Housing Market Congestion and Internal Migration In Major European Cities

Charles Cheng Zhang

University of Oxford

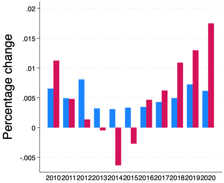
April 12, 2024

Reasons related to housing account for **41.6%** of the internal migration in 2022.

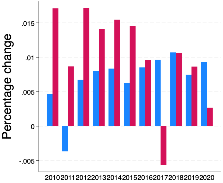
Motivation

Reasons related to housing account for **41.6%** of the internal migration in 2022.

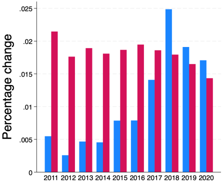
- Major European cities have grown in **population**, but not in **housing stock**.



Madrid



Munich



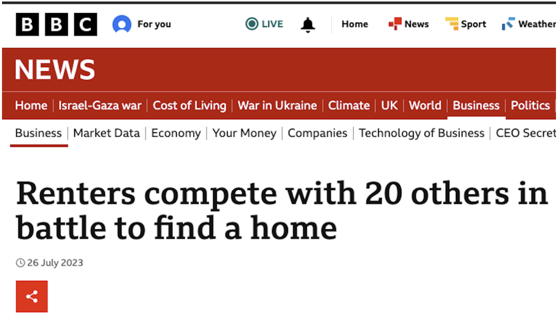
Copenhagen

Blue Bar: Housing stock annual percentage change. Red Bar: Population annual percentage change.

Motivation

Reasons related to housing account for **41.6%** of the internal migration in 2022.

- Major European cities have grown in **population**, but not in **housing stock**.
- **Longer searching time**: a 3X increase in enquiries for each rental property in London.



Reasons related to housing account for **41.6%** of the internal migration in 2022.

- Major European cities have grown in **population**, but not in **housing stock**.
- **Longer searching time**: a 3X increase in enquiries for each rental property in London.

The prevalence of **congestion** among renters. Why does it matter for migration?

Motivation

Reasons related to housing account for **41.6%** of the internal migration in 2022.

- Major European cities have grown in **population**, but not in **housing stock**.
- **Longer searching time**: a 3X increase in enquiries for each rental property in London.

The prevalence of **congestion** among renters. Why does it matter for migration?

- In theory: housing market clears through price and **time** (Han and Strange [2015]).
- In data: **search friction** is the biggest migration barrier (Bergman et al. [Forthcoming]).

Reasons related to housing account for **41.6%** of the internal migration in 2022.

- Major European cities have grown in **population**, but not in **housing stock**.
- **Longer searching time**: a 3X increase in enquiries for each rental property in London.

The prevalence of **congestion** among renters. Why does it matter for migration?

- In theory: housing market clears through price and **time** (Han and Strange [2015]).
- In data: **search friction** is the biggest migration barrier (Bergman et al. [Forthcoming]).

Research Question

How does congestion affect the housing market, and subsequently influence migration?

This Paper

Empirical:

- Proprietary housing market data on 34 major European cities from 2009-2021.
- Housing market congestion is **positively** correlated with **out-migration** using whole sample.
- **State dependent** corr in sub-sample: +(-) for cities with tight(loose) housing markets.

This Paper

Empirical:

- Proprietary housing market data on 34 major European cities from 2009-2021.
- Housing market congestion is **positively** correlated with **out-migration** using whole sample.
- **State dependent** corr in sub-sample: +(-) for cities with tight(loose) housing markets.

Mechanism: Congestion among renters gives rise to **two contrasting effects**.

This Paper

Empirical:

- Proprietary housing market data on 34 major European cities from 2009-2021.
- Housing market congestion is **positively** correlated with **out-migration** using whole sample.
- **State dependent** corr in sub-sample: +(-) for cities with tight(loose) housing markets.

Mechanism: Congestion among renters gives rise to **two contrasting effects**.

- Thick-market: higher probability for landlords to lease. **Match creation** $\uparrow$.
- Congestion externality: lower probability for renters to rent. **Search cost** $\uparrow$.
- Effects of $\uparrow$ in congestion depends on the trade-off between these channels.

This Paper

Empirical:

- Proprietary housing market data on 34 major European cities from 2009-2021.
- Housing market congestion is **positively** correlated with **out-migration** using whole sample.
- **State dependent** corr in sub-sample: +(-) for cities with tight(loose) housing markets.

Mechanism: Congestion among renters gives rise to **two contrasting effects**.

- Thick-market: higher probability for landlords to lease. **Match creation** $\uparrow$.
- Congestion externality: lower probability for renters to rent. **Search cost** $\uparrow$.
- Effects of $\uparrow$ in congestion depends on the trade-off between these channels.

Model:

- $\uparrow$ in congestion $\downarrow$ housing consumption when the market is **tight**. $\rightarrow$ out-migration.
- $\uparrow$ in congestion $\uparrow$ housing consumption when the market is **loose**. $\rightarrow$ in-migration.

This Paper

Empirical:

- Proprietary housing market data on 34 major European cities from 2009-2021.
- Housing market congestion is **positively** correlated with **out-migration** using whole sample.
- **State dependent** corr in sub-sample: +(-) for cities with tight(loose) housing markets.

Mechanism: Congestion among renters gives rise to **two contrasting effects**.

- Thick-market: higher probability for landlords to lease. **Match creation** $\uparrow$.
- Congestion externality: lower probability for renters to rent. **Search cost** $\uparrow$.
- Effects of $\uparrow$ in congestion depends on the trade-off between these channels.

Model:

- $\uparrow$ in congestion $\downarrow$ housing consumption when the market is **tight**. $\rightarrow$ out-migration.
- $\uparrow$ in congestion $\uparrow$ housing consumption when the market is **loose**. $\rightarrow$ in-migration.

Policy Implications:

- **Rent subsidies** $\downarrow$ **welfare** when used in cities with tight housing markets.
- **Housing stock expansion** $\uparrow$ **welfare** when used in cities with tight housing markets.
- Search and matching frictions are essential. In absence, policy implications are different.

Literature

- Housing market and inter-regional relocation:

  Ferreira et al. [2010], Head and Lloyd-Ellis [2012], Sterk [2015], Ganong and Shoag [2017], Cameron et al. [2005], Muellbauer and Cameron [1998], Nenov [2015], Stawarz et al. [2021], Bergman et al. [Forthcoming].

Literature

- Housing market and inter-regional relocation:

  Ferreira et al. [2010], Head and Lloyd-Ellis [2012], Sterk [2015], Ganong and Shoag [2017], Cameron et al. [2005], Muellbauer and Cameron [1998], Nenov [2015], Stawarz et al. [2021], Bergman et al. [Forthcoming].

  Contribution: first to show that housing congestion could be a potential channel.

- Housing market and inter-regional relocation:

  Ferreira et al. [2010], Head and Lloyd-Ellis [2012], Sterk [2015], Ganong and Shoag [2017], Cameron et al. [2005], Muellbauer and Cameron [1998], Nenov [2015], Stawarz et al. [2021], Bergman et al. [Forthcoming].

  Contribution: first to show that housing congestion could be a potential channel.

- Search and matching models in the housing market:

  Wheaton [1990], Genesove and Han [2012], Ngai and Sheedy [2020], Ngai and Sheedy [2020], Novy-Marx [2009], Diaz and Jerez [2013].

- Housing market and inter-regional relocation:

  Ferreira et al. [2010], Head and Lloyd-Ellis [2012], Sterk [2015], Ganong and Shoag [2017], Cameron et al. [2005], Muellbauer and Cameron [1998], Nenov [2015], Stawarz et al. [2021], Bergman et al. [Forthcoming].

  Contribution: first to show that housing congestion could be a potential channel.

- Search and matching models in the housing market:

  Wheaton [1990], Genesove and Han [2012], Ngai and Sheedy [2020], Ngai and Sheedy [2020], Novy-Marx [2009], Diaz and Jerez [2013].

  Contribution: highlights the role of congestion and generates state-dependent responses.

- Housing market and inter-regional relocation:

  Ferreira et al. [2010], Head and Lloyd-Ellis [2012], Sterk [2015], Ganong and Shoag [2017], Cameron et al. [2005], Muellbauer and Cameron [1998], Nenov [2015], Stawarz et al. [2021], Bergman et al. [Forthcoming].

  Contribution: first to show that housing congestion could be a potential channel.

- Search and matching models in the housing market:

  Wheaton [1990], Genesove and Han [2012], Ngai and Sheedy [2020], Ngai and Sheedy [2020], Novy-Marx [2009], Diaz and Jerez [2013].

  Contribution: highlights the role of congestion and generates state-dependent responses.

- "Subsidy/production" debate in housing policy:

  Apgar Jr [1990], Galster [1997], Yates and Whitehead [1998], Weicher [1990].

- Housing market and inter-regional relocation:

  Ferreira et al. [2010], Head and Lloyd-Ellis [2012], Sterk [2015], Ganong and Shoag [2017], Cameron et al. [2005], Muellbauer and Cameron [1998], Nenov [2015], Stawarz et al. [2021], Bergman et al. [Forthcoming].

  Contribution: first to show that housing congestion could be a potential channel.

- Search and matching models in the housing market:

  Wheaton [1990], Genesove and Han [2012], Ngai and Sheedy [2020], Ngai and Sheedy [2020], Novy-Marx [2009], Diaz and Jerez [2013].

  Contribution: highlights the role of congestion and generates state-dependent responses.

- "Subsidy/production" debate in housing policy:

  Apgar Jr [1990], Galster [1997], Yates and Whitehead [1998], Weicher [1990].

  Contribution: shows that policy implications could be state-dependent.

Outline

Model

The spatial version of Michaillat and Saez [2015]'s static model.

The Environment

The spatial version of Michaillat and Saez [2015]'s static model.

Geography and Primitives :

- The economy is composed of two cities, T and L.
- Each city is composed of N_i, $i \in (T, L)$ individuals.
- Locations are different in endowment, housing preference and housing stock.

The Environment

The spatial version of Michaillat and Saez [2015]'s static model.

Geography and Primitives :

- The economy is composed of two cities, T and L.
- Each city is composed of N_i, $i \in (T, L)$ individuals.
- Locations are different in endowment, housing preference and housing stock.

Housing market:

- Rental market to highlight the low home ownership rate in Europe.
- Housing services is supplied jointly from housing stock and home visits.

The Environment

The spatial version of Michaillat and Saez [2015]'s static model.

Geography and Primitives :

- The economy is composed of two cities, T and L.
- Each city is composed of N_i, $i \in (T, L)$ individuals.
- Locations are different in endowment, housing preference and housing stock.

Housing market:

- Rental market to highlight the low home ownership rate in Europe.
- Housing services is supplied jointly from housing stock and home visits.

Residents:

- They produce housing service: choose number of home visits.
- They demand housing service: choose between housing consumption and holding money.
- They migrate to improve housing consumption without costs.

The Environment

The spatial version of Michaillat and Saez [2015]'s static model.

Geography and Primitives :

- The economy is composed of two cities, T and L.
- Each city is composed of N_i, $i \in (T, L)$ individuals.
- Locations are different in endowment, housing preference and housing stock.

Housing market:

- Rental market to highlight the low home ownership rate in Europe.
- Housing services is supplied jointly from housing stock and home visits.

Residents:

- They produce housing service: choose number of home visits.
- They demand housing service: choose between housing consumption and holding money.
- They migrate to improve housing consumption without costs.

Spatial Equilibrium:

- Per resident housing consumption equalises across locations.

Matching

Matching/production function: $Y_i = [(\underbrace{V_i N_i}_{\text{Total no. visits}})^{-\gamma} + (\underbrace{\bar{K}_i}_{\text{Housing stock}})^{-\gamma}]^{-\frac{1}{\gamma}}, i \in (T, L)$.

- Y_i: aggregate housing service produced.
- V_i: number of visits per resident.
- N_i: number of resident.
- $\bar{K}_i$: number of housing stock.
- $\gamma > 0 \rightarrow Y_i < \min[V_i N_i, \bar{K}_i]$. Short-side of the market is not met due to trading friction.

Matching/production function: $Y_i = [(\underbrace{V_i N_i}_{\text{Total no. visits}})^{-\gamma} + (\underbrace{\bar{K}_i}_{\text{Housing stock}})^{-\gamma}]^{-\frac{1}{\gamma}}, i \in (T, L).$

Housing market tightness: $X_i = \frac{V_i N_i}{\bar{K}_i}$.

- Aggregate number of visits over total housing stock.

Matching/production function: $Y_i = [(\underbrace{V_i N_i}_{\text{Total no. visits}})^{-\gamma} + (\underbrace{\bar{K}_i}_{\text{Housing stock}})^{-\gamma}]^{-\frac{1}{\gamma}}, i \in (T, L).$

Housing market tightness: $X_i = \frac{V_i N_i}{\bar{K}_i}$.

- Aggregate number of visits over total housing stock.

Probability of a lease: $f(X_i) = \frac{Y_i}{\bar{K}_i} = (1 + X_i^{-\gamma})^{-\frac{1}{\gamma}}$.

- $f'(X_i) > 0$. The tighter the housing market, the easier to let.

Matching/production function: $Y_i = [(\underbrace{V_i N_i}_{\text{Total no. visits}})^{-\gamma} + (\underbrace{\bar{K}_i}_{\text{Housing stock}})^{-\gamma}]^{-\frac{1}{\gamma}}, i \in (T, L)$.

Housing market tightness: $X_i = \frac{V_i N_i}{\bar{K}_i}$.

- Aggregate number of visits over total housing stock.

Probability of a lease: $f(X_i) = \frac{Y_i}{\bar{K}_i} = (1 + X_i^{-\gamma})^{-\frac{1}{\gamma}}$.

- $f'(X_i) > 0$. The tighter the housing market, the easier to let.

Probability that one visit yields a purchase: $q(X_i) = \frac{Y_i}{V_i N_i} = (1 + X_i^{\gamma})^{-\frac{1}{\gamma}}$.

- $q'(X_i) < 0$. The tighter the housing market, the harder to rent.

Matching/production function: $Y_i = [(\underbrace{V_i N_i}_{\text{Total no. visits}})^{-\gamma} + (\underbrace{\bar{K}_i}_{\text{Housing stock}})^{-\gamma}]^{-\frac{1}{\gamma}}, i \in (T, L)$.

Housing market tightness: $X_i = \frac{V_i N_i}{\bar{K}_i}$.

- Aggregate number of visits over total housing stock.

Probability of a lease: $f(X_i) = \frac{Y_i}{\bar{K}_i} = (1 + X_i^{-\gamma})^{-\frac{1}{\gamma}}$.

- $f'(X_i) > 0$. The tighter the housing market, the easier to let.

Probability that one visit yields a purchase: $q(X_i) = \frac{Y_i}{V_i N_i} = (1 + X_i^{\gamma})^{-\frac{1}{\gamma}}$.

- $q'(X_i) < 0$. The tighter the housing market, the harder to rent.

Hence, tightness would capture congestion among renters.

Resident's problem:

$$\text{Max}_{C_i, \frac{M_i}{P_i}} [\chi_i C_i^{\frac{\epsilon-1}{\epsilon}} + (\frac{M_i}{P_i})^{\frac{\epsilon-1}{\epsilon}}]$$

s.t.

$$\underbrace{M_i + C_i[1 + \tau(X_i)]P_i}_{\text{Expenditure}} = \underbrace{\bar{\mu}_i + P_i f(X_i) \frac{\bar{K}_i}{N_i}}_{\text{Income}}$$

- C_i: consumption. χ_i: housing taste. M_i: money balance. $\bar{\mu}_i$: endowment. P_i: price.
- $\tau(X_i)$**: search and matching cost**. ↑ in congestion endogenously. Micro-foundation

Resident's problem:

$$\text{Max}_{C_i, \frac{M_i}{P_i}} [\chi_i C_i^{\frac{\epsilon-1}{\epsilon}} + (\frac{M_i}{P_i})^{\frac{\epsilon-1}{\epsilon}}]$$

s.t.

$$\underbrace{M_i + C_i[1 + \tau(X_i)]P_i}_{\text{Expenditure}} = \underbrace{\bar{\mu}_i + P_i f(X_i)\frac{\bar{K}_i}{N_i}}_{\text{Income}}$$

- C_i: consumption. χ_i: housing taste. M_i: money balance. $\bar{\mu}_i$: endowment. P_i: price.
- $\tau(X_i)$: **search and matching cost**. ↑ in congestion endogenously. Micro-foundation
- Congestion ↑

Resident's problem:

$$\text{Max}_{C_i, \frac{M_i}{P_i}} [\chi_i C_i^{\frac{\epsilon-1}{\epsilon}} + (\frac{M_i}{P_i})^{\frac{\epsilon-1}{\epsilon}}]$$

s.t.

$$\underbrace{M_i + C_i[1 + \tau(X_i)]P_i}_{\text{Expenditure}} = \underbrace{\bar{\mu}_i + P_i f(X_i)\frac{\bar{K}_i}{N_i}}_{\text{Income}}$$

- C_i: consumption. χ_i: housing taste. M_i: money balance. $\bar{\mu}_i$: endowment. P_i: price.
- $\tau(X_i)$**: search and matching cost**. ↑ in congestion endogenously. Micro-foundation
- Congestion ↑ → search and matching cost ↑

Resident's problem:

$$\text{Max}_{C_i, \frac{M_i}{P_i}} [\chi_i C_i^{\frac{\epsilon-1}{\epsilon}} + (\frac{M_i}{P_i})^{\frac{\epsilon-1}{\epsilon}}]$$

s.t.

$$\underbrace{M_i + C_i[1 + \tau(X_i)]P_i}_{\text{Expenditure}} = \underbrace{\bar{\mu}_i + P_i f(X_i)\frac{\bar{K}_i}{N_i}}_{\text{Income}}$$

- C_i: consumption. χ_i: housing taste. M_i: money balance. $\bar{\mu}_i$: endowment. P_i: price.
- $\tau(X_i)$**: search and matching cost**. ↑ in congestion endogenously. Micro-foundation
- Congestion ↑ → search and matching cost ↑ → effective purchasing price ↑.

Resident's problem:

$$\text{Max}_{C_i, \frac{M_i}{P_i}} [\chi_i C_i^{\frac{\epsilon-1}{\epsilon}} + (\frac{M_i}{P_i})^{\frac{\epsilon-1}{\epsilon}}]$$

s.t.

$$\underbrace{M_i + C_i[1+\tau(X_i)]P_i}_{\text{Expenditure}} = \underbrace{\bar{\mu}_i + P_i f(X_i)\frac{\bar{K}_i}{N_i}}_{\text{Income}}$$

- C_i: consumption. χ_i: housing taste. M_i: money balance. $\bar{\mu}_i$: endowment. P_i: price.
- $\tau(X_i)$**: search and matching cost**. ↑ in congestion endogenously. Micro-foundation
- Congestion ↑ → search and matching cost ↑ → effective purchasing price ↑.

Aggregate housing demand: $\mathcal{C}^D(X_i, P_i) = (\frac{\chi_i}{1+\tau(X_i)})^\epsilon \frac{\bar{\mu}_i}{P_i} \times N_i$.

Resident's problem:

$$\text{Max}_{C_i, \frac{M_i}{P_i}} [\chi_i C_i^{\frac{\epsilon-1}{\epsilon}} + (\frac{M_i}{P_i})^{\frac{\epsilon-1}{\epsilon}}]$$

s.t.

$$\underbrace{M_i + C_i[1 + \tau(X_i)]P_i}_{\text{Expenditure}} = \underbrace{\bar{\mu}_i + P_i f(X_i) \frac{\bar{K}_i}{N_i}}_{\text{Income}}$$

- C_i: consumption. χ_i: housing taste. M_i: money balance. $\bar{\mu}_i$: endowment. P_i: price.
- $\tau(X_i)$: **search and matching cost**. $\uparrow$ in congestion endogenously. Micro-foundation
- Congestion $\uparrow \rightarrow$ search and matching cost $\uparrow \rightarrow$ effective purchasing price $\uparrow$.

Aggregate housing demand: $\mathcal{C}^D(X_i, P_i) = (\frac{\chi_i}{1+\tau(X_i)})^\epsilon \frac{\bar{\mu}_i}{P_i} \times N_i$.

- Housing demand **strictly decreasing in tightness and price**.

Resident's problem:

$$\text{Max}_{C_i,\frac{M_i}{P_i}}[\chi_i C_i^{\frac{\epsilon-1}{\epsilon}} + (\frac{M_i}{P_i})^{\frac{\epsilon-1}{\epsilon}}]$$

s.t.

$$\underbrace{M_i + C_i[1+\tau(X_i)]P_i}_{\text{Expenditure}} = \underbrace{\bar{\mu}_i + P_i f(X_i)\frac{\bar{K}_i}{N_i}}_{\text{Income}}$$

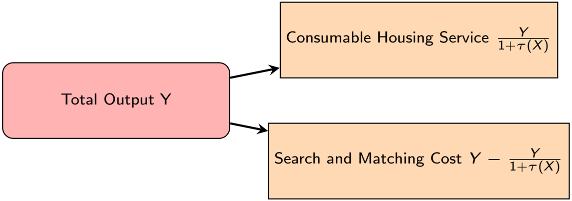
- C_i: consumption. χ_i: housing taste. M_i: money balance. $\bar{\mu}_i$: endowment. P_i: price.
- $\tau(X_i)$**: search and matching cost**. ↑ in congestion endogenously. Micro-foundation
- Congestion ↑ → search and matching cost ↑ → effective purchasing price ↑.

Aggregate housing demand: $\mathcal{C}^D(X_i, P_i) = (\frac{\chi_i}{1+\tau(X_i)})^\epsilon \frac{\bar{\mu}_i}{P_i} \times N_i$.

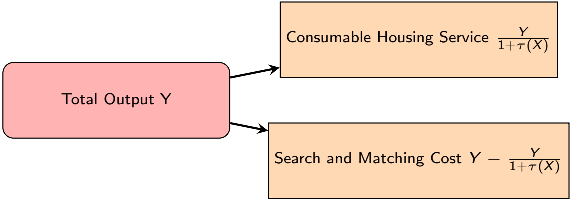
- Housing demand **strictly decreasing in tightness and price**.
- Endowment ↑ → housing demand ↑.
- Population ↑ → housing demand ↑.
- Housing taste ↑ → housing demand ↑.

Definition of housing supply: total consumable housing services produced.

Definition of housing supply: total consumable housing services produced.



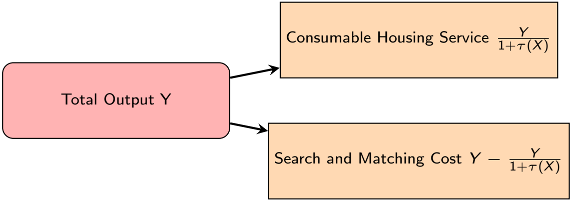
Definition of housing supply: total consumable housing services produced.



Aggregate housing supply: $\mathcal{C}^S(X_i) = \frac{f(X_i)\bar{K}_i}{1+\tau(X_i)}$

Housing Supply

Definition of housing supply: total consumable housing services produced.

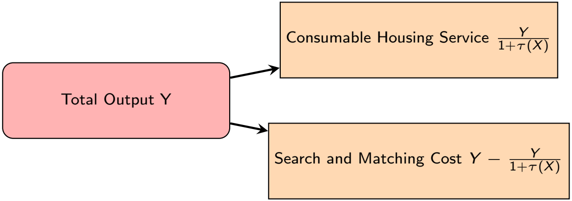


Aggregate housing supply: $\mathcal{C}^S(X_i) = \frac{f(X_i)\bar{K}_i}{1+\tau(X_i)} = (f(X_i) - \rho X_i)\bar{K}_i$.

Trade-offs between selling prob. and search cost capture the **thick-market VS congestion** effect.

Housing Supply

Definition of housing supply: total consumable housing services produced.



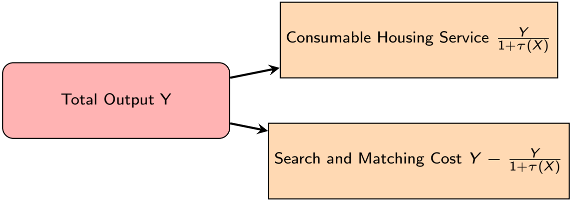
Aggregate housing supply: $\mathcal{C}^S(X_i) = \frac{f(X_i)\bar{K}_i}{1+\tau(X_i)} = (f(X_i) - \rho X_i)\bar{K}_i$.

Trade-offs between selling prob. and search cost capture the **thick-market VS congestion** effect.

$X_i \uparrow$

Housing Supply

Definition of housing supply: total consumable housing services produced.



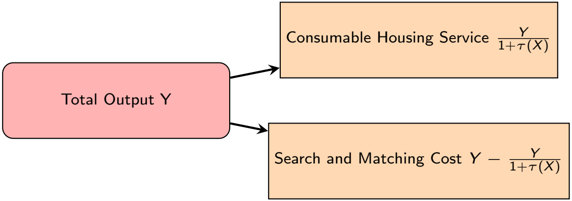
Aggregate housing supply: $\mathcal{C}^S(X_i) = \frac{f(X_i)\bar{K}_i}{1+\tau(X_i)} = (f(X_i) - \rho X_i)\bar{K}_i$.

Trade-offs between selling prob. and search cost capture the **thick-market VS congestion** effect.

$X_i \uparrow \rightarrow$ selling prob $\uparrow\uparrow$ and search cost $\uparrow$ initially

Housing Supply

Definition of housing supply: total consumable housing services produced.

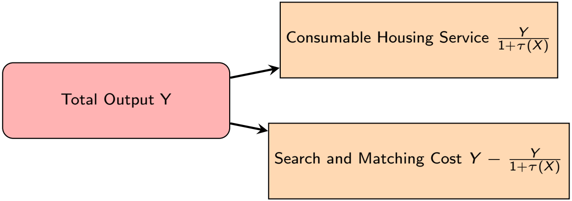


Aggregate housing supply: $\mathcal{C}^S(X_i) = \frac{f(X_i)\bar{K}_i}{1+\tau(X_i)} = (f(X_i) - \rho X_i)\bar{K}_i$.

Trade-offs between selling prob. and search cost capture the **thick-market VS congestion** effect.

$X_i \uparrow \rightarrow$ selling prob $\uparrow\uparrow$ and search cost $\uparrow$ initially $\rightarrow$ selling prob $\uparrow$ and search cost $\uparrow\uparrow$ later.

Definition of housing supply: total consumable housing services produced.



Aggregate housing supply: $\mathcal{C}^S(X_i) = \frac{f(X_i)\bar{K}_i}{1+\tau(X_i)} = (f(X_i) - \rho X_i)\bar{K}_i$.

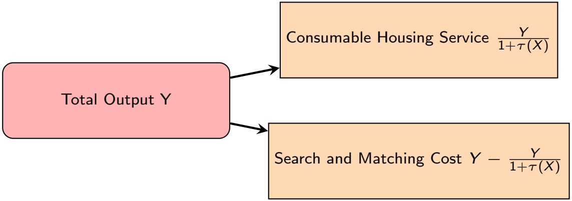
Trade-offs between selling prob. and search cost capture the **thick-market VS congestion** effect.

$X_i \uparrow \rightarrow$ selling prob $\uparrow\uparrow$ and search cost $\uparrow$ initially $\rightarrow$ selling prob $\uparrow$ and search cost $\uparrow\uparrow$ later.

Aggregate housing supply **first increases then decreases** with congestion.

Housing Supply

Definition of housing supply: total consumable housing services produced.



Aggregate housing supply: $\mathcal{C}^S(X_i) = \frac{f(X_i)\bar{K}_i}{1+\tau(X_i)} = (f(X_i) - \rho X_i)\bar{K}_i$.

Trade-offs between selling prob. and search cost capture the **thick-market VS congestion** effect.

$X_i \uparrow \rightarrow$ selling prob $\uparrow\uparrow$ and search cost $\uparrow$ initially $\rightarrow$ selling prob $\uparrow$ and search cost $\uparrow\uparrow$ later.

Aggregate housing supply **first increases then decreases** with congestion.

Wait for graphs :)

Housing Market Equilibrium

Definition of housing market equilibrium: $\mathcal{C}^S(X_i) = \mathcal{C}^D(X_i, P_i)$

- Aggregate housing supply equalises to aggregate housing demand.

Definition of housing market equilibrium: $\mathcal{C}^S(X_i) = \mathcal{C}^D(X_i, P_i)$

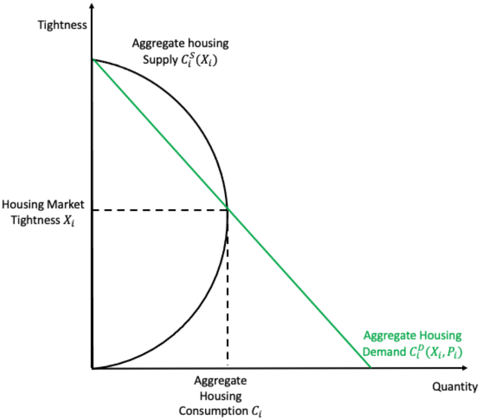
- Aggregate housing supply equalises to aggregate housing demand.

Graphic representation

Definition of housing market equilibrium: $\mathcal{C}^S(X_i) = \mathcal{C}^D(X_i, P_i)$

- Aggregate housing supply equalises to aggregate housing demand.

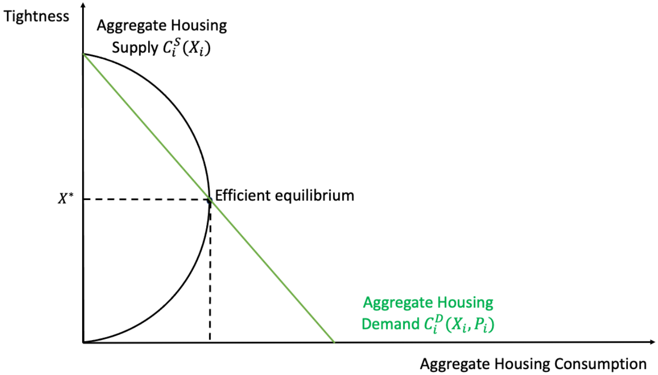
Graphic representation



Definition of housing market equilibrium: $\mathcal{C}^S(X_i) = \mathcal{C}^D(X_i, P_i)$

- Aggregate housing supply equalises to aggregate housing demand.

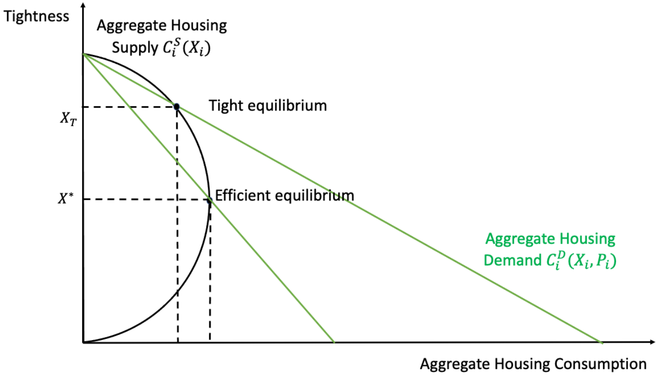
Three possible equilibrium regimes due to the shape of aggregate supply.



Definition of housing market equilibrium: $\mathcal{C}^S(X_i) = \mathcal{C}^D(X_i, P_i)$

- Aggregate housing supply equalises to aggregate housing demand.

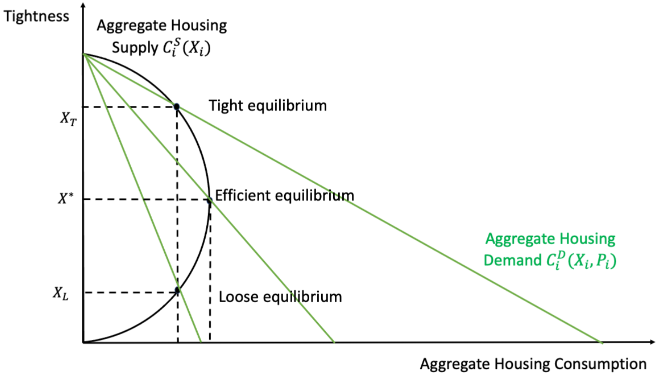
Three possible equilibrium regimes due to the shape of aggregate supply.



Definition of housing market equilibrium: $\mathcal{C}^S(X_i) = \mathcal{C}^D(X_i, P_i)$

- Aggregate housing supply equalises to aggregate housing demand.

Three possible equilibrium regimes due to the shape of aggregate supply.



Comparative Statics

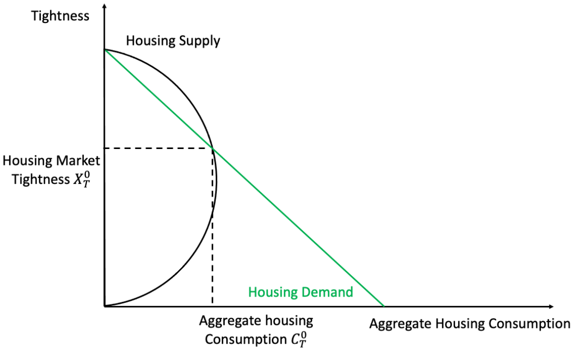
When tightness increases,

- Housing consumption $\downarrow$ if the equilibrium is tight.
- Housing consumption $\uparrow$ if the equilibrium is loose.

When tightness increases,

- Housing consumption ↓ if the equilibrium is tight.
- Housing consumption ↑ if the equilibrium is loose.

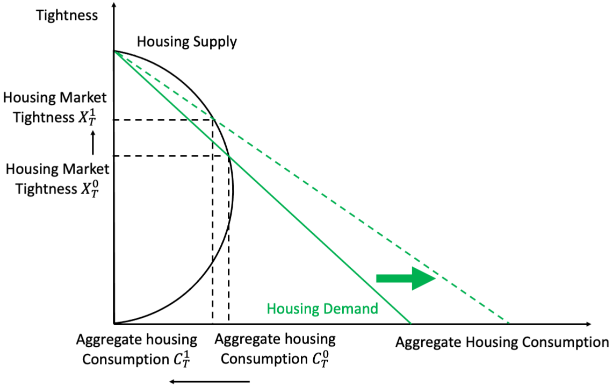
Graphic representation



When tightness increases,

- Housing consumption ↓ if the equilibrium is tight.
- Housing consumption ↑ if the equilibrium is loose.

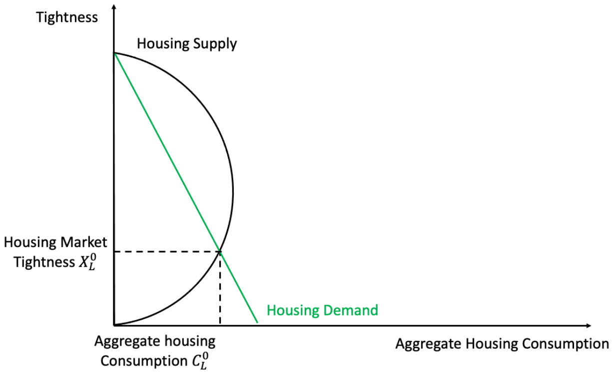
Graphic representation



When tightness increases,

- Housing consumption ↓ if the equilibrium is tight.
- Housing consumption ↑ if the equilibrium is loose.

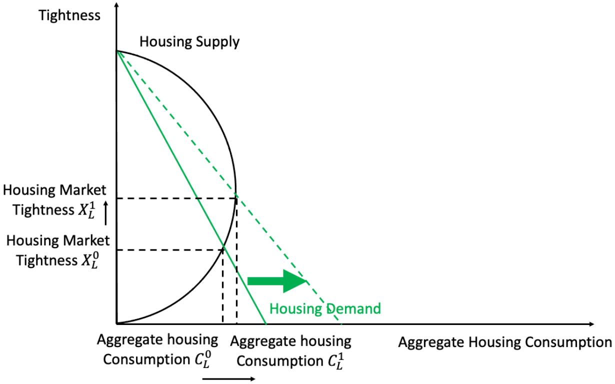
Graphic representation



When tightness increases,

- Housing consumption ↓ if the equilibrium is tight.
- Housing consumption ↑ if the equilibrium is loose.

Graphic representation



Migration

Out-migration occurs when congestion increases in a tight housing market.

Out-migration occurs when congestion increases in a tight housing market.

- Taking total derivative from the housing equilibrium

$$\underbrace{-\frac{dN_i}{N_i}}_{\text{out-migration rate}} = \underbrace{\left[-\frac{f'(X_i)-\rho}{f(X_i)-\rho X_i} + \frac{\partial \log C_i}{\partial X_i}\right]}_{\text{Semi-elasticity of out-migration w.r.t. } \Delta \text{ tightness}} dX_i + \frac{\partial \log C_i}{\partial P_i} dP_i$$

Out-migration occurs when congestion increases in a tight housing market.

- Taking total derivative from the housing equilibrium

$$\underbrace{-\frac{dN_i}{N_i}}_{\text{out-migration rate}} = \underbrace{\left[-\frac{f'(X_i)-\rho}{f(X_i)-\rho X_i} + \frac{\partial \log C_i}{\partial X_i}\right]}_{\text{Semi-elasticity of out-migration w.r.t. } \Delta \text{ tightness}} dX_i + \frac{\partial \log C_i}{\partial P_i} dP_i$$

- $f'(X_i) - \rho$ is state dependent. $\leftrightarrow$ Immigration's response to tightness is **state-dependent**.

Out-migration occurs when congestion increases in a tight housing market.

- Taking total derivative from the housing equilibrium

$$\underbrace{-\frac{dN_i}{N_i}}_{\text{out-migration rate}} = \underbrace{\left[-\frac{f'(X_i)-\rho}{f(X_i)-\rho X_i} + \frac{\partial \log C_i}{\partial X_i}\right]}_{\text{Semi-elasticity of out-migration w.r.t. } \Delta \text{ tightness}} dX_i + \frac{\partial \log C_i}{\partial P_i} dP_i$$

- $f'(X_i) - \rho$ is state dependent. $\leftrightarrow$ Immigration's response to tightness is **state-dependent**.

If rental prices are rigid, Formal derivation

$$-\frac{dN_i}{N_i} = -\frac{f'(X_i)-\rho}{f(X_i)-\rho X_i} dX_i + \frac{1}{C_i} dC_i$$

Out-migration occurs when congestion increases in a tight housing market.

- Taking total derivative from the housing equilibrium

$$\underbrace{-\frac{dN_i}{N_i}}_{\text{out-migration rate}} = \underbrace{[-\frac{f'(X_i)-\rho}{f(X_i)-\rho X_i} + \frac{\partial \log\ C_i}{\partial X_i}]}_{\text{Semi-elasticity of out-migration w.r.t. } \Delta \text{ tightness}} dX_i + \frac{\partial \log\ C_i}{\partial P_i} dP_i$$

- $f'(X_i) - \rho$ is state dependent. $\leftrightarrow$ Immigration's response to tightness is **state-dependent**.

If rental prices are rigid, Formal derivation

$$-\frac{dN_i}{N_i} = -\frac{f'(X_i)-\rho}{f(X_i)-\rho X_i} dX_i + \frac{1}{C_i} dC_i$$

- $f'(X_i) - \rho < 0$ in a tight housing market equilibrium as per definition.
- $dC_i > 0$, as households only migrate to improve consumption.
- Therefore, if $dX_i > 0$, $-\frac{dN_i}{N_i} > 0$.

Out-migration occurs when congestion increases in a tight housing market.

- Taking total derivative from the housing equilibrium

$$\underbrace{-\frac{dN_i}{N_i}}_{\text{out-migration rate}} = \underbrace{\left[-\frac{f'(X_i)-\rho}{f(X_i)-\rho X_i} + \frac{\partial \log C_i}{\partial X_i}\right]}_{\text{Semi-elasticity of out-migration w.r.t. } \Delta \text{ tightness}} dX_i + \frac{\partial \log C_i}{\partial P_i} dP_i$$

- $f'(X_i) - \rho$ is state dependent. $\leftrightarrow$ Immigration's response to tightness is **state-dependent**.

If rental prices are rigid, Formal derivation

$$-\frac{dN_i}{N_i} = -\frac{f'(X_i)-\rho}{f(X_i)-\rho X_i} dX_i + \frac{1}{C_i} dC_i$$

- $f'(X_i) - \rho < 0$ in a tight housing market equilibrium as per definition.
- $dC_i > 0$, as households only migrate to improve consumption.
- Therefore, if $dX_i > 0$, $-\frac{dN_i}{N_i} > 0$.
- **Congestion** $\uparrow \rightarrow$ **out-migration** in a tight housing market.
- Vice versa if housing market is loose.

Taking Stock

The theoretical framework shows:

- $\uparrow$ in housing market congestion $\rightarrow$ **out-migration**, when market is **tight**.
- $\uparrow$ in housing market congestion $\rightarrow$ **in-migration**, when market is **loose**.
- Key mechanism: trade-off between thick market and congestion externality.

The theoretical framework shows:

- $\uparrow$ in housing market congestion $\rightarrow$ **out-migration**, when market is **tight**.
- $\uparrow$ in housing market congestion $\rightarrow$ **in-migration**, when market is **loose**.
- Key mechanism: trade-off between thick market and congestion externality.

Do they hold empirically?

Empirics

Measuring Congestion

- Want to construct congestion $X_{it} = \frac{V_{it} N_{it}}{\bar{K}_{it}}$. However, home visits V_{it} are not observed.
- Instead, construct **transaction probability** $f(X_{it}) = \frac{Y_{it}}{\bar{K}_{it}} = \frac{\text{Number of housing transactions}}{\text{Number of housing stock}}$
- Measured using proprietary data. Data Sources

Measuring Congestion

- Want to construct congestion $X_{it} = \frac{V_{it} N_{it}}{\bar{K}_{it}}$. However, home visits V_{it} are not observed.
- Instead, construct **transaction probability** $f(X_{it}) = \frac{Y_{it}}{\bar{K}_{it}} = \frac{\text{Number of housing transactions}}{\text{Number of housing stock}}$
- Measured using proprietary data. Data Sources
- $f(X_{it}) \uparrow \rightarrow$ probability of a successful purchase $\downarrow \rightarrow$ congestion among renters.
- $f'(X_{it}) > 0$. One can also few $f(X_{it})$ as a proxy to congestion.

Measuring Congestion

- Want to construct congestion $X_{it} = \frac{V_{it} N_{it}}{\bar{K}_{it}}$. However, home visits V_{it} are not observed.
- Instead, construct **transaction probability** $f(X_{it}) = \frac{Y_{it}}{\bar{K}_{it}} = \frac{\text{Number of housing transactions}}{\text{Number of housing stock}}$
- Measured using proprietary data. Data Sources
- $f(X_{it}) \uparrow \rightarrow$ probability of a successful purchase $\downarrow \rightarrow$ congestion among renters.
- $f'(X_{it}) > 0$. One can also few $f(X_{it})$ as a proxy to congestion.

Richer/bigger cities tend to have more congested housing markets. Example: German cities

Baseline Regression

$$\underbrace{\text{net out-migration rate}_{it}}_{\frac{\text{outflow}_{it} - \text{inflow}_{it}}{\text{population}_{it}}} = \alpha + \beta_1 \underbrace{\text{trans-prob}_{it}}_{f(X_{it})} + \beta_2 \underbrace{\text{rent}_{it}}_{\substack{\text{log real} \\ \text{housing rent}}} + \underbrace{C'_{it}}_{\substack{\text{controls:} \\ \text{unemployment} \\ \text{rate and real} \\ \text{disposable income.}}} \Gamma + \underbrace{\eta_i}_{\text{city FE}} + \epsilon_{it}.$$

Baseline Regression

$$\underbrace{\text{net out-migration rate}_{it}}_{\frac{\text{outflow}_{it}-\text{inflow}_{it}}{\text{population}_{it}}} = \alpha + \beta_1 \underbrace{\text{trans-prob}_{it}}_{f(X_{it})} + \beta_2 \underbrace{\text{rent}_{it}}_{\text{log real housing rent}} + \underbrace{C'_{it}}_{\text{controls: unemployment rate and real disposable income.}} \Gamma + \underbrace{\eta_i}_{\text{city FE}} + \epsilon_{it}.$$

	(1)	(2)
Transaction probability	**0.174****	**0.200*****
	(0.0630)	(0.0535)
log real rent	0.00929***	0.00227
	(0.00373)	(0.00460)
N	266	266
adj. R^2	0.20	0.31
City & country FE	✓	✓
Time FE		✓
Cluster robust SE	✓	✓
Controls	✓	✓

- **Renter congestion** $\uparrow \rightarrow$ **out-migration** $\uparrow$ for 34 major European cities.
- Housing cost $\uparrow \rightarrow$ out-migration $\uparrow$. The same result as in previous studies.

Tight VS Loose Regression

$$\text{net out-migration rate}_{it} = \alpha + \beta_1 \text{trans-prob}_{it} + \beta_2 \text{trans-prob}_{it} \times D_i + \beta_3 \text{rent}_{it} + \Gamma C_{it} + \eta_i + \epsilon_{it}.$$

- City with a loose housing market: where $f(X_{it})$ is in the first quantile. $D_i = 0$.
- Otherwise, such a city has a tight housing market. $D_i = 1$.

Tight VS Loose Regression

$$\text{net out-migration rate}_{it} = \alpha + \beta_1 \text{trans-prob}_{it} + \beta_2 \text{trans-prob}_{it} \times D_i + \beta_3 \text{rent}_{it} + \Gamma C_{it} + \eta_i + \epsilon_{it}.$$

- City with a loose housing market: where $f(X_{it})$ is in the first quantile. $D_i = 0$.
- Otherwise, such a city has a tight housing market. $D_i = 1$.

	(1)	(2)
Transaction probability	**-0.404***** (0.145)	**-0.290** (0.172)
log real rent	0.00924*** (0.00326)	0.0013 (0.00322)
Transaction probability $\times$ dummy	**0.596***** (0.155)	**0.501***** (0.172)
N	266	266
adj. R^2	0.23	0.24
City & country FE	✓	✓
Time FE		✓
Cluster robust SE	✓	✓
Controls	✓	✓

- Out-migration's correlation with transaction probability is **state-dependent**.
- +(-) for cities with tight (loose) housing markets.

Sample splitting

- Splitting data based on trans. probability and run the baseline regression for each quantile.
- Plot the coefficient associated with trans. probability for each regression.
- Coefficient increases from negative to positive when renter's congestion ↑. Back

Robustness tests

- Use bootstrap standard error to address small sample size. Bootstrap table
- Restrict the sample to ↑ in real rent only. Sign restriction table
  - ↑ in both rent and $f(X_i)$ are more adequate to indicate ↑ in congestion.

Pairwise migration

- Theoretical model predicts workers would move to less congested housing markets.
- Would require knowledge of destinations. Use pairwise migration data in the U.K..
- Migrants prefer cities where housing market is less congested. Pairwise migration table

Same labour market participation

- Concerns that people move to participate in different labour markets.
- Limit the migration distance. Same results hold. Same labour market table

Policy

Demand Side Policy: Rental Subsidy

Rental subsidy would **reduce welfare** if imposed in cities with tight housing markets.

Demand Side Policy: Rental Subsidy

Rental subsidy would **reduce welfare** if imposed in cities with tight housing markets.

Mechanism: rental subsidy $\uparrow$ endowment

Demand Side Policy: Rental Subsidy

Rental subsidy would **reduce welfare** if imposed in cities with tight housing markets.

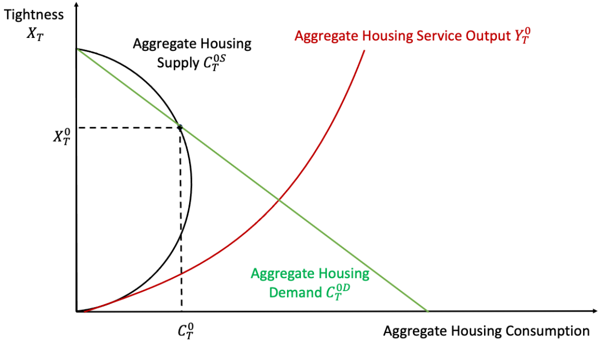
Mechanism: rental subsidy $\uparrow$ endowment $\rightarrow \uparrow$ housing demand

Rental subsidy would **reduce welfare** if imposed in cities with tight housing markets.

Mechanism: rental subsidy $\uparrow$ endowment $\rightarrow \uparrow$ housing demand $\rightarrow \downarrow$ housing consumption.

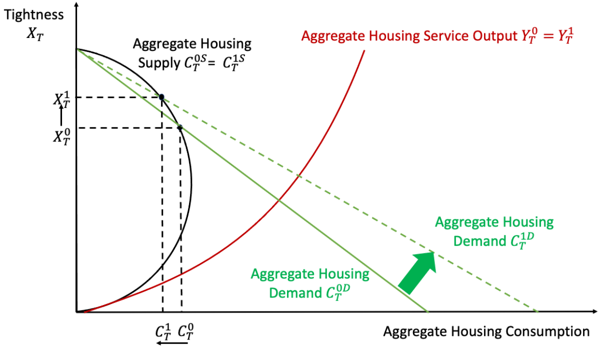
Rental subsidy would **reduce welfare** if imposed in cities with tight housing markets.

Mechanism: rental subsidy ↑ endowment → ↑ housing demand → ↓ housing consumption.



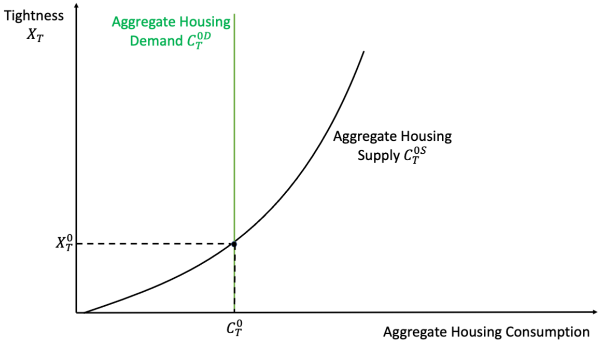
Rental subsidy would **reduce welfare** if imposed in cities with tight housing markets.

Mechanism: rental subsidy ↑ endowment → ↑ housing demand → ↓ housing consumption.

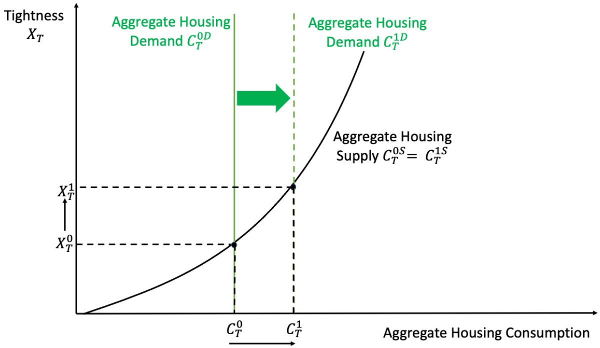


Demand Side Policy: Rental Subsidy

Search frictions are important. Policy implications **differ if the market were Walrasian**.



Search frictions are important. Policy implications **differ if the market were Walrasian**.



Conclusion

Conclusion

I show that **housing market congestion congestion** could be linked with **internal migration**.

- **Novel channel** independent of the "lock-in" and cost-related pathways.

Model:

- $\uparrow$ in congestion could incentivise **out-migration** in cities with **tight** housing markets.
- $\uparrow$ in congestion could incentivise **in-migration** in cities with **loose** housing markets.

Empirics:

- Out-migrations and congestion's correlation is **positive** for 34 **major** European cities.
- State-dependency: the correlation is **negative** for cities with **loose** housing markets.

Policy:

- **Rental subsidy** $\downarrow$ **welfare** when imposed in cities with tight housing markets.
- **Housing stock expansion** $\uparrow$ **welfare** when imposed in cities with tight housing markets.
- **Search frictions are essential**. Policy implications differ if housing markets were Walrasian.

References

References I

William C Apgar Jr. Which housing policy is best? 1990.

Peter Bergman, Raj Chetty, Stefanie DeLuca, Nathaniel Hendren, Lawrence F. Katz, and Christopher Palmer. Creating moves to opportunity: Experimental evidence on barriers to neighborhood choice. *American Economic Review*, Forthcoming.

Gavin Cameron, John Muellbauer, and Anthony Murphy. Migration within england and wales and the housing market. *Economic Outlook*, 29(3):9–19, 2005.

Antonia Diaz and Belén Jerez. House prices, sales, and time on the market: a search-theoretic framework. *International Economic Review*, 54(3):837–872, 2013.

Fernando Ferreira, Joseph Gyourko, and Joseph Tracy. Housing busts and household mobility. *Journal of urban Economics*, 68 (1):34–45, 2010.

George Galster. Comparing demand-side and supply-side housing policies: Sub-market and spatial perspectives. 1997.

Peter Ganong and Daniel Shoag. Why has regional income convergence in the us declined? *Journal of Urban Economics*, 102: 76–90, 2017.

David Genesove and Lu Han. Search and matching in the housing market. *Journal of urban economics*, 72(1):31–45, 2012.

Lu Han and William C Strange. The microstructure of housing markets: Search, bargaining, and brokerage. *Handbook of regional and urban economics*, 5:813–886, 2015.

Allen Head and Huw Lloyd-Ellis. Housing liquidity, mobility, and the labour market. *Review of Economic Studies*, 79(4): 1559–1589, 2012.

Pascal Michaillat and Emmanuel Saez. Aggregate demand, idle time, and unemployment. *The Quarterly Journal of Economics*, 130(2):507–569, 2015.

John Muellbauer and Gavin Cameron. The housing market and regional commuting and migration choices. 1998.

Plamen T Nenov. Regional reallocation and housing markets in a model of frictional migration. *Review of Economic Dynamics*, 18(4):863–880, 2015.

L Rachel Ngai and Kevin D Sheedy. The decision to move house and aggregate housing-market dynamics. *Journal of the European Economic Association*, 18(5):2487–2531, 2020.

Robert Novy-Marx. Hot and cold markets. *Real Estate Economics*, 37(1):1–22, 2009.

Nico Stawarz, Nikola Sander, and Harun Sulak. Internal migration and housing costs—a panel analysis for germany. *Population, Space and Place*, 27(4):e2412, 2021.

Vincent Sterk. Home equity, mobility, and macroeconomic fluctuations. *Journal of Monetary Economics*, 74:16–32, 2015.

John C Weicher. Comment on william apgar's "which housing policy is best?". 1990.

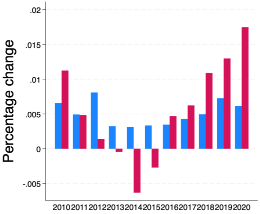
William C Wheaton. Vacancy, search, and prices in a housing market matching model. *Journal of political Economy*, 98(6): 1270–1292, 1990.

Judith Yates and Christine Whitehead. In defence of greater agnosticism: a response to galster's' comparing demand-side and supply-side housing policies'. *Housing Studies*, 13(3):415–423, 1998.

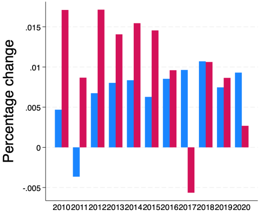
Appendix

Population VS Housing Stock

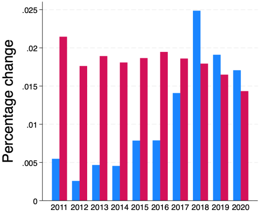
Figure: Population and Housing Stock Growth



Madrid



Munich



Copenhagen

- Blue Bar: Housing stock annual percentage change.
- Red Bar: Population annual percentage change.

Back

Search and Matching Cost

Set-up:

- Residents face a search and matching cost ρ of housing service during every visit.
- Total housing service required to consume C_i and pay V_i visits: $C_i + \rho V_i$.

Search and Matching Cost

Set-up:

- Residents face a search and matching cost ρ of housing service during every visit.
- Total housing service required to consume C_i and pay V_i visits: $C_i + \rho V_i$.

Number of visits:

- Aggregate housing service purchased: $Y_i = (C_i + \rho V_i)N_i$.
- Y_i can also be expressed as: $Y_i = q(X_i)V_i N_i$.
  - Total housing service produced is the probability of a successful visit $\times$ n.o. visits.
- Therefore, $V_i = \frac{C_i}{q(X_i) - \rho}$.
  - N.o. visits is consumption deflated by adjusted purchasing probability.

Search and Matching Cost

Set-up:

- Residents face a search and matching cost ρ of housing service during every visit.
- Total housing service required to consume C_i and pay V_i visits: $C_i + \rho V_i$.

Number of visits:

- Aggregate housing service purchased: $Y_i = (C_i + \rho V_i)N_i$.
- Y_i can also be expressed as: $Y_i = q(X_i)V_i N_i$.
  - Total housing service produced is the probability of a successful visit $\times$ n.o. visits.
- Therefore, $V_i = \frac{C_i}{q(X_i)-\rho}$.
  - N.o. visits is consumption deflated by adjusted purchasing probability.

Search and matching cost :

To consume 1 unit of housing service:

- Number of visits required is $V_i = \frac{1}{q(X_i)-\rho}$.
- Total amount of housing service required to buy is $1 + \frac{\rho}{q(X_i)-\rho}$.
- Let $\frac{\rho}{q(X_i)-\rho} \equiv \tau(X_i)$. Total amount of housing service required to buy is $1 + \tau(X_i)$.
- $\tau'(X_i) > 0$. **Congestion** $\uparrow \rightarrow$ **Search cost** $\uparrow$.

Back

Housing Market Equilibrium When Prices are Rigid

Fixed-price equilibrium

- Equilibrium has two unknowns but one equation $\rightarrow$ infinite (X_i, P_i) combinations.
- Need to fix one unknown as a parameter. I fix price.
- **Comparative statics of when price is rigid is the same as when price is fixed**.

Housing Market Equilibrium When Prices are Rigid

Fixed-price equilibrium

- Equilibrium has two unknowns but one equation $\rightarrow$ infinite (X_i, P_i) combinations.
- Need to fix one unknown as a parameter. I fix price.
- **Comparative statics of when price is rigid is the same as when price is fixed.**

Evidence of rigid rental price

- Since 2010, **85.3%** of the changes in nominal rent are non-negative.
- Wide use of rent indexation (to CPI). Applied to **70%** of new releases in Berlin.

Back

Overview and Data Description

Empirical challenge: Granular housing market data is not always available to public in Europe.

Overview and Data Description

Empirical challenge: Granular housing market data is not always available to public in Europe.

Solution: use panel data from PMA, a major independent property consultancy.

Overview and Data Description

Empirical challenge: Granular housing market data is not always available to public in Europe.

Solution: use panel data from PMA, a major independent property consultancy.

Housing market data

- Variables: housing transactions, stock and rent.
- 34 major European cities, from 2009 - 2021. Annual frequency.
- Performed various checks against official data/previous studies to ensure quality.
  PMA VS Official Data Comparison With Nenov [2015]

Overview and Data Description

Empirical challenge: Granular housing market data is not always available to public in Europe.

Solution: use panel data from PMA, a major independent property consultancy.

Housing market data

- Variables: housing transactions, stock and rent.
- 34 major European cities, from 2009 - 2021. Annual frequency.
- Performed various checks against official data/previous studies to ensure quality.
  PMA VS Official Data Comparison With Nenov [2015]

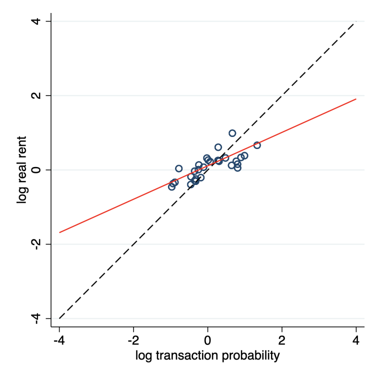
Migration and local economic data

- Migration variables: annual aggregate in and out-migrations at the city-level.
- Local economic variables: unemployment rate, GDP and disposable income per capita.
- From official statistical agencies (Eurostat, ONS, DESTATIS...)

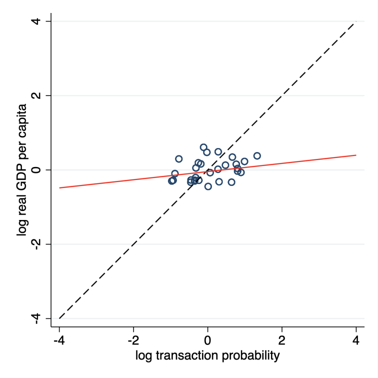
Back

Figure: Transaction Probability and Rent/GDP Per Capita

Trans. prob. and rent



Trans. prob. and GDP per capita

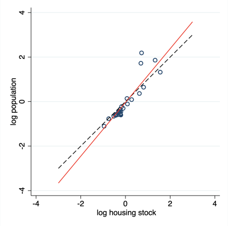


Back

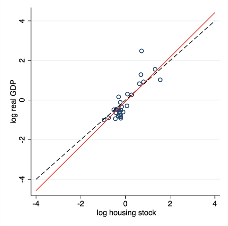
PMA Data Validation

Figure: Cross-sectional and Time Series Validation

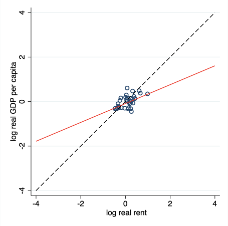
Stock and pop.



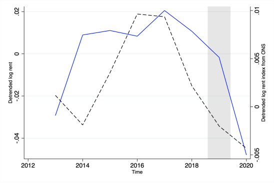
Stock and GDP



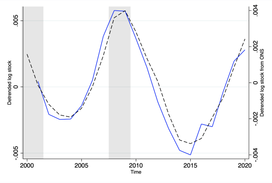
Rent and GDP



PMA and ONS rent



PMA and ONS stock



PMA and ONS trans.

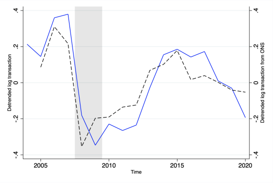


Table: Comparison with Nenov [2015]: rent and out-migration rate

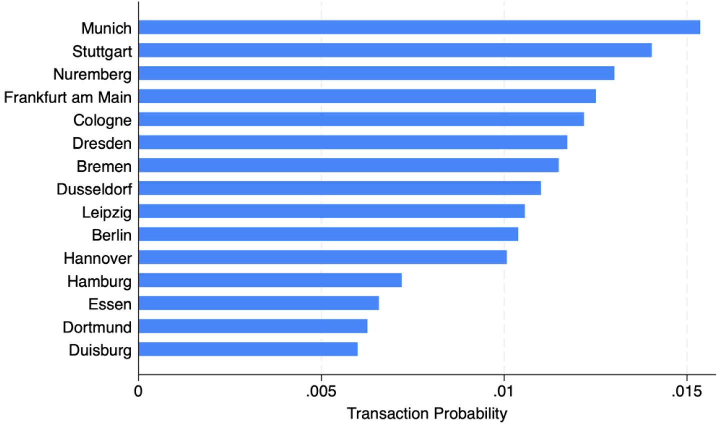
Dep. Variable:	log out-migration rate	
	(1)	(2)
log real rent	0.306***	0.319**
	(0.0985)	(0.138)
N	1338	291
adj. R^2	0.94	0.05
City FE	✓	✓
Time FE	✓	✓
Cluster robust SE	✓	✓
Controls	✓	✓

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Back

Transaction Probability: Germany

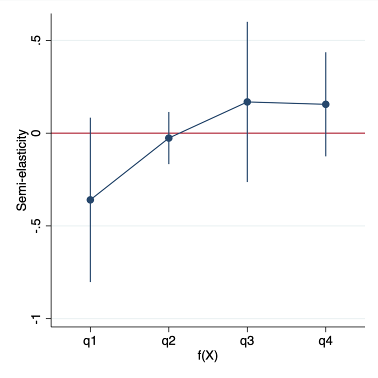
Figure: Transaction Probability in German Cities



Back

Coefficient Plot

Figure: Correlation between transaction probability and net out-migration rate



- Stratifying sample based on the level of $f(X_i)$, from the lowest to the highest.
- Plot of coefficient on $f(X_i)$ in the baseline regression for each quantile of $f(X_i)$.
- Error bars are in blue.

Back

Robustness Check: Bootstrap SE

Table: Robustness check: Bootstrap SE

Dep. Variable:	net out-migration rate	
	(1)	(2)
Transaction probability	0.200***	-0.290*
	(0.0462)	(0.165)
log real rent	0.00227	0.00238
	(0.00561)	(0.00466)
Transaction probability $\times$ dummy		0.50***
		(0.165)
N	266	266
adj. R^2	0.23	0.25
City & country FE	✓	✓
Time FE	✓	✓
Bootstrap SE	✓	✓
Controls	✓	✓

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Robustness Check: Sign Restriction

Table: Robustness check: Sign restriction on rent

Dep. Variable:	net out-migration rate	
	(1)	(2)
Transaction probability	0.136**	-0.244
	(0.0582)	(0.196)
log real rent	0.000982	0.00138
	(0.00464)	(0.00474)
Transaction probability × dummy		0.391*
		(0.198)
N	203	203
adj. R^2	0.26	0.28
City & country FE	✓	✓
Time FE	✓	✓
Cluster Robust SE	✓	✓
Controls	✓	✓

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Back

Pairwise Regression

Table: Correlation between destination transaction probability and out-migration

Dep. Variable:	log out-migration rate	
	(1)	(2)
Destination transaction probability	-6.828***	-6.828***
	(1.307)	(1.307)
N	2953	2953
adj. R^2	0.15	0.15
Origin - Destination FE	✓	✓
Origin - Time FE	✓	✓
Time FE	✓	✓
Cluster robust SE	✓	✓
Destination rent psf	✓	
Destination rent per unit		✓
Controls	✓	✓

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Back

Same Labour Market Restriction

Table: Correlation between destination transaction probability and out-migration

Dep. Variable:	log out-migration rate	
	(1)	(2)
Destination transaction probability	-5.494***	-3.774**
	(1.700)	(1.147)
N	1397	637
adj. R^2	0.13	0.09
Origin - Destination FE	✓	✓
Origin - Time FE	✓	✓
Time FE	✓	✓
Cluster robust SE	✓	✓
Destination rent psf	✓	
Destination rent per unit		✓
Controls	✓	✓

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Back

No Migration Benchmark: Rent Subsidy

Consider a lump-sum rent subsidy S_T imposed in city T where the housing market equilibrium is tight, and is funded by lump-sum taxes in both city T and L. The equilibrium tightness in each city satisfies the following equations respectively

$$f(X_T)(1+\tau(X_T))^{\epsilon-1} = \frac{\chi_T^{\epsilon}}{\bar{K_T}} \frac{\bar{\mu}_T + \frac{(\mathcal{S}_T - \mathcal{T}_T)}{N_T}}{P_T} \times N_T$$

$$f(X_L)(1+\tau(X_L))^{\epsilon-1} = \frac{\chi_L^{\epsilon}}{\bar{K_L}} \frac{\bar{\mu}_L - \frac{\mathcal{T}_L}{N_L}}{P_L} \times N_L,$$

No Migration Benchmark: Rent Subsidy

Consider a lump-sum rent subsidy S_T imposed in city T where the housing market equilibrium is tight, and is funded by lump-sum taxes in both city T and L. The equilibrium tightness in each city satisfies the following equations respectively

$$f(X_T)(1+\tau(X_T))^{\epsilon-1} = \frac{\chi_T^{\epsilon}}{\bar{K}_T} \frac{\bar{\mu}_T + \frac{(\mathcal{S}_T - \mathcal{T}_T)}{N_T}}{P_T} \times N_T$$

$$f(X_L)(1+\tau(X_L))^{\epsilon-1} = \frac{\chi_L^{\epsilon}}{\bar{K}_L} \frac{\bar{\mu}_L - \frac{\mathcal{T}_L}{N_L}}{P_L} \times N_L,$$

1. S and T represent subsidy and taxes. For concreteness, I divide subsidy and taxes by population. Effectively, per household endowment increases in T, and decreases in L. As a result, X_T increases and X_L decreases.

No Migration Benchmark: Rent Subsidy

Consider a lump-sum rent subsidy S_T imposed in city T where the housing market equilibrium is tight, and is funded by lump-sum taxes in both city T and L. The equilibrium tightness in each city satisfies the following equations respectively

$$f(X_T)(1+\tau(X_T))^{\epsilon-1} = \frac{\chi_T^{\epsilon}}{\bar{K_T}} \frac{\bar{\mu}_T + \frac{(\mathcal{S}_T - \mathcal{T}_T)}{N_T}}{P_T} \times N_T$$

$$f(X_L)(1+\tau(X_L))^{\epsilon-1} = \frac{\chi_L^{\epsilon}}{\bar{K_L}} \frac{\bar{\mu}_L - \frac{\mathcal{T}_L}{N_L}}{P_L} \times N_L,$$

1. S and T represent subsidy and taxes. For concreteness, I divide subsidy and taxes by population. Effectively, per household endowment increases in T, and decreases in L. As a result, X_T increases and X_L decreases.
2. $\frac{d\mathcal{C}_T}{d(\mathcal{S}_T - \mathcal{T}_T)} = \frac{d\mathcal{C}_T}{dX_T} \frac{dX_T}{d(\mathcal{S}_T - \mathcal{T}_T)} < 0$ since first term is negative and second term is positive. Hence, consumption in city T would decrease.
3. Moreover, $\frac{d\mathcal{C}_L}{d\mathcal{T}_L} = \frac{d\mathcal{C}_L}{dX_L} \frac{dX_L}{d\mathcal{T}_L} < 0$. Hence, consumption in city L would decrease too.
4. The aggregate welfare, which is the combined consumption across two cities, would decrease.

Back

No Migration Benchmark: Rent Subsidy (Walrasian Market)

The adverse effects of a rent subsidy on housing consumption and aggregate welfare are fundamentally shaped by search and matching friction.

No Migration Benchmark: Rent Subsidy (Walrasian Market)

The adverse effects of a rent subsidy on housing consumption and aggregate welfare are fundamentally shaped by search and matching friction.

1. When search and matching cost $\rho = 0$, the aggregate housing supply and demand satisfies $\mathcal{C}i^S = f(Xi)\bar{K}_i$ and $\mathcal{C}i^D = \frac{\chi i^{\epsilon}\bar{\mu}}{P_i} \times N_i$.

No Migration Benchmark: Rent Subsidy (Walrasian Market)

The adverse effects of a rent subsidy on housing consumption and aggregate welfare are fundamentally shaped by search and matching friction.

1. When search and matching cost $\rho = 0$, the aggregate housing supply and demand satisfies $\mathcal{C}i^S = f(Xi)\bar{K}_i$ and $\mathcal{C}i^D = \frac{\chi i^{\epsilon} \bar{\mu}}{P_i} \times N_i$.
2. Therefore, housing supply would increase with tightness, and housing demand is independent of tightness.

No Migration Benchmark: Rent Subsidy (Walrasian Market)

The adverse effects of a rent subsidy on housing consumption and aggregate welfare are fundamentally shaped by search and matching friction.

1. When search and matching cost $\rho = 0$, the aggregate housing supply and demand satisfies $\mathcal{C}i^S = f(Xi)\bar{K}_i$ and $\mathcal{C}i^D = \frac{\chi i^{\epsilon}\bar{\mu}}{P_i} \times N_i$.
2. Therefore, housing supply would increase with tightness, and housing demand is independent of tightness.
3. Moreover, the equilibrium tightness implies $f(X_i) = \frac{\chi_i^{\epsilon}\bar{\mu}i}{Pi\bar{K}_i} \times N_i$. Therefore, a net subsidy still increases tightness in T, and a tax still decreases tightness in L.

No Migration Benchmark: Rent Subsidy (Walrasian Market)

The adverse effects of a rent subsidy on housing consumption and aggregate welfare are fundamentally shaped by search and matching friction.

1. When search and matching cost $\rho = 0$, the aggregate housing supply and demand satisfies $\mathcal{C}i^S = f(Xi)\bar{K}_i$ and $\mathcal{C}i^D = \frac{\chi i^{\epsilon}\bar{\mu}}{P_i} \times N_i$.
2. Therefore, housing supply would increase with tightness, and housing demand is independent of tightness.
3. Moreover, the equilibrium tightness implies $f(X_i) = \frac{\chi_i^{\epsilon}\bar{\mu}i}{Pi\bar{K}_i} \times N_i$. Therefore, a net subsidy still increases tightness in T, and a tax still decreases tightness in L.
4. Hence, since in an equilibrium, $\mathcal{C}_i^S = \mathcal{C}_i$, $\frac{d\mathcal{C}T}{d(\mathcal{S}_T - \mathcal{T}_T)} = \frac{d\mathcal{C}T^S}{dX_T}\frac{dX_T}{d(\mathcal{S}_T - \mathcal{T}_T)} > 0$, as both terms are positive. In other words, consumption in city T would increase.

No Migration Benchmark: Rent Subsidy (Walrasian Market)

The adverse effects of a rent subsidy on housing consumption and aggregate welfare are fundamentally shaped by search and matching friction.

1. When search and matching cost $\rho = 0$, the aggregate housing supply and demand satisfies $\mathcal{C}i^S = f(Xi)\bar{K}_i$ and $\mathcal{C}i^D = \frac{\chi i^{\epsilon} \bar{\mu}}{P_i} \times N_i$.
2. Therefore, housing supply would increase with tightness, and housing demand is independent of tightness.
3. Moreover, the equilibrium tightness implies $f(X_i) = \frac{\chi_i^{\epsilon} \bar{\mu} i}{Pi\bar{K}_i} \times N_i$. Therefore, a net subsidy still increases tightness in T, and a tax still decreases tightness in L.
4. Hence, since in an equilibrium, $\mathcal{C}_i^S = \mathcal{C}_i$, $\frac{d\mathcal{C}T}{d(\mathcal{S}_T - \mathcal{T}_T)} = \frac{d\mathcal{C}T^S}{dX_T} \frac{dX_T}{d(\mathcal{S}_T - \mathcal{T}_T)} > 0$, as both terms are positive. In other words, consumption in city T would increase.
5. Conversely, $\frac{d\mathcal{C}L}{d\mathcal{T}_L} = \frac{d\mathcal{C}L^S}{dX_L} \frac{dX_L}{d\mathcal{T}_L} < 0$, since the first term is positive but the second term is negative, indicating that consumption in city L would decrease.

No Migration Benchmark: Rent Subsidy (Walrasian Market)

The adverse effects of a rent subsidy on housing consumption and aggregate welfare are fundamentally shaped by search and matching friction.

1. When search and matching cost $\rho = 0$, the aggregate housing supply and demand satisfies $\mathcal{C}i^S = f(Xi)\bar{K}_i$ and $\mathcal{C}i^D = \frac{\chi i^{\epsilon} \bar{\mu}}{P_i} \times N_i$.
2. Therefore, housing supply would increase with tightness, and housing demand is independent of tightness.
3. Moreover, the equilibrium tightness implies $f(X_i) = \frac{\chi_i^{\epsilon} \bar{\mu} i}{Pi\bar{K}_i} \times N_i$. Therefore, a net subsidy still increases tightness in T, and a tax still decreases tightness in L.
4. Hence, since in an equilibrium, $\mathcal{C}_i^S = \mathcal{C}_i$, $\frac{d\mathcal{C}T}{d(\mathcal{S}_T - \mathcal{T}_T)} = \frac{d\mathcal{C}T^S}{dX_T} \frac{dX_T}{d(\mathcal{S}_T - \mathcal{T}_T)} > 0$, as both terms are positive. In other words, consumption in city T would increase.
5. Conversely, $\frac{d\mathcal{C}L}{d\mathcal{T}_L} = \frac{d\mathcal{C}L^S}{dX_L} \frac{dX_L}{d\mathcal{T}_L} < 0$, since the first term is positive but the second term is negative, indicating that consumption in city L would decrease.
6. The implication on aggregate welfare is ambiguous if the market is Walrasian.

Back