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Erik B. Johnson
Randall Walsh

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ABSTRACT

The Tiebout model assumes that individuals 'vote with their feet' and choose to locate in the jurisdiction which best matches their fiscal preferences. In this paper, we test Tiebout's voting mechanism by examining whether housing purchase decisions are sensitive to changes in local property tax rates. Results from previous empirical tests of the link between property taxes and mobility are mixed and typically suffer from a myriad of identification problems including the confounding influence of tax rates on public good levels, tax endogeneity arising as a result of jurisdictional composition, and aggregation bias. In this paper, we are able to overcome many of the traditional obstacles to identification by: 1) focusing on purchasers of vacation homes who arguably receive no benefits from public goods funded by the tax change; 2) examining an exogenous and differential change in tax rates that arose from Michigan's Proposal A in 1994; and 3) using a high-resolution tax dataset at the Census Tract level. Our results provide some of the clearest evidence to date that household location choices are sensitive to tax changes. Further, consistent with theoretical predictions, the impact of tax changes on housing counts is found to be sensitive to the elasticity of housing supply.

Erik B. Johnson
Lender School of Business, Quinnipiac University
275 Mount Carmel Ave
Hamden, CT 06518-1908
Erik.Johnson2@quinnipiac.edu

Randall Walsh
Department of Economics
University of Pittsburgh
4901 WW Posvar Hall
230 S. Bouquet St.
Pittsburgh, PA 15260
and NBER
walshr@pitt.edu

1 Introduction & Background

Since Tiebout's (1956) seminal work on competition between local jurisdictions, public economists have argued that individuals vote with their feet and locate in jurisdictions which provide their favored tax/public goods pair. On the tax side, theoretical work has focused on the way in which the Tiebout mechanism causes changes in rates to be capitalized into housing prices. Hamilton (1975), Henderson (1980) and Henderson (1985) argue that capitalization will not occur if there is a perfectly elastic supply of housing. As households migrate into a jurisdiction, an entrepreneur supplies them with a new housing stock, leaving the current housing prices unchanged since increased demand is reflected solely in new buildings. On the other side of the debate, Yinger (1982), Yinger (1995), Wheaton (1993), Hoyt (1999), and Epple (1981), argue that capitalization will occur, as long as the housing supply function is upward sloping.[1]

Empirical work has also largely focused on capitalization instead of mobility. Early work on the capitalization effect was undertaken by Orr (1968) and Oates (1969). Orr's analysis supported the hypothesis of no capitalization, while Oates found a capitalization effect. More recently, Brasington (2002) estimated the housing price hedonic for both the interior and edge of an urban area and found that supply elasticity and public good expenditures capitalization are inversely related. While the magnitude of public goods capitalization is an ongoing debate its inverse relationship with supply elasticity is, for the most part, accepted.[2]

Empirical estimates of the pure-tax effect on household mobility have been mixed. The ambiguous results are most likely caused by identification problems due to the confounding influence of public goods, tax endogeneity, and aggregation bias. Through the use of a structural reform in Michigan's school finance system, a focus on the vacation home market,

[1]See Brasington (2002) for an in depth discussion and empirical test of the inverse relationship between capitalization and housing supply elasticity.

[2]The literature on capitalization is extensive and an excellent survey on both the theoretical arguments and empirical results is found in Ross and Yinger (1999).

and a census tract level dataset we are able to overcome many of the traditional identification obstacles. We provide some of the clearest evidence to date that residential mobility is sensitive to tax changes.

1.1 Identification Issues

Several confounding influences make it difficult to empirically isolate pure-tax impacts on home purchase decisions. First, differences in tax levels are typically associated with differences in levels of public good provision. Identifying the presumed negative effect of a tax in the presence of positive effects associated with the provision of public goods that are funded by said tax is a potentially difficult task. In perhaps the strongest empirical work to date on pure-tax mobility, Farnham and Sevak (2006) utilize a novel approach to this particular problem. They argue, based upon a life-cycle model of mobility, that the migration of 'empty-nesters' will be sensitive to differences in school taxes, but not to the public goods (public schooling) that these taxes provide. Farnham and Sevak find mixed evidence of the effect of taxation on household mobility – with the results being dependent both upon scale (within or across states) and state level fiscal constraints (i.e. the presence of school revenue equalization).

Our estimation approach employs a similar strategy of decoupling the public good and tax effects on household mobility by studying a population which does not consume the public good. Rather than the 'empty-nest' population, we evaluate the impact of school taxes on the location decisions of vacation homeowners. Since vacation homeowners by definition do not consume local public school provision, the entire mobility response in reaction to a change in school taxes is independent of the changes in public school quality and the mobility response is therefore attributable to a pure-tax effect.

A second source of endogeneity is due to the 'chicken or egg problem'. In this case it is not clear whether tax rates are attracting a specific demographic group or if a demographic group is voting to set tax rates so they meet their fiscal preferences. Consider the following observation on retirees and taxes: retirees are attracted to the southern United States and southern states have lower income taxes. This relationship may be described in two ways. First, it is possible that retirees are moving to the south for tax incentives. However, it is also possible that retirees move for other reasons such as a superior climate and then vote for lower taxes once they arrive. The issue of causality is important, as shown in recent work by Conway and Rork (2006). Conway and Rork find that elderly migration patterns are not driven by levels of EIG (Estate, Inheritance, or Gift) taxes but rather that the causation does, in fact, run in reverse.[3] In the current paper, we study the vacation home market. Vacation homeowners do not have a vote in local elections and therefore their presence in a jurisdiction will not directly bias tax rates.

However, while the vacation home population does not have the power to directly vote on local taxes, their presence may affect rates. Jurisdictional residents may be expected to base their public expenditure and taxation decisions partially on the fact that the vacation homeowners will bear a portion of the tax burden. In this case, the larger the vacation home tax base in a jurisdiction, the lower the tax price of public goods for voting residents. As a result, even if the vacation home population is completely unresponsive to tax rates, correlations between vacation home populations and tax rates may exist. Anderson (2006) provides empirical evidence that supports the relevance of this tax exporting motive. In his study of the vacation home market in Minnesota, he finds that a one-percent increase in the size of the vacation home tax base resulting from an exogenous change in assessment ratios will result in a .36% increase in per capita public goods spending. Because our analysis focuses explicitly on the market for vacation homes, we need to control for this potential endogeneity. As discussed below, we overcome this problem by leveraging exogenous changes

[3]This issue is of potential concern in regards to the findings of Farnham and Sevak (2006). Here we need to be concerned that 'empty-nesters' influence the political process in the areas where they choose to locate – yielding lower tax rates in these areas.

in school taxes that arose from the passage of Michigan's Proposal A in 1994.

Finally, even if *both* the direction of causality is determined *and* the effect of public goods is decoupled from tax rates, aggregation bias may still obfuscate the effect of taxes on household mobility. The majority of previous research uses highly aggregated, state or county level tax and population data to explore the tax effect on mobility[4]. One would expect the measurement error imparted by these approximations to bias estimated mobility effects toward zero since the impact of housing supply elasticity is obfuscated through this large spatial aggregation. For example, theory suggests that a rightward shift in housing demand due to a tax decrease may result in capitalization, mobility, or both depending upon a local jurisdiction's housing supply elasticity. In rural areas where the housing supply is elastic, a shift in demand leads to in-migration. In an urban area, with an inelastic housing supply, the shift in demand results in housing capitalization. Therefore, an estimate of the tax change on mobility which does not control for local heterogeneity in housing supply elasticity has the potential to overstate the effect of taxes on mobility in urban areas and understate the effect in rural areas.[5] In the current paper, we use a highly disaggregated census tract level data set that allows us to construct location specific variables that control for housing supply elasticity as well as other determinants of local mobility response. Therefore, we are able to overcome aggregation bias which may be introduced from generalizing population and tax data to the state level.

[4]See for instance: Conway and Houtenville (1998, 2001, 2003), Dresher (1994), and Duncombe et al. (2003).

[5]An additional empirical consideration regarding supply elasticity was identified by Glaeser and Gyourko (2005) and Glaeser and Gyourko (2006), who show that housing supply elasticity is sensitive to the direction of demand shifts as a result of the durability of housing structures. Since the vast majority of jurisdictions in our dataset exhibit positive vacation home growth, the relevant elasticity is that associated with growing demand – and we are not in a position to have to consider differing elasticities for growth and decline.

1.2 Michigan's Proposal A

As described above, a fundamental assumption of the Tiebout model is that individuals vote with their feet and locate in the jurisdiction that best matches their fiscal preferences. While Tiebout sorting depends upon household mobility, empirical support for tax-driven mobility is mixed, most likely as an outcome of the difficulties in estimation. Our analysis overcomes these identification issues by focusing on the impact of local property tax changes in Michigan between 1993 and 1995 on the distribution of vacation homes in the state. These tax changes arose as a result of 'Proposal A', a state-wide overhaul of the school funding mechanism which was passed by Michigan voters in 1994. Proposal A led to a complete re-ordering of school taxes rates in Michigan.[6] The law had three main components. First, in order to facilitate revenue equalization, a significant portion of school funding was shifted away from local property taxes to a statewide sales tax. Secondly, a statewide 6 mill property tax was levied and redistributed by the state. Finally a homestead property tax exemption was implemented that allowed local taxing authorities, in this case school districts, to provide tax relief of 18 mills ($18 for every $1,000 of taxable value) for an individual's primary residence. This policy change made it possible for local school districts to shift a greater portion of their local school operating costs onto the owners of vacation homes.

While there is almost no meaningful variation in the various jurisdiction's choice of tax differential[7] there is marked variation in the tax changes experienced by vacation homeowners in different locations. The important effect of this policy is that, once we control for the initial distribution of housing types and school tax levels, the change in tax rates can be treated as an exogenous 'natural experiment' thus solving any potential endogeneity problem associated with the link between vacation home populations and tax rates. Further, the population of interest can be reasonably assumed to be indifferent to the distribution of

[6] Courant et al. (1995) provides a detailed analysis of this law, especially its implications for school finance.

[7] The State of Michigan forced most local school districts to move to the 18 mill differential.

school expenditures. We therefore needn't worry about the confounding interactions of tax rates and public goods provision. Finally, in contrast to most previous work on the issue, we have constructed a tax data set with a very high level of spatial resolution (identifying tax rates down to each individual taxing jurisdiction). The high resolution data overcomes the traditional aggregation bias.

2 Data

Our study area is the entire state of Michigan. The data for our analysis fall in to three main categories. First, we identify a set of spatially delineated communities that form the basis of our analysis and use Census data to determine the number of vacation homes in each of these communities for the years 1990 and 2000. Second, we construct a spatially delineated tax rate dataset which identifies taxes for each level of local government for the years 1993 thru 2000. This spatial tax rate data is then used to compute the tax levels for each of our communities. Finally, for each of the communities, variables are constructed to control for additional determinants of vacation home demand.

2.1 Communities and the Prevalence of Vacation Homes

Our measure of the prevalence of vacation homes comes from the 1990 and 2000 Decennial Censuses identified at the Tract Level. Unfortunately, Census Tract boundaries often change from Census to Census. As a result, it is not possible to use Census Tract boundaries to directly delineate communities when evaluating the change in the number of vacation homes between 1990 and 2000. To overcome this problem, we identify sets of 1990 and 2000 tracts that when aggregated together share a common boundary across both Censuses. In the remainder of the paper, we refer to these aggregated groups of tracts as 'aggroups'. The State of Michigan is covered by 1830 aggroups. These are aggregated from 2533 and 2721 tracts in the 1990 and 2000 Census, respectively.

Given our aggroup definitions, we next construct a measure of both the number of vacation homes and the density of vacation homes in each aggroup. This is done as follows. First, for both 1990 and 2000 Decennial Censuses, we take the reported number of vacation homes in each tract and sum across all tracts in a given aggroup. Next, the by-aggroup vacation home counts are divided by the area of each aggroup - yielding a measure of the density of vacation homes in each aggroup (Vacation Homes/Km^2). An additional complication is the presence of large areas of publicly owned land in Michigan. By definition, these areas have been removed from potential development. To provide a more appropriate measure of the level of vacation home development in each aggroup, we use a GIS dataset (described below) on the location of publicly owned lands acquired from the Michigan Department of Geographic Information to exclude these publicly owned lands when calculating the area of each aggroup. Similarly, GIS water boundary data is used to exclude lakes and rivers when calculating the area of each aggroup. Panel 1 of Figure 1 displays the 1990 vacation home densities and Panel 2 of the figure displays the change in density from 1990 to 2000.

Finally, in order to control for differing housing supply elasticities across aggroups, we create a dummy variable for urban areas - aggroups where greater than 90% of the component tract areas are classified as urban in the 1990 Decennial Census.[8]

2.2 Tax Rates

School district tax rates in each school taxing jurisdiction for the years 1993 thru 2000 were obtained from the Michigan State Tax Commission and the Department of Treasury Office of Revenue and Tax Analysis. One limit of our data is that while second home counts are available for 1990 and 2000, the tax change that we are interested in occurred between 1993

[8]Note: an examination of the data revealed that the use of a 90 % level effectively identifies all built out areas in Michigan.

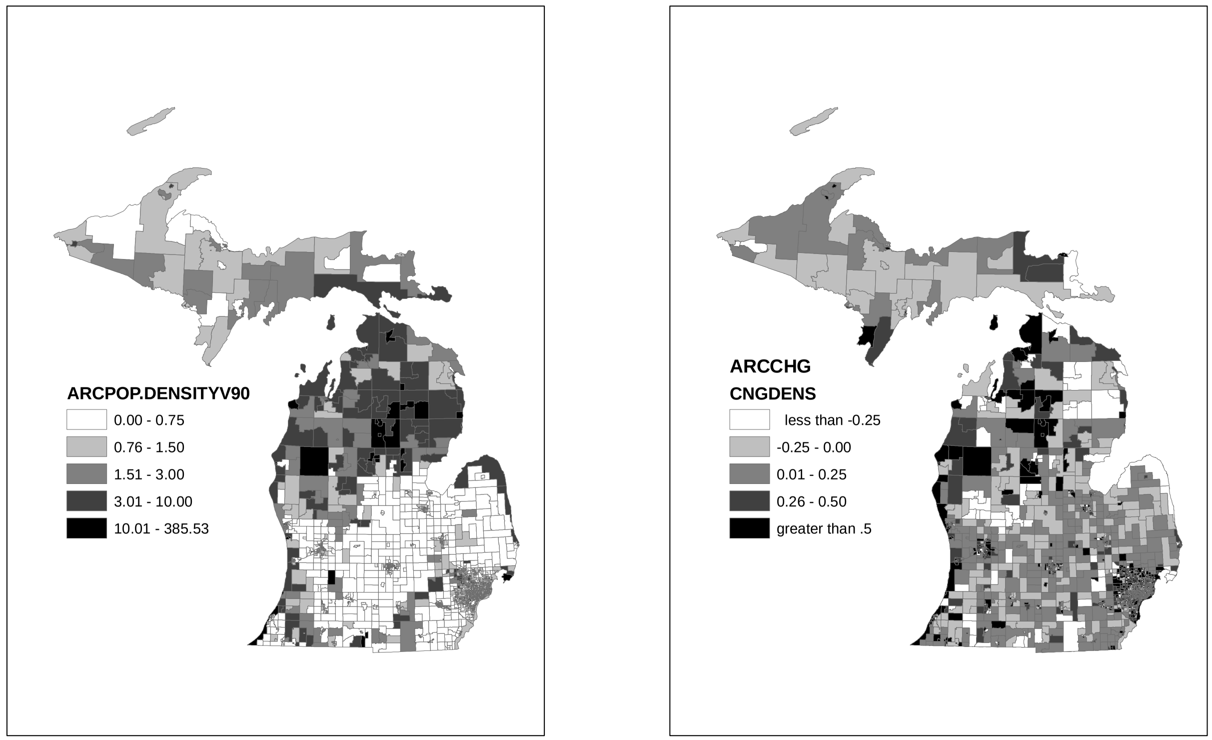

Figure 1: 1990 Vacation Home Density and 1990 to 2000 Change in Density

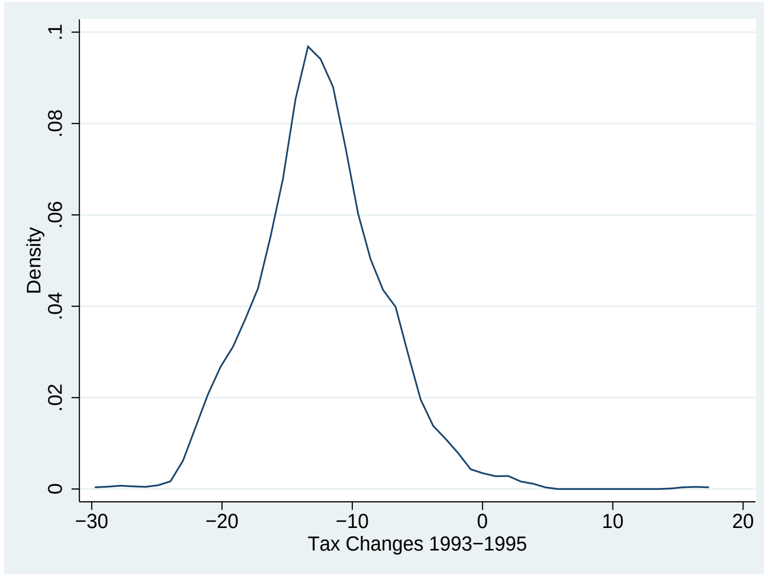

Figure 2: Distribution of 93-95 School Tax Changes

and 1995 (the two year lag reflects the fact that it took two years for these adjustments to be completed). Figure 2 displays the distribution of these tax changes. Potential issues arise due to the limitations associated with the decennial nature of the Census. While using 2000 vacation home counts is consistent with an expected lag in the adjustment of vacation home populations to changes in the tax rates, bias could be introduced by including changes in vacation home counts that occur between 1990 and 1993. Two specific concerns exist. First, assuming taxes were constant between 1990 and 1993, inclusion of the changes that occur over this time frame will introduce measurement error in our dependent variable which may weaken the precision of our estimates.[9] Of greater concern is the possibility that tax changes occurred between 1990 and 1993 that are correlated with the 1993-1995 changes - thus, biasing our estimates. Table 1 presents the correlation between tax rates for adjacent years from 1990 to 2000. Because we have been unable to locate school district level data for the years 1990-1992, county aggregates are used for the first three year pairs. District level correlations are presented for the remaining years. These correlations clearly show that

[9]In our analysis this concern is partially alleviated by the inclusion of 1993 school tax rates as a control variable.

Table 1: School Millage Rate Correlations 1990-2000

Years	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00
Cnty	0.9779	0.9739	0.9680							
Dist				0.2093	0.4205	0.9394	0.9545	0.9669	0.9718	0.9707

tax rates are stable prior to the 1993-1995 period when the Proposal A driven tax changes occurred. A final concern is that changes in vacation home counts are being driven by tax changes that may have occurred after the 93-95 changes.

Again, the data suggest that tax rates were stable following the Proposal A adjustments. Below, we test for the sensitivity of our results by examining the effect of 1995-2000 tax changes. This analysis suggests that post 1995 changes are not driving our empirical results.

In order to identify school tax rates for each aggroup, Census TIGER files were used to identify the spatial location of each school taxing jurisdiction in the state. These tax jurisdictions were then overlaid onto the corresponding census locations. The task of attaching tax rates to these aggroups is complicated by the fact that the tax jurisdictions do not share common borders with the aggroups. To address this problem, for each aggroup we compute the area weighted average tax rate. This area weighted average is given by equation 1:

$$\bar{\tau} = \frac{1}{A} \sum_{i=1}^{N} a_i \tau_i, \tag{1}$$

where A is the total aggroup area, a_i is the area covered by tax rate τ_i and N is the total number of unique tax jurisdictions within the aggroup.

One potential concern with this approach is the possibility for aggregation bias which could lead to attenuation of the parameter estimates on the tax variables due to measurement error. So that we could identify those aggroups with the largest potential for this type of bias and implement sensitivity analysis, we constructed tax dissimilarity indices for each aggroup. These indices accounted for the deviations from the area weighted average tax within the aggroup, while at the same time scaling these deviations by the sub-area of the deviating tax coverages. Specifically, the formula for this index is given in Equation 2:

$$TaxSim = \frac{1}{A}\sum_{i=1}^{n} a_i(\tau_i - \bar{\tau})^2, \qquad (2)$$

where all variables are defined as above for Equation 1.

2.3 Additional Determinants of Vacation Home Demand

Finally, data was constructed to control for other determinants of vacation home demand. The first set of control variables captures the effect that large numbers of potential vacation home-owners have on the number of vacation home-owners in a given location. According to the National Association of Realtors,

> Typical vacation-home buyers in 2005 were 52 years old, earned $82,800, and purchased a property that was a median of 197 miles from their primary residence.

In order to develop measures of potential demand, demographic data was collected for all tracts within the five states that share a boundary with the state of Michigan. This data was used to compute the count of householders between the age of 45 and 64 years old with a median income greater than $50,000 for both 1990 and 2000. We then computed the count of these householders that lived within 10, 50, 100, 250 and 500 miles of each aggroup. For each aggroup, this data was then used to construct counts of potential vacation home buyers residing in a set of four distant bands (10-50 miles, 50-100 miles, 100-250 miles, and 250-500 miles). Changes in these counts between 1990 and 2000 were also computed.

The calculations were complicated by the fact that for the Great Lakes region, distances need to be constructed over a non-convex surface. For instance, if an individual with a house in Chicago wanted to travel to Traverse City, Michigan, she would need to drive around

Lake Michigan. Thus, simply calculating the straight line distance from the centroid of her home census tract to the centroid of the appropriate aggroup in Traverse City would greatly underestimate the true distance. To compute appropriate distances, that account for the need to travel around the Great Lakes, we first constructed a network of paths connecting all potential first home locations and all aggroups (see figure 3). For all possible combinations of first and vacation home locations, we then compute the shortest distance using a modified Dijkstra algorithm on the network and used this as the travel distance between the two locations.

The second set of control variables account for the presence of public lands and bodies of water. In Northern Michigan and the Upper Peninsula, public lands comprise a large percentage of the total land area. These public lands include State and National Forest, State Parks, Military land, State Recreation Areas, State Wildlife Research Areas, and land under control of the Nature Conservancy. These lands are important for two reasons. First, the presence of public lands may be viewed as an amenity by vacation home owners because they provide public access to lands which may be used for recreational purposes. Second, as previously mentioned, the presence of public lands must be accounted for when the density of vacation homes is computed within an aggroup. To identify the public lands area in each aggroup, public lands boundary data provided by the Michigan Department of Geographic Information was intersected with the aggroup boundary files and the area of intersection was then calculated.

Lakes and Rivers are similarly important potential drivers of vacation home demand and have been identified by The National Association of Realtors as a major determinant in the locational choices of vacation home owners. As with public lands, it is not only important to control for the amenity value, but also to remove from the computed aggroup area the portion covered by water. To identify these areas, year 2000 Census water boundary maps were combined with lake and river data from the State of Michigan Geographic Data

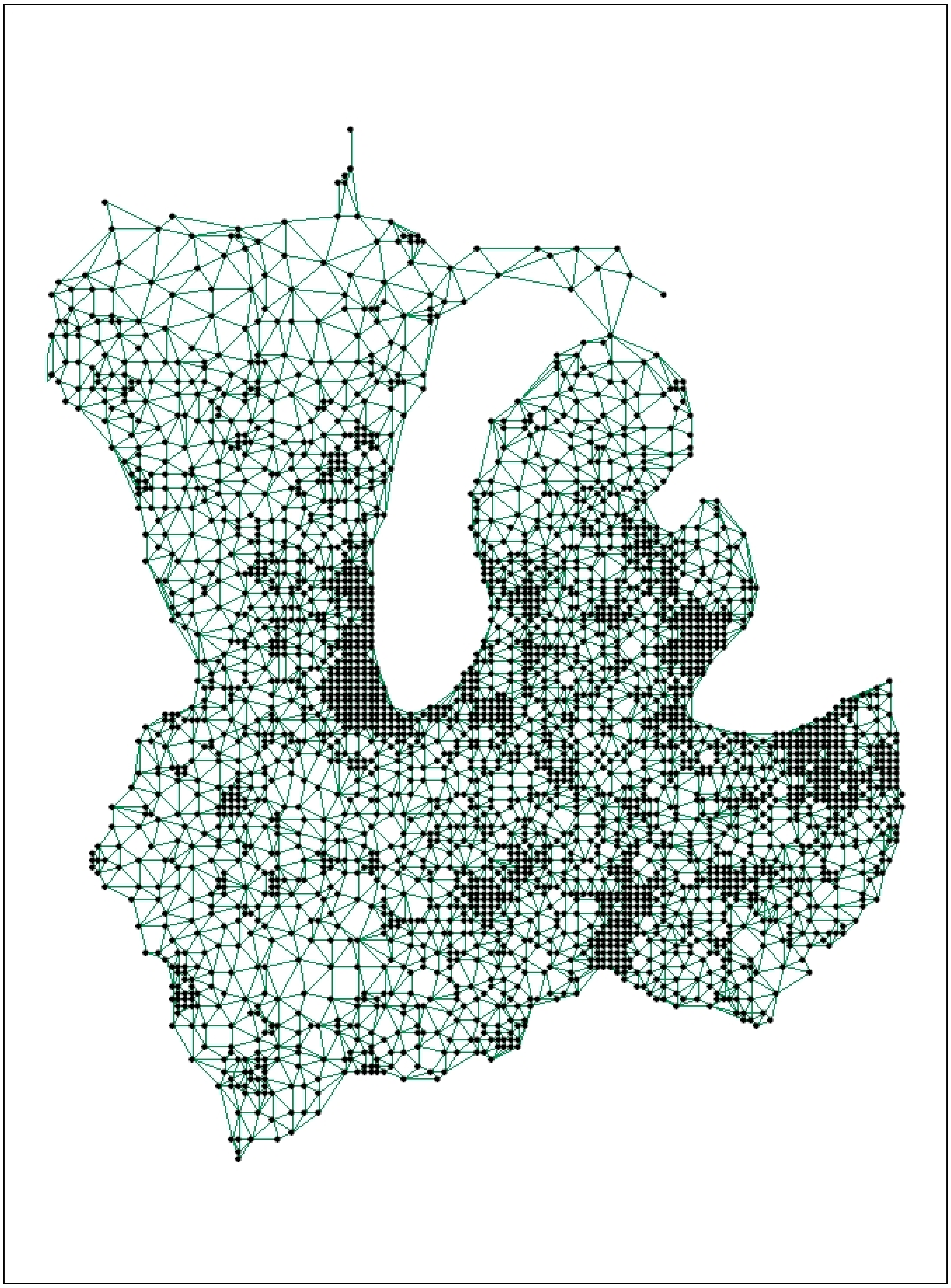

Figure 3: Five state Distance Network

Table 2: Summary Statistics

Summary Statistics (N=1828)		
Variable	Mean	Std. Dev.
Δ Vacation Home Density	0.75	2.90
$\Delta\tau_{93-95}$	-13.69	6.74
τ_{93}	35.88	4.98
τ_{95}	22.16	4.27
τ_{00}	23.23	3.72
% AreaPublic	0.04	0.11
% Vacation Home 1990	0.08	0.27
Median Income 1990	4.31	5.02
First Home Density 1990	494.75	521.75
Vacation Home Density 1990	1.93	10.71
% Lake	0.01	0.04
% Lake^2	0.00	0.02
No Lake	0.75	0.43
Demand 10-50 mi. 1990	11.43	7.53
Demand 50-100 mi. 1990	12.77	8.05
Demand 100-250 mi. 1990	67.40	23.68
Δ Demand 10-50 mi.	9.16	5.24
Δ Demand 50-100 mi.	11.59	6.14
Δ Demand 100-250 mi.	62.99	19.73

Library and GIS routines were used to address differences in the boundary files. Two separate measures were constructed using this data. First, the area within each aggroup covered by water was computed in the same manner as was the area of public lands. Second, in order to measure the potential for waterfront development, the percentage of the total land area within each aggroup located within 100 meters of a shoreline was computed.

Finally, tract-level Census data was aggregated to the aggroup level to develop a set of demographic control variables. These variables include median income of aggroup residents, the percentage of aggroup residents that own their home, and the density of first homeowners in the aggroup (constructed in the same manner as the vacation home density variable). Summary statistics for all variables are presented in Table 2.

3 Estimation and Results

As discussed above, our strategy for identifying the impact of school tax rates on vacation home development leverages the change in tax rates that occurred in Michigan between 1993 and 1995 as a result of the passage of Proposal A. This law led to a complete re-alignment of property tax rates in the state of Michigan. Because these changes were driven by a state-level shift in policy and owners of vacation homes are not consumers of local school expenditures, this 'natural experiment' overcomes most of the problems with confounding influences that typically plague analysis of a pure tax effect on location choice. There is however one important caveat. The changes that occurred as a result of the new law were systematically linked to pre-change tax revenues. As a result, to insure that we are identifying an actual response to differential changes in tax rates, in our regression analysis we control for pre-change tax levels *and* pre-change levels of primary and vacation homes. The inclusion of the baseline tax rates also helps to account for the fact that pre-tax change migration might have been driven by differences in the pre-tax change millage rates. The urban indicator variable is included to control for the theoretical prediction that supply responses will be attenuated (potentially absent) when supply is inelastic. To test for this effect, the urban indicator is interacted with both the tax change and baseline millage rate in order to estimate the differential effects on mobility as a result of differing housing supply elasticities.

A further wrinkle in the data is the significant heterogeneity in size across aggroups. To account for this heterogeneity, we use as our dependent variable the density of vacation homes (number of vacation homes in the aggroup divided by the area of the aggroup that is neither public lands or water). The Basic model for estimation is given in Equation 3.

$$
\begin{aligned}
&\Delta \text{VseasDensity}_i = \\
&\quad \beta_1 + \beta_2 \Delta\tau_i + \beta_3(\Delta\tau_i * \text{Urban}_i) \\
&\quad \beta_4 \text{BaselineTax}_i + \beta_5(\text{BaselineTax}_i * \text{Urban}_i) \\
&\quad \beta_6 \text{Demographics}_i + \beta_7 \text{Amenities}_i \\
&\quad + \beta_8 \text{Demand}_i + \beta_9 \Delta\text{Demand}_i + \beta_{10} \text{Urban}_i + C_i + u_i
\end{aligned} \tag{3}
$$

Where $\Delta \text{VseasDensity}_i$ is the change in vacation home density in aggroup i from 1990 to 2000, $\Delta\tau_i$ is the change in the tax rates between 1993 and 1995, Urban_i is the dummy variable equal to one if over 90% of the aggroup is in an urban area. BaselineTax_i is the 1993 tax rate, Demographics_i consist of demographic controls such as median income and first and vacation home densities in 1990, Demand_i are the relevant population in each distance band in 1990, and ΔDemand_i are the changes in the relevant populations located in the distance bands from 1990 to 2000. Finally, C_i is a county-specific fixed effect for the county in which aggroup i is located. As a result of the inclusion of these county fixed effects the model identifies changes in the distribution of vacation home locations that are driven by within county variation in the 1993-1995 tax rate change - controlling for within county variation in the other incorporated covariates[10]

Estimation results, including several sensitivity tests, are presented in Table 3. Model 1 reports results for the basic specification of Equation 3. Model 2 controls for the fact that the simple model puts equal weights on aggroups with no vacation homes and those with large numbers of vacation homes, running a weighted regression using the number vacation homes in 1990 as weights.[11] Model 3 tests for the impact of outliers, dropping the 10 aggroups with the biggest gain and biggest loss in vacation home density. Model 4 both weights by vacation home population and drops outliers. Finally, Model 5 addresses the issue of possible aggregation bias associated with aggroups which incorporate multiple school districts with different tax rates. This is done by dropping those observations that fall in the highest quartile of the dissimilarity index. The 1172 aggroups which have the least aggregation bias are used in this regression.

Because, by construction, the weighted models (two, four and five), place more emphasis on those locations that comprise the bulk of the vacation home market in Michigan, we believe they will most accurately reflect the 'average' tax effect. For this reason, and because we are also concerned about the effect of outliers and the possibility of attenuation bias from aggregating multiple tax rates within some aggroups, we focus our discussion of the results on models four and five which we believe to be the most robust specifications. These specifications are identical and include all controls, except for the fact that model five drops those aggroups containing the most variation in within-aggroup tax rates. We would however note that our results are consistent across *all* specifications.

First, we consider the estimated effects for the control variables - focusing on those which are the significant determinants of changes in vacation home density. In both models, a

[10]Standard errors where computed both with and without error clustering at the county level - with no difference in the significance levels across the two approaches.

[11]Sample size drops in this model because ten aggroups contain no vacation homes in 1990.

Table 3: Change in Vacation Home Density (Based on 1993-1995 Tax Change)

	Model 1	Model 2	Model 3	Model 4	Model 5
$\Delta\tau_{93-95}$	-0.107**	-0.227***	-0.025	-0.060***	-0.056***
	(-2.15)	(-6.10)	(-0.98)	(-5.23)	(-2.86)
$\Delta\tau_{93-95}$ * Urban Dummy	0.099*	0.124	0.020	0.084***	0.074**
	(1.87)	(1.27)	(0.73)	(2.79)	(2.09)
τ_{93}	-0.253***	-0.453***	-0.071**	-0.099***	-0.105***
	(-3.66)	(-8.91)	(-2.00)	(-6.16)	(-3.97)
τ_{93} * Urban Dummy	0.157**	-0.011	0.002	-0.048	-0.048
	(2.10)	(-0.07)	(0.05)	(-0.94)	(-0.84)
Urban Dummy	-4.350**	-1.433	0.373	2.537*	2.423
	(-2.01)	(-0.30)	(0.34)	(1.67)	(1.45)
% Vacation 1990	-0.780	-0.349**	-0.352	-0.257***	-0.499***
	(-1.64)	(-1.98)	(-1.35)	(-4.29)	(-6.51)
Median Income 1990	0.002	-0.022*	0.008	0.003	-0.011
	(0.12)	(-1.77)	(1.09)	(0.79)	(-1.41)
% Area Public	-1.114	0.169	-0.689	0.727***	1.012***
	(-1.01)	(0.34)	(-1.22)	(4.52)	(4.25)
First Home Density 1990	0.002***	0.010***	0.001***	0.003***	0.003***
	(7.36)	(9.96)	(8.66)	(7.33)	(7.23)
Vacation Home Density 1990	0.038***	0.023***	0.011**	0.015***	0.016***
	(4.38)	(7.10)	(2.46)	(14.54)	(13.82)
% Lake	15.268***	14.456***	3.748	5.021***	2.671
	(4.27)	(5.79)	(1.46)	(4.29)	(1.59)
% Lake^2	-28.631***	-26.218***	-5.108	-9.686***	-6.098
	(-4.18)	(-8.02)	(-0.70)	(-3.27)	(-1.40)
No Lake	0.464*	0.237	0.203	0.131*	0.037
	(1.83)	(0.96)	(1.51)	(1.71)	(0.39)
Demand 10-50 mi. 1990	0.147	-0.810**	0.155*	0.165	0.144
	(0.85)	(-2.02)	(1.75)	(1.31)	(0.81)
Demand 50-100 mi. 1990	0.023	0.099	-0.003	0.389***	0.362*
	(0.08)	(0.26)	(-0.02)	(3.14)	(1.72)
Demand 100-250 mi. 1990	-0.245	-0.390	-0.237	0.123	0.038
	(-0.75)	(-1.18)	(-1.43)	(1.20)	(0.18)
Demand 250-500 mi. 1990	-0.326	-0.753**	-0.340*	-0.051	-0.172
	(-0.93)	(-2.34)	(-1.91)	(-0.51)	(-0.76)
Δ Demand 10-50 mi.	-0.241	1.137**	-0.251*	-0.224	-0.217
	(-0.83)	(2.16)	(-1.70)	(-1.36)	(-1.02)
Δ Demand 50-100 mi.	-0.045	-0.409	0.031	-0.486***	-0.491**
	(-0.12)	(-0.89)	(0.15)	(-3.33)	(-2.25)
Δ Demand 100-250 mi.	0.371	0.395	0.370*	-0.126	-0.029
	(0.95)	(1.08)	(1.87)	(-1.12)	(-0.14)
Δ Demand 250-500 mi.	0.446	0.893**	0.466**	0.068	0.179
	(1.08)	(2.54)	(2.23)	(0.62)	(0.80)
cons	-9.281	-1.331	-14.439*	-0.061	2.172
	(-0.61)	(-0.21)	(-1.84)	(-0.03)	(0.33)
r^2	0.117	0.388	0.162	0.589	0.607
N	1825.000	1462.000	1787.000	1426.000	1172.000
Prob > F	0.724	0.260	0.636	0.404	0.563
Outlier Trimming	No	No	Yes	Yes	Yes
Population Weights	No	Yes	No	Yes	Yes
Similarity Control	None	None	None	None	sim00s < 6.8

higher percentage of the housing stock in use as vacation homes in 1990 is associated with a lower rate of growth in vacation home density. As expected, the effect of the presence of public lands in the aggroup is both positive and significant. To allow for flexibility in the effect of access to lake frontage, we include an indicator for the presence of no lake frontage and both linear and quadratic terms for the percentage of the aggroup in lake frontage. Both models predict that the change in vacation homes is increasing in percent lake frontage over the bulk of the observed distribution in lake frontages. However, these terms become insignificant when the sample size is reduced to control for tax heterogeneity within the aggroups. Finally, while jointly significant, the distance*population demand variables are all individually insignificant. This is likely due to the fact that inclusion of county fixed effects greatly reduces the relevant variation in these variables.

The model includes two different tax variables, the 1993 school millage rate (τ_{93}) and the 1993 to 1995 change in the school millage rate ($\Delta\tau_{93-95}$). Both of these tax variables are interacted with the housing supply elasticity dummies. The 1993 tax rates are included as controls, and their coefficient may be biased upward in magnitude due to the endogeneity issues discussed above. Coefficient estimates for this variable are negative and significant in all models.

Finally, we consider the impact of our exogenous tax instrument, the change in tax rates between 1993 and 1995. Focusing on Models 4 and 5, the estimates suggest that in rural areas a one standard deviation increase in this change is associated with a slower rate of growth in vacation home density of between .25 and .3 vacation homes per square kilometer (approximately 1/10th of the observed standard deviation in the sample). For urban areas, the effect of the tax change on net mobility is insignificant (the F statistic on $\Delta\tau_{93-95} + \Delta\tau_{93-95} *$ Urban Dummy $= 0$). These results serve to reinforce the theoretical argument that tax changes will lead to population changes when supply is elastic.

When evaluating these coefficient estimates, it is important to note that these estimates are capturing only the effect of within county variation in tax rate changes. Taken together, the results suggest that while tax rates are not the only driver of vacation home location choice, they do have a marked effect on vacation home location choices.

One remaining concern is that our results are driven by changes in tax rates that occurred between 1995 and 2000. As a sensitivity analysis, Table 4 presents results for the same models, only using 1995-2000 tax changes as our policy variable. These results suggest that tax changes from 1995-2000 are not driving the location decisions of the vacation home population.[12] Taken together, the coefficients on the 1993 school millage rate and the 1993-1995 change in millage rates provides some of the strongest evidence to date of a pure-tax mobility effect and its link to the elasticity of housing supply.

4 Conclusion

In this paper, we overcome the identification issues that are typically associated with isolating the effect of taxes on housing location choices. Identification is achieved by isolating exogenous changes in the distribution of local school tax rates that arose as a result of the passage of 'Proposal A' in Michigan in 1994. We then use a spatially disaggregated data set on local property tax rates and focus on the responses in the market for vacation homes to differential changes in property tax rates. This approach allows us to overcome issues of endogeneity, aggregation bias, and the confounding of tax rates and public goods provision that has been typical of previous empirical work on the subject. Our empirical results provide some of the clearest evidence to date that net housing counts are sensitive to differences in property tax rates. Further, consistent with theoretical predictions, these impacts appear to be sensitive to the elasticity of housing supply.

[12]This result is not surprising given the stability of tax rates following 1995 as reported in Table 1.

Table 4: Change in Vacation Home Density (Based on 1995-2000 Tax Change)

	Model 1	Model 2	Model 3	Model 4	Model 5
$\Delta\tau_{95-00}$	0.014	0.101*	0.011	0.014	0.009
	(0.23)	(1.92)	(0.36)	(0.85)	(0.47)
$\Delta\tau_{95-00}$ * Urban Dummy	0.001	-0.054	0.020	-0.056	-0.026
	(0.01)	(-0.26)	(0.55)	(-0.89)	(-0.39)
τ_{93}	-0.138***	-0.234***	-0.044**	-0.039***	-0.049***
	(-3.17)	(-6.68)	(-1.98)	(-3.55)	(-2.82)
τ_{93} * Urban Dummy	0.051	-0.092	-0.020	-0.135***	-0.128***
	(1.07)	(-0.92)	(-0.84)	(-4.19)	(-3.56)
Urban Dummy	-1.958	-0.211	0.890	4.594***	4.278***
	(-1.14)	(-0.06)	(1.02)	(4.03)	(3.38)
% Vacation 1990	-0.753	-0.314*	-0.337	-0.227***	-0.490***
	(-1.58)	(-1.76)	(-1.29)	(-3.78)	(-6.30)
Median Income 1990	0.002	-0.016	0.008	0.004	-0.012
	(0.10)	(-1.30)	(1.13)	(1.11)	(-1.51)
% Area Public	-1.095	0.361	-0.695	0.786***	1.066***
	(-0.99)	(0.71)	(-1.22)	(4.85)	(4.45)
First Home Density 1990	0.002***	0.010***	0.001***	0.003***	0.003***
	(7.35)	(10.03)	(8.62)	(7.26)	(7.21)
Vacation Home Density 1990	0.038***	0.023***	0.011**	0.014***	0.015***
	(4.41)	(6.96)	(2.47)	(14.32)	(13.71)
% Lake	15.212***	15.410***	3.661	5.597***	3.606**
	(4.25)	(6.10)	(1.43)	(4.75)	(2.17)
% Lake^2	-28.679***	-27.066***	-5.097	-11.250***	-8.533**
	(-4.19)	(-8.18)	(-0.70)	(-3.76)	(-1.98)
No Lake	0.442*	0.210	0.202	0.134*	0.027
	(1.75)	(0.84)	(1.50)	(1.73)	(0.28)
Demand 10-50 mi. 1990	0.154	-0.673*	0.160*	0.144	0.094
	(0.91)	(-1.72)	(1.86)	(1.18)	(0.57)
Demand 50-100 mi. 1990	0.033	0.146	-0.001	0.326***	0.286
	(0.11)	(0.38)	(-0.01)	(2.68)	(1.46)
Demand 100-250 mi. 1990	-0.210	-0.112	-0.232	0.157	0.035
	(-0.65)	(-0.34)	(-1.42)	(1.57)	(0.18)
Demand 250-500 mi. 1990	-0.300	-0.632**	-0.333*	-0.050	-0.186
	(-0.86)	(-1.97)	(-1.88)	(-0.50)	(-0.86)
Δ Demand 10-50 mi.	-0.248	0.968*	-0.261*	-0.203	-0.163
	(-0.86)	(1.86)	(-1.78)	(-1.25)	(-0.79)
Δ Demand 50-100 mi.	-0.046	-0.374	0.030	-0.386***	-0.396*
	(-0.12)	(-0.83)	(0.15)	(-2.68)	(-1.91)
Δ Demand 100-250 mi.	0.330	0.079	0.364*	-0.171	-0.049
	(0.85)	(0.22)	(1.86)	(-1.54)	(-0.25)
Δ Demand 250-500 mi.	0.415	0.772**	0.458**	0.067	0.174
	(1.01)	(2.19)	(2.20)	(0.61)	(0.81)
cons	-11.294	-6.539	-14.880*	-1.235	3.857
	(-0.74)	(-1.04)	(-1.90)	(-0.64)	(0.60)
r^2	0.115	0.373	0.162	0.580	0.603
N	1825.000	1462.000	1787.000	1426.000	1172.000
Prob > F	0.740	0.814	0.156	0.489	0.798
Outlier Trimming	No	No	Yes	Yes	Yes
Population Weights	No	Yes	No	Yes	Yes
Similarity Control	None	None	None	None	sim00s < 6.8

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