

# Do Minimum Wages Increase Rents?

## Evidence from US ZIP Codes Using High-Frequency Data

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October 28, 2021

## Motivation

Research on minimum wage (MW) has mostly focused on employment.

However, as MW policies are *place-based*, so one should expect broader effects in the local economy:

⇒ Housing market.

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⇒ Housing market.

## Prediction from theory

A canonical version of the (Muth-Mills) monocentric city model suggests that income increases will pass-through 1:1 to rents (**Brueckner1987**).

⇒ We are not aware of empirical estimates of that pass-through!

## This paper

We investigate the short term effects of MW policies on rents in the US:

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- Estimate pass-through of MW increases to rents.

To do so, we:

- Exploit high-frequency (monthly) high-resolution (ZIP Code) rents data from Zillow.
- Leverage timing and spatial variation in MW changes *within* metropolitan areas.
- Propose a novel model-based measure of exposure to MW changes based on commuting shares.

## Comparative statics intuition

Think of a metropolitan area, and a MW increase in the business district (CBD).

### **Partial equilibrium: short term**

- Firms producing in the CBD will pay a higher wage. Income redistribution from firms to low income workers.
- Income changes are heterogeneous across space because people work and reside in different locations.
- Housing is a normal good. Housing demand in some areas increases and landlords charge a higher rent.

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### **General equilibrium: long term** (Not this paper!)

- People change residence and workplace locations (sorting).
- Developers build more houses (supply response).

## A motivating example



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- A (naive) regression model of changes in rents on changes in MW's will imply that rents can only be affected in Cook County.
- However, MW workers in Cook County may also live elsewhere in the Chicago metropolitan area. → We need to take the commuting structure into account!

## A novel model-based measure of access to MW's

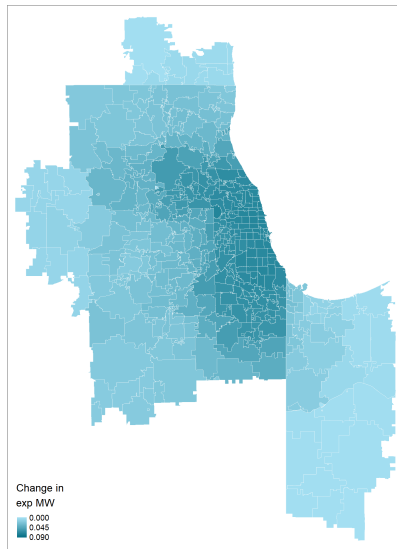
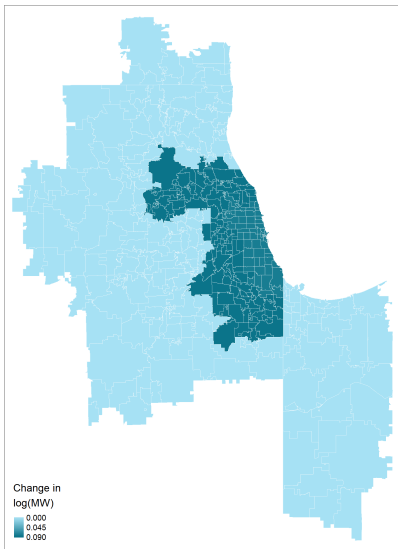
For ZIP code  $i$ , and month  $t$  we define it as:

$$\underline{w}_{it}^{\text{exp}} = \sum_{z \in \mathbb{Z}_i} \pi_{iz} \ln \underline{w}_{zt} ,$$

where

- $\mathbb{Z}_i$  are workplace locations of  $i$ 's residents, and
- $\pi_{iz} = \frac{L_{iz}}{L_i}$  is the share of  $i$ 's residents who work in  $z$ .

## A motivating example (Continuation)



Example NYC

Example Seattle

Example Bay Area

Example San Diego

Example Kansas City

# Outline for Today

A Partial Equilibrium Model of the Local Rental Markets

Data

Empirical Strategy

Identification

Results

Robustness and Heterogeneity

The incidence of counterfactual federal MW change

## A Partial Equilibrium Model of the Local Rental Markets

# Overview

Goals of the model:

- Stylized answer to: what is the short-term effect of MW changes in rent prices?
- Motivate a new access to MW measure: the experienced MW.
- Emphasize why one may expect residence and worker MWs to have different effects on the housing market.
- Motivate our empirical strategy: use commuting patterns to account for spatial spillovers of MW policies.

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The model is *not* intended to:

- Describe within-city residential sorting.
- Describe the local labor markets.
- Describe the local goods markets.
- Perform general equilibrium welfare analysis of MW policies.



## Setup

Static rental market of some residence ZIP code  $i$  embedded in a larger geography  $\mathcal{Z}$  with finite number of ZIP codes.

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- Exogenous and fixed  $L_{iz}$  that denotes the measure of  $i$ 's residents who work in  $z$ .
  - Measure of residents in  $i$ :  $L_i = \sum_{z \in \mathcal{Z}(i)} L_{iz}$ .
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- $D_i(r_i)$ : supply of square feet in  $i$ , which is increasing in  $r_i$ .

# Housing Demands

## Assumption (Housing demand)

*For all residence-workplace pairs, the housing demand functions  $h_{iz}(r_i, \underline{w}_i, \underline{w}_z)$  is:*

- 1. continuously differentiable in its three arguments;*
- 2. decreasing in rental prices  $r_i$ ;*
- 3. non-decreasing in workplace minimum wage  $\underline{w}_z$ .*
- 4. non-increasing in residence minimum wage  $\underline{w}_i$ ;*

*Furthermore, for at least one  $z \in \mathcal{Z}(i)$ , the inequalities in points (iii) and (iv) are strict.*

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**In words:** conditional on workplace MWs, residence MW may negatively affect disposable income and thus demand for housing.

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We think that the interpretation underlying point 4. is plausible:

- Recent evidence by **MiyauchiEtAl2021** shows that individuals tend to consume close to home. Households respond and are aware of price differentials in local consumption across neighborhoods.
- MWs have been shown to increase prices of local consumption (**AllegrettoReich2018; LeungForthcoming**).



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Potential microfoundation:

- If firms in  $i$  that produce non-tradable local goods, use MW workers as an input, then a MW increase will increase prices. Higher cost of non-tradables will translate into a lower demand for housing if the substitution effect on local demand of housing is smaller than the corresponding income effect.
- A sufficient condition for that is that housing and local consumption are complements.

## Equilibrium

Define the housing demand in Zip Code  $i$  as:

$$H_i(r_i, \{\underline{w}_z\}_{z \in \mathcal{Z}(i)}) = \sum_{z \in \mathcal{Z}(i)} L_{iz} h_{iz}(r_i, \underline{w}_i, \underline{w}_z)$$

The rental market of ZIP code  $i$  is in equilibrium if

$$H_i(r_i, \{\underline{w}_z\}_{z \in \mathcal{Z}(i)}) = D_i(r_i)$$

As housing demand functions are continuous and decreasing in rents, under suitable regularity conditions there is a unique equilibrium in this market.

We denote equilibrium rents as  $r_i^* = f(\{\underline{w}_i\}_{i \in \mathcal{Z}(i)})$ .

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We are interested in the effects of MW policies on rents.

- What is the effect of a change in the vector of MWs  $(\{d\underline{w}_i\}_{i \in \mathcal{Z}(i)})'$  on equilibrium rents?
- Under what conditions can we represent those effects in a simple way?

# Comparative Statics

## Proposition (Comparative Statics)

*Under the assumptions of:*

- 1. Fixed of workers across workplace and residence pairs.*
- 2. housing demand equation satisfying Assumption 1,*
- 3. continuously differentiable and increasing housing supply.*

*We have that:*

- workplace-MW hikes increase rents.*
- holding constant workplace-MW hikes, residence-MW hikes decrease rents.*

# Proof of Proposition (Comparative Statics)

Proof.

Fully differentiate the market clearing condition with respect to  $\ln r_i$  and  $\ln \underline{w}_i$  for all  $i \in \mathcal{Z}(i)$  and re-arrange terms to get:

$$\left( \eta_i - \sum_z \pi_{iz} \xi_{iz} \right) d \ln r_i = \sum_z \pi_{iz} \left( \epsilon_{iz}^i d \ln \underline{w}_i + \epsilon_{iz}^z d \ln \underline{w}_z \right), \quad (1)$$

where:

- $\eta_i = \frac{1}{L_i} \frac{dD_i}{dr_i} \frac{r_i}{D_i}$  is the elasticity of housing supply in ZIP code  $i$
- Commuter shares:  $\pi_{iz} = \frac{L_{iz}}{L_i}$
- $\xi_{iz} = \frac{dh_{iz}}{dr_i} \frac{r_i}{\sum_z \pi_{iz} h_{iz}}$  is the elasticity of housing demand at the average per-capita demand of ZIP code  $i$
- $\epsilon_{iz}^i = \frac{dh_{iz}}{d\underline{w}_i} \frac{\underline{w}_i}{\sum_z \pi_{iz} h_{iz}}$  and  $\epsilon_{iz}^z = \frac{dh_{iz}}{d\underline{w}_z} \frac{\underline{w}_z}{\sum_z \pi_{iz} h_{iz}}$  are the elasticities of housing demand to workplace and residence MWs also at the average per-capita demand of ZIP code  $i$

## Proof of Proposition (Comparative Statics) (Continuation)

Using that:

- $\xi_{iz} < 0$  for at least some workplace
- $\epsilon_{iz}^i < 0$
- $\epsilon_{iz}^z > 0$

It follows from (1) that:

1. an increase in workplace MW unambiguously increases rents
2. an increase in residence MW on rents is generally ambiguous (as long as some residents of  $i$  also work in  $i$ ) as it is composed of a direct negative effect and an indirect positive effect through changing the experienced MW.<sup>1</sup>
3. Holding constant workplace MWs, the effect of the residence MW is negative.

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<sup>1</sup>The sign of the overall partial effect depends on the sign of  $\pi_{ii}\epsilon_{ii}^z + \sum_z \pi_{iz}\epsilon_{iz}^i$ .

# Representation

## Proposition (Representation)

*Under the assumption of constant elasticity of housing demand (across workplace locations) to workplace minimum wages we have that:*

- *We can write the change in log rents as a function of the change in two MW-based measures: the **experienced log MW** and the **statutory log MW**.*

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- *We can write the change in log rents as a function of the change in two MW-based measures: the **experienced log MW** and the **statutory log MW**.*

## Proof.

Set  $\epsilon_{iz}^z = \epsilon_i^z$  for all  $z \in \mathcal{Z}(i)$  we can manipulate (1) to write:

$$d \ln r_i = \beta_i \sum_i \pi_{iz} d \ln \underline{w}_z + \gamma_i d \ln \underline{w}_i \quad (2)$$

where  $\beta_i = \frac{\epsilon_i^z}{\eta_i - \sum_z \pi_{iz} \xi_{iz}}$  and  $\gamma_i = \frac{\sum_z \pi_{iz} \epsilon_{iz}^i}{\eta_i - \sum_z \pi_{iz} \xi_{iz}}$ .

□



## Motivating our empirical Strategy

Using Proposition (Comparative Statics), our Proposition (Representation) implies that:

- The partial equilibrium effect of workplace MW,  $\beta_i = \frac{\epsilon_i^z}{\eta_i - \sum_z \pi_{iz} \xi_{iz}} > 0$
- The partial equilibrium effect of residence MW,  $\gamma_i = \frac{\sum_z \pi_{iz} \epsilon_{iz}^i}{\eta_i - \sum_z \pi_{iz} \xi_{iz}} < 0$ .

Therefore our model yields:

$$d \ln r_i = \beta_i \sum_i \pi_{iz} d \ln \underline{w}_z + \gamma_i d \ln \underline{w}_i \quad (3)$$

We will estimate an empirical analog assuming (for today) homogenous effects.

Data

## Zillow Data

- Leader online real estate and rental platform in the U.S. (more than 110 million homes and 170 million unique monthly users in 2019).
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Comparison with Small Area Fair Market Rents

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Comparison with Small Area Fair Market Rents

- Limitation: Zillow sample is not random.

Zillow Zip Codes and Population Density

## The Statutory MW

- Collect MW data at state, county and city levels between Jan 2010 and Dec 2019.
  - Up to 2016 we relied on data from Cengiz et al and Zippererr
- For each US Postal ZIP Code we assigned place, ZCTA, city, county, and state codes.
- Define statutory MW in ZIP code as maximum between state and local levels.

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- For each US Postal ZIP Code we assigned place, ZCTA, city, county, and state codes.
- Define statutory MW in ZIP code as maximum between state and local levels.
- ZIP codes available in Zillow contain 18,689 changes at the ZIP code-month level.
  - 151 state-level changes.
  - 182 county and city-level changes.

Distribution of MW changes

## Using LODES to construct the experienced log MW

Construct **origin-destination matrix** at ZIP code level from LODES 2009 to 2018.

We observe:

- Number of workers residing in a ZIP code and working in every other ZIP code.
- Analogous, matrix for number of workers younger than 29 and earning less than \$1,251.

In our baseline specification we use constant commuter shares using year 2017. We will show robustness with other fixed years and with time varying shares using the closest year.



## Other Data Sources

- Economic controls from the Quarterly Census of Employment and Wages (QCEW).
- IRS Statistics of income - ZIP Code Aggregates (New)
- ZIP Code Month panel of rents since 2018 from actual transactions data (New)

## Empirical Strategy

## Empirical (Naive) model

Ignoring the experienced MW, one may estimate the following first differences model:

$$\Delta \ln r_{it} = \tilde{\delta}_t + \tilde{\beta} \Delta \ln \underline{w}_{it} + \Delta \mathbf{X}'_{c(i)t} \tilde{\eta} + \Delta \tilde{\varepsilon}_{it},$$

where

- ZIP code  $i$ , county  $c(i)$ , month  $t$ ;
- $r_{it}$ : rents per square foot;
- $\ln \underline{w}_{it}$ : statutory log MW;
- $\tilde{\delta}_t$ : month fixed effects (ZIP code FE  $\tilde{\alpha}_i$  is implicit);
- $\mathbf{X}_{c(i)t}$ : time-varying controls.

## Empirical model

Now add experienced MW:

$$\Delta \ln r_{it} = \delta_t + \beta \Delta \underline{w}_{it}^{\text{exp}} + \gamma \Delta \ln \underline{w}_{it} + \Delta \mathbf{X}'_{c(i)t} \eta + \Delta \varepsilon_{it},$$

where  $\underline{w}_{it}^{\text{exp}}$  is experienced log MW (Recall  $\Delta \underline{w}_{it}^{\text{exp}} = \sum_{z \in \mathbb{Z}_i} \pi_{iz} \Delta \ln \underline{w}_{zt}$ ).

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For causal effect of  $\beta$  we need:

$$E \left[ \Delta \varepsilon_{ict} \Delta \underline{w}_{ict}^{\text{exp}} \mid \Delta \ln \underline{w}_{ict}, \delta_t, \Delta \mathbf{X}_{ict} \right] = 0 \quad \forall \tau \in [\underline{T}, \overline{T}]$$

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**In words:** conditional on FEs, controls, and MW in same ZIP code, unobserved innovations to rent shocks are uncorrelated with past and future values of log MW changes in nearby ZIP codes.

## Discussion Identification Assumption

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Analogously, for causal effect of  $\gamma$  we need:

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### Is this plausible?

- MW policies are rarely set by considering differential dynamics of the rental housing market within metropolitan areas.
- Furthermore, there is substantial heterogeneity in the housing market across ZIP codes.
- Indirectly test assumption through pre-trends, assuming no anticipatory effects in housing market.



## Testing Identification with a Dynamic model

Adding leads and lags of the experienced log MW:

$$\Delta \ln r_{ict} = \delta_t + \sum_{r=-s}^s \beta_r \Delta \underline{w}_{ic,t+r}^{\text{exp}} + \gamma \Delta \ln \underline{w}_{ict} + \Delta \mathbf{X}_{ct}' \eta + \Delta \varepsilon_{ict}$$

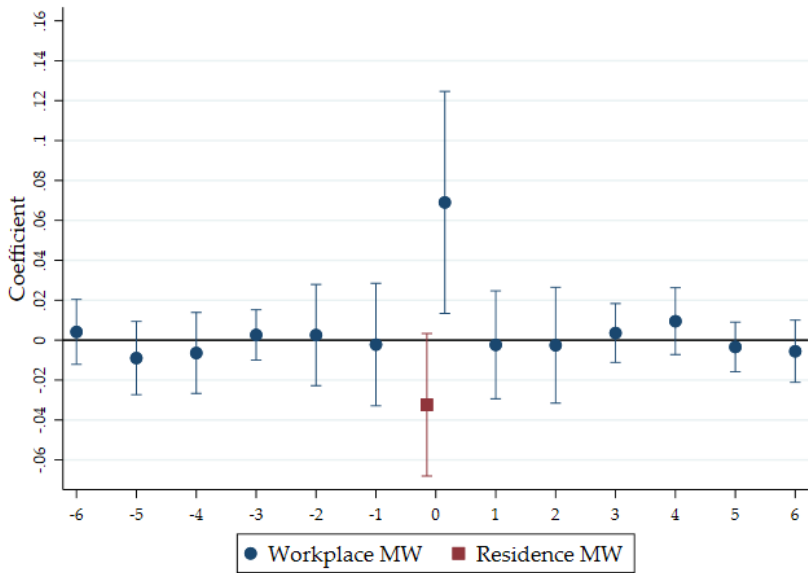
where  $\{\beta_r\}_{r=-s}^s$  are the dynamic coefficients.

Analogously, one can add instead the leads and lags of the log residence MW to test the identification assumption of  $\gamma$ .

# Identification

## Results

# Static



## Robustness and Heterogeneity

The incidence of counterfactual federal MW change

## Overview

Entire commuting structure determines the incidence of MW policies.

- In some ZIP codes both residence and workplace MW increase
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Consider an increase of the federal MW to \$9 in January 2020.

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How much out of each extra dollar is captured by landlords?

## Pass-through coefficients

Define pass-through coefficients

$$\rho_i := \frac{\Delta H_i}{\Delta Y_i} = \frac{h_i^{\text{Post}} r_i^{\text{Post}} - h_i^{\text{Pre}} r_i^{\text{Pre}}}{\Delta Y_i}$$

where

- $h$  denotes rented space in  $i$  (square feet)
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Change in rented space are unobserved. We assume  $h_i^{\text{Pre}} = h_i^{\text{Post}} = h_i$  so

$$\rho_i = \frac{h_i^{\text{Post}} r_i^{\text{Post}} - h_i^{\text{Pre}} r_i^{\text{Pre}}}{\Delta Y_i} = h_i \frac{\Delta r_i}{\Delta Y_i}$$

If  $\Delta h_i > 0$  then our estimate of  $\rho_i$  is a lower bound.

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- Pre and Post indicate moments before and after the increase

Change in rented space are unobserved. We assume  $h_i^{\text{Pre}} = h_i^{\text{Post}} = h_i$  so

$$\rho_i = \frac{h_i^{\text{Post}} r_i^{\text{Post}} - h_i^{\text{Pre}} r_i^{\text{Pre}}}{\Delta Y_i} = h_i \frac{\Delta r_i}{\Delta Y_i}$$

If  $\Delta h_i > 0$  then our estimate of  $\rho_i$  is a lower bound.

We construct empirical analogous of  $h_i$ ,  $\Delta r_i$  and  $\Delta Y_i$ .

## Estimates of total rented space

We haven't found data on  $\{h_i\}$ . Therefore we do the following

- From Zillow get median rental price  $R_i$  and median rental price per square foot  $r_i$
- Estimate average square footage  $q_i = \frac{R_i}{r_i}$
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Our estimates of total rented space in each ZIP code  $i$  are

$$\hat{h}_i = q_i N_i$$

## Model-based estimates of rent changes

Increase in federal MW to \$9 generates  $\{\Delta \ln \hat{w}_i\}_{i \in \mathcal{Z}}$

- $\Delta \ln \hat{w}_i = 0$  for ZIP codes with binding MWs above \$9



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Increase in federal MW to \$9 generates  $\{\Delta \ln \hat{w}_i\}_{i \in \mathcal{Z}}$

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We proceed as follows

- Estimate  $\{\Delta \ln r_i\}$  using our baseline model

$$\Delta \ln \hat{r}_i = \gamma \Delta \ln \hat{w}_i + \beta \sum_{z \in \mathcal{Z}_i} \pi_{iz} \Delta \ln \hat{w}_z$$

- Using  $r_i^{\text{Pre}}$  from Zillow as of December 2019, compute

$$\Delta \hat{r}_i = \left( \exp(\Delta \ln \hat{r}_i) - 1 \right) r_i^{\text{Pre}}$$

## Model-based estimates of income changes

Increase in federal MW to \$9 generates  $\{\Delta \ln \hat{w}_i\}_{i \in \mathcal{Z}}$

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- Use estimates from the literature (**CegnizEtAl2019**)

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- Use estimates from the literature (**CegnizEtAl2019**)

We proceed as follows

- Use elasticity  $\epsilon$  to get

$$\Delta \ln \hat{Y}_i = \epsilon \sum_{z \in \mathcal{Z}_i} \pi_{iz} \Delta \ln \hat{w}_i$$

- Compute  $\Delta \hat{Y}_i$  using  $Y_i^{\text{Pre}}$  as of 2018

$$\Delta \hat{Y}_i = \left( \exp(\Delta \ln \hat{Y}_i) - 1 \right) Y_i^{\text{Pre}}$$

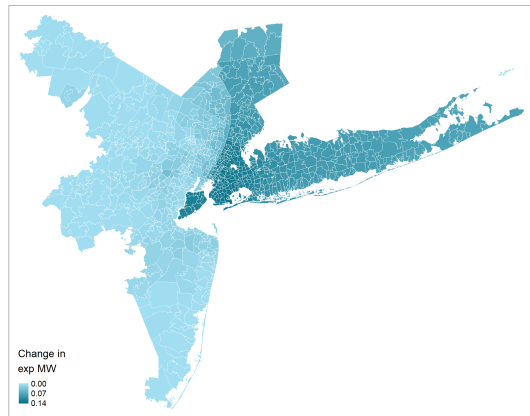
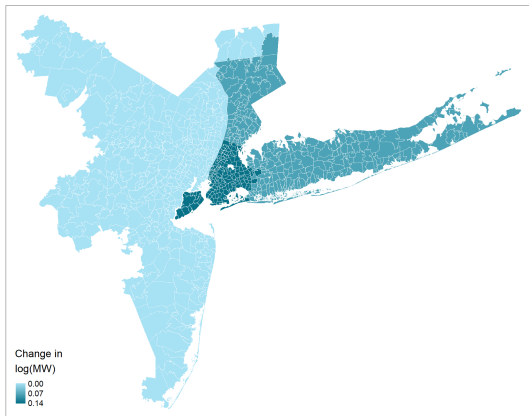
# The incidence of MW changes across space

Figure distribution here

Thank You!

# Appendix

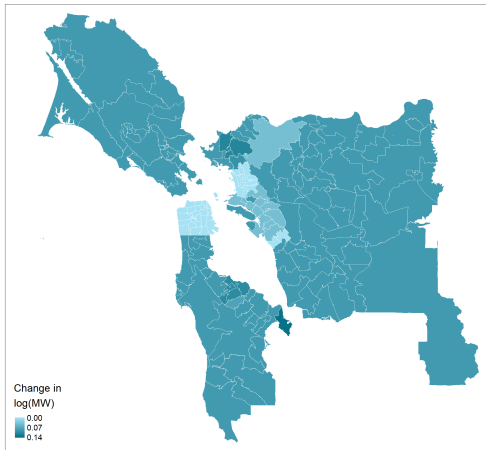
## Other examples: New York (MW Changes in January 2019)



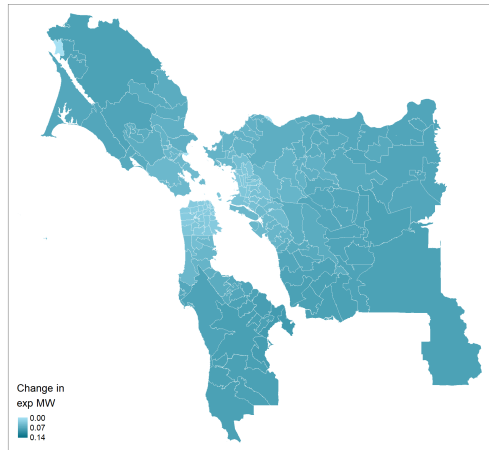
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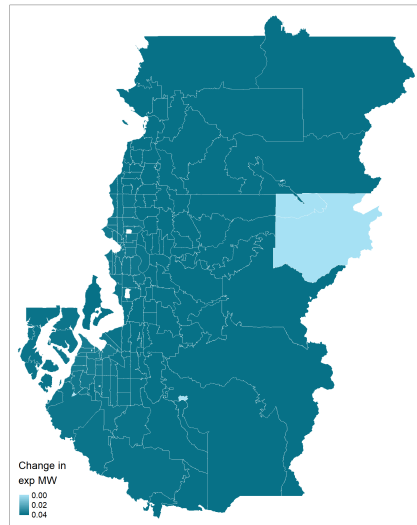
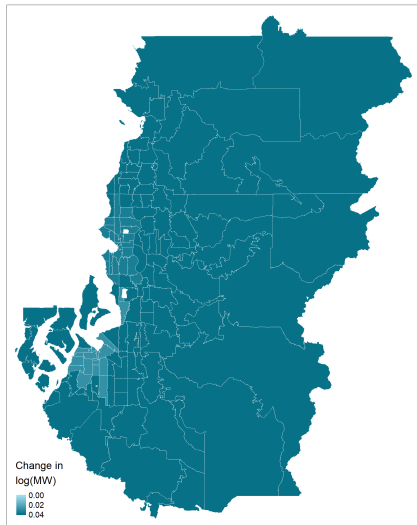
## Other examples: Bay area (MW Changes in January 2019)



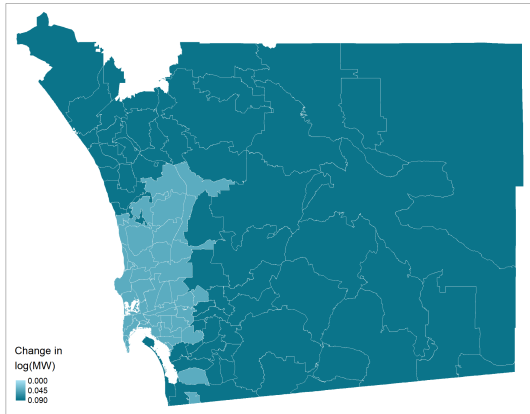
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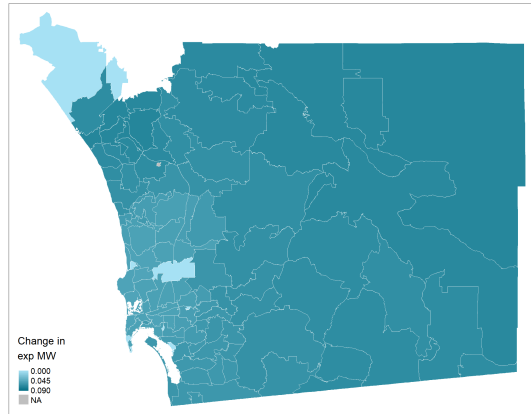
## Other examples: Seattle (MW Changes in January 2018)



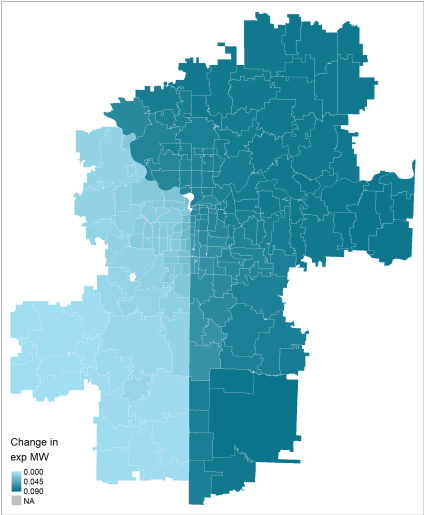
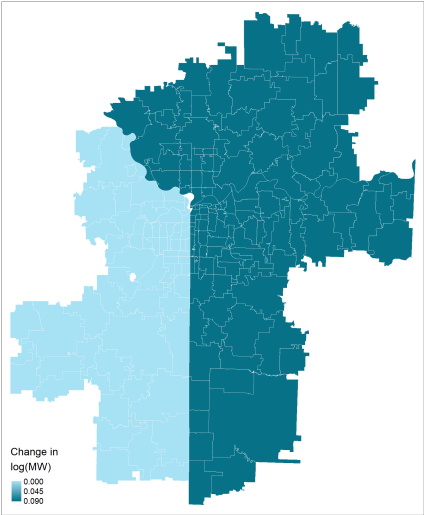
## Other examples: San Diego (MW Changes in January 2019)



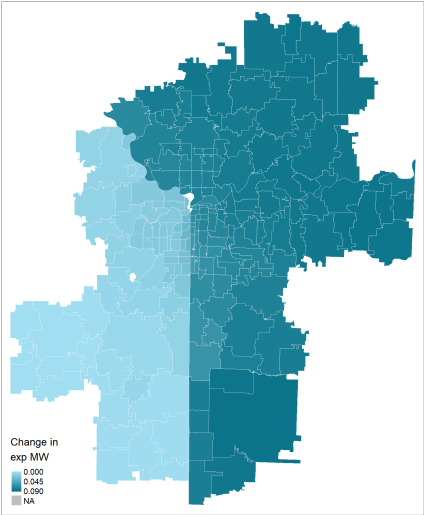
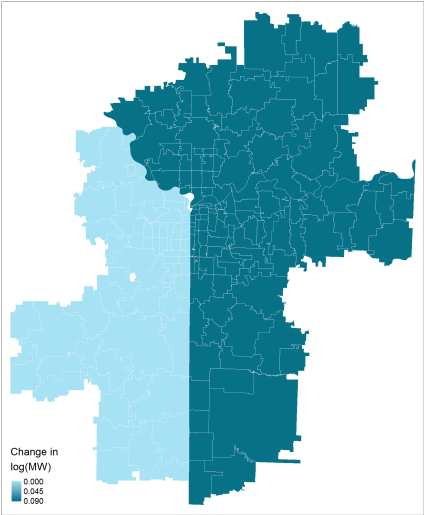
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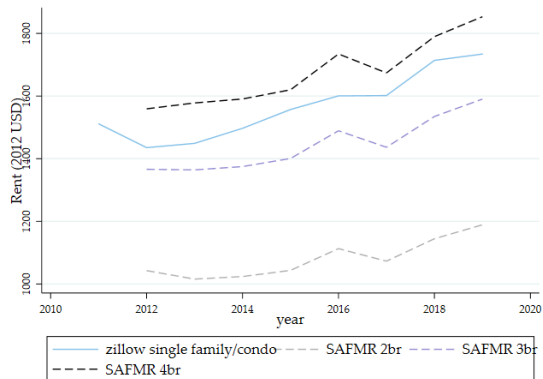
# Other examples: Kansas City (MW Changes in January 2019)



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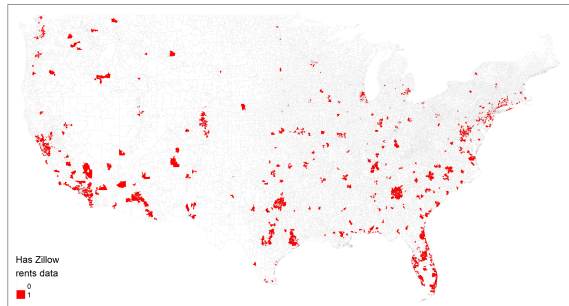
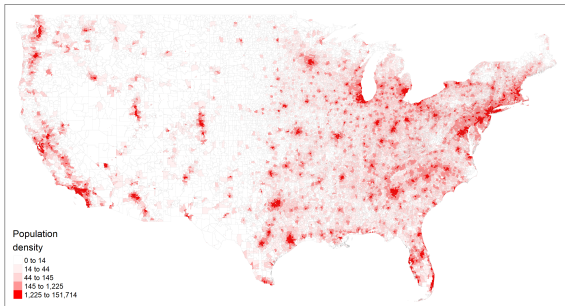


# Comparison between Zillow and Small Area Fair Market Rents



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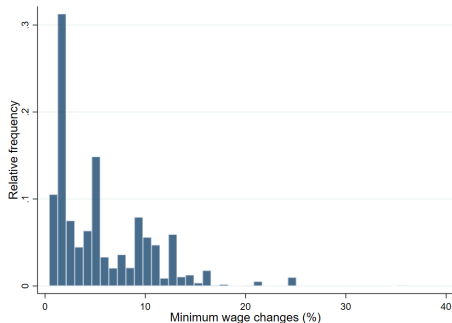
# Comparison between Zillow Sample and Population Density



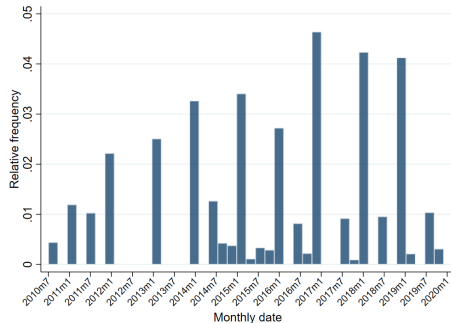
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# Distribution of (positive) MW changes

(a) Intensity



(b) Timing



*Notes:* The histograms show the distribution of positive MW changes in the full sample of ZIP codes available in the Zillow data.

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