0}R_{i,0}(r,q)\right] \\ & +\beta\sigma\left[p_{i,1,1}V^*_{i,1}+p_{i,1,0}V^*_{i,0}\right] \end{aligned}$$

Highest rent $\overline{r}$ unemployed renter willing to pay before resuming search (i.e. $R_{L,1}(\overline{r},q)=V^*_{L,1}$) gives

$$\overline{r}=y_L-\alpha+ \varphi_0\left(\frac{(1-\hat{\beta}\Delta p_L)(q\mathcal{E}(Q)-(1-\hat{\beta})V^*_{L,1})+\hat{\beta}p_{L,1,0}\cdot\beta\sigma\mathbb{E}_0[V^*_L]+\left(1-\hat{\beta}p_{L,0,0}\right)\beta\sigma\mathbb{E}_1\left[V^*_L\right]\}}{1-\hat{\beta}p_{L,0,0}}\right)$$

Simple to find small $\varphi_0$ to guarantee $\overline{r}<\underline{r}$. Sufficient condition in our calibration is $\varphi_0\leq 0.06$ (or overtime disutility $\approx$ twice flow utility from housing). Back

# Related Papers

- Abramson (2022):
  - Model of a renter with income fluctuations, consumption and savings decisions, and choice of whether to pay rent
  - No decision making by landlord on whether to evict a delinquent tenant
- Imrohoroglu and Zhao (2023)
  - Model of homeowners, renters, and unhoused
  - Income and health shocks drive people to default on rent payments
  - No landlord decisions
- Relative to these papers, we:
  - Focus on landlord decisions to evict delinquent renters and how that affects their incentives to supply and invest in rental units
  - Use a tractable search and matching framework
  - Characterize efficient allocations and study how lack of commitment and externalities lead to market failures

Back

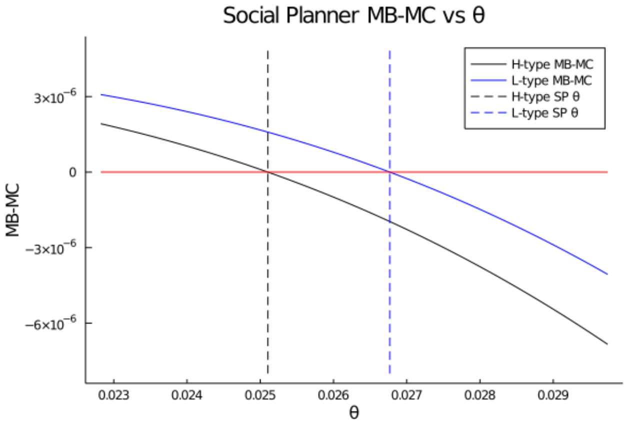
# Timing

The timing in any given period is as follows:

1. New housing is created at cost $\kappa$.
2. People receive income $y_i$ if employed and income $\alpha$ if unemployed.
3. Housed people receive utility $q \cdot \mathcal{E}(Q)$ from housing services while unhoused people receive zero utility.
4. Unhoused people match with housing according to $M(U, V)$.
5. Newly matched housing units receive quality investment $q$ at cost $c(q - f_i)$.
6. Housed people become unhoused with probability $\sigma$.
7. Employment status changes according to Markov process described above, independent from housing status.

Back

# Planner's Solution




- After substituting solution for $q_i^{SP}$ from (20) into (21), we graph MB-MC=0 to solve for $\theta_i^{SP}$
- Planner chooses slightly lower tightness/higher finding rates for type $L$ (would be identical if $f_H = f_L$).

Back

# Censoring

- Fundamental challenge to estimating employment and income processes for people who are likely to be evicted due to attrition.
- The CPS interviews members from a given address from month to month, which means that somebody who is evicted will not be in the same housing unit for a follow up interview.
- Therefore, we will miss people who report being unemployed and move before being interviewed again.
- This attrition likely biases our job-finding rates upward, since we are oversampling those with relatively short unemployment durations who find a job quickly enough to avoid eviction before their next interview.
- While over-estimating the job-finding rate of individuals at risk for eviction could affect our precise quantitative results, a lower job-finding rate for type $L$ individuals would only strengthen the incentive for landlords to evict them.
- We are less concerned about bias in the separation rate, since somebody who is interviewed the month before losing their job is likely to remain in the same unit the following month as well.

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## Decomposition

- Differences between planner and competitive allocations translate to large differences in aggregate discounted social surpluses.
- In Table 5 we calculate the losses from using the competitive equilibrium allocations of housing quality, tightness, and eviction decisions rather than the planner's optimal choices.
- We can then perform a simple accounting exercise to decompose how far the competitive allocation is from the efficient one both due to lack of commitment and to the externality.
- The row labeled "Baseline $Q$" reports the loss in steady-state aggregate social surplus, relative to the planner's optimum, using the tightnesses and qualities from the competitive equilibrium and assuming that matches are destroyed for type $L$ tenants whenever they lose their jobs.
- The row labeled "Planner $Q$" is similar, except that we fix the externality term at its value from the planner's allocation ($\mathcal{E}(Q) = \mathcal{E}(Q^{sp})$).
- This calculation isolates the loss in welfare from the competitive equilibrium's lack of commitment from the difference in the externality term.
- We find that three quarters of the loss (-13.8 percent) from the competitive equilibrium is due to lack of commitment, while another 4.5 percent is due to the externality ($-18.3$ percent in total).

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## SCF and CPS and RHFS Data

- Survey of Consumer Finance (SCF 2019):
    - Renter defined as any person who paid rent over the last year
    - Detailed snapshot of financial wealth, income, and rent payments
- Current Population Survey (CPS 2018-2019 panel):
    - Renter defined as someone who reported renting in any of the interviews (up to eight months)
    - Can track employment status over time and some income information
- Rental Housing Finance Survey (RHFS 2021)
    - Nationally representative sample of rental units in 2021.
    - Detailed information on revenues and costs of landlords.

## Many Renters Have Little Relative to Rent

**Table: Summary Statistics for Renters in SCF**

| | Overall | | Low Income | |
|---|---|---|---|---|
| Variable | Median | 25th% | Median | 25th% |
| Rent | \$860 | \$600 | \$690 | \$500 |
| Liquid Assets | \$1020 | \$100 | \$250 | \$0 |
| Networth | \$6700 | \$10 | \$2590 | \$0 |
| Income | \$38,688 | \$21,380 | \$21,380 | \$14,254 |

- Low income defined as below renter median income
- Little variation in rent (median is 43% higher than bottom quartile) while large variation in income (80% higher) and liquid assets (over 10 times higher)
- Median renter's liquid assets just cover rent while low income (below median) cannot cover rent from liquid assets
- Takeaway: hand-to-mouth is a good approximation for low income renters

BacktoCR

# Rent Burden is Falling in Income

**Figure: Rent Burden by Income, 2019 SCF**


- Rent burden is ratio of rent to household income.
- Bottom quartile pays about 50% of income in rent while second quartile pays about 30%.

# Low-Income Renters Differ Substantially In Employment Transition Rates

**Table: Average Labor Market Outcomes for Low-Income Renters in CPS**

| | High Employment | Low Employment |
|---|---|---|
| Monthly Earnings When Employed | $1025 | $501 |
| Job Finding Rate | 0.89 | 0.17 |
| Job Separation Rate | 0.04 | 0.43 |
| Fraction of each type | 0.9 | 0.1 |

- "Low employment" are those low-income renters in CPS who are employed in bottom decile of employment rate (fewer than half of months interviewed)
- High employment individuals have about 50% higher earnings when employed
- High employment individuals are much more likely to find a job if unemployed (avg duration of unemployment for type $H$ is a little over 1 month and for type $L$ is nearly 6 months) and to keep one while employed CPS

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# Rental Values

**Table: Summary Statistics from RHFS**

| Market Value Quartile | Rent | Operating Costs | Market Value | Flow Profit |
|---|---|---|---|---|
| Bottom 25% | $474 | $173 | $21,424 | $301 |
| 26-50% | $643 | $294 | $63,993 | $349 |

- Use operating costs as measure of flow cost to having unit occupied ($f_i$ in model)
- RHFS measure of operating costs includes utilities, insurance, landscaping, management company expenses, payroll expenses, maintenance, and security
- We add estimate of interest payments, which we compute using the RHFS information on mortgages (see paper for assumptions and imputations)
- Given most property taxes are 1% per year, add $\frac{1}{12}$% of the rental unit's market value to approximate the monthly property tax cost.

Match

## Neighborhood Externalities

**Table: Spillover Estimates from Autor, Palmer, and Pathak (2014)**

| Variable | Estimate |
|---|---|
| POST $\times$ RCI $\times$ RC | 0.25 |
| | (0.18) |
| POST $\times$ RCI $\times$ NON-RC | 0.13 |
| | (0.09) |

Autor, Palmer, and Pathak (2014) estimate the positive spillover on neighboring untreated housing values from lifting rent controls on treated housing units:

- After rent controls were lifted (POST $= 1$),
- Units under rent control (RC $= 1$) in neighborhoods with high rent control intensity (RCI $= 1$) saw a 25% increase in value.
- But even those not under rent control (NON-RC$=$1) saw a 13% increase in value (i.e. positive 50% spillover).
- To calibrate the externality, we use our model to conduct a local policy experiment similar to APP imposing rent control on some units, remove it, and then calculate the relative change in value for NON-RC to RC to calibrate the semi-elasticity $\eta$.

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## Characterization of Planner's Problem

The "first best" stationary allocation in the absence of commitment problems which internalizes the neighborhood externality satisfies:

$$c'(q_{i,e} - f_i) = \beta \frac{\mathcal{E}(Q) + Q\mathcal{E}'(Q)}{1 - \beta(1-\sigma)} \tag{20}$$

$$\kappa - \theta_{i,e}^2 \phi'(\theta_{i,e}) c(q_{i,e} - f_i) = \tag{21}$$

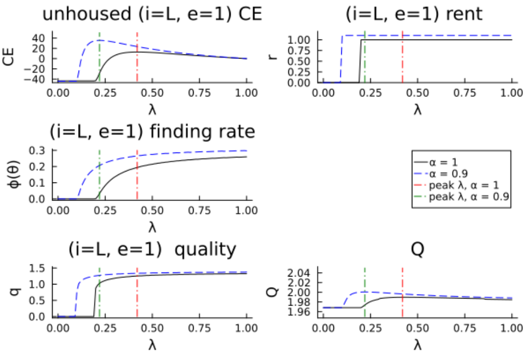
$$- \quad \beta \theta_{i,e}^2 \phi'(\theta_{i,e}) \left[ \frac{\mathcal{E}(Q) + Q\mathcal{E}'(Q) - f_i - \upsilon + \theta_{i,e}^{-1}(\kappa + c(q_{i,e} - f_i)\psi(\theta_{i,e}))}{1 - \beta(1 - \sigma - \phi(\theta_{i,e}))} \right]$$

$$Q = \frac{1}{\sigma} \sum_{i \in \{H,L\}} \sum_{e \in \{0,1\}} \mu_{i,e}^u \phi(\theta_{i,e}) q_{i,e} \tag{22}$$

Observations:

- FOC wrt $q_{i,e}$ in (20): marg. cost of quality = expected marg. benefit.
- FOC wrt $\theta_{i,e}$ in (21): marg. cost of vacancy = expected increase in social surplus.
- LOM wrt $Q$ in (22).
- No evictions (with commitment don't dissolve positive. surplus matches).
- No dependence in (20) and (21) on $e$ and $\mu_{i,e}^h$ integrated out in (22) $\rightarrow$ type dependent quality and tightness independent of $e$ with $q_H^{sp} > q_L^{sp}$ & $\theta_L^{sp} > \theta_H^{sp}$.

# Effect of Loosening Rental Constraints on Evictions

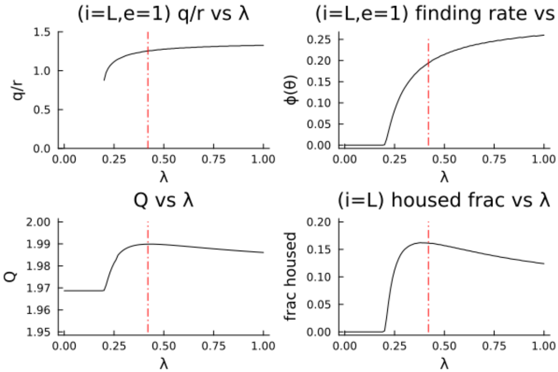



- Experiment where $\alpha$ falls from 1 to 0.9 effectively relaxing constraint on rental payments; peak $\lambda$ falls from 0.25 to 0.09
- $L$-type can pay more rent when employed, so policy can restrict evictions more without hurting ex-ante supply
- For sufficiently low $\alpha$, rent is high enough that landlord keeps unemployed $L-$type so $\lambda$ is irrelevant

Back

# Optimal Eviction Policy: Quality and Tightness

**Figure: Unhoused Employed Low-type Renter Policies**




- Quality-to-rent $q_{L,1}/r_{L,1}$ falls as evictions are restricted
- Rental finding rates $\phi(\theta_{L,1}))$ fall with too many eviction restrictions
  - Unintended consequence as in Hopenhayn and Rogerson (1993)
- Total quality is non-monotonic because share of $L-$type housed
  - Low $\lambda$: no $L-$type housed because finding rate is zero Back
  - High $\lambda$: highest $L-$type finding rate, but high eviction rate
  - Mid $\lambda$: highest $L-$type housed share because some finding, fewer evictions

# Decision Problem with Aggregate Uncertainty

Given the landlord $L_{i,e}(r,q;s)$ and renter $R_{i,e}(r,q;s)$ values conditional on matching, the unhoused renter solves the following:

$$\begin{aligned} V^*_{i,e}(s) &= y_{i,e} - \alpha \\ &+ \max_{r \le y_i - \alpha, q, \theta} \beta \mathbb{E}_{s'|s}\Bigg[\phi(\theta)\Big(p_{i,e}(s)R_{i,1}(r,q;s') + (1-p_{i,e}(s))R_{i,0}(r,q;s')\Big) \\ &+ (1-\phi(\theta))\Big(p_{i,e}(s)V^*_{i,1}(s') + (1-p_{i,e}(s))V^*_{i,0}(s')\Big)\Bigg] \end{aligned}$$

s.t.

$$\kappa \le \beta\psi(\theta)\mathbb{E}_{s'|s}\Big[p_{i,e}(s)L_{i,1}(r,q;s') + (1-p_{i,e}(s))L_{i,0}(r,q;s') - c(q-f_i)\Big],$$

- Argmax induces aggregate state dependent rents $r_{i,e}(s)$, qualities $q_{i,e}(s)$, and tightnesses $\theta_{i,e}(s)$. Back
  - In contractions, $L$-type finding rates fall in half (unhoused duration rises by 115 days) while $H$-type fall by only 4% (unhoused duration rises by 2 days).

# State Dependent Moratorium Outcomes

- Different policies have little effect on type $H$ hhs:
    - Not evicted in either state due to high job finding rate
- Different policies have an important effect, however, on type $L$ hhs:
    - The state dependent moratorium policy $(\lambda(g), \lambda(b)) = (1, 0)$ raises the welfare of the type $L$ household relative to no moratorium policy $(\lambda(g), \lambda(b)) = (1, 1)$
    - While not unexpected, imposing moratoria in all states $(\lambda(g), \lambda(b)) = (0, 0)$ leads to lower welfare since it collapses the rental market for the $L$-type hhs
- This provides an example where temporary moratorium policy to alleviate the effects of severe economic downturns can be welfare improving

Table Back