Average vs Market Rent*

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Abstract

There is a spatial configuration that would maximize economic welfare. But what if the mechanism that we use to sort the allocation of space (i.e., the market), has some frictions to it? In this paper, we study the friction that is generated when there is a wedge between the average rent (i.e., the rent that current consumers of space are paying) and the market rent (i.e., the rent that newcomers would have to pay in order to consume space), and its consequences. Data from the US housing market suggests that the ratio between the market and average rent (almost) always stays above one (meaning that market rents are consistently above the average rents), regardless of the scope of the data (i.e., at the country, states, county, and city levels). We hypothesise that the greater the ratio (which implies a greater relative difficulty to move in into a given space) the greater the fiction, and build a model around that. There are three phenomena that we will explore using this framework, (1) the data suggests that the ratio counter-balances across markets (that is, as you aggregate markets the ratio converges to 1.05 at the national level (from ratios that go up to 2 at the city level, meaning that the marginal rent goes from being double the average rent to only 5% greater at the national level), with variance also falling from [statistic] to [statistic], (2) what happens to the distribution of wealth as this ratio varies (which would [hopefully] yield a sufficient statistic to measure the inefficiency), and (3) what are the consequences of (a specific) government intervention. For this last one, we will use the COVID era to see what happens when a government implements two simultaneous policies: increasing the cost of new housing development, and redistributing wealth.

*I thank Phil Hoxie for his never ending willingness to talk about (urban) economics. A lot of ideas and intuitions on this paper came from discussions I had with him. And Fabian Eckert, for his guidance and support.

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1 Introduction

Spatial economics is used to think about the efficient allocation of economic activity (e.g., capital) across space [cite]. This includes the allocation of workers [cite]. Workers are usually portrayed (in the broader economic literature) as having a distribution on their productivity [cite], an assumption that has allowed for important analysis across various fields [cite]. Current work poses various mechanisms that impact the efficient allocation of workers, these include worker-location specific productivity [cite], spillover effects driving certain type of workers together [cite], and congestion [cite]. In a setting with complete and perfect markets, spatial allocation would be such that economic welfare is maximized (i.e., the efficient allocation) [maybe this needs a formal proof, but it is just an application of a more general theorem]. We will study what happens to the efficient allocation as we introduce a friction.

In this paper, we study the difference between the average rent (i.e., the rent that current consumers of space are paying) and the market rent (i.e., the rent that newcomers would have to pay in order to consume space) for the housing market. To do so, we use the marginal vs average rent ratio as our main statistic. In the data, this ratio stays consistently above one across markets and time, and regardless of the scope of the data (i.e., at the country, state, county and city data). Meaning that newcomers to a given location have to pay a higher rent relative to the people that already live there. This phenomena could come from various sources, including rent control (a policy popular in some big cities), sticky contracts (contracts are updated every so often), a premium on risk (if I have a good tenant, I might want to retain them, so the tenant has some bargaining power to keep the rent low), spatial constraints (space becoming scarcer), different legislative requirements (locations changing or adding requisites for new developments), and self-delusion (the owners that have not cleared the market might have an inflated sense of the value of their property) [cite].

We argue that this difference introduces a friction in the housing market by "grandfathering in" the workers that already live in a certain location to the exclusion of (ostensibly better suited) newcomers. We study (1) the impact this friction has on the allocation of workers and on the distribution of income, (2) the (apparent) counterbalancing of the ratio that occurs across markets, and (3) the consequences of introducing a government that imposes two simultaneous policies: increasing the cost of new housing development and redistributing income.

The rest of the paper is organized as follows: Section 2 discusses the used data and some empirics about the difference between market and average rent to motivate the discussion. Section 3 lays out the model that we will be using to explore the friction. In Section 4 the empirics and the model come together to study the (three) main concerns of this paper. And finally, Section 5 concludes.

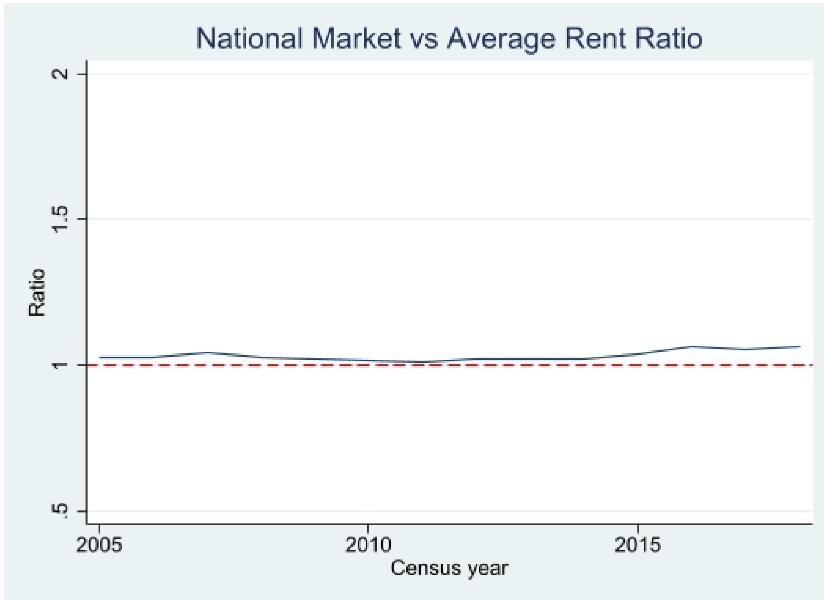
2 Empirics and Data

[This section still needs a lot of work. Data should be described more extensively (e.g., years used, number of observations, microdata sampling method from IPUMS). The statistics that we are using should be put in formula form and discussed in more detail. The Tables need to be discussed at length, and some footnotes need to be added. Empirics on the current distribution of workers is also needed.]

Using yearly data from the American Community Survey (ACS, provided by the US Census Bureau), we are able to recover the average and market rent for country, state, county and city levels. For every given market, we calculate their average rent $\bar{r}$ by averaging the amount that renters are currently paying to live in the market, and the market rent $\hat{r}$ by averaging the asking rent for the places that are unoccupied (i.e., the places available for incoming workers).

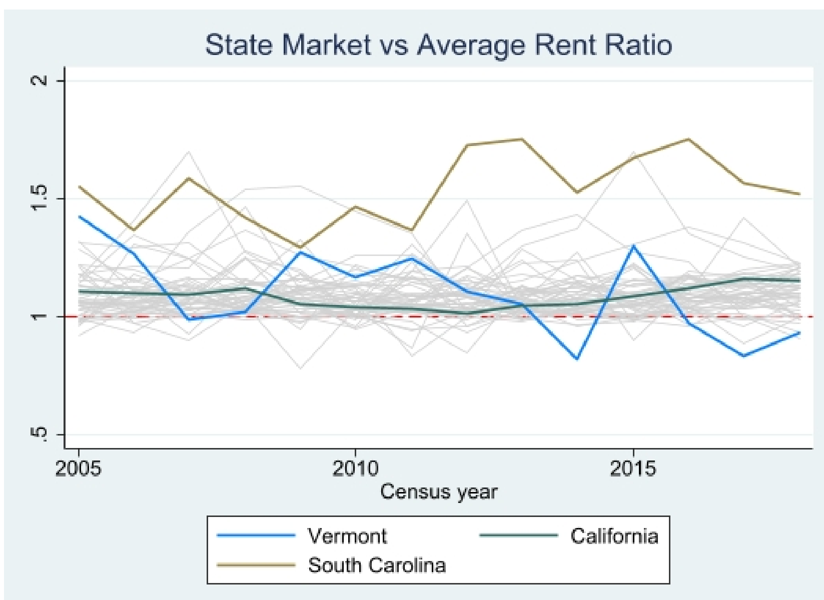
Figure 1 shows the market vs average rent ratio at the national level, for the years 2005-2018. Note that the ratio stays fairly around 1.05 without much variation. Figure 2 shows the ratio at the state level for the same years. Figure 3 does the same for California Counties. Note that as you aggregate markets (i.e., as you go to higher level markets), the variance of the ratio falls and it's value seems to approach to 1. Section 4.2 discusses this phenomena in detail. [I need to show other locations in depth besides California. Include Vermont, South Carolina and locations that show the pattern that repeats the most.]

Figure 1: National Market vs Average Rent Ratio



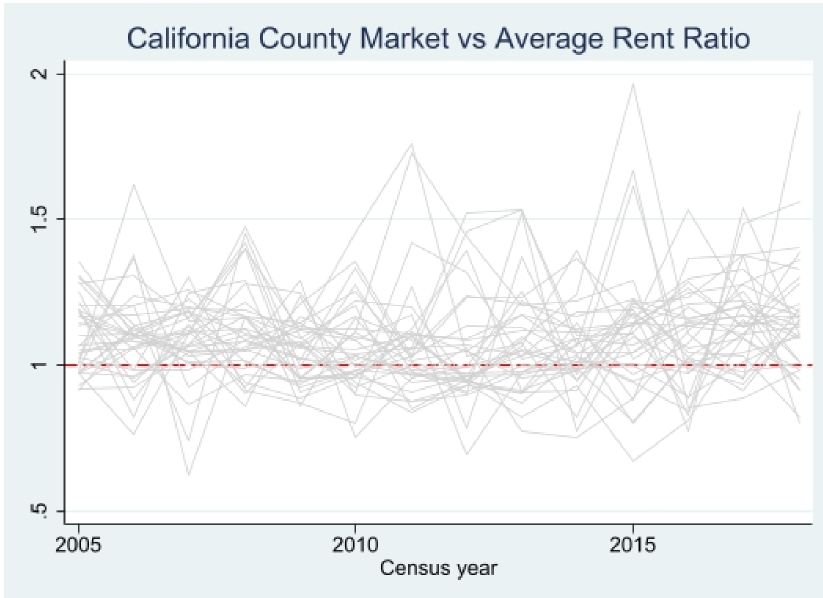
Notes: Market vs average rent ratio at the national level, for the years 2005-2018.

Figure 2: State Market vs Average Rent Ratio



Notes: Market vs average rent ratio at the state level, for the years 2005-2018.

Figure 3: California County Market vs Average Rent Ratio.

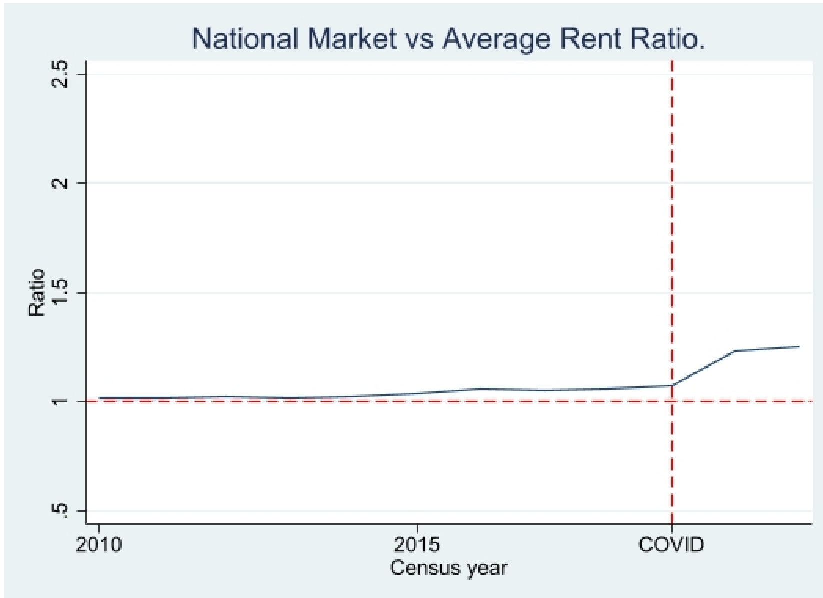


Notes: Market vs average rent ratio for California counties, for the years 2005-2018.

2.1 COVID Years.

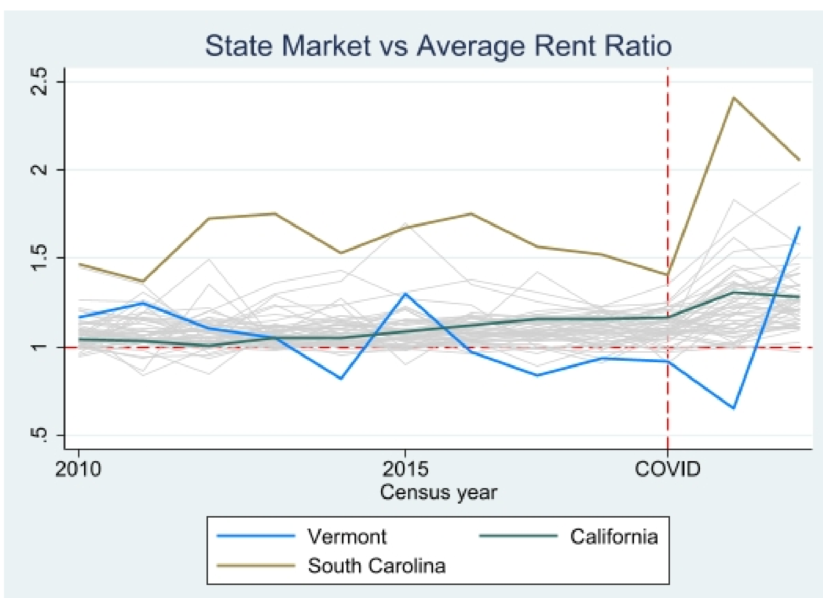
There is an interesting pattern that arises during the COVID-19 years. Figures 4 - 6 show the market vs average rent ratio for the years 2010 to 2021. Note that during the pandemic years, locations on average start increasing their ratio. This means that newcomers had to pay (increasingly) more relatively to the workers that already lived in a given location. There might be many potential explanations for this problem [cite, Johannes Wieland]. In this paper, we model this increase as a result of the government implementing two simultaneous policies: (1) increasing the cost of new housing, and (2) redistributing wealth. Section 4.3 studies this phenomenon.

Figure 4: National Market vs Average Rent Ratio. COVID.



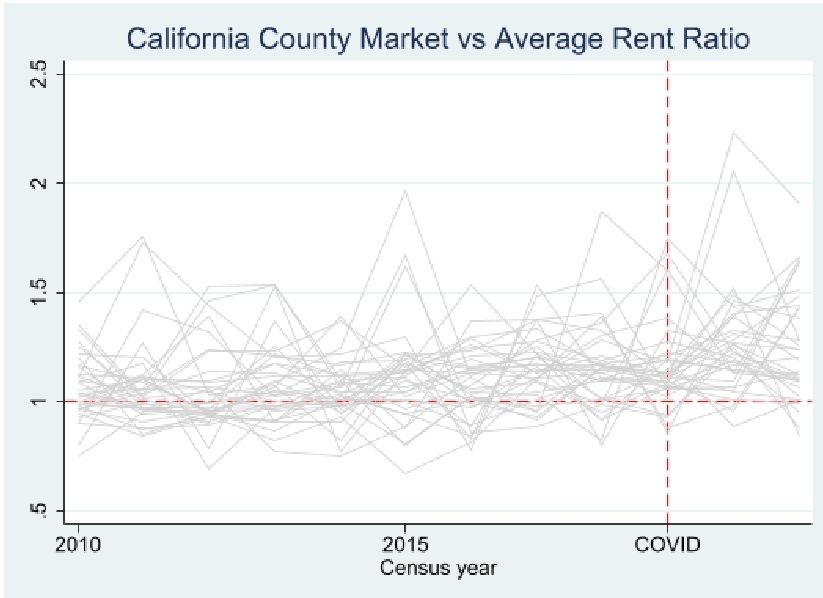
Notes: Market vs average rent ratio at the national level, for the years 2010-2021.

Figure 5: State Market vs Average Rent Ratio. COVID.



Notes: Market vs average rent ratio at the state level across time, for the years 2010-2021.

Figure 6: California County Market vs Average Rent Ratio. COVID.



Notes:

3 Model

We will start this section by constructing a partial equilibrium model (with only one location). Then we derive from it a general equilibrium model with multiple locations. This model is intended to be as simple as possible, and as such (at the moment) lacks the capability to study important things like dynamics. Nonetheless, the analytical tools that are (traditionally) used in macroeconomics are powerful (in the sense that one can study several phenomena with them, and that their assumptions are widely known and accepted). So [I think], a translation of this model exists to the more traditional (macro) spatial economics model, which would enable it to study other important phenomena. [Ask Fabian Eckert if I should work on that translation for this paper.]

3.1 (Frictionless) Partial Model

Suppose a (single) location l, a measure one of workers $i \in [0,1]$ and a measure one of developers $j \in [0,1]$. Worker's productivity w characterized by a (continuous and strictly increasing) cumulative distribution function $F(w)$. $F(w)$ is such that it has a probability density function $f(w)$ with support on $\mathbb{R}_+ \cup \{\infty\}$, such that each worker is indexed by their productivity level (i.e., $\forall\, w \in sup\, f(w), \exists$ a unique $i \in [0,1]$ s.t. $i = F(w)$).

Now, take a worker i with a given productivity w, that faces a rent level r. Then, their (conditional) individual demand for housing in l would be the indicator function:

$$d(w,r) = \mathbf{1}_{w \geq r}$$

That is, in the partial model workers demand a unit of housing when they are able to afford it. If we (horizontally) add the individual demand functions, we can obtain the aggregate demand function for housing in l:

$$\begin{aligned} D(r) &= \int_0^\infty d(w,r) dF(w) \\ &= \int_r^\infty dF(w) \\ &= 1 - F(r) \end{aligned}$$

Similarly, suppose developers j draw their (location-specific) costs z from a (continuous and strictly increasing) CDF $G(z)$. $G(w)$ is such that it has a pdf $g(w)$ with support on $\mathbb{R}_+ \cup \{\infty\}$, such that each developer is indexed by their cost level (i.e., $\forall\, z \in sup\, g(z), \exists$ a unique $j \in [0,1]$ s.t. $j = G(w)$). Suppose as well that developers have an individual supply function $s(z,r) = \mathbf{1}_{z \leq r}$ (such that they build/offer a unit of housing when their income is non-negative). Then, the aggregate supply function for housing in l would be:

$$
\begin{aligned}
S(r) &= \int_0^\infty s(z,r)dG(z) \\
&= \int_0^r dG(z) \\
&= G(r)
\end{aligned}
$$

In a frictionless setting, the market would clear at the (unique) rent level r^*, which solves for:

$$1 - F(r^*) = G(r^*)$$

The existence and uniqueness are ensured by the Intermediate Value Theorem.

3.2 General Equilibrium Model

For simplicity, suppose an economy with two locations k and k' [generalize this to n locations], each having their own measure one of developers $j_l \in [0,1]$ for $l = k, k'$. And a measure one of workers for the whole economy, $i \in [0,1]$. Such that half of them initially live in k, while the other half in k'. [Ask Fabian if it is worth it to allow for a more general initial allocation of workers.]

Take workers in location k. Suppose that the workers' productivity is given by the (well behaved) CDF $F(w)$, for $w = (w_k, w_{k'})$. $F(w)$ is such that it has a probability density function $f(w)$. $f(x)$ is such that it can be written as $f(w) = f_{k'|k}(w_{k'}|w_k)f_k(w_k)$. Suppose that $f_k(w_k)$ belongs to a uniform distribution that has a support on $[0, \omega]$, that is w_k is bounded above by $\omega > 0$. If moving is due to agglomeration of human capital, then one can think of ω as the maximum payoff from working on non-tradeable goods and services (productivity that does not benefit from concentration of human capital). For simplicity, normalize $F(w)$ by ω, such that $sup f_k(w_k) = [0, \frac{1}{2}]$. This allows us to (linearly) index workers $i_k \in [0, \frac{1}{2}]$ by their productivity in k.

Similar to partial equilibrium, workers' in k (conditional) productivity in k' is given by the (continuous and strictly increasing) conditional CDF $F_{k'|k}(w_{k'}|w_k)$, such that each worker is indexed by now both w_k

and $w_{k'}$ (note that the covariance parameter will determine how both productivity levels interact). [1]

Workers decide whether they stay in their initial location k or move to k'. If a given worker stays in k, they will pay the average rent in k, $\bar{r}$. And if they move to k' they will pay the market rent in k', $\hat{r}$. So, the individual demand function for housing in k' from a worker living in k would be:

$$\begin{aligned} d_{k'}(w,r) &= \mathbf{1}\{w_{k'} - \hat{r} > w_k - \bar{r}\} \\ &= \mathbf{1}\{w_{k'} > w_k + (\hat{r} - \bar{r})\} \end{aligned}$$

With $r = (\bar{r}, \hat{r})$, noting that r is now in terms of ω. That is, a worker in k would move to k' if they had more disposable income in k'.

The aggregate demand function for housing in k' coming from k, $D_{k'}(r)$, would be:

$$\begin{aligned} D_{k'}(r) &= \int_0^\infty \int_0^\infty d_{k'}(w,r)\, dF(w) \\ &= \int_0^\infty \int_0^\infty d_{k'}(w,r)\, f_{k'|k}(w_{k'}|w_k)\, f_k(w_k)\, dw \\ &= \int_0^\infty \int_0^\infty \mathbf{1}\{w_{k'} > w_k + (\hat{r} - \bar{r})\}\, f_{k'|k}(w_{k'}|w_k)\, f_k(w_k)\, dw \\ &= \int_0^\infty \int_{w_k + (\hat{r} - \bar{r})}^\infty f_{k'|k}(w_{k'}|w_k)\, f_k(w_k)\, dw \\ &= 2 \int_0^{\frac{1}{2}} \int_{w_k + (\hat{r} - \bar{r})}^\infty f_{k'|k}(w_{k'}|w_k)\, dw \\ &= 2 \int_0^{\frac{1}{2}} [1 - F_{k'|k}(w_k + (\hat{r} - \bar{r}))]\, dw_k \\ &= 1 - 2 \int_{(\hat{r} - \bar{r})}^{\frac{1}{2} + (\hat{r} - \bar{r})} F_{k'|k}(u)\, du \end{aligned}$$

Note that $D_{k'}(r)$ is well defined. The area under the curve $\int_{(\hat{r}-\bar{r})}^{\frac{1}{2}+(\hat{r}-\bar{r})} F_{k'|k}(u)\, du$ is bounded above when r is such that $F_{k'|k}(\hat{r} - \bar{r}) = F_{k'|k}(\frac{1}{2} + (\hat{r} - \bar{r})) = 1$, in that case $D_{k'}(r) = 0$. This is because $F_{k'|k}(\hat{r} - \bar{r})$ approaches 1 as $\hat{r}$ grows with respect to $\bar{r}$. Thus, decreasing to zero the demand for housing in k' from workers in k. Similarly, one can show that $D_{k'}(r)$ is bounded above by one (once we define our aggregate supply functions $S_l(r)$, we will be able to show that $D_{k'}(r)$ is bounded by $[0, \frac{1}{2}]$, which makes sense since we only have a measure one-half of workers in k).

Take our (measure one of) developers in $l = k, k'$. Take the same assumptions on them as we did in

[1] If the covariance is negative you get positive self selection. This means that both locations increase their productivity whenever any one worker switches location.

Section 3.1, so that they draw their costs z from the CDF $G_l(z)$, and have an individual supply function $s_l(z, r_l)$. Then the aggregate supply function would be:

$$\begin{aligned} S_l(r_l) &= \int_0^{\infty} s(z, r_l) dG_l(z) \\ &= \int_0^{r_l} dG_l(z) \\ &= G_l(r_l) \end{aligned}$$

[(Talk with Fabian Eckert) Towards a general equilibrium: There are a couple of ways in which we can close this model. The simplest version is obtained by assuming that each developer offers their house as if they were under perfect (or monopolistic) competition, which would imply that $\bar{r} = 2\int_0^{\frac{1}{2}} dG_l^{-1}(i)$ (under monopolistic competition, it would be some simple transformation of this). And that $\hat{r}$ is the one we obtain from the equation $\frac{1}{2} = G_{k'}(\hat{r})$. The first assumption is fine, but I am uncomfortable with the second one, because it would imply that workers make the decision to move from k to k' assuming they all get to pay the same rent $\hat{r}$. Moving away from this second assumption to something like $\hat{r}$ being the expected rent of the people that will be moving from k to k' might be more realistic, and might allow us to introduce some dynamics.]

4 Studied Phenomena

4.1 Distribution of Workers and Income

[Talk to Alexis Toda.]

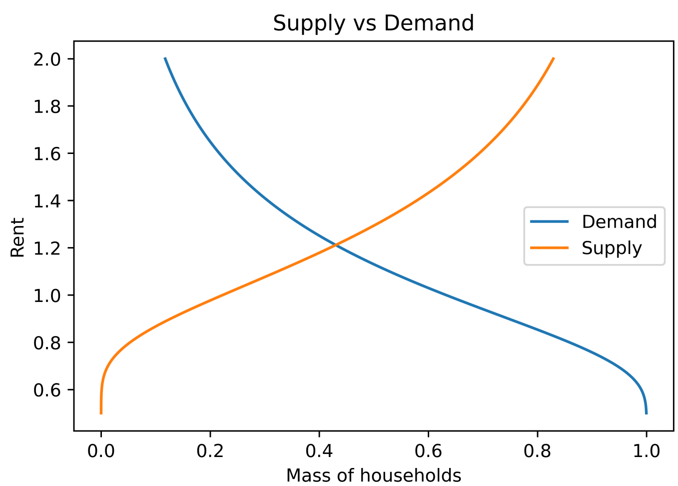
Take our partial equilibrium model. And assume a (widely used in spatial economics) Fréchet distribution on both worker productivity w and developer cost z [cite], so that:

$$F(w) = exp(-Tw^{-\theta})$$

$$G(z) = exp(-Rz^{-\theta})$$

Figure 7 shows the plotted aggregate supply and demand curve we would obtain from this specification.

Figure 7: Supply and Demand in the Partial Model



Notes: This figure shows the aggregate supply and demand curves for location l in our partial equilibrium setting. The intersecion point determines the clearing rent r^* and the fraction of workers that would live in l, h. In this example, $T > R$.

In this (frictionless) case, the market clearing rent r^*, obtained from $1 - F(r^*) = G(r^*)$ would be:

$$r^* \approx (T + R)^{\frac{1}{\theta}}$$

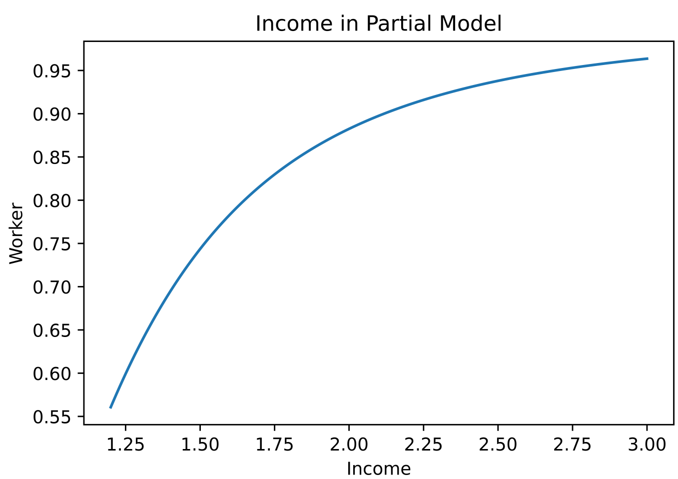
Note that higher T implies a higher overall productivity from residing in our location l (and thus a higher demand), and a higher R implies higher overall costs, thus a lower supply. A higher θ implies lighter tails on the distribution, implying lower rents. The fraction of workers that would live in l would be:

$$h \approx \frac{T}{T+R}$$

Note that the higher the productivity is in l, relative to its cost, the more people the location is going to be able to accommodate.

To see the distribution of income, note that the workers living in l are the subset $i_l \in [1-h, 1]$ of the original measure of workers $i \in [0,1]$. Maintaining the indexing we used in Section 3.1, we obtain a one-to-one mapping from a given worker i_l to their productivity $w_l \in [r^*, \infty]$ using (a truncated version of) $F(w)$, as we showed in Section 3.1. Figure 8 shows a plot between worker index i_l, to their productivity w_l. (Since we are working with closed sets, when using this model empirically, the support can be rescaled to $sup\, f(w) = [r^*, \max\{w_{empirical}\}]$. Making data analysis easier.)

Figure 8: Income in Partial Model



Notes: This figure maps one-to-one worker i_k to their income w_k using (a truncated version of) $F(w)$. Note that the indexing is the left hand side of a Fréchet's CDF bounded below in its support by r^*. On this particular example, r^* is high enough so that we can only see the right hand side tail of $F(w)$.

Using this indexing, we can generate the income CDF $Y(w)$. First, note that for every $w > r^*$, the measure of workers with income of less than or equal to w is $F(w) - F(r^*)$, and zero otherwise. Then $Y(w) = \frac{F(w)-F(r^*)}{1-F(r^*)}$ would be the CDF of the distribution of income, and it would have a pdf $y(w) = \frac{f(w)}{1-F(r^*)}$ (with $sup\, y(w) = [r^*, \infty]$). Since Fréchet distributions have pareto tails, then $Y(w)$ has a pareto tail on the right hand side of the distribution.

[Talk with Alexis Toda. In the general equilibrium setting with 'n' locations, the upper side of the distribution of economy-wide income would be the sum over 'n' distributions with pareto tails, this would generate a pareto tail in its right hand side. Two main questions (1) the distribution of income in each location is the result of migration from 'n-1' different locations. This means that the distribution of income in the whole economy is characterized (in its right hand side) by the sum of '$n(n-1)$' potentially different distributions. So are there relaxations on the imposition of pareto tails on the productivity of workers? My sense is that at least one of those distributions has to have a pareto tail in order to get a pareto tail in the income in the whole economy. But is there something that can be said further? And (2), as part of my simplifying assumptions, I required that income of the non-movers be linear on their indexing. This means that the left hand side of the distribution of income in the overall economy would have a linear tail. My objective is to be able to have doulbe pareto tails. Do you have tips on how I can relax that assumption and still get some tractable maths?]

[Maybe a sufficient statistic for inefficiency can be obtained from the ratios. Think of it as the difference between marginal productivity of each type of capital, when studying capital missalocation.]

4.2 Counter Balancing

Data suggests that as we aggregate markets so that we go to higher level markets, the ratio seems to counterbalance (i.e., the variance is reduced, and there seems to be a convergence to a number close to 1). Figures 9 and 9 show this pattern.

Figure 9: Comparison of State and National Levels. Market vs Average Rent Ratio.

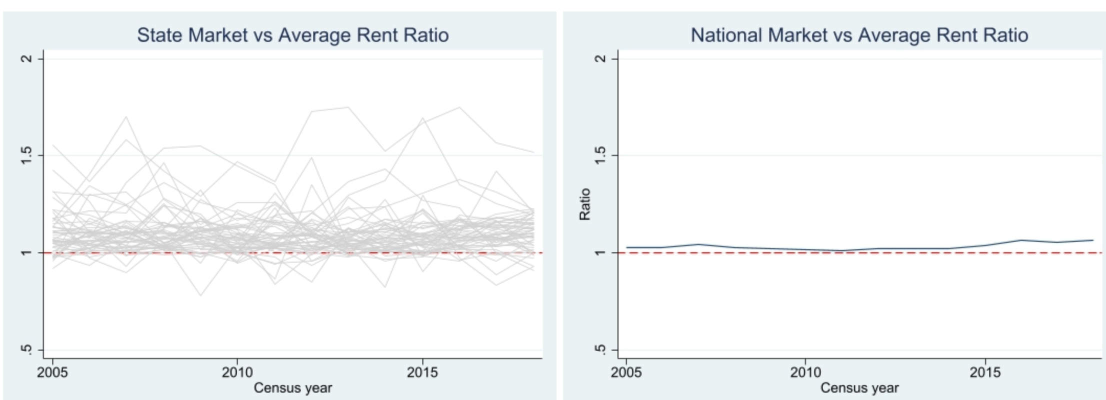


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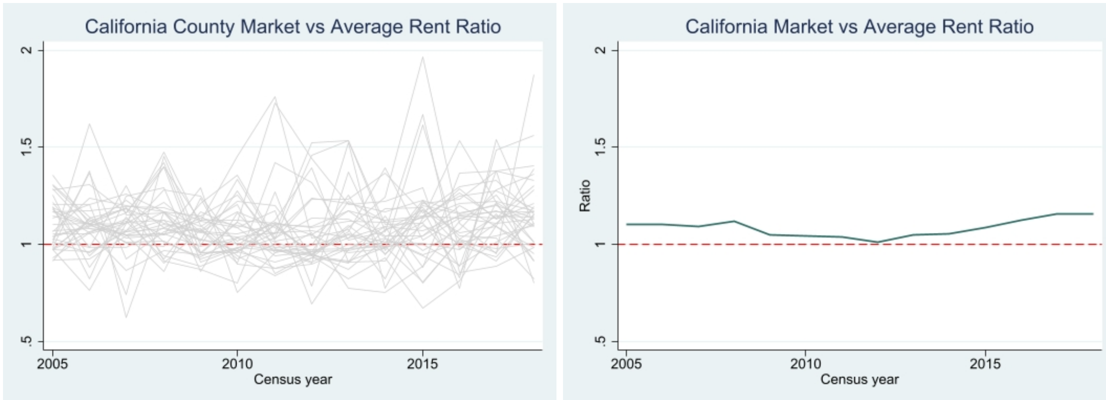
Figure 10: Comparison of County and State Levels for California. Market vs Average Rent Ratio.



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4.3 Government

[Working with Phil Hoxie. Talk to DK Choi.]

To introduce the government, we will be using the partial model in Section 3.1 (partial equilibrium can be thought of as a model on a 'small and open' location). The government will be enacting two simultaneous policies: (1) it will increase the cost of building new housing (and obtain taxes through that), and (2) will redistribute the taxes to some workers that would initially live in the location. [(Ask Fabian Eckert) Should I also see what the general equilibrium model could say (maybe now governments can compete to maximize their income)? Should the cost of government be assumed $c = 0$?]

[Some other phenomena I would like to explore on this paper:]

4.4 Ghost Towns

[Talk with Santiago Cantillo. Maybe the following mechanism could help explain cities with zero populations: Assume there are some fixed costs of maintaining a city (roads, sewage, ...), and that government has to levy taxes to at least cover it. Let $S_l(r)$ be the supply function such that $S_l(0) = c$ where $c > 0$ is the fixed cost. This means that the zero intercept of the supply function starts at c. Any city that does not have a demand big enough to cover c spirals down to zero.]

4.5 Luxury Housing

[Allowing each developer to invest in quality would make housing a differentiable good (instead of the perfectly substitutable good so far), and maybe that will allow higher cost developers invest to attract workers with higher productivity. Increasing the total consumption of housing in equilibrium (instead of consuming part of the cheaper housing, they would switch to a more expensive type, freeing cheap housing for newcomers).]

4.6 Some people don't get housing.

5 Conclusions

References