THE ASYMMETRICAL GROWTH OF HOUSING PRICES: THE IMPACT OF REGULATION

by

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THE ASYMMETRICAL GROWTH OF

HOUSING PRICES: THE IMPACT OF REGULATION

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Abstract

The growth of housing prices in the United States has been asymmetrical over the past decade, especially so in metropolitan statistical areas (MSAs). This piece conducts five separate regression analyses in order to determine the factors contributing to this asymmetrical rise in housing prices. Analysis of the data reveals that housing prices are, in fact, rising disproportionately in different areas and factors like the level of regulation, the increase in employment, and the increase in population contribute to the rise in housing prices. The variables representative of income and rental prices were not found to be impactful in increasing housing prices. This piece further describes some possible ways to combat the massive increase in housing prices in MSAs with strict regulations on housing and high demand in the market.

Introduction

Housing prices in the United States have been in flux since the economic market crash of 2008. After the massive drops induced by the crash, prices have recovered steadily, but price increases have not aligned in all places. There are some cities across the United States where prices have skyrocketed, some where the price of housing is relatively stable, and some where the housing values may even be decreasing in real dollars. Examples of large increases in housing prices include Metropolitan Statistical Areas such as Dallas-Fort Worth, the San Francisco Bay area, and New York City. In fact, price increases have become so drastic that there has been a shortage in affordable units in many of these metropolitan areas.

The academic norm defines an unaffordable home as one on which a family spends more than 30% of its household income. According to the U.S. Census Bureau, the average percentage of individuals spending more than 30% of their household income on housing is 29.3%. But states with large, fast-growing Metropolitan Statistical Areas have a far higher percentage of households living in unaffordable housing units, such as California (39.5%) and New York (35.4%) (Factfinder.census.gov, 2019). This discrepancy is not simply due to an increased amount of poverty in states with urban areas. Rather, the discrepancy results in large

part from different types of housing markets that exist in metropolitan areas with fast growing economies. Factors like population growth, income increases, rental price increases, low unemployment, and regulation in these markets all likely produce upward pressure on housing prices.

Economists often divide housing markets in the United States into three different types. The first type are markets that are lightly regulated, but at the same time have growing populations and growing economies. In these markets, the supply curve is relatively elastic. The first type of markets includes areas such as Colorado Springs, Akron, and Des Moines. The second type are markets in which the demand curve for housing has decreased harshly over the years. These markets are characterized by a surplus of housing, because the supply of housing cannot be easily changed after a unit is built. In other words, housing does not diminish over time, and once the demand for housing falls, already built units lie dormant. An example of an area of the second type is Detroit. The third and final type of housing market is a market with a fast-growing economy and an increasing population and other factors that drive up the cost of land. However, this third type of market differs from the first type, in that is heavily regulated by various means such as zoning restrictions and other delays caused by intervention in the market during the construction process. This combination of factors results in a steep supply curve for housing. Examples of metropolitan areas of the third type are San Francisco, New York, and Los Angeles. This thesis will focus on confirming these different types of housing markets and examining more closely what is happening in third type of housing market described above. It will then suggest possible policy solutions to help slow these aggressively growing housing prices and thus provide additional affordable housing units.

The paper's methodology uses regression analysis and compares each potential factor to housing prices, to determine whether that factor statistically impacts housing prices or not. I have collected data focused on both the supply and demand side factors of a typical housing market. I have used the data to examine how, from the years 2010 to 2017, regulation and a number of other independent variables impacted the increase in housing prices over that seven-year period in counties across the United States.

The paper will proceed as follows: it will begin by covering some of the current literature on housing markets and factors affecting prices within them. The paper will then define all of the dependent and independent variables in the Data Description, present and analyze results from my regression analysis, and conclude with some possible policy solutions for unaffordable housing prices.

Literature Review:

There has been extensive research done on the topic of housing markets, with a particular focus on the impact of regulation. Nils Kok, Paavo Monkkonen, and John M. Quigley examined the relationship between regulation and housing prices in their 2014 article *Land Use Regulations and the Value of Land and Housing: An Intra-metropolitan Analysis*. This piece examines data for housing transactions in metropolitan areas within the San Francisco Bay Area over a nine-year period and concludes that in areas requiring a greater number of independent reviews to obtain building permits or zoning changes, land prices tend to be higher. Those higher land prices, in turn, are closely linked to higher prices for homes.

The Economic Implications of Housing Supply, by Edward Glaeser and Joseph Gyourko (2018), uses a cost-based approach to gauge whether markets are supplying housing units at an

appropriate price. The results reveal a gap between housing prices and production costs which can be viewed as a regulatory tax, thus establishing that regulation acts as a barrier to supply and drives up housing prices.

Min Hwang of the National University of Singapore and John M. Quigley of the University of California Berkley also discuss the extensive impact of regulation on housing prices in their piece *Economic Fundamentals in Local Housing Markets: Evidence from U.S. Metropolitan Regions (2006)*. In addition, they find factors on the demand side of the housing market that link to housing prices, specifically, the level of employment and income. Hwang and Quigley also find that the vacancy rate in owner-occupied housing markets are linked to housing prices.

Literature focused exclusively on the demand side of the housing market is far scarcer than that focused on the supply side. In 1991, Isaac Megbolugbe, Allen Marks, and Mary Schwartz wrote *The Economic Theory of Housing Demand: A Critical Review.* This piece surveys the previous three decades of economic literature on housing demand, and concludes that that the neoclassical model for housing consumption provides little guidance for observed housing consumption. They also conclude that demographic factors are crucial in determining housing prices. Due to complexities like this on the demand side, the authors argue, further research is necessary to formulate an accurate theory about housing demand. Some gaps have been filled in since the publication of this piece in 1991, but many items remain unsure.

In the 2019 piece *Labor Demand Shocks and Housing Prices across the United States: Does One Size Fit All?,* Michael J. Osei and John V. Winters examine the effect of labor demand shocks on housing prices. Results suggest that there is a positive relationship between labor demand shocks and housing prices. It also notes that findings vary for different types of MSAs.

This motivates the use of independent variables focused on increases in employment and others related to employment increases.

The empirical literature described above provides the context for this paper's regression analysis. There has been lots of work examining the relationship between housing prices and regulation. Although this relationship may have been logically clear already, the literature assures me that the level of regulation is linked to housing prices, but does not necessarily answer all questions about how impactful regulation is on housing prices—a topic my regression analysis explores. Works focused on housing demand do leave questions unanswered, however, the existing literature combined with economic theory allowed me choose a number of independent variables I believe are representative of demand in housing markets. The following section provides a detailed description of dependent and independent variables used in my regression analysis and some additional motivation for their use.

Data Description:

Housing Prices

The Housing Price Index (HPI) provides an accurate measure for housing prices across the United States. An HPI value is the dependent variable in each of the regressions performed. The Federal Housing Finance Agency created the HPI to provide a measure for the movement of single-family home prices. The HPI is a weighted, repeat sales index, meaning that it measures average price changes in repeat sales or refinances on the same properties. This information is obtained by reviewing "repeat mortgage transactions on single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975 (Federal Housing Finance Agency, 2020)." The HPI is a popular index used to represent housing prices among economists and provides a precise representation of housing prices by

area. The HPI in this experiment is measured as the percent increase in the HPI from 2010 to 2017.

Regulation

The most difficult measure on the supply side of the equation is regulation. Although it is not hard to identify those areas with more regulation, it is more difficult to assign numerical values that represent and compare regulation across different areas. Although state regulation exists, much of the regulation comes at more localized levels. Joseph Gyourko, Albert Saiz, and Anita Summers developed what is known as the Wharton Residential Land Use Regulation Index or WRLURI in the mid 2000s. Due to the complexity of measuring regulation, the index exists only as a point in time statistic. However, due to the barriers involved with changing regulations, it is assumed that these values have remained relatively consistent since their measurement. A description of how the WRLURI was created follows below.

A national survey of local land use control environments generated the WRLURI statistic. Gyourko divided this survey into three types of questions. The first portion of the survey featured general questions about the characteristics of the regulatory process. This set of questions included queries on the process of zoning getting approved or rejected. The second set of questions focused on the localized rules of land use regulation. These rules include restrictions on property use and minimum lot size requirements. The final set of questions addressed the outcome of the regulatory process and included items like the change in cost of development and overall review time spent on a specific development. The WRLURI is also broken down into eleven sub-indices of which represent different types of regulation in the market. A description of these indices is below.

Regulation: Sub-Indices

The first sub index is the Local Political Pressure Index (LPPI), which measures the degree of involvement by various local actors in the development process. The State Political Involvement Index (SPII) represents how involved the state-level legislative and executive branches are in regulation and the degree to which they enforce regulation during that involvement. The State Court Involvement Index (SCII) is an estimate of the judicial environment and represents the tendency of courts to uphold or restrain from involving themselves in land-use regulations, including impact fees, exclusionary zoning, and fair share development regulations. The Local Zoning Approval Index (LZAI) is the sum of the number of entities whose approval is needed to conduct a zoning change. The Local Project Approval Index (LPAI) is the sum of the number of organizations that must approve a project that does not need any change to current zoning. The Local Assembly Index (LAI) is a measure of direct democracy and displays whether there is a community meeting or assembly before which any zoning request must be presented to be voted either up or down. This is a common specifically in the New England area. The Supply Restrictions Index (SRI) shows the extent to which there are explicit constraints or caps on supplying new units to the market. The Density Restrictions Index (DRI) represents density restrictions in the form of minimum lot size requirements. The Open Space Index (OSI) reflects whether home builders in the community are subject to open space requirements or have to pay fees in lieu of such dedications. This is a dummy variable which takes a value of 1 if such requirements are in place and 0 if not. The Exactions Index (EI) involves whether developers are required to pay their allocable share of costs for any infrastructure improvement associated with a new development. The EI is a dummy variable which takes the value of 1 if the developer must pay the fee and 0 if not. The Approval Delay Index (ADI) reflects the average duration during the review process (Gyourko, 2008). It

incorporates time between application for rezoning and issuance of building permits, the typical amount of time between application for subdivision approval and the issuance of a building permit.

The sub-indices described above will allow me to hone in on which *types* of regulation are driving price, if any, and to what extent each are doing so. The sub-indices also separate local land-use regulation from that done at the state level. This is an important distinction to make. Because local policy makers are also homeowners in the affected areas, incentives at the local level may be focused on protecting housing values. Those local policy makers are also homeowners in the affected areas. This means that state level legislation may be less focused on things like minimum lot size requirements which help keep housing prices high in certain areas. A positive relationship between the percent increase in HPI, the WRLURI, and all sub-indices is expected. In other words, as supply is restricted through regulation, we expect housing prices to increase.

Housing Units

Also, on the supply side, I use the percent increase in housing units by county as an independent variable. This metric is essential to show how much the supply actually increased in the market. The data that represents this is from the U.S. Census Bureau and is an overall housing count conducted annually. It is written as the percent increase in housing units by county from 2010 to 2017. A negative relationship between the percent increase in housing units is expected. As supply increases in the housing market, prices will decrease if all else is held constant.

Demand Side Independent Variables

When examining the demand side of the market, things such as income, population, and employment are some of the key elements to examine. In addition, rental units can act as a substitute for housing units. In other words, as the demand for rental units increases the price for housing units should, holding all other variables constant, increase as well. Thus, a positive relationship between rental units and housing prices is expected. Income is represented by data for median household income by county from the U.S. Census Bureau. This will be measured as a percent increase in the median household income (dollars) from 2010 to 2017. Population change is another metric produced by the U.S. Census Bureau, which estimates the natural population increase by county. This is also panel data from 2010 to 2017. Employment is represented by U.S. Census Bureau data which counts the total number of employed persons. It is measured as a percent increase in the number of employed persons from 2010 to 2017. Rental values are represented by U.S. Census Bureau data for median contracted rent (dollars). It is measured as the percent increase in median contracted rent from 2010 to 2017. Since all of these independent variables represent things that cause increases in demand in the housing market, we expect a positive relationship between the all independent variables and the percent increase in HPI. The independent variables chosen above are representative of other forces working in the housing market which are impacting our dependent variable, the HPI.

In order to get a full picture of what is going on in the housing market, I ran multiple regressions with different datasets. The first uses all n = 2,367 cases both within and outside metropolitan areas while using the WRLURI to indicate regulation. The second uses those same n = 2,367 cases while dividing the WRLURI into its eleven sub-indices in to represent regulation. This allows for analysis on how the different sub-indices impact the HPI specifically. The third uses those n = 1,723 cases that are located in a Metropolitan Statistical Area (MSA)

using the WRLURI as a measure of regulation. The fourth uses those same n = 1,723 cases located in MSAs with the eleven sub-indices representing regulation. The final uses those n = 430 cases in which the WRLURI is highest, and the WRLURI as a measure of regulation. Conducting regressions specifically on those cases located in MSAs allows for a deeper analysis of what is going on precisely in those areas and helps better compare those areas in which prices have risen drastically and those in which prices have not. The smaller final case, only including areas with high regulation, will allow us examine how our independent variables affect housing prices differently in these areas with high regulation, typically areas with the fastest growing housing prices. The regression equation is displayed below in Equation 1.

Equation 1

HPI = b0 + b1*$WRLURI_c^I$ + b2*$Natural\ Population\ Increase_c$ - b3*$Percent\ Increase\ in\ Housing\ Units_c$ + b4*$Percent\ Increase\ in\ Employment_c$ + b5*$Percent\ Increase\ of\ Income_c$ + b6*$Percent\ Increase\ of\ Median\ Contracted\ Rent_c$ + $error$

Results:

Before going into regression analysis, it is beneficial to take a look at look at the problem through data. To start, let us look at some descriptive statistics. The descriptive statistics table below displays the summary statistics of all independent and dependent variables. This dataset is refined to the MSA only case with only those n = 1,723 data-points that lay inside an MSA. In addition, descriptive statistics are separated into quartiles based on WRLURI values. These separate quartiles group areas with similar values of regulation and let us examine how our dependent variable percent increase in HPI and our independent variables act in areas with

different levels of regulation. The fourth quartile group is the dataset for the final regression case.

Table 1: Descriptive Statistics

Quartile	Statistic	HPI	WRLURI	Population	Housing Units	Employment	Income	Rent
I								
	n	431	431	431	431	431	431	431
	Mean	15.95	-1.01	33685	4.76	7.75	10.51	17.76
	St. Dev.	16.53	0.30	77073	5.08	8.84	5.29	6.83
	Median	9.81	-0.96	4303	3.09	7.00	10.17	17.16
	Min	-17.25	-2.02	-26832	-1.09	-15.06	-9.39	-7.62
	Max	66.66	-0.59	539224	40.42	33.82	34.62	42.72
II								
	n	431	431	431	431	431	431	431
	Mean	19.88	-0.27	36121	5.08	9.02	10.83	18.03
	St. Dev.	19.00	0.18	83699	5.61	8.90	6.04	7.05
	Median	13.20	-0.27	6576	3.37	7.98	10.26	17.23
	Min	-12.60	-0.58	-26832	-1.05	-15.62	-19.34	-0.78
	Max	73.05	0.03	539224	40.42	38.10	44.71	43.71
III								
	n	431	431	431	431	431	431	431
	Mean	24.53	0.33	49389	4.90	9.93	10.83	18.41
	St. Dev.	21.12	0.19	103041	4.85	8.24	5.65	7.72
	Median	19.27	0.32	9600	3.46	9.33	10.10	17.16
	Min	-16.95	0.03	-26832	-1.04	-21.07	-3.40	-0.78
	Max	82.60	0.60	539224	32.34	36.39	39.05	67.43
IV								
	n	430	430	430	430	430	430	430
	Mean	25.71	1.4	47443	4.61	9.36	11.56	19.51
	St. Dev.	21.54	0.68	103856	4.48	8.47	6.30	8.52
	Median	19.10	1.23	9837	3.37	9.14	11.15	18.50
	Min	-9.40	0.69	-26832	-1.21	-19.41	-10.77	-2.67
	Max	82.60	4.80	539224	32.34	33.84	45.46	48.96
Total								
	n	1723	1723	1723	1723	1723	1723	1723
	Mean	21.52	0.12	41656	4.84	9.02	10.94	18.42
	St. Dev.	20.01	0.97	92833	5.02	8.64	5.84	7.58
	Median	14.36	0.03	7295	3.37	8.39	10.26	17.56
	Min	-17.25	-2.02	-26832	-1.21	-21.07	-19.34	-7.62
	Max	82.60	4.80	539224	40.42	38.10	45.46	67.43

I will first discuss the total case. As seen above, the mean of the HPI is positive at over 21%. This large increase once again reaffirms the problem. Housing prices have risen immensely from 2010 to 2017 and at the same time mean of the percent increase in income rose only 11%. In areas where housing prices rise much more quickly than income, we are sure to see an uptick in the amount of unaffordable housing units. Separating the data into quartiles based on WRLURI values gives us the ability to identify the different types of housing markets discussed in the introduction.

The first quartile, with a very low WRLURI value, represents housing markets with very low regulation paired with a very low demand for housing. The mean of the WRLURI is below -1 in this case and indicates the lack of regulation in these areas. These areas with low regulation also see the slowest growth in housing prices by far. The mean of the percent increase in HPI for this quartile is under 16%, the smallest increase by far. These housing markets with low regulation and slower increases in housing prices were also predicted to have smaller increases in population, employment, and income. We saw in the descriptive statistics shown above low mean values for the all of these independent variables: percent increase in employment, percent increase in income, and natural increase in population. Since the dataset has been restricted to only those cases within MSAs, this first quartile may not be representative of those areas in which demand is actually decreasing, although this is possible in some.

The fourth quartile can act as a representation of those housing markets in which there are high regulation values, represented by the high mean of the WRLURI at 1.41 and the very large increase in housing prices shown by a 25.7% increase in HPI. We can also see in this area that there is a very large increase in the natural population increase. This helps reaffirm our link

between large increases in population and the rise in housing prices. Let us look a bit closer at how the independent and dependent variables act as we move from quartile I to quartile IV.

First and most important, the percent increase in HPI increases from quartile I to quartile IV. This is crucial in identifying the relationship between housing prices and regulation. I predicted a positive relationship due to economic reasoning, and this data adds a layer of validity to that hypothesis. It should be noted that the median of the percent increase in the HPI is slightly smaller than the mean. This indicates that the mean could be weighted by outliers. However, the median of the percent increase in HPI also increases from the first to fourth quartiles which again supports the idea of a positive relationship between level of regulation of housing prices.

The natural increase in population is also expected to be larger in areas in which regulation is higher. We saw the natural increase in population in the first quartile at just over 31,000 and the fourth at over 47,0000. This represents higher demand in areas in which there is more regulation in the housing markets. The percent increase in number of employed persons is also representative of demand in an area. We saw a low percent increase in the number of employed persons at 7.75% in the first quartile and higher values (over 9%) in the third and fourth quartiles. It is interesting to note that one independent variable—income—does not seem to have much of a trend as the WRLURI increases. The relationship between increase in income and the increase in housing prices will be discussed further in the analysis of the regression results.

The variable percent increase in median contracted rent is expected to act similarly to the percent increase in HPI. If housing values have increased in certain areas, rental values can be expected to rise as well. This is because rental units face similar supply restrictions through

regulation and also encounter increases in demand when individuals move into the area. The first quartile contains the smallest mean at 17.76% and rises until the fourth quartile at 19.51%. This range, however, is much smaller than that of the percent increase in HPI. While this shows how rental prices trend according to levels of regulation, the data leaves questions about the relationship between rental prices and housing prices. The regression results below help determine whether the rate at which rental price grow in an area have an impact on how quickly housing prices grow.

The percent increase in housing units is representative of the supply of housing in areas. We have seen that areas with high WRLURI values we have higher mean values for independent variables representing demand. In these areas, this higher demand for housing would typically result in more housing units being built and a higher percent increase in housing units. However, regulation is also interfering with new housing developments in these areas. We can see that the percent increase in housing units does not show any significant trends as we look at quartiles I – IV. This exhibits the significant impact that regulation can have on the supply of housing. We can see these impacts even further through the regression results. The Regression Results table below displays all of the coefficients from regression cases 1-5.

Table 2: Regression Results

	Case 1	Case 2	Case 3	Case 4	Case 5
WRLURI	1.94**	0.00	2.33**	0.00	3.66**
Population***	4.65**	4.00**	3.89**	03.06**	3.89**
Housing Units	-0.53**	0.49**	-0.90**	-0.78**	-0.92**
Employment	1.39**	1.32**	1.70**	1.57**	1.71**
Income	0.10	0.10**	0.09	0.08	0.10
Rent	0.23**	0.21**	0.32**	0.29**	0.33**
LPPI	0.00	0.25	0.00	0.17	0.00
SPII	0.00	3.40**	0.00	4.13**	0.00
SCII	0.00	3.54**	0.00	4.06**	0.00
LZAI	0.00	0.80**	0.00	0.74*	0.00
LPAI	0.00	-0.19	0.00	0.33	0.00
LAI	0.00	-2.17	0.00	-1.73	0.00
SRI	0.00	-0.30	0.00	0.29	0.00
DRI	0.00	-0.84	0.00	-1.04	0.00
OSI	0.00	0.06	0.00	0.41	0.00
EI	0.00	0.64	0.00	0.03	0.00
ADI	0.00	0.16**	0.00	0.11	0.00
Intercept	4.06	-6.12	4.06	-8.31	0.90
Observations	2367.00	2367.00	1723.00	1723.00	1723.00
F-Value	338.79	146.17	294.72	131.82	287.35
R-Squared	0.46	0.50	0.51	0.55	0.50

** indicates statistically significant at an alpha value of 0.1*
*** indicates statistically significant at an alpha value of 0.05*
**** Population measured in 100,000s*

Case 1

First let's examine how well our model fits. We have an F value of 338.79 and an R-squared value of .46 With such a large F value we can easily conclude that our independent variables are reliably predicting the HPI. The same holds true for all t values except for that of the percent increase in income (t=1.95). The R-squared value shows that the model accounts for just over 46% of the changes in the HPI. Although the independent variables do not account for all aspects of the housing market, they do cover a significant portion and certainly enough to draw conclusions about the effect of the independent variables.

The results from above show a number of interesting relationships. First, looking at regulation, we can see that the WRLURI is statistically significant with a t value of 6.44. We see for each one percent increase in the WLURI, the percent increase in HPI increases by about 1.94%. In the summary statistics, we see the WRLURI ranges between -2.152 to 4.796 with a standard deviation of .97. While the coefficient of the WRLURI may seem small, an increase of almost 2% of the HPI is certainly noticeable especially due to range of the WRLURI.

The natural increase in population is statistically significant as well with a t value of 12.67. For a natural population increase of 100,000 additional persons, the percent increase in HPI will rise by 4.65%. The standard deviation of the natural population increase is 82291.88. It is easier to get a picture the impact of population increases on the HPI by looking at how a shift of one standard deviation of the natural population increase will change the percent increase in HPI. This one standard deviation shift of the natural increase in population will increase the percent increase in HPI by more than 3.75%, one that is certainly impactful. The percent increase in housing units is also statistically significant with a t value of -6.67. The coefficient is -.53 which indicates that for a 1% increase in the number of housing units, the percent increase in HPI will fall by .53%. This negative relationship indicates that in areas with slower growing housing prices, the percentage increase of housing units tends to rise faster. This relationship makes sense if you think about other actors in the market which cause barriers in higher priced markets. We saw from the quartile analysis that for areas in which housing prices are rising slower, regulation tends to be higher and vice versa.

The percent increase in employment is statistically significant with a t value of 30.93. This variable signifies that for each 1% increase in employment, the percent increase in HPI will rise by 1.39%. This large positive relationship is one that was anticipated. As the employment

increases in an area, new individuals will move to that area providing more competition for housing units. Also, as employment is increasing in areas income is likely rising as well. The percent increase in income is the only independent variable that is not statistically significant at an alpha of .05. While conclusions cannot be made about income at this time, the coefficient of income, even if the percent increase in income was statistically significant, is very small and does not noticeably affect the HPI.

The percent increase in rent is statistically significant and shows a positive relationship with the HPI. For each 1% increase in the median contracted rent, the percent increase in HPI will rise by .23%. This is a relationship that I predicted in the data description and further backs the idea that rental units and housing units act as substitutes. Now, let us take a look at Case 2 which uses all n = 2,367 cases but breaks the WRLURI down into its 11 sub-indices.

Case 2

Looking at the model's fit as a whole we see an F value of 146.17 and an R-squared value of .50. This demonstrates that the independent variables are reliably predicting the HPI. The model explains almost half of the percent change in HPI, again more than enough from which to draw conclusions. There was not significant change in the 5 independent variables that were tested in the first experiment, but this is expected. The sub-indices are where we are able to pinpoint some specific impacts of regulation.

Only four of the sub-indices are statistically significant at an alpha value of .05. Those four include the SPII, SCII, LZAI, and the ADI. Recall what each of these indices represent. The SPII is a basic profile of each state-level legislative and executive branch activity relating to land use regulation as well as a question regarding how involved that state legislature is in

affecting residential building activities. The SCII represents the judicial environment in each of the fifty states and the tendency of courts to uphold or restrain land-use regulation. The LZAI is the simply sum of the number of entities whose approval is required to conduct a zoning change, and the ADI reflects the average duration during the housing review process.

Notice that both state indices are statistically significant. Although this is true, it is difficult to conclude that these indices have more of an effect on housing prices than other sub-indices representing local regulation just because more are statistically significant. We can see that for each unit increase of the SPII, the percent increase HPI will rise by 3.40% and for each unit increase in the SCII, the percent increase in HPI will rise by 3.54%. It is important to note that separating the WRLURI into these smaller sub-indices means that each index is measuring only a small portion of regulation in the market. While this is the purpose of separating them in the first place, it also means that these coefficients represent only how that one small aspect of regulation is affecting the percent change in HPI. This is likely the reason for the amount of statistically insignificant independent variables.

The LZAI and ADI both also have very small coefficients. For each unit increase in the LZAI, the percent change HPI will increase by .80% and for a unit increase in the ADI, the percent change HPI will increase .16%. The LZAI ranges from 0 to 6 and the ADI from -.59 to 29.39. While slightly larger LZAI coefficient indicates it could be providing some significant impact on housing prices, the smaller coefficient of the ADI paired with such a large range indicates the impact of the ADI on housing prices is likely small. More analysis of this is presented below in the conclusion.

Case 3

In the experiments below, the dataset was refined to those places considered to be in an MSA. Of the 2,367 observations in cases 1 and 2, 1,723 of them lie within an MSA. Case 3 and 4 focus in on those n =1,723 data points. Let us first consider the fit of the model. With an F value of 294.72 we can easily say that the independent variables are able to predict housing prices. We have an R-squared value of .50 which indicates that the model represents just over half of the drivers of the percent change in HPI.

We should note the significant increase that we see in coefficients for WRLURI, and the employment. Looking at these coefficients, we see that a one unit increase in the WRLURI results in a 2.33% increase in the percent change in HPI, and a one percent increase in the percent increase in employment results in a 1.70% increase in the percent change in HPI, holding all else constant. We can also see that the coefficient for the natural increase in population has decreased. This indicates that in those places outside of metropolitan areas, population increases have a larger impact on housing prices. In our MSA sample, without those non-MSA areas weighting the natural increase in population coefficient, for an increase of 100,000 of the natural increase in population, the percent increase in HPI will rise by 3.89%.

One other interesting change since experiment 1 is the decrease in the coefficient of the percent increase of housing units. The coefficient reflects that for a one percent increase in housing units, the percent change in HPI is expected to decrease by .90%. Again, in theory this makes sense. This decrease indicates that in these more highly regulated metropolitan areas, the change in HPI is more responsive to changes in housing units. The percent increase in median contracted rent is also statistically significant with a t value of 6.07. A one percent increase in the median contracted rent predicts a .32% increase in the percent change in HPI. The relationship between rental prices and housing prices is once again positive here.

The independent variable income is statistically insignificant once again at an alpha value of .05. This once again indicates that income is not having a significant effect on housing prices, a relationship that was consistent in experiments 1 and 2 as well. This is reaffirmed when we look at the very small coefficient on income. Even if the variable was statistically significant, a one percent increase in income in a specific area would only predict a .09% increase in the percent change in HPI. A value that is relatively small, especially compared to the impacts the other independent variables have on housing values. More will be discussed about income and in the conclusion section.

Case 4

In experiment 4, we have once again broken the WRLURI into its eleven sub-indices, this time restricting the cases to only those n of which lie in an MSA. The model, as in all others, does an accurate job predicting the independent variable with an F value of 131.82. It also accounts for more than half of the predictors of the HPI with an R-squared value of .55. In this experiment, only three of the sub-indices are statistically significant, the SPII, the SCII, and the LZAI. For each one unit increase in the SPII, the percent change in HPI increases by 4.13%. For each one unit increase in the SCII, the percent change in HPI increases by 4.06%, and for each one unit increase in the LZAI, the percent change in HPI increases by .74%. While this does not add much additional information to our knowledge base about which parts of regulation are most impactful for prices, case 5 below further demonstrates the influence regulation holds in the market.

Case 5

The final case tests the quartile of data points in which WRLURI values are highest. We can see that the model does an accurate job predicting the independent variables with an F value of 287.35. The R-squared value indicates that the model accounts for over 50% of the change in HPI. The coefficient of the WRLURI is the most interesting change since the previous cases. We can see that for a one unit increase in the WRLURI, the percent increase in HPI rises 3.66%. This is a much larger coefficient than in any other case. This indicates that in these areas with very high regulation values, housing prices are much more sensitive to regulation. This relationship logically follows as regulation acts as a barrier to supply. These areas with higher regulation face a much steeper supply curve for housing, meaning housing prices are much more responsive to any change in demand. We can see that all other independent variables have increased in terms of their absolute value. Although other independent variables did show slight increases in the absolute value of their coefficients, none were substantial other than the increase in the WRLURI. After conducting these experiments, more work was done to analyze the results in the following section as well as to propose some possible policy solutions for the issue of rising housing prices.

Analysis:

The regression results from the four experiments conducted above prompt a number of topics for discussion. First, before analyzing the regression results, let's return to the problem. We have seen through the quartile analysis in Table 1 above how the means of the percent change in HPI and other independent variables shift according to areas with higher levels of regulation. We can fit the highest quartile into the third type of market described in the introduction with steep barriers to supply or high WRLURI values, coupled with a fast rise in demand represented through the high means of the natural increase in population and percent

increase in employment. Paired with this, we have income levels rising at a rate far below that of the HPI. These areas are those in which the amount of unaffordable housing units is highest. We have an average of over 25% increase in housing prices and just over an 11% increase in income. The problem is clear: drastic increases in housing prices are occurring in areas with high levels of regulation and high demand for housing, and income is not keeping up. This results in lots more individuals being forced to buy unaffordable homes. The question of why housing prices are acting this way can be partially answered through our regression results.

First let us look at the impact of supply restrictions or regulation. The WRLURI is an index that encompasses as many aspects of regulation in the housing market as possible. It measures everything from construction costs, to zoning costs, to state-level intervention. The regression results revealed that the WRLURI is statistically significant for all five cases. The impact of the WLRURI is substantial in all experiments, and the increasing impact in the MSA only cases tells us that it has a much larger impact on those metropolitan areas. Regulation is perhaps the most important independent variable in this experiment as it is the only one depicting supply restrictions, and it is clearly the easiest to change. Let us begin by discussing the 11 sub-indices.

Let us begin by discussing the 11 sub-indicies. The regression results do not add as much information as initially anticipated, but some valuable information is revealed. We saw that both state indices were statistically significant in both regression cases. There is thus a clear positive relationship between a state's legislative, executive, and judicial involvement in the housing market with a faster increase in housing prices. One other index is statistically significant in both samples, the LZAI. The LZAI represents the number of entities required in order to conduct a zoning change. We see a clear positive relationship between the high LZAI values and

the percent increase in housing values. From this we can conclude that zoning delays do in fact have a significant impact on the rise in housing prices in an area. While no other sub-indices are statistically significant enough to draw conclusions about, they are still likely, impacting supply.

While these sub-indices don't give us the perfect picture of what needs to be changed about regulation, looking at how the coefficient of the WRLURI increased so drastically in the fifth case tells us how impactful regulation is on prices. In that final case, we are looking at a type of market similar to the third type discussed in the introduction, also touched upon at the beginning of this section. In this case, we saw the impact of a one unit increase of the WRLURI on housing prices rise substantially. This indicates that within these areas with already high regulation values, how high that regulation value is becomes even more impactful. This means adding additional regulation to areas already experiencing high barriers to supply will increase the change in housing prices even faster. A possibility that is likely being discussed at this moment in areas across the United States.

The percent increase in housing units is another measure of supply. We see that this value is statistically significant with a negative relationship with the percent increase in HPI in all cases. This indicates that as supply is increased, housing prices in a specific area will decrease. When looking at the quartile summary statistics, we do not see much change in the number of housing units built and the level of regulation. At the same time, the natural population increase mean rises steadily from quartile I-IV. With demand increasing at such a fast rate in certain areas, but the number of housing units not increasing to match this uptick in persons requiring housing, it is clear there is a lack in the supply of housing units. This lack of supply paired with the large increase in demand is what is influencing housing prices to skyrocket in these areas and not in some others.

Moving to the demand side adds additional evidence to support our theory. We see that the natural population increase and percent increase in the number of employed persons are both statistically significant in all above experiments. They both also have a positive relationship with the percent increase in HPI. This paired with the quartile analysis which shows a rise in both population and persons employed in areas with high WRLURI values, tells us that areas with higher WRLURI values have increased levels of demand in the housing market. Logically this follows as these two variables represent increases in demand in the housing market. Paired with a steep supply curve in some areas caused by high regulation, these increases in demand lead to the very fast increases in housing prices we see.

The percent increase in median contracted rent is another statistically significant variable. The positive relationship theorized from the idea that rental units and housing units act as substitutes was a reality in all regression cases above. However, the coefficients on the variable percent increase in median rent are very small in each case. The rental market does seem to have a statistically significant impact on housing prices, although not nearly as much of an impact as those variables that are more representative of the level demand in the market such as population or employment, or as restrictions on supply like the WRLURI. The rental market is still crucial to think about when determining solutions to the problem of unaffordable housing units resulting from high rises in prices. Many lower income individuals tend to rent rather than buy and government intervention through rent assistance is much cheaper and common in the rental market. This intervention, can then lead to results in the housing market due to the positive relationship between rental prices and housing prices found from our results.

The independent variable income is perhaps the most interesting one on the demand side. We can see that the variable was not statistically significant in any of the above experiments. In

addition to not being statistically significant, coefficients on the percent increase in income were very small in all experiments as well. This paired with the quartile analysis, which revealed income was not actually increasing consistently as housing prices were increasing in those areas, tells us that income likely does not have a large effect on housing prices.

Policy Solutions:

Our analysis has revealed several things going on in different housing markets. The asymmetrical rise in housing prices is impacted by things on both the supply and the demand side of the market. Those areas where housing prices are rising the fastest are metropolitan areas in which there are significant barriers to supply, represented by high WRLURI values, paired with significant increases to demand, represented by increases in population and employment. Housing prices across the United States will continue to rise asymmetrically unless something is done about this problem. There are a number of possible solutions, a few of which I will discuss further below.

Clearly, the most effective option would be to increase supply. An upward shift in supply would cause a decrease in housing prices. The simplest way to increase supply is to incentivize building through decreasing regulation. A decrease in regulation would create a more elastic supply curve where large increases in in demand will not result in as high prices. Barriers to supply are causing the lack of affordable housing units in the first place, and this is obviously a clear solution. There are a number of ways in which the government, both at state and local levels, can do this. I will go into detail about some of the issues associated with regulation of the housing market and some possible answers to these problems in the following pages.

Remember (from the regression results for Cases 2 and 4) that the LZAI, which represents the number of entities required for a zoning change, was statistically significant. Zoning is perhaps the most important factor in local regulation. Local legislative bodies such as city councils often create zoning laws in the form of minimum standards. These include things like minimum height requirements, minimum lot size requirements, or minimum parking requirements. Zoning dictates where and what developers are able to build. Remember again how the incentive structure works in the housing market. While the majority of regulation is done at the local level, individuals who elect those local officials have an incentive to protect the value of their house. Officials are often elected with the idea that protecting housing values is their prime directive in terms of housing policy and that adding additional affordable units is frowned upon due to the possibility it may lower existing values. This leads to harsh minimum standards in many areas, specifically wealthier suburban areas within MSAs. These minimum standards are often input with the idea of protecting housing values, however, they are a major cause of the kink in the supply of housing that we see in many of these metro areas.

Highly localized levels of regulation lead to other issues as well. Housing markets do not follow the imaginary lines set by city councils or neighborhood associations. Housing markets in metropolitan areas often contain multiple cities, and/or counties, which almost always results in varied regulation depending on where you are located within the MSA itself. This often leads to miscommunication about the overall goals for the housing market and about what regulation or deregulation is necessary to achieve those goals. A more standardized, state lead approach to things like zoning and minimum standards with advisement from local authorities on special issues could help change the incentive structure into one which values creating more affordable housing units over protecting values of existing units. These incentives would likely result in

lower minimum standards and reduced zoning headaches which would in turn would bolster supply and help lower the price of housing. Some specific areas where minimum standards could be adjusted are described in the following paragraphs.

There are a number of economists at the center of the movement to deregulate the housing market. These include Edward Glaeser of Harvard, author of *The Triumph of the City* and numerous other studies on housing regulation, Joseph Gyourko, also of Harvard and creator of the WRLURI index and numerous other pieces on supply restrictions in the housing market, as well as a number of other notable names. The idea of deregulating aspects of the housing market has legitimate backing in academia.

One great example of how these regulations affect development is in apartments. In many areas of the United States, there are often zoning restrictions against building apartments. Cities across the US have effectively banned the building of apartment buildings in most neighborhoods, and even areas with large populations who need housing ban apartments from being built on 75% of land. Also, from our regression results, there was strong evidence backing the idea that rental prices and housing prices are substitutes. Thus, as rental prices are increasing, housing prices increase as well. If state governments were to lower zoning restrictions related to height restrictions for apartments in some areas, specifically those with very fast rises in housing prices, the decrease in the price of rental units caused by the increased supply of apartments could help lower or at least slow the rate of increase of housing prices. Doing this is called upzoning. A more formal definition of upzoning is changing zoning regulations to allow for taller and/or denser buildings. This would allow for additional apartment buildings and other multifamily units to be built.

Another option is to reduce minimum parking requirements. Donald Shoup of University of California Berkley wrote *The High Cost of Free Parking,* a book and study that examines the cost of parking requirements for developers and finds that they are excessive, increase costs, and reduce potential land for new housing units. In fact, there is an entire movement called the "Shoupsistas" who work for parking deregulation. These excessive parking requirements are driving up costs for developers and thus increasing the price of housing. Deregulating parking requirements or at least tweaking them to be more realistic would help slow the growth in housing prices by saving developers lots of cash. This also would allow developers to create additional housing units for the same amount of land. Tweaking minimum lot size requirements would decrease a major barrier to development and incentivize an increase supply. Smaller housing units are obviously more inexpensive, and restricting the building of these types of units in certain areas is not only exclusionary, but is another item fueling the large increases in housing prices that we see. Government intervention in the housing market is not always a bad thing.

State-sponsored housing units in areas with fast rising housing prices could possibly help act to combat the rise in prices as well. This increase in supply directly through the government is perhaps the most efficient way to increase supply, although it is a costly one. However, the government directly bolstering supply through producing units both in the rental and in the housing markets would certainly in turn lead to a slow in the rise in the prices of housing. Government intervention can be used on the demand side as well through subsidies on housing for qualified individuals, housing vouchers, and many other programs. Intervention in the rental market occurs as well through rent subsidies and rent controls. Although things like the voucher program and limited rent control in some cities exist, expanding these could provide many more

households with affordable housing units. These could take some of the financial burden carried by developers and place it on the government. This reduction in cost for developers would spark more construction and thereby an increase in supply and a decrease in the price of housing.

Conclusion:

Housing prices remain somewhat of a puzzle, but my thesis provides some additional pieces. I gathered data, examined summary statistics and ran regressions, analyzed those results, and proposed some possible policy shifts which could possibly combat the rise in housing prices. This piece confirms the idea of different types of metropolitan housing markets and gives at least a partial explanation of why housing prices act differently in different geographic areas. Although factors on the demand side like increases in population and employment are important to housing prices, the most important factor impacting the increase in the price of housing is the level of regulation in the market.

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