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Commuting times and land use regulations

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Abstract

Land use regulations are one of the primary ways in which state and local governments influence the urban landscape, affecting where people live, how much they commute and the impact they have on the environment. Using a new, novel data on the stringency of land use regulation in the U.S. over the past decades, we study the effect of local regulation on the individual commuting times. Paired with demographic data from the U.S. Census, we examine whether land use policies disproportionately affect particular socioeconomic or demographic groups and find a positive relationship between land use regulation and commuting time. In addition, we show that this relationship increases disproportionately for workers with a Bachelor's degree or more, and that these impacts could be mitigated by the establishment of a public transit system.

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1. Introduction

Since World War II, U.S. urban landscapes have evolved dramatically, affecting where Americans live, how they commute, with whom they interact and the impact they have on the environment. Similar transformations are occurring throughout the developing world with major environmental and social consequences. Land use regulations are one of the primary ways in which state and local governments influence the urban landscape. This paper answers two questions related to a specific way by which land use regulation in the U.S. affect individuals. First, do individuals spend more time commuting in locations with strict land use regulation, and second, does the correlation between land use regulation and commuting times vary with demographics?

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This paper bridges two distinct literatures in urban economics. This first set of papers examine cross-sectional correlation between land use regulation and housing prices (e.g., Glaeser et al. (2005) and Katz and Rosen (1987). A second set of papers studies housing and implied commuting choices by individuals (e.g., White (1988)). To our knowledge, our paper would be the first attempt to link the two using panel data on land use regulatory stringency and inform the link between land use regulation and commuting patterns.

This paper builds on the framework in Ganong and Shoag (2013), which found that restrictive land use policies raised housing prices and depressed migration in some areas, particularly after 1980. One potential channel for these effects is that restrictive land use policies force workers to reside farther from work, increasing the cost of commuting and lowering the attraction of the high-wage location. In this paper, we provide direct evidence by studying the relationship between commuting patterns from the Census and land use policies extending back several decades.

Our work informs other issues in transportation policy as well. Despite the fact that state and federal fuel tax revenues are no longer sufficient to cover anticipated infrastructure investment, the perceived regressivity of gasoline taxes is an important political road-block to changing gasoline taxes from the nominal levels set in the early 1990s. Poterba (1991) examines the degree to which gasoline taxes fall on individuals at different points in the income distribution and the expenditure distribution. By examining Census data, we are able to study this distributional effects of land use policies by investigating how land use policies differentially affect commuting times by demographic group. Our work sheds light on how land use policy may directly impact the regressivity of the gasoline tax by inducing particular socioeconomic or demographic groups to live further from the urban center and thus face increased exposure to gasoline taxes.

1.1. Previous Literature

The decentralization of America's cities and the increase of urban sprawl is a well-documented phenomenon. Baum-Snow (2007) shows that from 1950 to 1990, populations in the central cities of metropolitan areas fell 17 percent on average, while total population in those metropolitan areas grew by 72 percent. Similarly, land use regulations began a rapid ascent during this period. From 1970 to 1990, national regulation grew from 25% of its current level to 75% of its current level as measured by Ganong and Shoag (2013). Restrictive zoning policies have the potential to increase commuting times on two fronts: first, by increasing the pace and prevalence of sprawl and second, by distorting firm and employee location choices thus exacerbating any negative impacts of decentralization.

While land use regulation in cities may increase housing prices and push workers to locate farther from their place of work, this could be mitigated by firms moving outside of cities and closer to workers. Firm and worker co-movement is addressed by Baum-Snow (2010) who finds that substantial firm decentralization did occur on average from 1950 to 1990. Land use policies, however, often restrict fir and worker location options, forcing them into different zones. As such, land use regulation could serve as a particularly pernicious mechanism by which commuting times are increased. In this paper, we examine the basic association between land use regulations and commuting times as well as heterogeneous effects by worker and city characteristics.

Several papers address the relationship between commuting costs and land use regulation, though not always directly. Gordon et. al. (1989), for example, find that particularly high residential or commercial densities were related to longer commuting times. Koster and Rouwendal (2013) suggest that distance to commercial zones is positively related to residential rents in residential areas but negatively associated with rents in mixed and commercial zones. Furthermore, Acker and Witlox (2011) discuss the commute time trade-off between decreased car ownership and shorter commuting distances associated with mixed zones in Belgium. The commuting benefits of mixed zones are extolled further by Silva et. al. (2012) who conclude that mixed zones are associated with significantly decreased commuting distances. The relationship between commuting time and land use regulations is examined directly by Kim and Hewings (2013) and Ogura (2010) who both find that increased regulation is correlated with increased commuting time.

The previous literature offers a useful starting point for our analysis, which both builds on the scope of existing research and makes a novel contribution with respect to how land use stringency is measured. To our knowledge,

our paper will be the first to analyze regulation intensity and commuting times using panel data on regulations and a large, national dataset of commuting times and worker demographics.

2. Data and Methodology

The choice of home and work locations are complicated; a model that fully endogenizes both decisions is outside the scope of this paper. Rather, we consider a summary statistic that reflects the combined home and work choices made by individuals: the average amount of time a person reports spending commuting. Our commuting data come from decennial U.S. Census surveys from 1980 to 2010 compiled in the Integrated Public Use Microdata Series (iPUMS) and reflects the average amount of time each individual in the data spends commuting. The census data also include detailed demographic information, including race, educational attainment, home ownership, and wage income. In total, over 19 million workers are included in our sample, though approximately 4 million are excluded from analysis because of missing commuting time (missing in raw data or after removing extreme outliers). We focus on four characteristics plausibly correlated with housing and commuting choices: (1) income, (2) education, (3) ethnicity, and (4) home ownership.

We match Census data to one of the unique measures of land use stringency created by Ganong and Shoag (2013) that varies by state and year. As described in their paper, "[The] measure of land use regulations is based upon the number of state appellate court cases containing the phrase "land use" over time. Municipalities use a wide variety of tactics for restricting new construction, but these rules are often controversial and any such rule, regardless of its exact institutional origin, is likely to be tested in court. This makes court decisions an omnibus measure which capture many different channels of restrictions on new construction." To account for changes in the legal environment over time and across states, we use the rolling average of the fraction of land use cases to total cases.

Finally, we match cities and states that have subway systems with information about the year of establishment for those subway systems. Summary statistics for the land use measure, commuting time and relevant demographic information from iPUMS, and an indicator for whether or not the worker lives in a city with a subway system are displayed in Table 1. Reported commuting time averages 23 minutes. Mean wage income is $26,400 and 22, 16 and 29 percent of respondents report having a bachelor's degree, being part of a minority group and renting, respectively.[†] Just over five percent of the respondents live in cities with a subway system.

Table 1: Summary statistics

	N	Mean	Std. Dev	Min	Max
Commuting time (minutes)	14,828,767	22.63	17.20	1	99
Land use regulation	18,898,135	0.410	0.342	0.0231	3.388
Renter	18,898,135	0.289	0.453	0	1
Wage Income (thousands)	18,898,135	26.40	22.88	0	156.7
Minority	18,898,135	0.160	0.366	0	1
Bachelors degree or more	18,898,135	0.220	0.414	0	1
City has subway	17,676,137	0.0512	0.220	0	1

[†] In the following regressions, wage income above the top-coded level in 1980 is dropped because the top-code limit varies by year, with 1980's being the lowest.

We employ a linear regression model of land use regulation on commuting time with an extensive set of controls. Commuting time and the demographic control variables are worker-level while land use regulation varies by state-year. We estimate the following model:

$$CommutingTime_{ist} = \alpha + \beta LandUseReg_{st} + \theta X_i + \delta_s + \gamma_t + \varepsilon_{ist}$$

Xi is a matrix of worker-level demographic controls, such as, marital status, sex, race, ethnicity, educational attainment, home ownership, occupation, wage income and wage income squared. Year and state fixed effects are represented by γ_t and δ_s, respectively. With the inclusion of fixed effects, identification of β follows from differential trends in land use regulation across states.

To analyze demographic-specific relationships between land-use regulation and commuting times, we further interact our individual demographic variables with land-use regulation in the model above. All observations are weighted using Census sample weights. The results are discussed in detail below.

3. Results

Table 2 presents the results of our basic specification as well as the models with interaction terms.

Table 2: Land-use regulation and commuting time

	(1)	(2)	(3)	(4)	(5)	(6)
Land use	0.859***	1.034***	1.149**	0.249	0.270	0.436
	(0.232)	(0.354)	(0.445)	(0.294)	(0.512)	(1.005)
Renter	-0.559*	-0.293	-0.565*	-0.553*	-0.558*	-0.478
	(0.292)	(0.601)	(0.284)	(0.292)	(0.293)	(0.563)
Minority	2.871***	2.868***	3.520***	2.862***	2.865***	3.418***
	(0.632)	(0.628)	(1.182)	(0.633)	(0.633)	(1.157)
Bachelors or more	0.557***	0.555***	0.561***	-0.289	0.559***	-0.0951
	(0.196)	(0.194)	(0.199)	(0.359)	(0.196)	(0.297)
Income	0.145***	0.145***	0.145***	0.145***	0.143***	0.149***
	(0.00636)	(0.00642)	(0.00637)	(0.00623)	(0.00963)	(0.00995)
Income^2	-0.000707***	-0.000709***	-0.000708***	-0.000716***	-0.000846***	-0.000846***
	(3.85e-05)	(3.86e-05)	(3.84e-05)	(3.46e-05)	(3.85e-05)	(3.84e-05)
Renter x Land use		-0.592				-0.179
		(0.716)				(0.636)
Minority x Land use			-1.405			-1.209
			(1.354)			(1.303)
Bachelors x Land use				1.799**		1.395***
				(0.694)		(0.511)
Income x Land use					0.00626	-0.00451
					(0.0153)	(0.0153)
Income^2 x Land use					0.000235***	0.000235***
					(7.17e-05)	(7.24e-05)
Observations	14,788,777	14,788,777	14,788,777	14,788,777	14,788,777	14,788,777
R-squared	0.081	0.082	0.082	0.082	0.082	0.082

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at state level in parentheses.

In column 1, we find that some demographic characteristic are modestly correlated with time spend commuting. All else equal, wealthy individuals tend to have longer commutes.‡

Relative to an individual with mean wage income, an individual one-standard deviation above the mean commutes an extra 1.9 minutes on average, an increase of approximately 9 percent. Similarly, individuals

‡ Although the coefficient on income-squared is negative, the positive linear coefficient dominates for incomes in the range of our sample.

identifying as a member of a minority group tend to have longer commutes as do individuals with a bachelor's degree. Minorities in our sample commute 2.9 more minutes on average, and increase of approximately 13 percent related to the mean. The commuting differences are less pronounced by income - individuals with a bachelor's degree spend half-a- minute more commuting, approximate 2-3 percent relative to the mean.

A priori, theory does not provide sharp predictions on the signs of these coefficients. An individual's choice of where to live and where to work are driven by many factors, including an individual's budget, employment options, disutility associated with commuting and preferences for local amenities. Focusing on income as an example, high wage worker may have the resources to locate close to their place of work and may associate a higher opportunity cost with commuting. On the other hand, they may have access to a more geographically diverse set of employment options and may have higher preferences for amenities offered by suburban areas. For high income and educated workers, our results suggest that the latter effect tends to dominate the former - workers in these groups tends to live further from their place of employment.

Considering the relationship between land use and commuting time, Column 1 suggests that individuals living in locations with more stringent land-use regulation tend to have longer commutes. In columns 2 through 5, we introduce interaction terms. The coefficient on land use regulation falls dramatically when we introduce the interaction with workers who hold Bachelor's degrees or more and the interaction with wage income. This suggests that the relationship between commuting times and land use regulation is not similar across demographic groups. Rather, high income workers and highly educated workers are those whose commute times increase the most with land-use regulation.

Similar to the baseline demographic results above, our estimates suggest that in locations with land-use regulation, high wage and highly educated workers tend to locate further from their place of work. Despite fairly strong correlation between wage income and level of education, both coefficients remain significant when we include all of the interaction terms in column (6).

Finally, we look at one way in which cities may be able to temper any negative consequences of land use regulation. In Table 3, we compare locations with and without public transit systems under the hypothesis that public transit may provide one way to mitigate stringent land-use policies. Although most cities either have or do not have subways throughout our period, we do observe some subway entry during our study period. Column 1 treats all workers in a state as having access to a subway system if any city in the state does, Column 2 only treats workers in cities with subways as having access to a subway system, Column 3 restricts the analysis to cities that ever have a subway.

Table 3: Land use impacts and subway presence

	(1)	(2)	(3)
Land use	0.994***	0.907***	4.164*
	(0.268)	(0.244)	(2.099)
Subway state x Land use	-0.270		
	(0.324)		
Subway state	0.828**		
	(0.324)		
Subway city x Land use		-10.71***	-2.878**
		(2.635)	(1.144)
Subway city		12.14***	3.321**
		(1.891)	(1.232)
Observations	14,788,777	14,788,777	850,196
R-squared	0.080	0.091	0.097

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at state level in parentheses.

We find that locations with subways tend to have higher commuting times on average, reflecting the endogeneity of which cities choose to build mass-transit systems. In addition, we continue to find that land use regulation is also associated with longer commuting times. Interestingly, though, the presence of a subway attenuates the relationship between land use regulation and commuting times. In column (3), in which we focus only on cities that have a subway at some point during the study period, we find that the magnitude of the relationship between more stringent land-use regulation and commuting times decreases by two-thirds after the introduction of the subway.

4. Discussion

A long literature in public finance and other applied fields documents the distributional consequences of public policies. This paper provides the first analysis of this type for land use regulations. Focusing on the amount of time spent commuting, a summary statistics that reflects individuals' choices of where to live and where to work, we find that land-use regulations are associated with increases in commuting times and that the burden of increased commuting times is most heavily borne by more educated and wealthier individuals. Although commuting times are only one dimension on which the costs and benefits of land-use regulation may be distributed, this work takes a first step in understanding the regressivity or progressitivity of policies designed to influence the urban environment.

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