Abstract - Owners of vacation homes pay local property taxes, yet cannot vote on local referenda. From the standpoint of full–time residents, significant numbers of vacation homes reduce the real costs of public spending, since vacation home owners pay property taxes but consume very few public services. A one–time change in Minnesota tax assessments of vacation property in 1996 affords the opportunity to identify the effect of vacation property on local spending. The results suggest that a one–percent increase in the concentration of vacation homes in local tax base is associated with a 1.5–percent increase in per–capita spending.

INTRODUCTION

According to the U.S. Census, as of 1999 there were approximately 3.6 million vacation homes in the United States. Vacation homes constitute just over three percent of all housing units in the United States, with 14 states having at least five percent of their housing units classified as vacation homes. Maine and Vermont are the states with the highest concentration of vacation homes, with vacation homes representing 15.6 percent and 14.6 percent of their housing units, respectively.

Owners of vacation homes argue that their local property tax payments are too high given that they spend very little time in the locality and, thus, consume fewer services. Indeed, from the perspective of full–time (i.e., permanent) residents, the presence of vacation home owners reduces the real costs of public spending, since vacation home owners contribute to local revenues but consume relatively few public services. These incentives may cause local spending and tax rates to be higher than might otherwise be expected, especially when considering that vacation home owners are almost universally prohibited from voting on local referenda.1

1 In many states, vacation home owners actually pay more in property taxes because they are not eligible for property tax credit programs that apply to resident home owners. In certain states, such as Michigan, they are subject to property taxes above and beyond what residential home owners face. Until recently, vacation home owners in Minnesota had to pay twice as much in property taxes as the owners of an equivalently valued residential home in the same jurisdiction.
The potential reduction in the real costs of service provision associated with vacation homes provides an as-of-yet empirically unexplored example of tax exporting by local communities. Tax exporting refers to the ability of residents to impose a tax burden on non-residents (i.e., taxpayers that cannot vote), thereby lowering the tax price faced by permanent residents. The tax price faced by a permanent resident is the private income that resident must forgo, in the form of additional property taxes, to consume another unit of a public service. If financing and providing another unit of a public service requires an additional $1,000 of property tax revenue, a permanent resident’s tax price is the share of the $1,000 that she must pay. If additional services are financed by property taxation, her share of the $1,000 equals her share of the property tax base.

Vacation homes reduce the tax prices of permanent residents because they allow residents to pay for only a small portion of total local expenditure. Of course, the reduction in the share of taxes paid by residents may not reduce the real costs of service provision if vacation home owners cause the costs of service provision to increase. Local governments provide a variety of services such as health care, libraries, streets, parks, police, fire, transit, water, and sanitation services. Vacation home owners most likely use fewer health, library, sanitation, transit, and street services than do permanent residents. Their relative use of police and fire services is less clear since they enjoy the protection of the police department and fire department even when they are not vacationing.

Analysis of a unique data set of communities in Minnesota demonstrates that permanent residents take advantage of the lower tax prices provided by exporting taxes to vacation home owners by substantially increasing expenditures on public services. In any given year, Minnesota communities with a higher concentration of vacation home property in their local tax base have higher property tax revenues and expenditures, and face higher property tax rates. Cross-sectional estimates suggest that a one-percent increase in the share of tax base derived from vacation homes is associated with a 0.26 percent increase in local per-permanent-resident expenditures. This association between vacation properties and local expenditures may be caused by the peculiarities of vacation home communities and not by any price effects on the demand for local public services. This strong association between fluctuations in residential tax share and local property tax revenue is evident, however, even after accounting for differing local taste factors and public service costs across communities. After controlling for the effects of each individual community on expenditure, the price elasticity for local expenditure is estimated at 0.23, that is, a one percent increase in the share of tax base derived from vacation homes is associated with a 0.23 percent increase in local per-permanent-resident expenditures. These results

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2 This study focuses on spending and taxation by municipal and township governments. Educational services are provided by school districts, not municipalities and townships. However, many of the issues discussed here are also applicable to educational services.

3 According to the National Association of Realtors (2002), approximately 70 percent of vacation home owners spend less than three months in their vacation home, and 84 percent of owners never rent out their vacation home when they are not present. The median distance of a vacation home from the owner’s primary residence is 185 miles, and 42 percent of vacation homes are located in the same state as the owner’s primary home. Most vacation homes are located in resort areas or rural areas. Nationally, the median second home owner is 61 years old and has a household income of $76,900.

4 As of 1999, there were over 106,000 vacation homes in Minnesota, representing over five percent of all housing units in the state. The concentration of vacation homes in any single community can be well over 50 percent (source: U.S. Census Bureau).
correspond to a price elasticity of demand for public services of 0.23.

These results closely resemble results found in previous research concerning how differences in tax base composition and, thus, differences in local tax prices affect local demand for public services. The results from previous research and the vacation home results discussed above, however, may differ from the actual price elasticity of demand for local services. These results may be biased because the estimates do not take into account how expenditures affect tax prices. Local expenditures on public services affect both the location and value of property and, thus, the composition of the tax base. Furthermore, zoning policies instituted by local governments restrict location decisions and alter the composition of the local property tax base.

Communities with large observed expenditures on public services may also have, because of migration and capitalization, a large component of their tax base derived from residential property owned by permanent residents. These observations result in an observed positive association between the tax prices of permanent residents and local expenditures. This positive association between tax price and expenditures should not, however, be interpreted as the effect of tax price on public expenditures. Confusion regarding the effects of expenditures on local tax prices and the effects of tax prices on expenditures results in incorrect estimates of the price elasticity of demand for public services.

This paper uses a data set that eliminates confusion concerning the reverse causality of tax price and expenditure. In 1996, the Minnesota state government reduced the taxable value of vacation homes by reducing the assessment rate on vacation properties (i.e., the percentage of their market value that is taxable). This reform produced changes in tax price not caused by changes in local expenditure. Once the tax price effect on expenditure is distinguished from the effect of expenditures on tax price, the measured price elasticity is more substantial. The results suggest an association between tax price and local expenditure that is over 500 percent higher than the 0.23 association discussed above. A one–percent increase in share of tax base derived from vacation homes is associated with a 1.5–percent increase in per–permanent–resident expenditures, implying a price elasticity of demand for public services of 1.5.

VACATION HOMES, TAX PRICE, AND EXPENDITURES

The relationship between residential tax share and tax price and the corresponding effects of tax price on expenditure are easily seen from a standard model of local public service determination in which a local government finances expenditures on service quality, \( q \), by levying a property tax on all property owners within its jurisdiction. All property owners, \( k = 1, 2, ..., K \), are taxpayers paying ad–valorem property taxes (at rate \( \tau \)) on the value of their real estate property, \( V_k \), to fund local public services. A taxpayer’s after–tax income is devoted to the consumption of housing, \( h \), and a composite private good, \( b \). Housing, \( h \), is measured in units of housing services with a gross–of–tax price of \( p = p_h(1 + \tilde{\tau}) \). There are only two types of taxpayers: owners of vacation homes \( \tilde{i} = v \) and permanent residents owning residential property (i.e., residents) \( \tilde{i} = r \). Vacation home owners are taxpayers without the right to vote. Each taxpayer \( k \) is one and only one type and remits taxes to only one jurisdiction. The total number number of taxpayers in jurisdiction \( j \) is \( K_j \).

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5 As Ross and Yinger (1999) note, a taxpayer’s tax payment is \( T = \tau V = \tau V_k \cdot h/r = \tilde{\tau} p_h \cdot h \). Note that \( \tau \) rather than \( \tilde{\tau} \) will be used throughout this paper.
\( n_{ij} + n_{ip} \), where \( n_i \) is the number of taxpayers of type \( i \) in jurisdiction \( j \).

A resident-taxpayer, \( k \), in community \( j \) has the right to vote and wishes to maximize her utility, \( U(b, h, q_j) \) subject to her budget constraint and the community’s budget constraint. The community’s tax rate is chosen through a majority rule process. All residents have the same preferences and \( U \) is increasing, strictly quasi-concave, and twice continuously differentiable in all its arguments. Taxpayers differ in their exogenously given income, \( I_k \). A resident’s budget constraint is:

\[
I_k = b_k + p_h \cdot h_k + \tau \cdot p_h \cdot h_k.
\]

The local government’s budget must be balanced:

\[
\tau \cdot p_h \cdot H = C_q \cdot q,
\]

where \( H = \sum_{n=1}^{K} h_k \) is the total consumption of real estate services (land and capital) in a jurisdiction and \( C_q \) is the marginal cost of \( q \). The public service quality, \( q_j \), is determined through a majority voting process and preferences are such that the median voter is decisive.

A cost function, \( C(\cdot) \), describes the total cost of providing a given level of \( q \) to each taxpayer in a community. The costs of providing a unit of service quality in a community are affected by the composition of the tax base.\(^6\) Define \( \theta_j \) as the \( K \times 1 \) vector containing the marginal cost of providing quality to each taxpayer in community \( j \), and \( q_j \) as the \( K \times 1 \) vector containing the quality of service enjoyed by each taxpayer (these could all be the same). The cost function takes the form \( C(q, \theta) \) where \( C(\cdot) \) is linear, differentiable and increasing in all arguments.

Utility maximization implies the following first order condition for public service provision, where \( \bar{h} \) is the average consumption of housing by permanent residents:

\[
\frac{U_q(\cdot)}{U_k(\cdot)} = C_q \cdot \frac{h_k}{n_i \cdot \bar{h}_r} \cdot \frac{H}{H}.
\]

A resident’s preferred choice regarding the quality of local services, and, thus, expenditure and tax rates, is influenced by the level of that voter’s income or wealth and the real costs of providing a level of service quality, \( q \). The expression on the right hand side of the equality is the voter’s tax price. The last two terms represent the ratio of the tax base of the voting permanent resident to the average tax base of all voting permanent residents and the permanent resident tax share (i.e., the share of tax base that is residential).\(^7\)

All else equal, a large amount of vacation homes lowers the residential tax share and reduces marginal costs if the costs of providing services to vacation home owners is relatively low. It is possible, however, that vacation home owners might increase the marginal costs of service provision if they locate in less densely populated areas of a community. The ultimate effect of vacation homes on service demand will depend on their

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\(^6\) Schwab and Oates (1991) consider the case of differing costs of public service across communities in a model featuring lump sum taxation. Gramlich and Rubinfeld (1982) consider the case where the consumption of a public service differs across residents according to their incomes. This follows Bradford, Malt, and Oates (1969) in that holding revenue and \( K \) constant the amount of the public service delivered depends on community characteristics, namely \( \theta \). See Ross and Yinger (1999) for more details on various specifications of the technology of public service production and how these specifications can affect the existence of equilibrium. These assumptions regarding the cost function are sufficient but not necessary for internal equilibrium.

\(^7\) See Ladd (1975) for a similar derivation and Crane (1990) for an example of the derivation of the tax price when housing demand depends on levels of the public service. See Wildasin (1987) for a consideration of tax exporting with a pure public good. In the context of his model, a local community is able to tax a traded good and the burden of this taxation falls at least partially on those who live outside the jurisdiction (i.e., importers). For other papers that discuss tax exporting, see Braid (2005) and Kim (1998).
effects on marginal costs, residential tax share, and any influence they may have on political outcomes.

An increase in demand for service quality caused by additional vacation home tax base does not necessarily imply an increase in the tax rate. The larger tax base enables a voter to consume more $q$ with a tax rate that is lower than the previous rate. In fact, keeping the rate the same would increase revenues and service quality. A voter’s demand for a higher tax rate would imply a desire to forgo private consumption in favor of increased public service consumption. Only when the price elasticity is less than or equal to $-1$ will increases in tax base imply a higher tax rate.\(^8\)

**ESTIMATING PRICE ELASTICITY OF DEMAND WITH FIXED EFFECTS**

The problems of measuring the effect of vacation homes on local expenditure are related to the general problems involved with estimating the price elasticity of demand for public services. Although problems with cross-sectional estimation of price elasticities for public services are well documented, nearly all previous work estimating the price elasticity of demand for local public services has used cross-sectional variation in tax price and income to obtain parameter estimates (e.g., Ladd (1975) and Bergstrom and Goodman (1973)). The near exclusive reliance on cross-sectional data is due both to the limited availability of reliable panel data (especially for consecutive years), and the lack of variation in income and tax price within communities from year to year. Thus, even when panel data are available, cross-sectional data provides more variation in tax price generating more precise estimates of price elasticity. Furthermore, any changes in tax price within a community over time may be endogenously caused by migration or capitalization due to changes in tax rates, revenues, and expenditures. Given these issues, estimation with panel data usually offers few advantages over cross-sectional data.

Most cross-sectional studies use community level data while others use household and individual level data.\(^9\) Cross-sectional individual and community level studies generally find values for the price elasticity as small as zero and as large as $-0.5$. The dependent variable in these studies is most often expenditure on a particular service or group of services. Examples of local services under study are education (Feldstein, 1975; and Ladd, 1975), fire services (Duncombe, 1991), and general expenditures, police,

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\(^8\) Using the budget constraint, the effect of changes in costs and total tax base on the local tax rate can be expressed as:

\[
\frac{d\tau}{\tau} = (1 + \varepsilon_q) \left( \frac{dC_i}{C_i} - \frac{dH}{H} \right)
\]

The direction of change in the tax rate will depend on the price elasticity of demand for $q$, $\varepsilon_q$, as well as the relative changes in total tax base and aggregate marginal cost. If non-residential tax base increased without an increase in the aggregate marginal cost, the first order condition (eq. [3]) implies an increase in demand for the public service. The increase in demand will not, however, be large enough to call for an increase in the tax rate unless $\varepsilon_q < -1$.

\(^9\) Inman (1979) reviews community level studies and Rubinfeld (1987) reviews studies using individual level data. For a review of studies outside of the United States and a discussion of various methods of identifying the decisive voter, see Ross and Yinger (1999). See the study of the composition of local Norwegian expenditure by Borge and Rattso (1995) for an example of a study using panel data. As the authors point out, however, their estimates of the price elasticity are not comparable to results from studies with endogenous local budget constraints (i.e., the United States). One panel study with U.S. data is Holtz-Eakin and Rosen (1990) who examine the effect of property tax deductibility on local tax rates.

Cross–sectional analysis of Minnesota data confirms that permanent residents residing in communities with relatively high concentrations of vacation homes in their tax base face lower tax rates and enjoy more expenditure per permanent resident than do other communities. Even if, however, the correlations between vacation homes and higher expenditure reflect a causal relationship, the problem of accurately measuring the magnitude of the expenditure effects of vacation homes persists. Vacation home owners may, for example, prefer to locate in communities where permanent residents exhibit relatively low preferences for public expenditures causing estimates of the expenditure effects of vacation homes to be biased towards zero.

In 1996, a special feature of the Minnesota property tax system produced relatively large and plausibly exogenous within–community variation in the share of community tax base derived from vacation homes. In communities with relatively large amounts of vacation home tax base, this special feature produced large changes in residential share and, thus, changes in tax price. The relatively large magnitudes of within–community variation in tax price allow for more precise estimates of the effects of vacation homes than panel data usually provides.10

The potential problems with cross–sectional estimation and the advantages of a fixed–effects approach combined with relatively large within–community variation in local tax prices can be seen in the context of a system of simultaneous equations. Understanding several institutional features of the Minnesota property tax is essential to understand the course of the large within–community variation discussed above. In Minnesota, a jurisdiction’s tax base is called its Net Tax Capacity (NTC). The net tax capacity of an individual property $k$ is its estimated market value, $M_k$, multiplied by its “class rate.” Each property is assigned a class such as Residential Homestead, Commercial–Industrial, Non–Commercial Seasonal Recreational (e.g., vacation home), or Agricultural Homestead. Each of these classes has its own class rate, $z_c$, where $c$ denotes the property class. Class rates are determined each year by the state legislature and do not vary across communities.11

Taxable market values for taxes payable in the following year are determined by a local assessor using information on property values from the preceding year. For example, taxes payable in 2003 are based on assessments finalized on January 1, 2002; the assessment finalized on

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10 At least two other recent studies have used abnormally large and plausibly exogenous within–community variation in tax price to identify price elasticities of demand for education. These studies find relatively small elasticities of greater than –0.1 but still statistically different from zero. Both use the same property tax exemption program in New York to generate within–community variation in tax price. Eom, Duncombe, and Yinger (2005) measure voter tax share as the median voter’s tax share using census data on median home values. Rockoff (2003), focusing on the very important issue of how the distribution of tax relief affects local decisions, does use information on residential tax shares, but variation in these tax shares is not exogenous.

11 Local assessors are responsible for assigning each property a class according to criteria set by the state. Each year, the Minnesota state legislature determines these class rates. Vacation homes are classified as Non–Commercial Seasonal Recreational. There is an incentive for vacation home owners to claim their vacation home as a residential homestead, since, all else equal, incorrect classification would reduce their tax liability. The state recognizes this incentive and combats it in two major ways. First, the burden of proof is on the homeowner to prove that their home is a residential homestead. They must demonstrate that they are employed nearby or receive their mail at the address. Second, homeowners are allowed to have only one home classified as residential homestead. Furthermore, given the fiscal benefits of vacation homes, full–time residents have an incentive to insure that vacation homes are classified as vacation homes.
January 1, 2002 must rely on information on market values from 2001.

The total property tax payment for property \( k \) will depend on the tax rate its owner faces in jurisdiction \( j \) at time \( t \), \( \tau_{jt} \); the class rate for its class of property at time \( t \), \( z_{ct} \); and the taxable market value of the property \( M_{jkct} \) owned by taxpayer \( k \) in jurisdiction \( j \) at time \( t - 1 \), classified as property type \( c \).\(^{12}\)

\[ \text{tax payment}_{ijt} = \tau_{jt} \cdot z_{ct} \cdot M_{jkct}. \]

For example, in 1995 the class rate on a residential homestead property valued at $70,000 was 0.01. Given this class rate, the net tax capacity of a residential homestead property valued at $70,000 is equal to $700. The only variable that a jurisdiction can control directly is the tax rate, \( \tau_j \), which is set at the rate required to raise the desired amount of property tax revenue. In Minnesota, the amount of revenue is the policy variable that is voted on, with the revenue level implying a corresponding tax rate.

These institutional features and the first order condition (eq. [3]) guide the formation of the tax price term. Tax price includes local per–permanent–resident marginal costs, \( c_p \), the median voter’s share of residential tax base, and the share of tax base that is residential.\(^{13}\)

The share of total Net Tax Capacity (i.e., total tax base) that is derived from property classified as residential is the residential tax share. In any year, the share of the total tax base derived from residential property is a function of market value and class rates. Denoting the median voter’s taxable value at time \( t \) as \( \tilde{M}_{jt} \), the median voter’s tax price is:

\[ p_{\beta} = c_{q} \cdot \frac{\tilde{M}_{jt}}{(\tilde{M}_{jt-1} | c = r)} \cdot \frac{z_{ct} \cdot (m_{jt-1} | c = r)}{z_{ct} \cdot m_{jt-1}}, \]

where \( z_i \) is a vector with entries for the class rate of each property \( k \) at time \( t \), and \( m_{jt-1} \) is a vector of the property values of all \( k \) properties within the jurisdiction at time \( t - 1 \). The expression \( z_{ct} \cdot (m_{jt-1} | c = r) \) denotes the total NTC of all residential property.

Below is a system of equations describing the relationship between expenditures (\( y \)) and the median voter’s tax price (\( p \)). The variable \( \tilde{I}_{jt} \) denotes the income of the median voter in community \( j \) at time \( t \). The indicator variable \( d_j \) controls for time–invariant characteristics of community \( j \) that affect expenditure. The variable \( x_{jt} \) is a vector of other explanatory variables, such as lump–sum aid. With all variables in logs, equation [7a] illustrates the basic log–linear model of expenditure decisions by local government, equation [7b] details how class rates and the distribution of market values determine residential tax share, and equation [7c] details the relationship between the real estate market and local government expenditures today and expected expenditures at time \( t + 1 \):\(^{14}\)

\[ y_{\beta} = a + b_0 \cdot t + b_1 \cdot p_{\beta} + b_2 \cdot \tilde{I}_{jt} + b_3 \cdot x_{jt} + \sum_{j=1}^{L} f_j \cdot d_j + \varepsilon_{\beta}, \]

\(^{12}\) Letting \( V_t \) represent a vector of property sales prices in year, \( M_{jkct} = f(V_{jt-1}) \). That is, estimated market values that determine tax share for taxes payable in 2003 are based on property sales information from 2001.

\(^{13}\) Tax price also contains the price effects of matching grants from state governments and environmental variables that affect marginal cost (e.g., local poverty rates). The tax price terms becomes more complex when additional revenue sources such as income and sales taxes are considered. One of the advantages of the estimation procedure done here is that relatively few (1) of the localities in the sample levy sales taxes. Many other variables have been used to describe the tax prices of median voters. See Bergstrom, Rubinfeld, and Shapiro (1982) for an excellent summary of different specifications of the tax price variable.

\(^{14}\) A more complete specification of equation [7c] might include expectations of future expenditures beyond the next period as they may affect property values today.
The primary advantage of the fixed-effects approach is the ability to control for time-invariant determinants of expenditure, \( dj \), that are correlated with tax price, \( p \), and income, \( I \). These time-invariant attributes are difficult to control for in a cross-sectional study. An example particularly relevant to vacation homes in Minnesota is the cost of snow removal on local roads. Vacation homes are often located relatively far from the homes of permanent residents (perhaps on a lake outside of town); thus, a relatively large amount of vacation homes may actually increase the costs of snow removal since the snow plow will have to travel farther and plow more roads. A positive correlation between vacation homes and expenditure would exist because of the increased costs of service provision, not because the median voter faces a lower tax share. The fixed effect may also capture time-invariant preferences for public services. For instance, all else equal, vacation home owners may prefer to locate in towns with low tax rates and low spending levels caused by permanent residents with little desire for public services. Failure to control for these preferences would bias the estimates of price elasticity toward zero. Furthermore, as Bergstrom, Rubinfeld, and Shapiro (1982) point out, cross-sectional median voter studies have the disadvantage that estimates of elasticities depend at least in part on the extent to which local decisions on expenditure approximate the median voter model. Since fixed effects control for time-invariant variables, if local preferences affecting public policy remain constant over the sample period, the estimate of the price elasticity will not be biased because of incorrect identification of the median or decisive voter.

Another source of biased estimates of the price elasticity of demand is incorrect specification of tax price. Both Wildasin (1989) and Crane (1990) cite the failure of empirical work to consider that the median voter’s tax price is not fixed. Wildasin considers the ability of the median voter’s tax share to change over time because expenditures are funded by distortionary taxation. Crane considers the potential effects of public expenditure on migration and the consumption of housing services. Consideration of these distortions increases the effective price of public service provision. Ignoring these considerations biases estimates of price elasticity toward negative one. This bias is present even if the constant elasticity specification is correct. If the additional costs of distortionary taxation, migration, and housing consumption considered by voters are time-invariant over several years, the fixed effects approach will control for

\[ \begin{align*}
\text{[7b]} & \quad p_{it} = c_i \cdot \frac{\tilde{M}_{it-1}}{(M_{it-1} | c=r)} \cdot z_{it} \cdot (m_{it-1} | c=r) ; \\
\text{[7c]} & \quad m_{it} = \gamma_0 + \gamma_1 \cdot y_{it} + \gamma_2 \cdot E[y_{it+1}] \\
& \quad + \sum_{j=1}^{J} g_j \cdot d_{ij} + u_{it}. 
\end{align*} \]

15 Bergstrom and Goodman (1973) discuss the necessary assumptions for the estimation of income and price elasticities from cross-sectional data using the median voter model. Failure to properly account for across-community variation in the tastes for public services, prices for both factors and goods, and community characteristics affecting the costs of service provision bias cross-sectional estimates of price and income elasticities. See Goldstein and Pauly (1981) for a discussion of how median voter income may not control for differences in preferences across communities (i.e., Tiebout bias).

16 Successfully controlling for differences in costs across communities can have substantial effects on estimates. Several recent cross-sectional studies consider the effects that community characteristics have on the cost of public services. For example, studies by Ladd and Yinger (1989) and Duncombe (1991) have found that variables such as the poverty rate, building age, and the presence of commercial and industrial capital all influence the costs of providing local services and estimates of income and price elasticities.
these factors far better than a cross-sectional approach.\footnote{Communities with relatively more vacation homes may have a superior amenity. This heightened attraction to the community can create market power which may allow the community to raise tax rates without fear of out-migration. Failure to control for differences in this market power across communities may also bias results. Here again, using first differences provides an advantage over cross-section estimation if market power is time-invariant.}

Note the failure of both the fixed-effects and cross-sectional approach to account for the effects of expenditure, $y$, on tax price, $p$. The cross-sectional equation will be as in equation \[8a\], and the error term \[8b\] will include the fixed effect:

\begin{align*}
\[8a\] & y_{jt} = a + b_0 \cdot t + b_1 \cdot p_{jt} + b_2 \cdot I_{jt} \\
& \quad + b_3 \cdot x_{jt} + v_{jt}, \\
\[8b\] & v_{jt} = f \cdot d_j + \epsilon_{jt}.
\end{align*}

For example, a large observed residential tax share, corresponding to a higher tax price for the median voter, could be caused by strong preferences for public services resulting in high quality public services being capitalized into the value of residential homes. In this case, a researcher might incorrectly conclude that having a high concentration of residential property (i.e., a high tax price) causes higher spending on parks and recreation when the causal effect actually runs the opposite way. This causes the error term, $v_{jt}$, to be correlated with $p_{jt}$ and will bias estimates of the price elasticity of demand towards zero.

To ensure consistency in the fixed effects estimation, the tax price in each community in each year must be uncorrelated with deviations from the average error term.\footnote{See Wooldridge (2002) for a discussion of consistent estimation with panel data and the strict exogeneity assumption.} Again, letting $p_{jt}$ denote tax price, the requirement for consistency is that:

\begin{equation}
E[p_{jt} (v_{jt} - \overline{v}_t)] = 0, \quad t = 1, 2, \ldots, T.
\end{equation}

While this requirement is less strict than the cross-sectional requirement that the tax price be uncorrelated with the entire error term, it can still fail to hold. Temporary increases in expenditure—perhaps the purchase of a durable good or service—affect tax price and produce estimates of the price elasticity that are biased and inconsistent. Trends in expenditure that are correlated with $p_{jt}$ can bias fixed effects estimates. For example, a community might be gradually decreasing expenditures in order to lower tax rates and attract more vacation home owners. If communities with relatively high concentration of vacation homes disproportionately engage in this policy, failure to control for the trend will bias estimates towards negative one.

**EXOGENOUS VARIATION IN TAX PRICE**

The twin problems for using within-community variation in tax price are (1) the magnitudes of the changes in tax price are usually much too small to produce precise estimates, and (2) the changes, if any, are possibly endogenous and their cause is unknown. A policy innovation in Minnesota ameliorates both of these problems. In 1996, the Minnesota state legislature made legal changes that produced exogenous and unanticipated changes in the vacation home tax base of taxing jurisdictions. Specifically, class rates on vacation homes fell by 12.5\%\footnote{Minnesota employs a progressive property tax rate system where the average effective tax rate (tax payments as percent of market value) increases with market value. In 1995 (taxes payable 1996), there were two class rates for vacation homes. The first $72,000 of market value faced a class rate of two percent, while anything beyond that faced a class rate of 2.5 percent. In 1996, the class rate on the first $72,000 of market value was reduced to 1.75 percent.}. All else equal, a lowering of...
class rates reduces total vacation home tax base in every jurisdiction and, thus, total tax base in every jurisdiction. These exogenous changes in the vacation tax base also produced exogenous changes in the fraction of total tax base that is derived from vacation homes. These exogenous changes are used as an instrumental variable to address possible problems with endogeneity of the tax price term. There were no other significant changes to the property tax code in 1996. See Table 3 for a brief summary of residential and vacation class rates for 1995 and 1996.20

These class rate changes were large enough to have significant effects on local communities with vacation homes. For instance, if there was no behavioral response to the class rate changes (that is, if there were no changes in property value, property location, or tax rates), the changes themselves would have decreased revenue by over four percent on average. In order to hold revenue constant, the tax rate would have to increase by four percent, or 0.7 percent in levels, on average. The average predicted decrease in the share of NTC derived from vacation homes would be eight percent, and the average predicted increase in residential tax share would be 4.3 percent.21

Changes over time in the values and locations of property cause the actual change in residential tax share to be different from the changes in tax share caused only by the modifications to class rates. In order to capture only the exogenous change in tax price, an instrumental variable is defined as the change in tax price that would have occurred if class rates changed but all property values and locations remained as they were prior to the change in class rates.

The instrument for the change in tax price is defined as:

\[
\Delta p_j^* = p_{j1996} - p_{j1995},
\]

where the implied tax price in 1996 is defined as:

\[
p_{j1996} = c_j \cdot \frac{\tilde{M}_{j1994}}{(M_{j1994} | c=r)} \cdot \frac{z_{1996} \cdot (m_{c1994} | c=r)}{z_{1996} \cdot m_{j1994}}
\]

as opposed to the actual tax price in 1996:

\[
p_{j1996} = c_j \cdot \frac{\tilde{M}_{j1995}}{(M_{j1995} | c=r)} \cdot \frac{z_{1996} \cdot (m_{c1995} | c=r)}{z_{1996} \cdot m_{j1995}}
\]

Since the class rate changes were decided at the state level and are uniform across the state, the fact that any change occurred is clearly exogenous to local tax and spending decisions. It is possible, however, that since class rates are lower, nonresidential property owners might choose to relocate, since at any given statutory tax rate, their effective tax rate is now lower. Relocation caused by class rate changes may depend on local fiscal policy, making changes in tax base composition endogenous.

These location effects would be relatively less important if the legislative changes were both unanticipated and made after the date at which the relevant location decisions could have been made. It seems unlikely that the class rate changes were anticipated. Many owners of second homes in Minnesota are in the

---

20 Note that Table 3 also demonstrates that vacation homes are taxed at a higher effective rate than the equivalent residential home at every location.

21 These figures apply to communities deriving at least 10 percent of their tax base from vacation homes in 1995.
Beggar Thy Neighbor? Property Taxation of Vacation Homes

metropolitan area of Minneapolis–St. Paul and they had been lobbying for years to have the class rates on vacation homes reduced. Measures to reduce class rates were proposed for five consecutive years until they finally passed in May of 1996. The reduction in class rates was a controversial issue. Legislatures from Northern Minnesota vehemently opposed the reduction, with one legislator comparing the reduction in class rates to a “terrorist act.” The reduction finally passed as a result of a late-night bargaining session.22

Since effective tax rates were immediately lowered on many types of property and, all else equal, residential tax shares were to increase, the class rate changes may have increased the market values of certain property classes and decreased the market values of others. This would only affect the actual changes in residential tax share if the class rate changes were anticipated by assessors (and the housing market) by January 1, 1996. To protect against potential problems involving relocation and capitalization, the instrument, as noted above, uses property value and location as of January 1, 1995 (i.e., property values from 1994), a full one and a half years before the class rate changes.

Since every community is subject to the same class rates, it is the initial distribution of vacation home value within communities that creates heterogenous treatment strengths and allows for identification of price effects. The actual receipt of the treatment of lost vacation home tax base is exogenous to each locality. The strength of the treatment, however, depends not only on the amount of vacation home value within a community, but also on the distribution of that value within a community. Since only the class rates on the first $72,000 of vacation value were changed, communities with a greater percentage of their vacation home tax base valued at under $72,000 will be affected more than places with relatively more of their value above $72,000.23 If the treatment strength is only correlated with the persistent component of the error term, a fixed effects approach will produce consistent estimates. Inconsistent estimates will only result if the strength of the treatment is correlated with the temporary components of the error term. For example, if a community receives a large treatment because it has a large and beautiful lake that attracts vacation homes, the strength of the treatment is correlated with a persistent component of the error term and there is no endogeneity. Treatment strength will be endogenous if a community only has more vacation homes and receives a larger treatment because, for example, the community has been aggressively lowering spending and tax rates over time to attract vacation homes.

DATA: SOURCES AND DESCRIPTIONS

Analysis is restricted to the sample of communities in Minnesota with a population of at least 500 but not greater than 20,000 during the sample period. The restrictions limit the sample to a more homogeneous group of communities than would be considered if large metropolitan areas were also included in the sample. Out of 919 localities in the sample, 489 are townships and 430 are municipalities. While cities have councils and engage in a representative democracy, townships in

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22 In Minnesota property is assessed as of January 1 each year, but the legislative change was not ratified until June 1996. The location of the assessment on January 1 determines to which jurisdiction a property owner will pay their taxes; thus an anticipatory move would have to have been made before January 1, 1996.

23 A community without vacation homes is not directly affected by the class rate change and has an implied change in residential tax share of zero.
Minnesota are required to feature more direct voting by local residents on fiscal issues.24

The property tax is the only ad valorem tax available to townships in Minnesota, and while cities can levy sales taxes, only four municipalities in the sample elect to do so. These restrictions on revenue sources reduce the possibility of specification error in the tax price variable. In both years of the sample, property tax revenues constitute, on average, over 33 percent of total local revenue. State and federal aid make up on average approximately 30 percent of both total municipal and township revenue. Property taxes constitute, on average, more than 70 percent of own source revenue for the 480 townships in the sample and approximately 29 percent of own source revenues for the 430 municipalities in the sample.25 Table 1 shows examples of some of the communities in the sample. Table 2 shows the summary statistics for the variables used in the regression analysis discussed in the next section.

The dependent variable in regressions is city and township per–permanent–resident expenditure on public services.26 The main independent variable of interest is the tax price faced by permanent residents. Tax price includes residential tax share, defined as the share of community tax base that is derived from residential homes owned by permanent residents. The rest of the tax base is derived from other properties such as commercial–industrial property, vacation homes, apartments, and farm land.

The economic model discussed above implies that the tax price variable includes not only residential tax share, but also the ratio of the median voter’s home value to the average residential home value and the marginal costs of service provision. The marginal costs of service provision are not directly observable for any years. Factors that affect production and costs are not expected to vary much from year to year, however, and the use of fixed effects should control for variation in these variables across communities.

Data on median home values are available from the U.S. Census in 1989 and 1999. A measure of the ratio of median to average home value using 1999 data was incorporated into the tax price variable in some regressions, but its inclusion had no quantitatively substantive effect on cross–sectional or fixed–effects estimates. The ratio of median value to average value varies little across communities, especially compared to the variation in the residential tax share. The median to average ratio is not included in the regressions discussed below.

To the extent that local costs and the ratio of the median voter’s home value to average residential value change from year to year, the estimated price elasticity may be biased. The shorter the time period of the estimating sample, the more likely it is that these assumptions hold.

Other independent variables include a measure of per–permanent–resident residential property wealth in a jurisdiction, and the per–permanent–resident amounts of state–aid programs to cities and towns in Minnesota.27 Per–permanent–resident residential wealth may be endogenous as it is likely influenced by revenue and

---

24 Cities are also sometimes subject to levy limits. Regressions interacting tax price with city–township status fail to reject the hypothesis that cities and towns respond similarly to price changes.

25 There are two explicit revenue sharing programs in Minnesota: one in the Minneapolis–St. Paul metropolitan area and one in Northern Minnesota on the “Iron Range.” These programs began in 1971 and 1997, respectively. Both programs share a portion of the growth in commercial–industrial tax base across cities/towns. None of the communities in this sample participates in either program.

26 Total expenditure does not necessarily equal total revenue. In fact, nearly every township and city in the sample collects excess revenue they do not spend each year. They allow the money to accumulate in a variety of funds and investments, spending some of excess revenue in later years.

27 The two largest programs are local government aid (LGA) and homestead agricultural credit aid (HACA).
<table>
<thead>
<tr>
<th>Name</th>
<th>Pop</th>
<th>Vac Share</th>
<th>Res Value</th>
<th>Vac Value</th>
<th>$\tau$</th>
<th>Revenue</th>
<th>Aid</th>
<th>Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Carver City</td>
<td>777</td>
<td>0</td>
<td>31,468.75</td>
<td>0</td>
<td>52.49</td>
<td>265.24</td>
<td>119.7</td>
<td>1,116.28</td>
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<td>Waterford Town</td>
<td>500</td>
<td>0</td>
<td>22,307.39</td>
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<td>48.75</td>
<td>26.89</td>
<td>143.68</td>
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<td>Glenville City</td>
<td>783</td>
<td>0</td>
<td>11,885.98</td>
<td>0</td>
<td>33.31</td>
<td>72.54</td>
<td>137.13</td>
<td>755.33</td>
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<td>Madelia City</td>
<td>2,234</td>
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<td>10,201.29</td>
<td>0</td>
<td>55.76</td>
<td>140.17</td>
<td>209.25</td>
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<td>Pine Island Town</td>
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<td>12,826.83</td>
<td>0</td>
<td>9.56</td>
<td>56</td>
<td>101.05</td>
<td>321.97</td>
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<tr>
<td>Lauderdale City</td>
<td>2,708</td>
<td>0</td>
<td>17,314.22</td>
<td>0</td>
<td>25.81</td>
<td>104.88</td>
<td>69.02</td>
<td>329.84</td>
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<td>Alden City</td>
<td>611</td>
<td>0</td>
<td>14,193.45</td>
<td>0</td>
<td>44.78</td>
<td>126.44</td>
<td>276.93</td>
<td>528.57</td>
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<tr>
<td>Gaylord City</td>
<td>2,001</td>
<td>0</td>
<td>14,492.3</td>
<td>0</td>
<td>42.17</td>
<td>120.67</td>
<td>279.97</td>
<td>2,555.28</td>
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<tr>
<td>Champlin City</td>
<td>19,154</td>
<td>0</td>
<td>30,974.1</td>
<td>0</td>
<td>18.23</td>
<td>78.24</td>
<td>89.33</td>
<td>888.85</td>
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<td>Norwood Young America City</td>
<td>1,387</td>
<td>0</td>
<td>18,377.39</td>
<td>0</td>
<td>37.61</td>
<td>138.54</td>
<td>114.33</td>
<td>797.47</td>
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<tr>
<td>Top 10</td>
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<td></td>
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<tr>
<td>Cross Lake City</td>
<td>1,347</td>
<td>69.25</td>
<td>61,394.99</td>
<td>117,316.77</td>
<td>14.96</td>
<td>548.44</td>
<td>30.8</td>
<td>1,659.37</td>
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<td>Breitung Town</td>
<td>612</td>
<td>69.29</td>
<td>16,980.26</td>
<td>25,299.21</td>
<td>35.3</td>
<td>268.18</td>
<td>90.77</td>
<td>674.23</td>
</tr>
<tr>
<td>Breezy Point City</td>
<td>544</td>
<td>70.39</td>
<td>44,817.38</td>
<td>111,709.34</td>
<td>29.44</td>
<td>961.77</td>
<td>56.61</td>
<td>1,459.82</td>
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<tr>
<td>Ponto Lake Town</td>
<td>537</td>
<td>70.74</td>
<td>25,211.71</td>
<td>44,102.05</td>
<td>6.97</td>
<td>88.08</td>
<td>18.2</td>
<td>96.73</td>
</tr>
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<td>Ideal Town</td>
<td>790</td>
<td>71.41</td>
<td>64,368.84</td>
<td>152,754.33</td>
<td>7.46</td>
<td>352.39</td>
<td>9.74</td>
<td>691.92</td>
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<td>South Harbor Town</td>
<td>625</td>
<td>71.91</td>
<td>27,231.57</td>
<td>39,730.37</td>
<td>9.75</td>
<td>114.11</td>
<td>13.07</td>
<td>146</td>
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<td>Baylake Town</td>
<td>734</td>
<td>72.43</td>
<td>41,348.38</td>
<td>96,096.27</td>
<td>7.93</td>
<td>222.04</td>
<td>39.81</td>
<td>532.09</td>
</tr>
<tr>
<td>Greenwood Town</td>
<td>569</td>
<td>72.54</td>
<td>49,104.21</td>
<td>91,410.65</td>
<td>11.07</td>
<td>290.44</td>
<td>38.9</td>
<td>714.39</td>
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<tr>
<td>Woodrow Town</td>
<td>516</td>
<td>72.93</td>
<td>43,622.64</td>
<td>92,183.26</td>
<td>4.47</td>
<td>115.65</td>
<td>41.11</td>
<td>241.91</td>
</tr>
<tr>
<td>Shamrock Town</td>
<td>871</td>
<td>75.06</td>
<td>31,330.28</td>
<td>65,327.19</td>
<td>10.79</td>
<td>189.7</td>
<td>32.23</td>
<td>405.24</td>
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<tr>
<td>Dunn Town</td>
<td>696</td>
<td>76.09</td>
<td>33,842.84</td>
<td>91,492.59</td>
<td>9.62</td>
<td>242.22</td>
<td>23.58</td>
<td>199.44</td>
</tr>
</tbody>
</table>

Source: Author’s tabulations based on Minnesota Department of Revenue Data.
Note: Sample is restricted to cities and townships with population greater than or equal to 500 but not greater than 20,000 in both 1995 and 1996. Variables: population or number of permanent residents (Pop), share of tax base that is derived from vacation homes (Vac Share), per-capita market value of residential homes (Res), per-capita market value of vacation homes (Vac), the statutory property tax rate expressed as taxes due per $100 of assessed value ($\tau$), per-capita local property tax revenue (Revenue), aid from state and federal sources (Aid), and expenditures (Expenditure). Where appropriate, variables are in 1995 U.S. dollars. The year is the assessment year not the taxes payable year.
### Table 2
**Sample Descriptives: Local Expenditure, Revenue and Tax Base Variables**
*Means 1995–1996*
*(Standard Deviations in Parentheses)*

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>1995</th>
<th>1996</th>
<th>%Δ96–95</th>
</tr>
</thead>
<tbody>
<tr>
<td>property tax rate</td>
<td>26.96</td>
<td>26.6</td>
<td>−1.83</td>
</tr>
<tr>
<td></td>
<td>(20.64)</td>
<td>(21.16)</td>
<td>(17.66)</td>
</tr>
<tr>
<td>property tax revenue</td>
<td>116.91</td>
<td>116.82</td>
<td>1.51</td>
</tr>
<tr>
<td></td>
<td>(126.17)</td>
<td>(111.8)</td>
<td>(18.43)</td>
</tr>
<tr>
<td>expenditure</td>
<td>575.61</td>
<td>578.79</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>(728.26)</td>
<td>(640.51)</td>
<td>(0.6)</td>
</tr>
<tr>
<td>residential tax share</td>
<td>64.89</td>
<td>66.13</td>
<td>2.64</td>
</tr>
<tr>
<td></td>
<td>(20.85)</td>
<td>(20.35)</td>
<td>(5.35)</td>
</tr>
<tr>
<td>vacation home tax share</td>
<td>7.87</td>
<td>7.16</td>
<td>−9.99</td>
</tr>
<tr>
<td></td>
<td>(16.29)</td>
<td>(15.12)</td>
<td>(69.57)</td>
</tr>
<tr>
<td>residential property wealth</td>
<td>28,359.93</td>
<td>29,488.04</td>
<td>4.18</td>
</tr>
<tr>
<td></td>
<td>(16,418.45)</td>
<td>(16,874.98)</td>
<td>(4)</td>
</tr>
<tr>
<td>total aid</td>
<td>158.21</td>
<td>164.98</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>(194.88)</td>
<td>(212.88)</td>
<td>(0.65)</td>
</tr>
<tr>
<td>non–property local–source revenue</td>
<td>291.04</td>
<td>299.7</td>
<td>1.44</td>
</tr>
<tr>
<td></td>
<td>(512.92)</td>
<td>(471.05)</td>
<td>(6.67)</td>
</tr>
<tr>
<td>population</td>
<td>2,140.39</td>
<td>2,182.8</td>
<td>1.74</td>
</tr>
<tr>
<td></td>
<td>(3,046.65)</td>
<td>(3,108.46)</td>
<td>(5.93)</td>
</tr>
</tbody>
</table>

Observations 919 919 919

Source: Author’s tabulations based on Minnesota Department of Revenue Data.
Note: Standard deviations are in parentheses. All variables are means for the entire sample. Sample is restricted to cities and townships with population greater than or equal to 500 but not more than 20,000 in 1995 and 1996. The property tax rate is the municipal property tax rate and is expressed as taxes owed per $100 of taxable property value. Variables indicating percentages of total tax base (i.e., tax share) express the amount of tax base that is residential per $100 of total tax base. Property tax revenue, expenditure, residential property wealth, total aid, and non–property local–source revenue are all expressed in per capita terms. The last column displays the average percentage change across communities in the variable from assessment year 1995 to assessment year 1996. Where appropriate, variables are in 1995 U.S. dollars. The year is the assessment year not the taxes payable year.

### Table 3
**Minnesota Class Rate Changes**
*(Share of market value that is taxable)*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacation homes</td>
<td>0.02</td>
<td>0.025</td>
<td>0.0175</td>
<td>0.025</td>
</tr>
<tr>
<td>Residential homestead</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Source: Minnesota Department of Revenue.
Note: Entries represent the class rate on vacation homes and residential property for 1995 and 1996. Class rates increase with the market value of a property. The class rate applies only to that portion of the property’s market value that is within the stated limit. The product of a property’s class rate and market value is its taxable value. Class rates on the first $72K of vacation–home market value decreased by 12.5% in 1996. Property tax payments equal the product of a property’s taxable value and the local property tax rate. There were no other class rate changes in 1996. The Minnesota state legislature sets class rates each year. The class rate change occurred after market values were already fixed for 1996.
expenditure decisions. It is, however, important to distinguish between the wealth effects of residential property values and the corresponding price effects of residential property values. Fortunately, the estimated coefficients on residential tax share are for the most part not sensitive to the inclusion of the residential property wealth variable.\(^{28}\)

In addition to residential property wealth, median income is also included in many regressions estimating price elasticities. Observations of median income are not available for 1995 or 1996. Again, however, Census data are available and median income from 1999 was included in several cross-sectional regressions. Yet again, the inclusion of median income had no substantive quantitative effect on cross-sectional estimates of the price elasticity. Median income in a community is also likely approximately constant over the two-year sample period and will be controlled for by the fixed effect.\(^{29}\)

All aid programs are distributed according to a state formula and their amounts are announced before cities and towns decide on their spending for the year.\(^{30}\) Revenue from other local sources is also included in the regressions. Filing fees, fines, special assessments, licenses, fund transfers, and returns on investments constitute the majority of these other revenue sources. Availability of these sources may reduce the need for revenues from the property tax and certainly assists in the financing of expenditures. While revenues from fees, fines, and licenses appear fairly stable, investment revenue, transfers across funds, and special assessment are extremely volatile and often appear one year only to be absent the next year. Of the 919 communities in the sample, 334 had no special assessment revenue in 1996 and 269 have no special assessment revenue from 1994 through 1996. Over 90 percent of the sample had no fund transfers in 1996, but 12 communities had fund transfers of over $100,000. In addition, over 75 percent of the sample did not generate any revenue from the sales of investment, but just under five percent of the sample generated more than $50,000 from the sale of investments in 1996.

Data on the taxable and market values of all properties within Minnesota from 1995 through 1996 (taxes payable 1996 and 1997) were made available by the Minnesota Department of Revenue. These data detail property values by class of property for every county, township, city, and school district in Minnesota.\(^{31}\) There are

\(^{28}\) All regressions were run with and without the residential wealth variable. The coefficients on all other variables exhibited very little variation across these different regressions. As expected, variation in the coefficient was especially minimal in the instrumental variable regressions.

\(^{29}\) Many cross-section regressions of demand for public expenditure include median income. When column (2) of Table 4 includes median income (U.S. Census, 2000) along with the other control variables, the sample size falls to 904 because of data availability and merging issues. The coefficient on tax share becomes \(-0.24\) with a standard error of \((0.035)\). Median income has a coefficient of \(0.199\), with se = 0.068 and residential wealth has a coefficient of \(0.086\) with se = 0.034.

\(^{30}\) These are not matching grants. The LGA formula in 1995 and 1996 was adopted in 1993 and consists of two parts: an amount determined by the formula and a “base” amount, also known as grandfathered aid. The base amount does not change unless specifically provided for in legislation. Each locality’s formula aid is equal to a percentage of the difference between its “need” and “ability to pay.” Ability to pay is the city’s tax base and need is based on four factors: population, population decrease, percent of its housing built before 1940, and percent of its tax base that is classified as commercial or industrial. The total amount of aid each year is capped. See Baker, Hinze, Dalton, Michael, and Massman (2003) for more details.

\(^{31}\) The distribution of property values within each class is also available in these data. These data are actually based on a geography called a “unique taxing jurisdiction (UTJ).” This is an area in which all properties face the same statutory tax rates. For example, in Minnesota two homes can be in the same city but in different school districts. They would be located in two different unique taxing jurisdictions. It is possible to collapse these UTJ level data to the city, township or school district level, and that is what is done here.
12 major classes of property in Minnesota with various subclasses within each class as well. Data on property tax revenue, tax rates, and state aid were also made available for 1995 through 1996 at the city, township, school district and county levels by the Department of Revenue. Total expenditure levels at the city and town level were obtained from the Office of the State Auditor in Minnesota. All amounts are expressed as 1995 U.S. dollars. All variables included in regressions are in natural logs.

RESULTS

Data analysis suggests that permanent residents substantially increase expenditures in response to the reduction in tax price caused by vacation homes. A one-percent increase in the proportion of the tax base that is derived from vacation homes, causing the tax price to fall is associated with at least a one-percent increase in expenditures. Instrumental variables estimation suggests that endogeneity of the tax share variable biases the point estimates of price elasticity towards zero.

Columns (1) and (2) in Table 4 show the results of a cross-section regression with per-permanent-resident expenditure as the dependent variable. The relationship between residential tax share and expenditure is first examined without additional explanatory variables. The coefficient in column (1), denoted $\beta_{vq}$, represents an elasticity, suggesting that a one-percent increase in residential tax share is associated with a 1.047-percent decrease in per-permanent-resident expenditure. Including additional explanatory variables in column (2) substantially lowers $\beta_{vq}$ to −0.267, with a smaller standard error. Both coefficients are significant.

<table>
<thead>
<tr>
<th>Dependent Variable: expenditure</th>
<th>OLS (1)</th>
<th>OLS (2)</th>
<th>FE (3)</th>
<th>FE (4)</th>
<th>FE IV (5)</th>
<th>FE IV (6)</th>
<th>RT IV (7)</th>
<th>RT IV (8)</th>
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</thead>
<tbody>
<tr>
<td>residential tax share</td>
<td>−1.047 (0.089)</td>
<td>−0.267 (0.032)</td>
<td>0.26 (0.386)</td>
<td>−0.231 (0.252)</td>
<td>−1.211 (0.65)</td>
<td>−1.508 (0.649)</td>
<td>0.399 (0.4)</td>
<td>−3.045 (2.154)</td>
</tr>
<tr>
<td>residential property wealth</td>
<td>0.194 (0.025)</td>
<td>−0.196 (0.292)</td>
<td>0.209 (0.405)</td>
<td>−0.356 (0.25)</td>
<td>0.495 (0.585)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>aid</td>
<td>0.45 (0.019)</td>
<td>0.322 (0.03)</td>
<td>0.334 (0.033)</td>
<td>0.239 (0.033)</td>
<td>0.241 (0.037)</td>
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<tr>
<td>local non-property revenue</td>
<td>0.327 (0.012)</td>
<td>0.204 (0.013)</td>
<td>0.207 (0.013)</td>
<td>0.198 (0.012)</td>
<td>0.2 (0.013)</td>
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<td></td>
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</tr>
</tbody>
</table>

Observations: 919 919 919 919 919 919 904 904
R-squared: 0.151 0.906 0.001 0.421 — — 0.36 —

Note: Standard errors are in parentheses. The table shows results from cross section and fixed effects regressions of per-permanent resident local expenditures on residential tax share. All variables are in logs so that the coefficients represent elasticities. Columns (1) and (2) report results using OLS on 1996 data. Columns (3) and (4) use fixed effects and columns (5) and (6) use first differences with the instrumental variable for years 1995 and 1996. The instrument for residential tax share is the change in residential share caused only by a policy change in Minnesota that decreased the class rate of vacation home properties. Columns (7) and (8) use data for 1994–1996 to estimate a random trends model. The sample size is smaller in columns (7) and (8) because only cities and towns with 3 consecutive years of data were included.

Sample is restricted to cities and townships in Minnesota with population greater than or equal to 500 but not more than 20,000 during the sample period. Variables indicating percentages of total tax base (i.e., tax share) express the amount of tax base that is residential per $100 of total tax base. Where appropriate, variables are in 1995 U.S. dollars.

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32 Data on revenue are adjusted for inflation using the Consumer Price Index (CPI) for all items from the Bureau of Labor Statistics.
different from zero. Residential market value is included in the regression because increases in residential tax share may also be caused by increases in residential home values, which, by increasing the wealth of residents, may increase the demand for local services and local revenue. The coefficient on per-capita residential market value is significant and positive at 0.194, indicating that localities with more per-capita residential wealth have higher expenditures. To the extent that any changes in income are correlated with changes in residential market value, this coefficient reflects income elasticity as well. Previous cross-sectional studies (e.g., Ladd (1975)) have found this coefficient to be positive and significant.33

The coefficient on per-capita state aid is 0.45, indicating that a one-percent increase in per-capita state aid is associated with a 0.45-percent increase in local per-permanent-resident expenditure. The coefficient on local non-property tax revenue of 0.327 implies a relatively large and positive association with local per-permanent-resident expenditures. This is because communities with more non-property-tax revenues tend to be larger and provide more services. Larger non-property-tax revenues, in the form of larger fees, fines, and special assessments, may also indicate a stronger preference for public services. There is a strong negative correlation between residential tax share and local non-property revenue. This negative correlation arises because municipalities have larger populations, more non-residential property, and substantially more non-property-tax revenue on average.34

This is not an exhaustive list of control variables. Using fixed effects, however, controls for any time-invariant variables that are correlated with the residential tax share and local expenditures. Columns (3)–(6) detail the results from fixed effects regressions with and without instrumental variables.35 Column (3) is the simple regression of per-permanent-resident expenditure on residential tax share. The coefficient on tax share in column (3) is actually positive at 0.26 and is biased above zero because of the omission of the other control variables. The fixed effects coefficient on tax share without control variables is substantially different than the −1.047 found in the cross-sectional regression without controls.

Column (4) shows that the coefficient on tax share is less than zero upon the inclusion of the residential wealth, aid, and other revenue variables. The tax share coefficient is now −0.231 and is similar to its counterpart in column (2), possibly reflecting the limited effect of omitted time-invariant variables in the cross-sectional regressions. The standard error, however, is larger than the coefficient, making it impossible to reject that the null hypothesis that the actual coefficient is zero. The coefficient on residential market value in column (4) is lower than its estimate in column (2) and is negative at −0.196. Again, however, the standard error is quite large. There is limited variation in residential wealth from 1995 to 1996, making it difficult to calculate precise estimates. The coefficient on aid is significantly different from zero, at 0.3224, implying that a one-percent increase in

33 Ladd (1975) found a coefficient of 0.2392 on residential wealth where the dependent variable was per pupil education expenditure.

34 When the natural log of population is also included in the regression estimated in column (2), its coefficient is estimated to be 0.04 and is significantly different from zero. The inclusion of population decreases lowers the coefficient on residential tax share slightly to −0.272 while the standard error remains nearly identical. Including township status as an additional control variable also lowers the coefficient on residential tax share only slightly to −0.277.

35 The results reported here are for regressions with a constant term that allows for different year effects on expenditure.
aid is correlated with a 0.322–percent increase in expenditure. The coefficient on local non–property–tax revenue is 0.204, making both the aid coefficient and the non–property–revenue coefficient slightly lower than their cross–sectional counterparts in column (2). The estimated coefficient on residential tax share implies a relatively low price elasticity. These estimates, however, are biased towards zero because of the simultaneity between expenditures and residential tax share. Columns (5) and (6) use the instrumental variable to control for the endogeneity of residential tax share arising from the effects of local fiscal variables on location choices and property values.

The instrument produces implied changes in residential tax share that are exogenous to each locality and, in some cases, highly correlated with the actual changes in residential tax share. As described above, the instrument is defined as the change in a community’s residential tax share that is implied only by the class rate change in Minnesota in 1996. The implied change assumes that property values and property location (across communities) did not change. The first stage equation regresses actual changes in residential tax share on the implied changes in residential tax share for all 919 communities in the sample and has an R–squared of 18 percent. See Table 5 for the results of the first stage regres-

<table>
<thead>
<tr>
<th>TABLE 5</th>
<th>FIRST STAGE REGRESSION</th>
<th>(Standard errors in parentheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable: actual %Δ res. share</td>
<td>(1)*</td>
<td>(2)*</td>
</tr>
<tr>
<td>implied %Δ res. share</td>
<td>0.286</td>
<td>0.327</td>
</tr>
<tr>
<td></td>
<td>(0.074)</td>
<td>(0.101)</td>
</tr>
<tr>
<td>residential property wealth</td>
<td>−0.125</td>
<td>−0.421</td>
</tr>
<tr>
<td></td>
<td>(0.091)</td>
<td>(0.086)</td>
</tr>
<tr>
<td>lump–sum aid</td>
<td>0.01</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>local non–property revenue</td>
<td>0.003</td>
<td>−0.001</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>% vacation</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

Observations | 919 | 919 | 233 | 233 |
R–squared | 0.168 | 0.183 | 0.586 | 0.663 |

Note: Standard errors are in parentheses. The table shows results from fixed effects (first difference) regressions of actual changes in residential tax shares on implied changes in residential tax shares. The implied change in residential tax share is the change that would have occurred if only the class rates on vacation homes had changed and property locations and values had remained the same. All variables are in logs so that the coefficients represent elasticities. Property wealth, aid, and local non–property revenue are all per–resident numbers. Columns (1)–(4) use data from 1995 and 1996. Columns (1) and (2) are used for estimation.

The samples used in columns (1)–(4) include cities and townships that have a population of at least 500 and not more than 20,000. The regressions are run on various samples as indicated by the “% vacation” entry in the table. Columns (1) and (2) do not restrict the sample beyond the population restriction. Columns (3) and (4) restrict the sample to include only those cities and townships deriving at least 5% of their tax base from vacation homes.

The reason for including population in the cross–section regression is to consider economies of scale and cost differences. The reasoning is less clear in first differences across two years as the level of population changes being considered are not going to change costs significantly.

If the first stage is run on a sample of communities with a percent of tax base derived from vacation homes of at least five percent, the R² is 0.66 with the coefficient on implied change in residential tax share of 0.734. This suggests that capitalization and migration are not playing a large role in determining the tax price in the communities most likely to be affected by the class rate change.
sion under two different samples, with columns (1) and (2) used for the estimates discussed below.

Without any additional explanatory variables, the I.V. estimate for price elasticity in column (5) is \(-1.211\) and it is significantly different from zero. The inclusion of the additional explanatory variables in column (6) changes the coefficient to \(-1.508\), with the standard error remaining virtually the same. The point estimates of the price elasticity for the I.V. regression are substantially different and much larger in absolute value than the coefficients from the non–I.V. regressions, suggesting that endogeneity in residential tax share is playing a large role. In fact, in the 340 communities with no vacation homes in their tax base, all of the variation in residential tax share may be endogenous.\(^{38}\) As explained earlier, the simultaneity of expenditures and residential tax share creates endogeneity that biases estimates of the price elasticity towards zero. The I.V. estimates of price elasticity imply that a one–percent increase in residential tax share is associated with a 1.5–percent decrease in per–permanent–resident expenditure. The standard errors of the estimated coefficients in columns (5) and (6) are relatively large. The null hypothesis that the elasticity is zero can be rejected, but the null hypotheses that the true elasticity is \(-0.5\) or even \(-0.2\) cannot be rejected.\(^{39}\)

It might be possible that certain communities were, for example, increasing expenditure over time. If the communities experiencing an upward trend in expenditure tended to be places with few vacation homes, the I.V. estimates would be biased in the negative direction because the change in residential tax share implied by the instrument would be negatively correlated with local expenditure trends. Columns (7) and (8) display results from regressions that allow each community to have its own linear time trend in expenditure (i.e., a random trends model).\(^{40}\) In order to estimate the community–specific linear time trend, it is necessary to incorporate an additional year of data. The regressions in columns (7) and (8) use data from 1994 through 1996. Column (7) uses actual variation in residential tax share, while column (8) uses only the variation caused by the class rate change. Note that the implied change in residential tax share is zero for all communities from 1994 to 1995 since there was no policy change.

These results again demonstrate the substantial positive bias that results from using endogenous variation in local tax prices (i.e., residential tax share). The coefficient on residential tax share in column (7) is positive at 0.399. The remaining coefficients on aid, residential wealth, and other local revenue are similar to their counterparts in column (4). Column (8) presents results from a regression that

\(^{38}\) Regressions that restrict the sample to contain only those communities with tax base derived from vacation homes of at least five percent result in estimated elasticities very similar to the instrumental variable results reported above. This is to be expected since most of the variation in the instrument is coming from these communities.

\(^{39}\) Changes in residential wealth may also be endogenous as they are likely influenced by local fiscal policy. Regressions were run both with and without the residential wealth variable in order to test the robustness of the results with regard to the residential wealth variable. The inclusion (and omission) of residential wealth has minimal influence on the I.V. and non–I.V. fixed effects estimates. For example, the coefficient on residential tax share using fixed effects but not controlling for residential wealth is \(-0.264\), compared to \(-0.231\) when residential wealth is included. The institutional features of the assessment system imply that the measure of residential wealth in assessment year 1996 is actually residential wealth in 1995, and the expenditure for assessment year 1996 occurs in 1997 and is decided in late 1996. This makes residential wealth effectively a lagged variable. Lagged variables, however, may still violate strict exogeneity. The coefficients on residential wealth, however, should be interpreted with caution as they may be biased.

\(^{40}\) See Wooldridge (2002) for a description of random trends modeling.
uses only exogenous variation in local tax price. The coefficient on residential tax share is substantially more negative at −3.045, with a standard error over two-thirds the size of the coefficient. Including 1994 substantially increases the standard error in column (8) because there is no variation across communities in the instrument for residential tax share from 1994 to 1995. The point estimate, however, demonstrates that the large negative coefficient estimated in column (6) is not simply caused by the omission of community-specific time trends.

The reduced class rates caused by the policy change reduce the total tax base and alter its composition. Is it possible that the results above are not behavioral, but are simply the result of communities maintaining the same tax rates and simply collecting less revenue with which to finance expenditures? This is most certainly not the case. The change in class rates was announced in May of 1996 and local property tax revenues and property tax rates for assessment year 1996 (taxes payable 1997) are not approved until the fall and are not finalized until January 1997. In addition, local governments in Minnesota are legally required to set property tax revenue with the tax rate only being determined by the ratio of the revenue to the total property tax base. Thus, in order to maintain the same tax rate, a community would have to consciously alter their requested revenue to maintain the same revenue to tax base ratio. Finally, and perhaps most succinctly, none of the 919 communities in the sample maintained the same statutory tax rate from assessment year 1995 to assessment year 1996.

An estimated price elasticity of demand of greater than one suggests that a community responds to additional vacation home tax base, and the corresponding reduction in tax price, by increasing its tax rate in order to finance higher expenditures. Remember that with the addition of new tax base, a community could actually decrease its statutory tax rate and still maintain or even increase total revenues and expenditures. Since communities have revenue sources other than the property tax, the expenditure regressions only suggest, but do not directly demonstrate, that property tax revenues increase to finance the additional expenditure.

Table 6 displays results from regressions with property tax revenue as the dependent variable. These results confirm that the reduction in tax price caused by vacation homes is associated with increases in property tax revenues as well as increases in expenditures. Again, columns (1) and (2) present the results for cross-sectional regressions for 1996, while columns (3) and (4) display results using data from 1995 and 1996 and controlling for fixed effects. The coefficient on residential tax share in column (4) suggests that a one-percent increase in residential tax share is associated with a 0.561-percent decrease in property tax revenues. The instrumental variables estimation in column (6) suggests that this coefficient, like the coefficient in column (4) in the expenditures regression, is biased towards zero because of the endogeneity of residential tax share. Estimates from column (6) suggest that a one-percent increase in residential tax share is associated with a 1.317-percent decrease in property tax revenues. The estimated response in property tax revenues is consistent with a scenario in which a community reacts to more vacation home tax base by increasing its property tax rate to finance additional expenditures.

41 The large difference in the tax share coefficient in columns (5) and (6) is caused by the residential property wealth variable. Since residential property wealth is potentially endogenous, this may cause concerns about these results. The expenditure I.V. results, however, are not sensitive to the residential wealth variable as is demonstrated in columns (5) and (6) in Table 4.
As with expenditure, it is possible that community–specific linear time trends may bias results. Again as with the expenditure regressions, the endogeneity of tax share biases the coefficient in column (7) towards zero. The instrumental variable results in column (8) are consistent with the elasticity near one found in column (6). The standard errors are large, however, and it is impossible to reject that the true elasticity is actually one or zero.

**CONCLUSION**

The variation in vacation home tax base in these data offers an excellent opportunity to understand the response of local governments to differences in the real costs of public expenditure. Previous estimates of the elasticity of demand for public services range from 0 to 0.5. By exploiting exogenous variation in the residential tax share, this study identifies a much larger elasticity than those found in previous research. The estimated elasticity is as high as 1.5, implying that a one–percent–higher tax price is associated with expenditures that are as much as 1.5–percent lower. These results suggest that local governments take advantage of the minimal political power of vacation home owners and a reduced tax price by substantially increasing expenditures on public services.

The regression results above suggest that the primary reason for the much larger elasticity found in this study is that the results are no longer biased towards zero by the endogeneity of the local tax price. Indeed, the difference in the point estimates suggests that the effects of the endogeneity of local tax price on elasticity estimates may be substantial. The results suggest that the endogeneity of local tax price may bias estimates of the elasticity downward by as much 500 percent.

There are, however, other differences between this study and previous studies.
that may explain some of the difference in the estimated elasticities between this and previous work. First, most previous work has focused on estimating demand functions for large cities in the United States, while this study examines relatively small communities in Minnesota. Results could differ if these communities provide a different mix of services than other communities or if the preferences of Minnesotans diverge widely from that of most Americans.42

Second, most previous studies examining tax prices and tax exporting have focused on expenditures by school districts, not those by local governments. It is very possible that the price elasticity of demand for educational services differs from the price elasticity of demand for municipal and township services.

Third, the within-community variation in local tax price, while having the advantage of being exogenous, is derived only from changes in the tax base derived from vacation homes. It is entirely possible that communities respond differently to variation in vacation home tax base then they do to variation in commercial–industrial tax base. If, for example, vacation home tax base were less mobile (perhaps due to attraction to a local amenity) then commercial tax base permanent residents would be more able to increase taxes without fear of losing tax base.

Given the difficulty in establishing any causal results of tax base composition on local fiscal decisions, this study provides a starting point for estimates of the causal effects of differences in local tax prices and tax base composition on fiscal policy. The estimated elasticities demonstrate the substantial bias that can result from the endogeneity of local tax price. Future work on the effects of tax base composition and differences in local tax prices on fiscal variables must focus on finding variation in tax base composition that is not caused by variation in the fiscal (outcome) variables under study.

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