Rent Control, Housing Price Constraints, and Economic Productivity: A Case Study in San Francisco

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Abstract:

   In an analysis of the municipal 1994 rent control law in San Francisco, we analyze the effect of limiting housing prices on worker productivity and nominal wages. We utilize American Community Survey data from 2000 to 2017, organized into microdata through IPUMS to analyze municipal housing units. We find that on average, 51% of all residential units are rented and 66% of all renter-occupied units are under some form of citywide rent control. Controlling for broader demographic characteristics including education level, race, gender, and household status, we find that there's a 17.2% decline in the price of controlled units and a 6.62% decline in occupant nominal wage within rent-controlled units. We tentatively conclude, under the assumptions of the Rosen-Roback model, that there is a consistent correlation between rent-controlled prices and lower average nominal wage.

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INTRODUCTION

Over recent decades, the Bay Area, and in particular, the city of San Francisco, has experienced some of the strongest increases in labor productivity within the United States, and with it, rapidly accelerated living costs within the area. Like many, large metropolitan areas with significant industry growth, a high demand for housing, and a static housing supply, San Francisco and neighboring cities have experienced rapidly accelerating housing demands and sharp increases in both the costs of purchasing and renting housing within the area. Subsequently, structuring housing policy in urban areas to increase the amount of affordable housing has been a key focus of public policy[1]. Within the San Francisco city area and the greater Bay Area, rent control is a highly popular policy proposal to combat accelerating rent and living costs, with the primary objective being to limit displacement, largely for those who are disenfranchised. Although the precise definition and enactment of rent control can vary depending on the location, in essence, the policy of rent control first and foremost, limits the magnitude of rent increases landlords are able to implement amongst existing tenants and limits tenant eviction. Since existing households that hold a constant amount of income are particularly vulnerable in the wake of rising housing demand, rent control and similar housing pricing policies are proposed to limit the amount of dislocation amongst current residents.

Within the city of San Francisco, due to a municipal 1994 rent control law, The Residential Rent Stabilization and Arbitration Ordinance, units located in multi-family buildings built prior to 1979 are thus subject to rent control, which provides principal protections against both evictions and rent raises. In such a scenario, rents are dictated and set from the date of first occupancy, and can only be raised annually up to a predetermined amount. Within San Francisco

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[1] **Moretti, Enrico.** 2012. *The New Geography of Jobs*. Boston: Houghton Mifflin Harcourt.

specifically, a 2018 housing report by the San Francisco Planning Department found that 65% of all city households rented their residence, which was significantly higher than the Bay Area average of 45% of all households[2]. Amongst the 65% of the city's renting population, 40% resided in rent-controlled housing, 16% resided in non-rent controlled housing, and 9% of the household was deed-restricted affordable housing. However, the precise number of rent-controlled units appears to fluctuate amongst different bodies of research and according to different sources. For instance, the San Francisco Rent Board reported that amongst rental units under rent control or subsidy status, 71% of all city units were rent-controlled, 11% were market-rate units, and 18% of the units are simply categorized as 'other'. Subsequently, a significant portion of the units appear to be subsidized or are of unknown status based on a single data source.[3] We discuss the implications of the fluctuations in data and how precisely to remedy the discrepancies in results in Section III, in methodologies.

Within the broader Bay Area, the Costa-Hawkins Rental Housing Act, a California state law enacted in 1995, places limits on municipal rent control ordinances, limiting the effectiveness and enforcement of rent control laws. The Cost-Hawkins Act of 1995 limits local government's ability to apply rent control in three ways: (1) rent regulation can no longer be applied to single-family homes, (2) housing built after 1995, or any earlier cut-off date already in local rent ordinances is thus exempted from any local rent regulation, and (3) vacancy decontrol becomes mandatory, meaning that rent controls no longer apply to vacant units and owners can

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[2] "San Francisco Housing Needs and Trends Report." *San Francisco Planning*, San Francisco Planning Department, July 2018, San Francisco Housing Needs and Trends Report.
[3] "San Francisco Rent Board Appendix,", *San Francisco Rent Board,* 2018 https://sfrb.org/sites/default/files/FileCenter/Documents/1868-housing.pdf).

thus increase rents to market rate between tenancies.[4] Thus, rent control in the state of California

is largely enacted by city governments, with one of the key exceptions being San Francisco's

1994 rent control law, which despite existing state and federal limitations, has ultimately left the

majority of San Francisco's housing stock under rent control and has left market-rate units

comprising a mere fraction of the existing units[5]. Currently, nine of California's fourteen rent

control ordinances are located in Bay Area cities, and in total, current Bay Area rent regulations

cover 318,000 housing units, or a quarter of total rental units in the Bay Area[6].

Unfortunately, a significant body of economic research on rent control as a means of

mitigating housing displacement in urban areas primarily highlights its negative consequences,

including publications that focus specifically on the Bay Area, and on the city of San Francisco,

even examining the aforementioned 1994 rent control law. A recent 2018 publication examining

the 1994 law change and subsequent variation in rent control assignment in San Francisco

concluded that while rent control prevented the displacement of a number of incumbent

residences, it ultimately drove up market prices in the long-run, rendering the intention of the

law moot. Due to the municipal law, landlords were ultimately driven by the dynamics of rent

control to remove 30% of the rent-controlled units in the study from the market, leading to a 15%

[4] Cash, Anna, et al. "Proposition 10: Estimating the Scale of Expanded Rent Control in the Bay Area." *Urban Displacement*, 25 Oct. 2018, https://www.urbandisplacement.org/sites/default/files/images/policybrief_rentcontrol_102518.pdf.

[5] Diamond, Rebecca, Tim McQuade, and Franklin Qian. 2018. Who Bene fits from Rent Control? The Equilibrium Consequences of San Francisco's Rent Control Expansion. Stanford University Mimeo.

[6] Cash, Anna, et al. "Proposition 10: Estimating the Scale of Expanded Rent Control in the Bay Area." *Urban Displacement*, 25 Oct. 2018, https://www.urbandisplacement.org/sites/default/files/images/policybrief_rentcontrol_102518.pdf.

citywide decrease in total rental units.[7] Additional research on the impact of rent control illustrates that limiting rent increases below market rates leads to spatial misallocation and overconsumption of rent-controlled apartments[8], maintenance neglect[9], and negative spillovers onto neighboring housing, and ultimately, devaluing the area[10].

Whilst it appears the general consensus amongst economists regarding rent control is that it 1) accelerates housing price increase in the long run by 2) decreasing incentives for increasing housing supply, there is relatively little research on the impact of rent control on the worker productivity and worker wages. Understandably, within regions that have growing industries and high levels of economic productivity, an increase in economic productivity is normally followed by a rise in housing demand, as laborers choose to optimize their housing residence by living closely to their place of employment. Previous research centered on rent control demonstrates that implementing such a policy limits the amount of displacement for certain demographics, particularly for incumbent residents, for those residing on the lower spectrum of the city's income bracket, and for racial minorities[11].

Though rent control limits housing supply in the long-run and generally constrains access to living amenities who benefit, the net effect of rent control on the economic productivity of

[7] Diamond, Rebecca, Tim McQuade, and Franklin Qian. 2018. "Who Benefits from Rent Control? The Equilibrium Consequences of San Francisco's Rent Control Expansion." Stanford University Mimeo.

[8] Gyourko, Joseph, and Peter Linneman. 1990. "Rent Controls and Rental Housing Quality: A Note on the Effects of New York City's Old Controls." Journal of Urban Economics, 27(3): 398 409.

[9] Downs, Anthony. 1988. "Residential Rent Controls." Washington, DC: Urban Land Institute.

[10] Autor, David H, Christopher J Palmer, and Parag A Pathak. 2014. "Housing Market Spillovers: Evidence from the End of Rent Control in Cambridge, Massachusetts." Journal of Political Economy, 122(3): 661 717.

[11] Diamond, Rebecca, Tim McQuade, and Franklin Qian. 2018. "Who Benefits from Rent Control? The Equilibrium Consequences of San Francisco's Rent Control Expansion." Stanford University Mimeo.

cities remains ambiguous. Alternative pieces of literature, particularly in increasing housing supply for urban areas that experience high amounts of demand, conclude that constraints on housing supply result in misallocation, given that it limits the number of workers who have access to high productivity in cities[12]. Housing-constrained cities, namely cities that restrict housing supply through zoning laws and building codes, ultimately face lower aggregate output and welfare of workers. This also falls under a general consensus that increased housing density in cities ultimately generates higher levels of productivity amongst workers, and thus raises overall economic wages, by increasing access to the various amenities available within cities and by minimizing commute time of laborers[13].

Subsequently, within the following report, I seek to evaluate the effect of rent control on labor productivity and worker nominal wage, utilizing the city of San Francisco as a case study. Given that the enforcement of Costa-Hawkins leaves only the impact of the 1994 rent control law, The Residential Rent Stabilization and Arbitration Ordinance to study, in a region that has experienced rapid industry growth and intense demand for housing. Within examining the effect of the law, we concentrate on the effect of rent control, the alterations in housing prices, and the subsequent changes in worker productivity. Moreover, due to the Costa-Hawkins Act placing limits on potential rent control laws, this provides a natural experiment for us to examine the sole effect of the 1994 law in question. Thus, the following paper distinguishes itself on a number of key factors from previous economic literature. Firstly, we focus on the city of San Francisco

[12] Hsieh, Chang-Tai, and Enrico Moretti. 2019. "Housing Constraints and Spatial Misallocation." *American Economic Journal: Macroeconomics*, 11 (2): 1-39.
[13] Kline, Patrick, and Enrico Moretti. 2014. "People, Places, and Public Policy: Some Simple Welfare Economics of Local Economic Development Programs." *Annual Review of Economics* 6 (1): 629–62.

specifically, rather than analyzing a variety of urban areas, and utilize the 1994 municipal rent control law to evaluate a different natural experiment, analyzing data at the municipal level. Secondly, while other papers have utilized the impact of the 1994 rent control law to evaluate the value of rent control protection and the effect of rent control on housing prices and supply, little past literature analyzes its impact on the potential productivity of the city region. Past references examine the changes in productivity within alternative housing laws, such as removing building codes and zoning restrictions, but not the effect of rent control, rendering the following paper a new contribution to economic literature on rent control laws.

Thus, the following paper is divided into the following sections: Section I describes the data and summarizes the variables used in analysis; Section II discusses past literature and history, including providing context on the history of rent control in San Francisco to explain data and methodologies and other publications on rent control. Section III describes the methodologies. Section IV presents the empirical results from the data. Section V presents the Rosen-Roback model, its implications, and potential shortcomings. Ultimately, the paper seeks to evaluate the potential effect of rent control in impacting nominal wage, and thus, limiting economic productivity in the area.

SECTION I: DATA

In order to analyze the effect of the 1994 rent control law, we utilize data from the American Community Survey (ACS), organized in the format of the Integrated Public Use Microdata Series (IPUMS). The IPUMS database collects and systematizes U.S. Census Bureau data with enhanced documentation, particularly on information regarding local and municipal data. Since we intend to analyze the intended effect of a citywide rent control law, we utilize annually documented, city-specific data, organized and weighted by household. From the IPUMS-USA database, we acquire current information regarding the size and composition of the

city's housing inventory, including the year of construction, condition of the building, building unit size and structure, alternative housing costs, as well as population demographic characteristics and characteristics of both unit occupants and recent movers.

We initiate our analysis from the year 2000, since this is the earliest year in which the present format of the American Community Survey data is available and the earliest year in which the required municipal data is available to distinguish between rent-controlled and non rent-controlled city-specific units for San Francisco. IPUMS data additionally includes harmonized income and occupation variables. Since we seek to not only analyze the composition of residents who live within rent-controlled units, but to evaluate the subsequent correlations between worker wage, we also focus on occupant nominal wages, employment status, education level, worker placement in an occupational prestige index depending on industry, and socioeconomic status, among a number of additional variables, described in detail later.

Table 1.1: Ownership Summary

Variable:	No of Obs.:	Mean:	Median:	Std. Dev.:	Min:	Max:	Skewness:
Ownership:	94,786	1.466482	1	0.5590897	0	2	-0.414649

We provide context first by examining the status of city homeownership. In the above table, out of a total of 94,786 city-specific observations, the value of 1 represents homes that are owned or in the process of being purchased. The minimum value, 0, represents household units in which the ownership status is certain, and the maximum value, 2, represents units that are rented. Disregarding household units of unknown status, we can re-summarize the data, in which the maximum value of 1 represents units which are purchased and the minimum value of 0 represents rented units.

Table 1.2: Ownership Summary - Adjusted

Variable:	No. of Obs.:	Mean:	Median:	Std. Dev.:	Min:	Max:	Skewness:
Ownership:	91,767	.4852725	0	0.4997858	0	1	0.0589356

Figure 1.1:
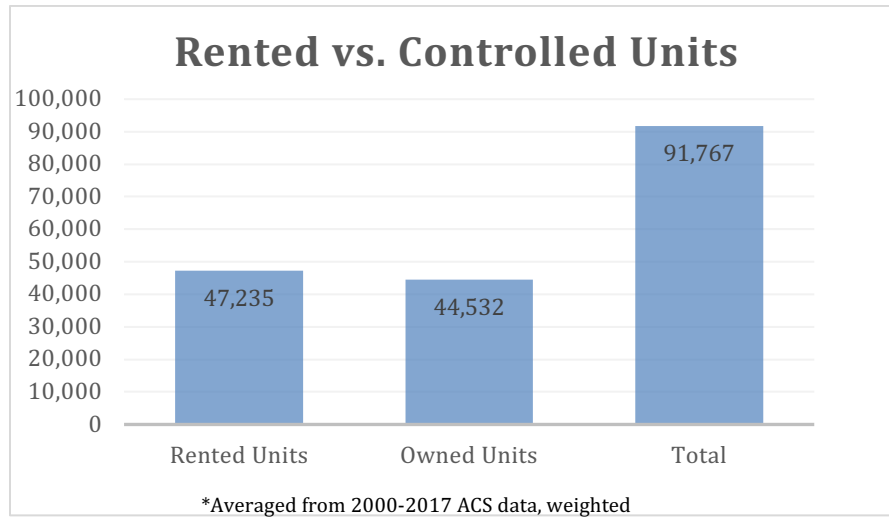
Thus, out of a total of 91,767 observations, approximately 48.5% are purchased units and the remaining 51.5% are rented units. Since we seek to evaluate the impact of the rent control law in contrast to the case scenario in which units are not rent-controlled, we focus our analysis on only those occupying rented units, disregarding the characteristics of homeowners. The following structure of our analysis is centered on the 47,235 rented units. Below, we include a table of summary statistics regarding this city sub-population, which provides information on occupant renters, including, the value of rent, the nominal worker wage, usual hours worked, sex, age, education level, household occupational score, and household socioeconomic status.

To "score" occupational prestige and socioeconomic status, we utilize (1) a constructed variable that assigns occupational prestige scores to each occupation and (2) the Hauser and Warren Socioeconomic Index, a measure of occupational status on the basis of educational attainment and earnings. We do this for a number of reasons, with the primary being that the sector in which a person is employed is likely to impact predicted wages, but also because of the

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wide variety of industries to account for, the implications of their prestige and influence, and their inherent link to a person's previous socioeconomic status and educational level. Since both indices are designed to be applicable to datasets with occupational data coded to the 1990 census occupational scheme, we incorporate both within the American Community Survey extraction.

We also note the accounted household and person weight, in which each recorded observation within the IPUMS sample is weighted by the frequency by which its values are estimated to occur. Though a number of database samples remain unweighted, meaning that each observation has an equal chance of occurring, but the variation for the metropolitan data for San Francisco indicates that household observations hold unequal probabilities.

Table 1.3A: Summary Statistics

Variable:	No. of Obs.:	Mean:	Median:	Std. Dev.:	Min:	Max:	Skewness:
Rent:	47,235	1555.625	1500	1011.701	0	3800	0.4945225
Log(rent)	45,932	7.176707	7.313221	0.7214405	1.386294	8.242756	-1.424642
Incwage:	47,235	138171.8	30000	292031.7	0	999999	2.508234
Log(incwage):	34,339	10.95684	10.91509	1.598014	3.401197	13.81551	-0.077995
Household weight:	47,235	113.7571	91	74.68675	14	1028	2.365088
Person weight:	47,235	123.769	97	84.94374	11	1180	2.424265
Sex (= 1 for male):	47,235	0.5010903	1	0.5000041	0	1	-0.004361
Age:	47,235	38.54692	35	19.57045	0	94	0.1809894
Usual hours worked:	47,235	26.88667	37	21.43706	0	99	-0.055497
Education:	47,235	7.436837	8	3.435726	0	11	-0.839196
Occupational score index:	47,235	22.3898	24	16.95557	0	80	0.1949544
Socioeconomic index:	47,235	30.72865	30.3	23.24446	0	80.53	0.0549516

Table 1.3B: Summary Statistics – Race

Variable:	Obs.:	Mean:	Median:	Std. Dev.:	Min:	Max:	Skewness:
Race: white	47,235	0.5621255	1	0.4961307	0	1	-0.2504429
Race: black	47,235	0.059511	0	0.236581	0	1	3.723829
Race: Asian	47,235	0.2720864	0	0.4450388	0	1	1.024252
Race: Native	47,235	0.0048693	0	0.0696108	0	1	14.22584
Race: other	47,235	0.0557002	0	0.2293443	0	1	3.874563
Race: mixed	47,235	0.0457076	0	0.2088525	0	1	4.350412

Table 1.3C: Summary Statistics – Household Structure

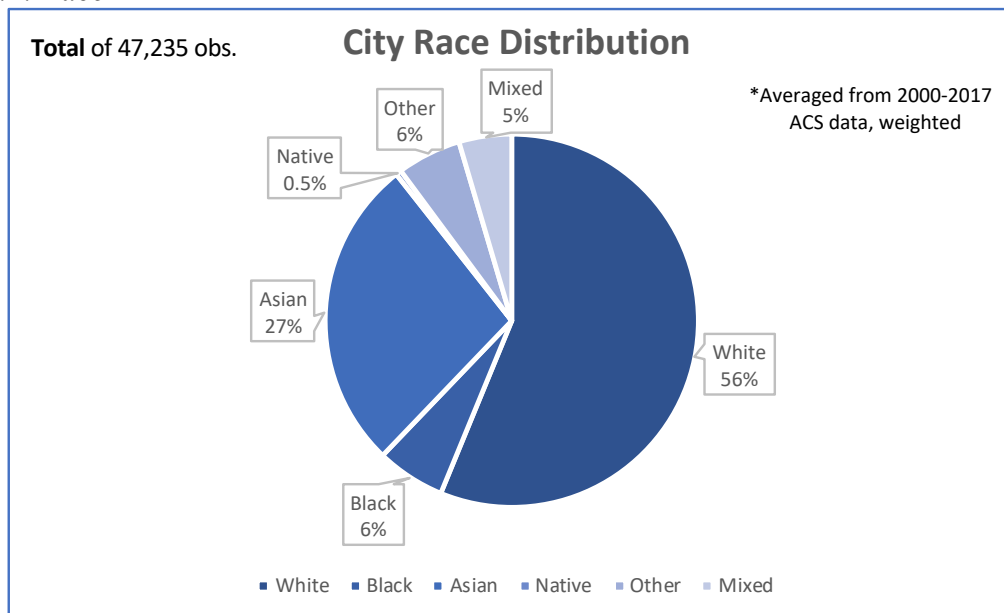| Variable:	Obs.:	Mean:	Median:	Std. Dev.:	Min:	Max:	Skewness:
Married, spouse present:	47,235	0.2664126	0	0.4420872	0	1	1.056759
Married, spouse absent:	47,235	0.0227797	0	0.1492021	0	1	6.397031
Separated:	47,235	0.1335027	0	0.3401208	0	1	2.155123
Never married:	47,235	0.577305	1	0.493993	0	1	-0.312983

Figure 1.2: Race
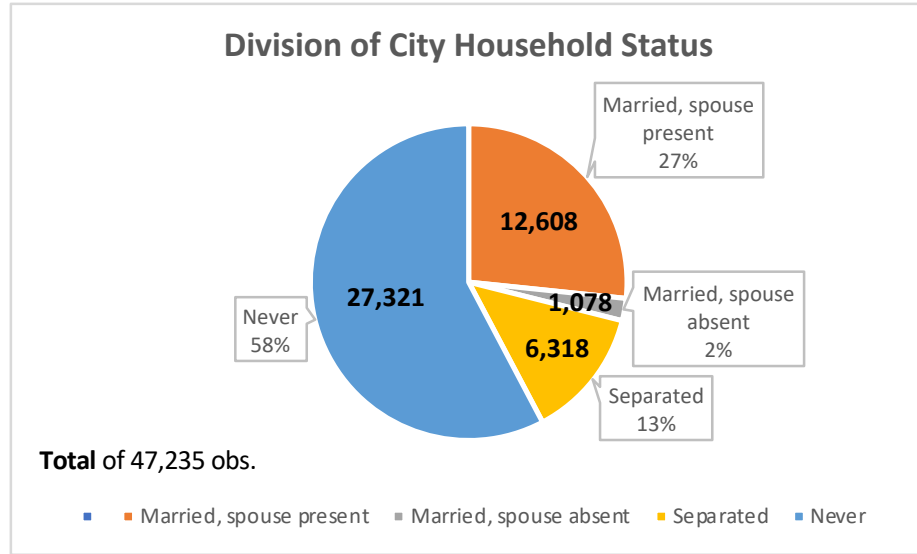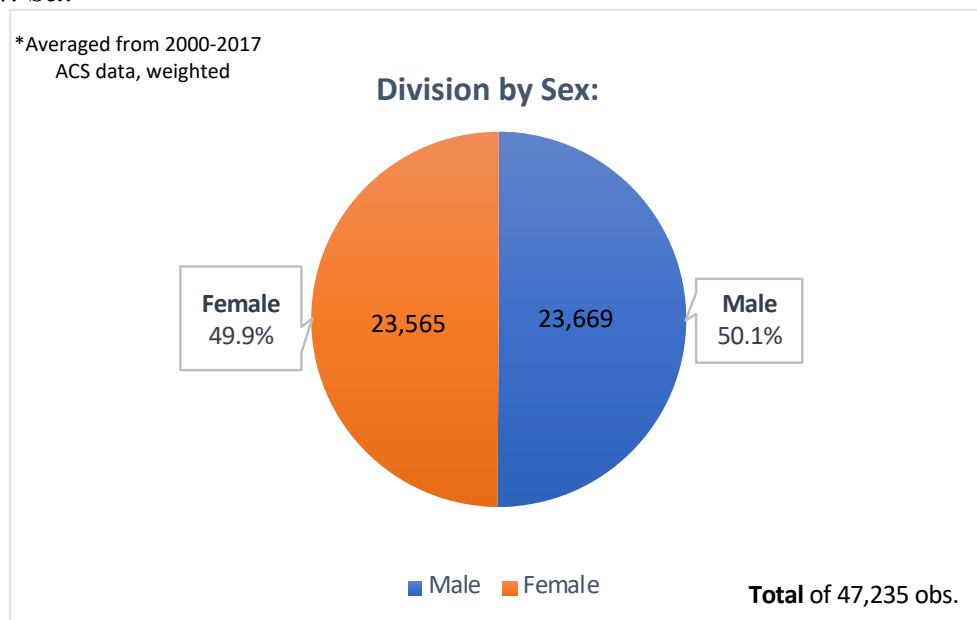
Figure 1.3: Household Structure

Division of City Household Status

Married, spouse present 27%

12,608

27,321

Never 58%

1,078 — Married, spouse absent 2%

6,318 — Separated 13%

Total of 47,235 obs.

- Married, spouse present
- Married, spouse absent
- Separated
- Never

Figure 1.4: Sex

*Averaged from 2000-2017 ACS data, weighted

Division by Sex:

Female 49.9%

23,565

23,669

Male 50.1%

- Male
- Female

Total of 47,235 obs.

We include the above variables summarized later on in our analysis; we also separately account for the divisions of race, household status, and sex. It appears that the majority of the surveyed sample size, comprising of San Francisco renting occupants, are generally speaking, white, with unmarried or single households, and have at least some college education. There is little to no gender bias within sample selection.

SECTION 2: PAST LITERATURE AND HISTORY
Section 2.A: Rent Control in San Francisco

For the majority of U.S. history, local economic booms were followed by booms in

housing construction, in which within the 1960s, construction was only subject to light

regulation in nearly all major American cities, though this altered between the 1960s and the

1990s - particularly amongst regions which experienced strong economic growth. Higher

economic productivity in the San Francisco Bay Area, in conjunction with its extensive

restrictions on housing construction and land use, now results in higher housing prices, rather

than more homes and more workers. To provide context regarding the 1994 municipal law, we

examine the precise history and legal restrictions San Francisco's rent control established. Rent

control in San Francisco began the year of 1979, when the city's first rent control was signed

after intense pressure to rent control rose due to strong housing demand in San Francisco. A

recently passed Proposition 13, which capped nominal rent increases to 7% and covered all

rental units built prior to June 13th, 1979, held one key exemption: owner-occupied buildings

containing 4 units or less. Small multi-family structures made up about 44% of the rental housing

stock in 1990, substantiating a large exemption to the rent control law. Hence, in 1979, the city

of San Francisco imposed rent control all standing buildings with five or more apartments,

categorized in the American Housing Survey as units. Though all large buildings built as of 1979

would be rent-controlled, new construction would be exempt from rent control in order to

continue new development and construction.

Subsequently, the 1979 rent control law placed rent control restrictions on large

buildings, while all buildings built in 1980 and afterwards would be exempt from the law. In

addition, smaller multi-family units were exempt from rent control, being viewed as lacking

market power over rents. in a 1994 San Francisco ballot initiative, the 1979 rent control law

changed. Over the years, small multi-family buildings were purchased by larger businesses, who then sold a small share of the building to a live-in owner to satisfy the law exemption. Through a new ballot initiative, passed in 1994, the small multi-family exemption was removed, in which small proponents stated that small multi-family housing was now primarily owned by large businesses, and as such, should face the same rent control restrictions of large multi-family housing. Since the original 1979 rent control law only affected units built from 1979 and prior, the removal of the small multi-family exemption only affected properties built 1979 and earlier, ultimately leading to a rent control expansion in 1994 based on whether the small multi-family housing unit was built prior to or after 1980. To summarize, the 1994 law then subjected all multi-family structures with four units or less, built in 1979 or earlier, to rent control. All multi-family residences built from 1980 or after are not subject to rent control[14].

San Francisco rent control laws have remained stable since, which could be attributed to the passage of the Costa-Hawkins Rent Control Act, which limits any California city from rent-controlling any housing stock built in 1994 or later. In recent years, rent control has become an increasingly popular proposal. Of the 101 jurisdictions in the Bay Area, nine cities have rent control ordinances, including the city of San Francisco.

Section 2.B: Housing Constraints and Productivity

What appears to be the most pertinent piece of research in regards to determining the effect of the 1994 municipal law on worker productivity is a publication which utilizes quasi-experimental variation in the assignment of rent control in San Francisco to evaluate its impact on tenants and landlords. Admittedly, despite policy interest, there is little well-identified

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[14] Diamond, Rebecca, Tim McQuade, and Franklin Qian. 2018. "Who Benefits from Rent Control? The Equilibrium Consequences of San Francisco's Rent Control Expansion." Stanford University Mimeo

evidence demonstrating how precisely local rent controls affect tenants, landlords, and the broader housing market. Diamond et. al utilizes the unexpected 1994 law change, which ultimately rent-controlled a subsector of city buildings and their tenants, ultimately finding that with new data tracking individual migration, that the rent control law limited renter mobility by 20% and lowered displacement from San Francisco. The study found that between five to ten years after the law change, that the beneficiaries of rent control are on average, 3.5 percentage points more likely to remain at their 1994 address relative to the control group. Given that only 18% of the control group remained at their 1994 address, the rent control in effect correlated with a 19.4 percent increase in not moving. Admittedly, the majority of the renters residing at their rent-controlled residence would not have continued living there if it were not for the rent control law. However, the landlords did not react to the law change passively, but rather chose to convert the existing buildings into alternative forms of real estate. In particular, large buildings subject to rent control laws were then converted to condos and redeveloping buildings. Thus, in the long-run, landlords substituting owner-occupied and newly constructed rental supply both lowered the supply of affordable housing available, raised the average rent of a unit in the city, and accelerated the gentrification of San Francisco. Subsequently, while rent control benefited a number of incumbent renters in the short run, the long-run loss of housing supply rose up market rents in the long run.

There is a wealth of literature that describes the economic impact of rent control, and more precisely, limiting rent increases below market rates, including over-consumption of housing by tenants of rent-controlled apartments, misallocation of heterogeneous housing to heterogeneous tenants, negative spillovers onto neighboring housing, and neglect of maintenance. A substantial body of economic research has warned about potential negative

efficiency consequences of limiting rent increases below market rates, including over-

consumption[15] of housing by tenants of rent-controlled apartments[16], misallocation of

heterogeneous housing to heterogeneous tenants[17] [18] [19] [20], negative spillovers onto neighboring

housing[21] [22] and neglect of required maintenance[23]. Yet, in an empirical model of joint decisions

of where to live and where to work, Kim et. al found that wages are higher in metropolitan

markets, but that housing prices are also higher in urban areas, and when equal wage growth

across labor markets occurs, there is a shift in the relative population from less populated to

urban areas[24].

Misallocation arises because the constraints on housing supply in the most productive US

cities effectively limit the number of workers who have access to such high productivity. Instead

of increasing local employment, productivity growth in housing-constrained cities primarily

[15] Olsen, Edgar O. 1972. "An Econometric Analysis of Rent Control." Journal of Political Economy, 80(6): 1081-1100.

[16] Gyourko, Joseph, and Peter Linneman. 1989. "Equity and Efficiency Aspects of Rent Control: An Empirical Study of New York City." Journal of Urban Economics, 26(1): 54-74.

[17] Suen, Wing. 1989. "Rationing and rent dissipation in the presence of heterogeneous individuals." Journal of Political Economy, 97(6): 1384-1394.

[18] Glaeser, Edward L, and Erzo FP Luttmer. 2003. "The Misallocation of Housing under Rent Control." The American Economic Review, 93(4): 1027-1046.

[19] Sims, David P. 2007. "Out of Control: What Can We Learn from the End of Massachusetts Rent Control?" Journal of Urban Economics, 61(1): 129-151.

[20] Bulow, Jeremy, and Paul Klemperer. 2012. "Regulated prices, rent seeking, and consumer surplus." Journal of Political Economy, 120(1): 160-186.

[21] Sims, David P. 2007. "Out of Control: What Can We Learn from the End of Massachusetts Rent Control?" Journal of Urban Economics, 61(1): 129-151.

[22] Autor, David H, Christopher J Palmer, and Parag A Pathak. 2014. "Housing Market Spillovers: Evidence from the End of Rent Control in Cambridge, Massachusetts." Journal of Political Economy, 122(3): 661-717.

[23] Downs, Anthony. 1988. "Residential Rent Controls." Washington, DC: Urban Land Institute.

[24] Kim S. So, Peter F. Orazem, Daniel M. Otto."The Effects of Housing Prices, Wages, and Commuting Time on Joint Residential and Job Location Choices." *American Journal of Agricultural Economics*, Volume 83, Issue 4, November 2001, Pages 1036–1048, https://doi.org/10.1111/0002-9092.00228

pushes up housing prices and nominal wages. The resulting misallocation of workers lowers aggregate output and welfare of workers in all US cities. In a related paper, Hsieh and Moretti analyzed the aggregate productivity costs of housing constraints through the prism of a Rosen-Roback model, in which aggregate output and welfare growth are affected by local shocks within cities. Subsequently, aggregate output and welfare growth depend on a weighted average of productivity shocks in each city and the efficiency of the allocation of workers across cities, the latter of which heavily depends on the elasticity of housing supply in high productivity cities. In the scenario that a city has a significant housing supply and simultaneously experiences productivity growth, local employment increases and workers in other cities benefit from reallocation of jobs. Alternatively, if a city has a restrictive housing supply, then the reallocation of jobs is limited, and thus productivity growth in the city is limited due to the higher price of housing. We find that the increased spatial misallocation of labor due to housing supply constraints in cities with high productivity growth rates *lowered* aggregate growth between 1964 and 2009 by a significant amount. By calculated an increase in housing supply in New York, San Jose, and San Francisco by relaxing land use restrictions to the level of the median US. city, the U.S. growth rate of aggregate output would increase by 36.3%. In the following scenario, U.S. GDP in 2008 would 3.7 percent higher, translating into an additional $3,685 in average annual earnings. Within the framework of the Rosen-Roback model, the aggregate benefit of growth in New York and the Bay Area was offset by increased misallocation of labor due to inelastic supply of housing[25]. More precisely, the annual earnings and subsequently, the average nominal

[25] Hsieh, Chang-Tai, and Enrico Moretti. 2019. "Housing Constraints and Spatial Misallocation." *American Economic Journal: Macroeconomics*, 11 (2): 1-39.

wage of the city, would decline in relation to a less elastic housing supply, which is due to housing constraints.

Thus, within the same framework, despite the absence of literature on the precise effect of rent control, the alteration on changing housing prices, previous literature implies that rent control while reducing housing prices below the market-rate price, high housing prices are correlated with higher wages, though the framework of causality may be in question. Within a hedonic model, the spatial equilibrium assumption holds the possibility that housing prices can be used to accurately assess people's willingness to pay for location specific amenities. In an agglomeration model, the spatial equilibrium framework iterates that high housing prices, objectively bad things, are offset by good things in a location, such as high wages. High wages may also be a locational attribute, that attract workers - and thus, high wage regions are assumed to be areas that are more economically productive. Whether it is the higher wages of individuals supplying an increase in housing demand that results in overall high housing prices, or the value of certain amenities and the demand of location that causes a spike in demand, there appears to be a correlation between high housing prices and high wages.

SECTION III: METHODOLOGY

To evaluate the effect of the 1994 rent control policy, we first distinguish between rent-controlled and market-rate units. Under the 1994 law, which additionally encompasses the original 1979 rent control law in San Francisco, we therefore classify rent-controlled units as units built prior to 1980, which are also not single-family homes or condominiums where the respondent moved in or after January 1, 1996. The latter statement, regarding single-family homes and condominiums, is a key addition largely because owners of large rental units were converting large buildings to smaller multi-family units in order to become exempt from rent

control. In contrast, market-rate units are city units constructed in the year 1980 or afterwards, which demonstrate no government housing subsidy and are separate from public housing and include all single-family homes and condominiums where the respondent moved in January 1, 1996, or later.

Subsequently, the primary variable of interest, representing whether a household is under rent control or not, is dictated by 1) the decade in which the building is constructed, specifically before or after 1980, 2) the structure of the building – and whether it is a single family home or condominium or not, 3) the move-in date of the occupants, 4) the number of units in the building structure, and 5) exclusion from public housing and government subsidy, in which we have already disregarded all housing units that have been purchased. All remaining units that did not fit into the labels of rent-controlled or market-rate were classified as other and excluded from analysis, as noted prior in the summary statistics. This leaves us with a sample size of approximately 47, 235 for which we can construct a treatment variable of rent control for.

Understandably, the 'other' has a statistically significant impact on the results, though to justify the exclusion, upon comparison of our data results to recent studies on rent control from numerous sources, including the San Francisco Housing Data Hub, the San Francisco Rent Board, the San Francisco Planning Commission, all of which had a distinct category of 'other in contrast to market-rate and rent-controlled units. Thus, we see such an exclusion both as a precedent established in previous forms of analysis and add, as a result, the analysis here should primarily be considered a comparative analysis of the two types of units, market-rate and rent-controlled, which comprise the outstanding majority of San Francisco households. This is largely due to the limited amount of construction in recent years, leaving the majority of building units constructed prior to 1980.

Table 3.1: Decade of Construction:

Variable:	No of Obs.:	Mean:	Median:	Std. Dev.:	Min:	Max:	Skewness:
Before 1980:	47,235	0.8461734	1	0.3607863	0	1	-1.919015
1980's:	47,235	0.0532232	0	0.2244807	0	1	3.980578
1990's:	47,235	0.0465333	0	0.2106392	0	1	4.30567
2000's:	47,235	0.0470202	0	0.2116844	0	1	4.279812
After 2010:	47,235	0.0070499	0	0.0836678	0	1	11.78363

The overwhelming majority of city units were built prior to 1980, with an estimated 84.6% of occupant renters residing in such buildings. San Francisco belongs to a number of cities in which rent-controlled units form the majority of rented housing, likely due to the low levels of new housing construction. Less than one percent of all sample units were constructed within the past decade. It also explains the relatively static nature of city rent-controlled units, especially in comparison to other urban regions: with little new construction and few legislative changes, rent-controlled buildings substantiate the better part of metropolitan housing.
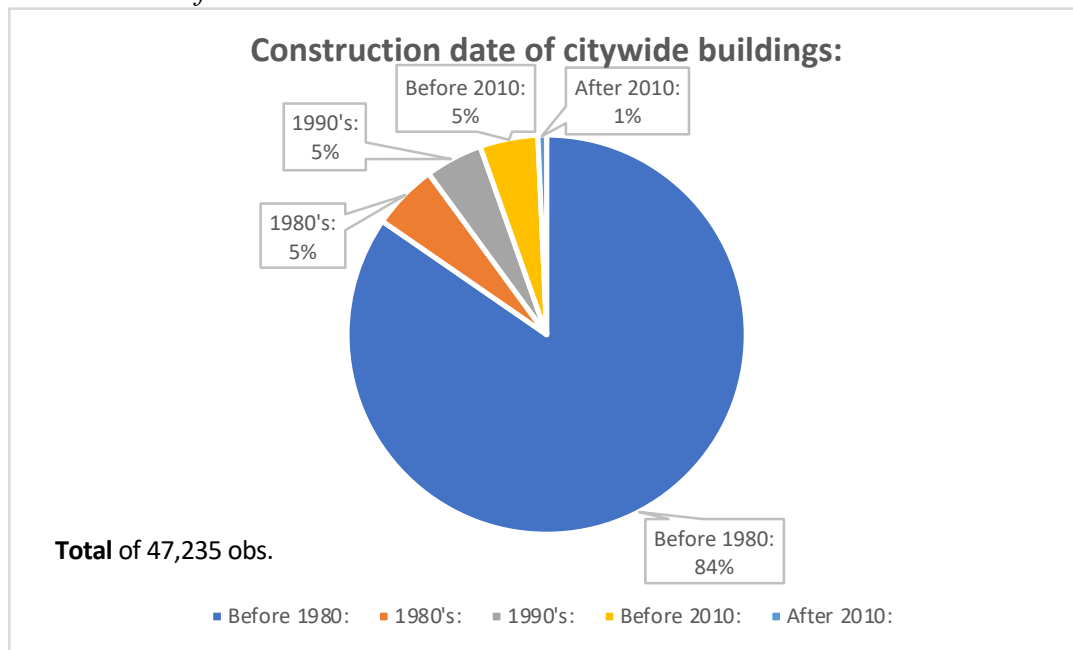
Figure 3.1: Decade of Construction:

Construction date of citywide buildings:

1990's: 5%
Before 2010: 5%
After 2010: 1%
1980's: 5%
Before 1980: 84%

Total of 47,235 obs.

Before 1980: | 1980's: | 1990's: | Before 2010: | After 2010:

Table 3.2: Description of rent control dummy

Variable:	No. of Obs.:	Mean:	Median:	Std. Dev.:	Min:	Max:	Skewness:
Rent control:	47,235	0.6643802	1	0.4722117	0	1	-0.6962215

Following applying previously listed restrictions in rent control regarding building unit size, construction date, move-in date, and the absence of government subsidy, rent-controlled units appear to substantiate approximately 66.4% of all citywide rent units, or make up approximately 31,400 units, while only 33.6% of all renting occupants reside in market-rate housing. Given that this outcome falls within the estimated range of already published research on the number of rent-controlled units, the outcome of the dummy variable appears reasonable. We find the average of the percentage of rent-controlled units by applying listed household and person weights to the data and by taking the average of the rent control dummy variable over time. Though there is an initial negative correlation between the years passed and the average value of city units under rent control, with the addition of other key demographic variables, particularly rent, estimated worker wage, and race, there is no statistically significant change found in the value of the rent control variable over time.

Table 3.3: Regression of rent control over time

No. obs.	47, 235	47, 235
Rent control:	-0.2975592*** [.0365607]	-0.0486249 [0.0359738]
Rent:		0.0011109*** [0.0000191]
Incwage:		-1.11e-08 [5.77e-08]
Race: white		-0.4362465* [0.2397534]
Race: black		-0.2041007 [0.2480734]
Race: Asian		0.0771728 [0.2405699]
Race: other		0.7723133*** [0.2486919]
Race: mixed		0.4684593* [0.2510817]
Constant:	2011.429*** [0.0298005]	2009.685*** [0.2409219]

*Note: *** = p < 0.01, ** = p < 0.05, * = p < 0.1*
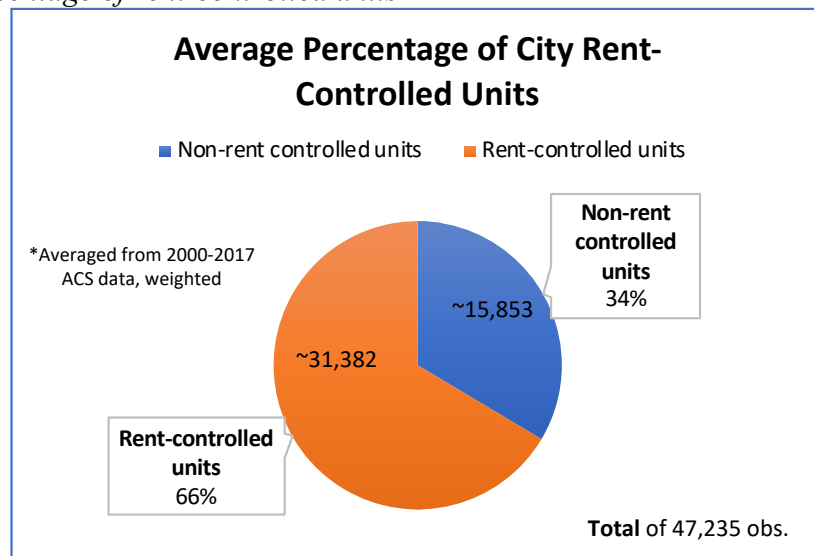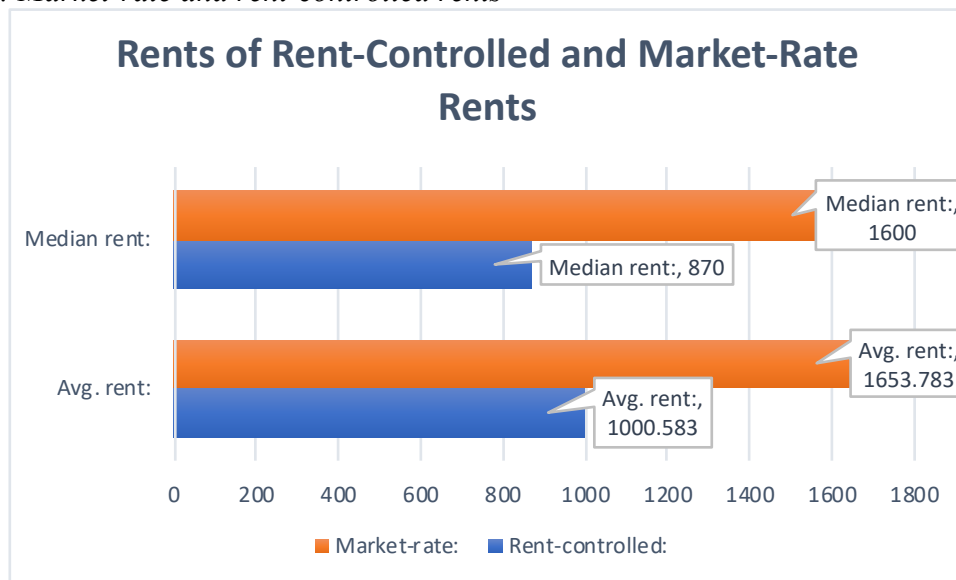
Figure 3.2: Percentage of rent-controlled units

Average Percentage of City Rent-Controlled Units

■ Non-rent controlled units   ■ Rent-controlled units

*Averaged from 2000-2017 ACS data, weighted

~15,853

Non-rent controlled units 34%

~31,382

Rent-controlled units 66%

Total of 47,235 obs.

Figure 3.3: Market-rate and rent-controlled rents

Rents of Rent-Controlled and Market-Rate Rents

Median rent:
- Median rent:, 1600
- Median rent:, 870

Avg. rent:
- Avg. rent:, 1653.783
- Avg. rent:, 1000.583

■ Market-rate: ■ Rent-controlled:

SECTION IV: RESULTS

We conduct two series of multi-variate regressions, with the dependent variable being the logarithmic value of rent and the logarithmic value of wage, respectively. We select the following two variables since 1) we should affirm the intended impact of rent control and 2) examine the correlation between rent control and nominal wages. IPUMS microdata is organized by individual and household-level records, though the responses of each observation are

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recorded in separate variables, in distinction to aggregate data and are subsequently weighted by estimated frequency with which the observation result occurs. Since the primary variable of interest is rent control, and the subsequent effect of rent control on the logarithmic values of rent and wage, the following tables first list the coefficient of rent control, the standard deviation of the coefficient, and the subsequent coefficients of the control variables added.
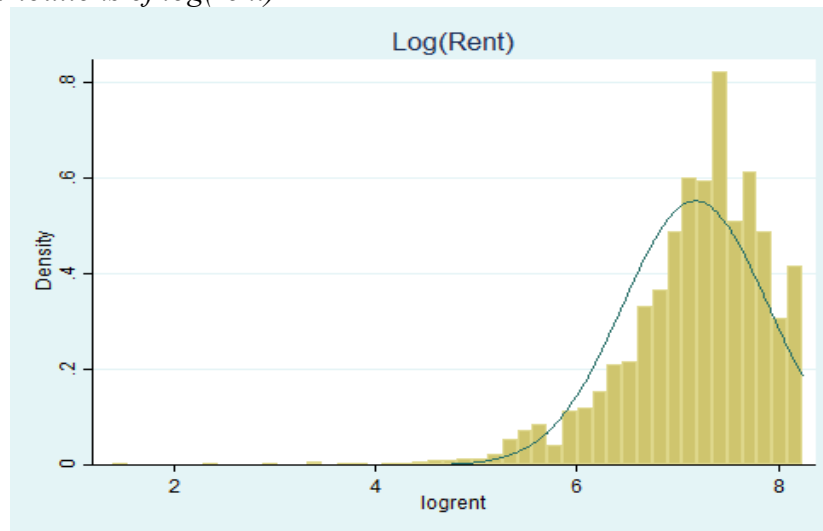
Figure 4.1: Distributions of log(rent)
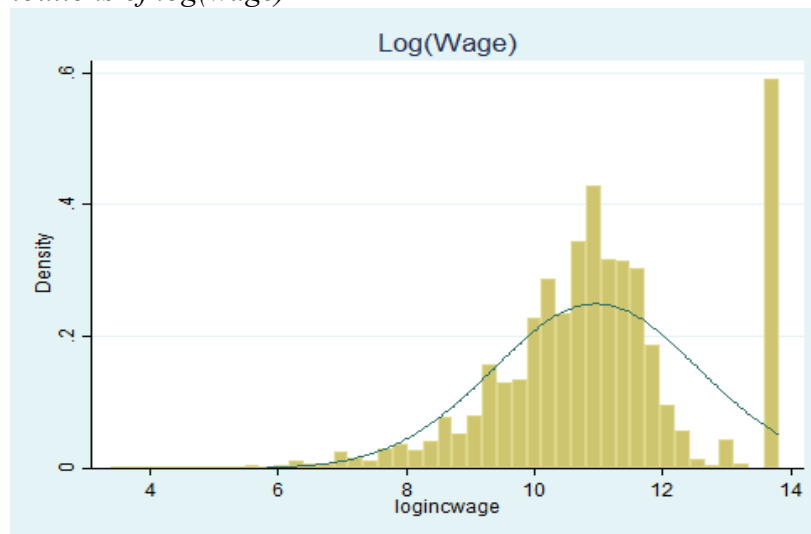

Figure 4.2: Distributions of log(wage)

Table 4.1: Regression on log(rent)

No. obs.	45,932	45,932	45,932	45,932	45,932	45,932	45,932
Rent control:	-0.09571*** [0.0071513]	-0.16413*** [0.006833]	-0.13484*** [0.0064353]	-0.1346803*** [0.0064335]	-0.16585*** [0.0062727]	-0.1710267*** [0.0062027]	-0.1724176*** [0.0061952]
Education:		0.068368*** [0.0009354]	0.078244*** [0.0008886]	0.0781789 [0.0008884]	0.066907*** [0.0009056]	0.0435389*** [0.0011443]	0.0389987*** [0.0012103]
Age:			-0.01211*** [0.0001559]	-0.0120895 [0.0001559]	-0.01135*** [0.0001531]	-0.0104376*** [0.0001539]	-0.0102428*** [0.0001546]
Sex:				0.0313874 [0.0059794]	0.018111*** [0.0058083]	0.0020198*** [0.0057626]	0.0037894 [0.0057566]
Race: white					0.408221*** [0.0418047]	0.4060025*** [0.0413245]	0.4014133*** [0.0412688]
Race: black					-0.23555*** [0.0432293]	-0.2079153*** [0.042741]	-0.2076536*** [0.0426813]
Race: Asian					0.203408*** [0.0419591]	0.2078263*** [0.0414773]	0.2052233*** [0.04142]
Race: other					0.260147*** [0.0433365]	0.2637759*** [0.0428388]	0.2644363*** [0.042779]
Race: mixed					0.260147*** [0.0437514]	0.3237874*** [0.0432495]	0.3199952*** [0.0431903]
Occupation index:						0.0073662*** [0.0002247]	0.0035775*** [0.0004014]
Socioeconomic index							0.0035457*** [0.0003115]
Constant:	7.240938*** [0.0058585]	6.776744*** [0.0084313]	7.148148*** [0.0092574]	7.132109*** [0.0097461]	6.914599*** [0.0424219]	6.897492*** [0.0419378]	6.903047*** [0.0418821]

*Note: *** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.1$*

In Table 4.1, in running regressions on the logarithmic value of rent, we utilize years of education, sex, race, occupational index score, and socioeconomic index score as control variables to evaluate the changes due to rent control with a total of 45,932 observations. The initial regression of the treatment variable of rent control onto the logarithmic value of rent, with no added control variables, results in a negative coefficient of -0.0957076, statistically significant at the p-value of 0.01, meaning that rent-controlled municipal units are correlated with a decrease in the value of rent by 9.57%. With each added control variable, Table 4.1 demonstrates an additional decrease in the coefficient value for rent control, meaning that with the more variables controlled for in the multivariate regression, the more significantly the treatment effect of rent control appears to affect the logarithmic value of rent. The full regression, accounting for all aforementioned control variables, lists a negative coefficient of -0.1724176, or that rent-controlled units are correlated with a decrease in the value of rent by 17.2%, in which all coefficients, both for the treatment and control variables, are statistically significant at a p-value of 0.01. This implies a significant correlation between rent-controlled

units and lowered values of rent within the city of San Francisco and affirms the purpose of the

1994 law in question.

Table 4.2: Regression on log(wage)

No. obs.	34,339	34,339	34,339	34,339	34,339	34,339
Rent control:	-0.205039*** [0.0183073]	-0.20189*** [0.0182708]	-0.221282*** [0.0184011]	-0.233015*** [0.0180952]	-0.13817*** [0.0176095]	-0.0662422*** [0.0170468]
Sex:		0.20736*** [0.017194]	0.2018252*** [0.0171817]	0.192395*** [0.016918]	0.248651*** [0.0164035]	0.1745734*** [0.0158916]
Race: white			0.4920404*** [0.1252133]	0.474468*** [0.1230683]	0.643496*** [0.1190801]	0.8529357*** [0.1149478]
Race: black			0.4806796*** [0.1305128]	0.4363074 [0.128267]	0.381974*** [0.1240626]	0.4268203*** [0.1196831]
Race: Asian			0.3212656** [0.1259174]	0.3626314 [0.1237992]	0.395820*** [0.1197383]	0.4744651*** [0.1155187]
Race: other			0.3789212*** [0.1296882]	0.3718361 [0.1274666]	0.339309*** [0.1232852]	0.2523904** [0.1189423]
Race: mixed			0.8707326*** [0.1304031]	0.7717198 [0.1281933]	0.717885*** [0.1239912]	0.8251388*** [0.1196297]
Married, spouse present:				0.1226076 [0.0330561]	0.158179*** [0.0319796]	0.1793507*** [0.0308527]
Married, spouse absent:				-0.1846679 [0.0647983]	-0.17196*** [0.0626723]	-0.2143551*** [0.060464]
Never married:				0.6836382 [0.0300757]	0.512815*** [0.0292996]	0.5282629*** [0.0282661]
Usual hours worked:					-0.02328*** [0.0004783]	-0.0022763*** [0.0006206]
Education:						-0.1630573*** [0.0032219]
Constant:	11.09423*** [0.0149858]	10.98451*** [0.0175044]	10.53985*** [0.125539]	10.09418*** [0.1257629]	10.80989*** [0.1225208]	11.16383*** [0.1183992]

Note: *** = p < 0.01, ** = p < 0.05, * = p < 0.1

In the above table, Table 4.2, we run multivariate regressions on the logarithmic value of

nominal wage, evaluating the effect of the treatment variable, rent control, and utilizing sex,

race, household status – such as married or never married, usual hours worked by individual, and

years of education as control variables to evaluate the impact from a database comprised of

34,339 observations. In the initial regression, in which we solely evaluate the effect of rent

control on the logarithmic value of wage, the initial coefficient is -0.205039, or that rent-

controlled units on average hold a lower nominal wage by 20.5% in comparison to non rent-

controlled units, statistically significant at a p-value of 0.01. Interestingly enough, with each

control variable added, the coefficient of the rent control variable remains negative, but

decreases in weight. The final regression, incorporating all of the aforementioned control variables, states the coefficient value for rent control is -0.0662422, or that while accounting for sex, race, household status, usual hours worked, and years of education, the estimated effect of rent control upon nominal wage is a decrease of approximately 6.62%, statistically significant at a p-value of 0.01

Thus, the microdata set acquired by the American Community Survey affirms two important premises, the first being that rent-controlled units are strongly correlated to a decrease in rent and housing prices, and the second that, rent-controlled units are also correlated to lowered nominal wage, while separately controlling and accounting for the impact of demographic effects including age, sex, and education level, among others.

Table 4.3: Ownership status and rent

No. obs.	94,786
Rent control:	0.000404***
	[1.22e-06]
Constant:	1.153227***
	[0.0015606]

To affirm the validity of the constructed rent control variable, we first run a regression between the variable ownership and rent; given that ownership represents home status, the evident conclusion is that rented homes should yield not be affected by the ownership variable. The above table, which illustrates the regression of documented rent on ownership status has a coefficient of 0.000404, or approximately zero, statistically significant at a p-value of 0.01.

Table 4.4: Homeownership and rent control

No. obs.	47,325
Rent control:	0.00***
	[1.22e-06]
Constant:	2***
	[1.22e-06]

We also examine the relationship between the ownership variable and the rent control variable; since the rent control variable should only affect renting occupants, it should yield no

effect on home owners, and thus, should have no relationship – and above, the regression which examines the effect of rent control on homeowners demonstrates a negligible effect. Subsequently, the multivariate regressions denote a correlation between the enforcement of rent control and a consistent decline in both housing prices and nominal wages; we evaluate the implications of this within the model framework listed below.

SECTION V:
Section 5.1: Model Framework

In order to determine the relationship between city housing prices and nominal wages of workers, we utilize the Rosen-Roback model to finalize our interpretation, in which local forces in a city affect local employment, wages, and housing, and as such, such a model functions as a core tool for understanding housing price differentials amongst different areas. Within the Rosen-Roback model, we treat each metropolitan area as a single homogeneous entity, and as such, every individual residing within the same metropolitan area is assumed to hold the same housing costs, transport costs, and amenity levels, given differentials in income. Subsequently, upon examining a single metropolitan area, we enforce the following assumptions:

Within the Rosen-Roback model and to facilitate data analysis, we assume perfect mobility. In such a setting, workers choose the city that maximizes utility. In the scenario of perfect mobility across cities, we assume workers hold homogenous tastes and subsequently, are willing to relocate to cities where wages, net of cost of housing and amenities, are higher. Thus, the local labor supply to a city - namely the number of workers who are willing to relocate for a higher wage or better amenities - is infinitely elastic. As a result, cities with higher wages, lower cost of housing, or better amenities attract more workers, but not an infinite number of workers.

Subsequently, given that the following data analysis focuses solely on a single metropolitan region, we assume that laborers in the city exist within the city per choice since it

maximizes the individual's utility. As a result, the local labor supply to the metropolitan area in

question is held as negligible to the question we seek to answer, which is how rent control and

the subsequent changes in housing pricing affect worker wages and productivity.

Local employment, wages, and housing prices - in a city indexed by i produces a homogenous
good with the following technology, can be represented by the equation below:

(1) $Y_i = A_i L_i^a K_i^n T_i^{(1-a-n)}$

In the above equation, A_i captures the productivity of the city, L_i the employment of the

city, K_i the capital of the city, and T_i, the land available for business use. We assume that within

the above production function, there are constant returns to scale in capital, labor, and land. We

also assume that the supply of land T_i is fixed in each city. The above production function makes

three assumptions. It first assumes that all cities produce the same product. It then assumes the

production function elasticities *a* and *n* are the same in all cities. Lastly, it assumes that the

production function is constant returns to scale in capital, labor, and land. We assume the supply

of land, T_i, is fixed in each city.

Labor supply in a city is limited by the condition that workers are freely mobile and in
equilibrium choose the city that maximizes utility. Indirect utility of workers, V, is given by:

(2) $V = W_i * Z_i / P_i^{\beta}$

In the above equation, P_i denotes the local housing price, β the expenditure share on

housing, and Z_i the value of local amenities. Using previous literature as a precedent, we note

two important characteristics of the above Rosen-Roback model. The first being that workers

have homogenous tastes over locations. While workers do care about wages, housing costs, and

amenities, there is no individual specific preference for a city over another. Subsequently, we

assume that the labor supply facing a city is infinitely elastic and constant. Secondly, we assume

that the wage is the only source of income, discounting other potential sources of wealth accumulation. Thus, utilizing the listed parameters, we use the definition of indirect utility, listed in equation 2, to express the nominal wage as a function of V and the ratio of local housing prices and local amenities:

(3) $W_i = V * P_i{^\wedge}\beta / Z_i$

As a result, as dictated amongst the above equations, the nominal wage and its fluctuations is determined by differences in city size and population, local amenities, and the local elasticity of the city's housing supply. Holding all other variables constant, if city housing prices increase, assuming the expenditure share of housing is constant, the nominal wage increases. In the same scenario in which all other variables are held constant, if housing prices decrease, then the nominal wage would decrease as well. Hence, nominal wage is increasing in a city's employment with a city-specific elasticity, depending on the elasticity of housing supply and the value of local amenities. Henceforth, in examining the value of V, the indirect utility, by concentrating on a single city and metropolitan area, it is reasonable to extend that the labor supply of the city remains at a constant, and thus, the value of indirect utility of a city remains at a constant. In addition, within the same metropolitan area, it is reasonable to see that the value of Z, of amenities, remains constant. Since, rather than examining the Rosen-Roback model at a national level and the differentials of nominal wages between different cities, we examine the differences in housing prices amongst a single city, we hold the value of indirect utility V, constant and we control for the value of local amenities, Z, as constant, since within the same city, we may assume a negligible difference for amongst different households.

And thus, within the following model and the assumptions in place, the average nominal wage of the city of San Francisco is proportional to the average value of the housing price unit

raised to the power of the unit expenditure share of housing. With the values of indirect utility and local amenities assumed to be constant in a single city, this means that the percentage change in housing price raised to the expenditure share of housing reflects the percentage change in nominal wage.

(4) W_i = (fraction of rent-controlled housing)*avg[$P_{\text{rent-controlled}i}^{\wedge}\beta$] + (fraction of market-rate housing)*avg[$P_{\text{market-rate}i}^{\wedge}\beta$]

By virtue of the following Rosen-Roback model and the assumptions made with it, in distinction between market-rate and rent-controlled housing as iterated previously, the above equation dictates that the recorded nominal wage of San Francisco is thus proportional to the sum of the fraction of rent-controlled units in the city, multiplied by the average of the rent-control price raised to the power of expenditure share of housing for rent-control units, added to the fraction of the market-rate housing units in the city, multiplied by the average of the market-rate price raised to the power of the expenditure share of housing on market-rate units.

Subsequently, utilizing the analysis from the IPUMS microdata sample and assuming the conditions for the Rosen-Roback model would yield true, the negative correlation between rent control and both housing prices and nominal wage, while controlling for a number of demographic variables, implies that the implementation of rent control is in some way, connected to lower nominal wage. The previous multivariate regressions for rent control yielded an estimated decrease in housing price of 17.24% for renter-occupied units, and subsequently a decrease of 6.62% in worker nominal wage; holding that the assumptions of the above equation hold true, the decrease in housing price does directly relate to lower nominal wage. The precise reason is unknown: it could be that those with higher wages are more likely to reside in market-rate housing, or that rent-controlled housing is likely to attract those with less disposable income.

Section 5.2: Shortcomings

However, the primary shortcoming of using the above model to interpret results is that we only use city-specific data within our analysis, whereas the Rosen-Roback model is dependent on assuming workers come from a variety of cities. Within the model, we assume that spatial equilibrium allows for housing prices to accurately assess people's willingness to pay for location-specific amenities, but that characteristic is absent here – in which we hold no comparative city data, aside from that of San Francisco, which makes the model application significantly weaker and less rigorous. By virtue of only having a single city's data and concentrating on the specific dynamics of a municipal law there, we cannot assume that the assumptions that substantiate the model hold – so the conclusion that relates the decline in housing price from a citywide rent control law to a decline in nominal wage and extends what was produced by the multivariate regressions, remains tentative at best.

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