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# Tiebout Sorting, Zoning, and Property Tax Rates

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**Abstract:** This paper examines certain implications from the literature on Tiebout's model of local government service provision, particularly Hamilton's extension of the model to include local control of land use and property taxation. Our empirical analysis focused on the use of fiscal zoning to lower property tax rates, a topic that has not been addressed in the extensive literature on Tiebout's model. Using data for over 100 municipalities in the Miami, Florida, metropolitan area, we specified property tax rates as a function of fiscal zoning measures, other municipal characteristics, and tax mimicking. We conclude that single-family zoning is by far the most important variable explaining municipal property tax rates.

**Keywords:** Tiebout model; fiscal zoning; single-family zoning; property taxation; Miami

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## 1. Introduction

### 1.1. Overview

This paper presents an empirical analysis of certain implications of Charles Tiebout's seminal 1956 article, "A pure theory of local expenditures" [1], and subsequent work expanding on Tiebout's model (a useful review of this work is provided by Oates [2]). Tiebout argued that a system of local governments in a metropolitan area can provide an efficient market for public services by allowing households to choose to live in a municipality that provides an optimal combination of taxes and public services. Subsequent research—notably by Hamilton [3]—has emphasized the role of property taxes as the price for public services, and for their role in local control of land use as an exclusionary tool that can be used in some circumstances to zone out uses that consume large amounts of services relative to the property taxes they yield. One implication of this is that single-family residential uses may be preferred over multi-family residential uses. Within a metropolitan region, smaller and wealthier municipalities may be better able to employ land use controls to lower property tax rates than larger, more diverse municipalities, such as central cities [4]. We analyse over 100 municipalities in the Miami-Fort Lauderdale-West Palm Beach, Florida, Metropolitan Statistical Area (the "Miami MSA"), to determine whether property tax rates were a function of factors implied by the literature on Tiebout residential sorting. We were particularly interested in measuring the impacts of fiscal zoning on property tax rates, a topic that to our knowledge has not previously been addressed in the extensive Tiebout literature.

In a Tiebout-like jurisdiction, the effective property tax rate is the price for public goods and services paid by a resident owning a property [5]. It is the nominal property tax rate set by the tax authority of the jurisdiction multiplied by the property's assessment ratio, which is the ratio of assessed value to market (or sale) price [6]. The variation in effective property tax rates across properties within the same municipality arises from the variation in assessment ratios because these properties share the same nominal property tax rate. However, the variation in effective property tax rates across properties in different municipalities is attributed to variation in the assessment ratio across properties and variation in nominal property tax rates across municipalities.

The nominal property tax rate is a function of, among other things, socio-economic characteristics of the jurisdiction, which influence demand for local public services. In a system of local jurisdictions, municipalities behave strategically in setting property tax rates. Tax rates mimic those of nearby municipalities, due to either competition for movable tax base or yardstick competition. Each jurisdiction attempts to keep its nominal property tax rate low to preserve its tax base and satisfy its residents. Fiscally-motivated zoning may be employed in some situations to keep tax rates low. Benefit spillover effects may also cause municipalities to keep tax rates lower than would otherwise be the case. In the literature on tax mimicking, what is referred to as the property tax "reaction" function relates the nominal or effective property tax rate of a strategic jurisdiction not only to its own characteristics, but also to the tax rates in competing jurisdictions.

An individual property's effective tax rate is affected by the determinants of the property's assessment ratio and determinants of the municipality's nominal property tax rate. The property's assessment ratio is affected by property characteristics associated with systematic errors made by assessors, as well as any legal constraints on increases in assessed values or property tax rates. The effective property tax rate for a property in a given jurisdiction is based on the assessment ratio and nominal property tax rate of the jurisdiction, so it is a function of property characteristics, fiscal zoning measures, socio-economic characteristics of the jurisdiction, tax rates in competing jurisdictions, and regulatory limits.

We measured municipal property taxes in two ways. First, we used the official or nominal tax rate set by the local government. Second, we used the mean of the effective tax rates applicable to residential properties in the municipality. We modelled nominal and effective tax rates as a function of socio-economic characteristics, land use (zoning) characteristics, and reliance on the property tax as a source of revenue. We also added spatial lags to the model to allow for the possibility of tax mimicking and externalities.

Our preferred model had the mean effective tax rate as a dependent variable. We found that effective tax rates were negatively related to the proportion of residential property in single-family rather than multi-family use, which is consistent with the Tiebout-Hamilton theoretical framework. We also found strong evidence that commercial zoning, and weaker evidence that industrial zoning, were used for tax shifting purposes. There was a negative relationship between expected tax rates and mean household income and positive relationships between effective tax rates and municipal population, the percentage of children, and reliance on the property tax as a source of revenue. We also concluded that a spatial lag model was appropriate for our data, consistent with the existence of spillover or mimicking effects across municipal boundaries.

The balance of this introductory section includes a more detailed review of the literature on Tiebout sorting, interactions among jurisdictions, and other factors relevant to nominal and effective property tax rates. This is followed by sections on our econometric strategy and data, results, and a concluding discussion section.

There are two major lines of literature relevant to this study. The first of these is concerned with the relationship between Tiebout sorting, local land use regulation, and property tax rates. The second line of research investigates how property tax rates are affected by fiscal interactions with other jurisdictions. The literature also suggests a number of other factors that may affect property tax rates.

### 1.2. Tiebout Sorting

Tiebout's well-known paper [1] argued that a system of local governments can efficiently provide public services to households that sort themselves across municipalities according to their preferences (i.e., they "vote with their feet"). Hamilton [3] pointed out that Tiebout did not specify a way to set prices for local services, stating that "the Tiebout Hypothesis seems to be a formula for musical suburbs, with the poor following the rich in a never-ending quest for a tax base" (p. 205). Hamilton argued that local control of land use, combined with the use of property taxes to fund local public services, provides the means to restrict entry. Viewed more broadly, municipalities can, under certain circumstances, use fiscal zoning techniques to give preference to land uses that result in low demands for public services relative to the property tax revenue they generate. We note that a municipality's preference for single-family residential uses may also have other motivations, such as a desire to keep out low-income or minority households [7].

There are two primary versions of fiscal zoning: one approach gives preference to single-family residential uses over multi-family uses, while the other gives preference to commercial and perhaps industrial uses over residential uses. Zoning that favours single-family uses may also require relatively large lots. The logic underlying these practices is that single-family uses generate more property tax revenue per capita than multi-family uses, and commercial and industrial uses generate tax revenue but may require relatively little in the way of local public services. These practices are workable only in relatively small, homogeneous municipalities [8]. For example, single-family zoning can work to exclude multi-family housing only in small municipalities where relatively well-off households want to live. While the use of single-family zoning by relatively wealthy communities to restrict entry to lower-income households is an implication of the Tiebout-Hamilton theoretical framework, commercial or industrial zoning does not restrict entry to any class of households but instead is a form of tax shifting that generates revenues from non-residents.

Single-family or large-lot zoning may not be necessary to achieve income segregation or variation across municipalities. Ellickson [9] argued that households will voluntarily segregate if housing and local public services are complements in their utility functions; he assumed that public services are funded with a proportional property tax. However, wealthier communities can achieve high levels of public services with relatively low property tax rates, leading to the "musical suburbs" problem identified by Hamilton [1]. Another possibility is that higher-income, wealthier households simply outbid other households for desirable locations [10–12]. In this case, less well-off households cannot compete successfully for properties in municipalities with high levels of public services and low property tax rates. This suggests that there could be a direct relationship between household income levels and property tax rates separate from the indirect effect of household income via fiscal zoning.

The two forms of fiscal zoning should appeal to different kinds of municipalities. All communities could view commercial and industrial uses as nuisances, but the fiscal benefits of such uses compensate for negative environmental externalities [13]. The costs of the externalities would be greater in wealthier municipalities with high property values, suggesting that such municipalities would be less likely to employ fiscal zoning favouring commercial and industrial uses. Indeed, our measures of commercial and industrial zoning are significantly negatively correlated with both single-family residential zoning and household mean income, while single-family residential zoning is significantly positively correlated with household mean income. Also, industrial uses may tend to generate more negative externalities than commercial uses, meaning that the costs of permitting them are more likely to outweigh the benefits. Hence, industrial uses are less likely than commercial uses to be part of a fiscal zoning or tax shifting strategy.

### *1.3. Interactions among Jurisdictions*

In the pure Tiebout model, tax competition would not occur, because property taxes are simply payments for the services preferred by each municipality's residents and there are no externalities. In a more nuanced version of the model, however, residents would prefer to pay less rather than more for a given level of services and spillovers (negative and positive) do exist. A line of literature has explored the theory of fiscal interactions among jurisdictions [14,15]. Fiscal interactions may be the result of benefit spillovers, tax competition, and yardstick competition. In the benefit spillover model, residents of one jurisdiction consume public goods provided by neighbouring jurisdictions. Alternatively, some jurisdictions may impose negative externalities on their neighbours. In both cases, there is fiscal interaction among jurisdictions that may cause less than optimal provision of public goods. In the tax competition model, there is inter-jurisdictional mobility of the tax base, while in yardstick competition residents of one municipality refer to the tax rates of neighbouring jurisdictions when evaluating the performance of their own elected officials. As a result, jurisdictions behave strategically when choosing property tax rates and their tax rates "mimic" those of their neighbours. Moreover, large jurisdictions may compete with distant large jurisdictions, while small jurisdictions compete only with nearby jurisdictions.

A line of empirical literature has investigated the strategic choice of nominal property tax rates. Heyndels and Vuchelen [16] studied the choice of property tax rates by Belgian municipalities. They investigated how the local tax rate was influenced by various municipal characteristics plus tax rates in other jurisdictions. The characteristics included number of inhabitants, per capita income, percentage of people under 20 years, percentage over 60 years, and the municipality's land area. Their general results were that tax rates were indeed copied among neighbouring municipalities.

Brett and Pinkse [17] studied the regional pattern of municipal business property tax rates in the Canadian province of British Columbia. They found some evidence that municipal governments responded to tax changes in neighbouring jurisdictions. They also found some evidence that municipal tax rates were sensitive to variations in taxes set on the same base by super-municipal bodies.

Using a spatial lag econometric model and cross-sectional data on property taxes and other socio-economic variables for cities in the Boston metropolitan area, Brueckner and Saavedra [14] estimated reaction functions. The socio-economic characteristics were per capita income, per capita state aid, the African American proportion of the population, the proportion of the adult population with at least a college education, public sector earnings per capita, and the annual rate of population growth. They presented results for two periods before and after imposition of Proposition $2\frac{1}{2}$ (a statewide property tax limitation measure introduced in Massachusetts in 1980) and found strategic interaction.

Revelli [18] modelled tax mimicking across English local governments ("districts") and found that neighbouring jurisdictions' rates were highly significant. Independent variables in his model included socio-economic characteristics, political party of the jurisdiction's leadership, and measures describing the tax base. Bordignon, Cerniglia, and Revelli [19] used Italian data to investigate yardstick competition. They tested how the local property tax rate was affected by local characteristics (such as area, population, and degree of urbanization), fiscal variables, political variables, and neighbouring jurisdictions' tax rates. Their results showed that local property tax rates were positively spatially auto-correlated only for those jurisdictions where the mayor could run for re-election and the election outcome was uncertain.

Allers and Elhorst [20] provided a spatial econometric analysis of Dutch municipalities' property tax rates. In their specifications, the municipal tax rate was dependent on tax rates in neighbouring municipalities and observed local characteristics. They found evidence of tax mimicking. Moreover, they found that tax mimicking was less pronounced in municipalities governed by coalitions backed by a large majority. This points to yardstick competition as the most likely source of tax mimicking.

Unlike other empirical studies, Lyytikäinen [21] did not find evidence of interdependence in property tax rates among municipalities in Finland. This may be due to circumstances that were unique to the Finnish case. As other researchers have noted, Lyytikäinen pointed out that spatial relationships found in the tax competition literature may in fact be due to unobserved spatially correlated factors rather than fiscal interactions. This is an instance of a general identification problem in models where the focus is on spatial relationships [22]. We are agnostic about the causes of the spatial relationships that we find in our data. As our focus was not on tax mimicking, our concern was just to control for spatial correlation, whatever its source. Nevertheless, our results are quantitatively similar to the findings of much of the research that has been published on local tax competition. Empirical estimates regarding the impacts of spatially lagged tax rates typically range between 0.2 and 0.6 [20]; our estimates are near the middle of that range.

### *1.4. Other Factors*

The tax mimicking studies cited above employ a variety of different control variables, but typically include measures related to socio-economic characteristics and tax base or revenue aspects of municipalities. One factor likely to affect effective tax rates is a municipality's reliance on the property tax as a source of revenue. Some municipalities are better positioned to take advantage of other sources of revenue, particularly external sources, such as federal and state grants or state revenue sharing. Some may also be able to rely more on user fees. Greater ability to tap these other sources of revenues should allow for lower property tax rates. Some studies address this by including measures such as the value of intergovernmental grants per capita [14,19]. We focused more directly on the property tax as a percentage of general government fund revenue, which captures the impact of all alternative sources of general revenue.

Some municipalities may also be able to generate income from enterprise-type activities; however, in most cases these just reflect the cost of providing certain types of services that are provided by some, but not all, municipalities. For our sample of municipalities, the primary examples of enterprise activities included water and sewer utilities and garbage and solid waste disposal. A few municipalities also generated significant revenues from other types of enterprises, such as electric utilities, parking, and bridge tolls. For example, in one municipality, Bay Harbor Islands, about one-third of $26.8 million in total revenues in 2017 came from causeway tolls. These types of revenues were excluded from the analysis as they were unlikely to affect property tax rates.

Super-municipal property tax rates have also been proposed in the literature as potentially relevant [17]. Taxes imposed by entities such as counties, school dis ricts, and regional districts (such as water management boards) could vary and have some influence on rate setting at the municipal level. However, there was very little variability in these rates across our sample, so this was not relevant in the context of the present study.

Some studies have considered socioeconomic factors such as the age distribution, unemployment rates, and education levels [14,21]. For example, municipalities with large numbers of children or the elderly may have different preferences for public services. In preliminary estimations, we found that the percentage of children had a positive impact on effective tax rates, but the percentage of elderly had no impact. The positive finding may reflect the preferences of families with children for parks and recreational facilities; in contrast, locally-financed public services required by the elderly may not differ substantially from those required by other adults. We found that education level (measured as the percentage of college graduates in the 25 and older population) was highly correlated with household income and added no explanatory power to our models; however, in some cases it outperformed income as an explanatory variable. Indeed, multicollinearity may explain why previous research that has included a combination of income, unemployment, and education level has found insignificant results for at least some of these variables [19,21]. We also found that the unemployment rate was not significant in any of our estimations.

## 2. Materials and Methods

### *2.1. Previous Empirical Strategies*

Black [5] studied the variation in effective property tax rates across Census tracts in Boston. He used the mean assessment ratio, the ratio of assessed value to market price, as a proxy for the mean effective tax rate. Several characteristics of tracts were regressed on the mean assessment ratios for each tract. These characteristics included median family income, non-white population, density of deteriorated and dilapidated housing, and mean value of owner-occupied property.

Brueckner and Saavedra [14] used a spatial lag econometric model to relate the nominal property tax rate in a community to its own socio-economic characteristics and to the tax rates in competing communities. They used cross-sectional data for cities in the Boston metropolitan area. The socio-economic variables were per capita income, per capita state aid, the African American proportion of the population, the proportion of the adult population with at least a college education, public sector earnings per capita, and the annual rate of population growth.

### *2.2. Our Econometric Strategy*

Previous research has used both nominal and effective tax rates as dependent variables in studies of the determinants of local property tax rates. Theory does not provide a clear justification for choosing one of these dependent variables over the other. Local jurisdictions have control over nominal tax rates, but not effective tax rates, suggesting that the former may be more directly related to the various determinants of property tax rates. (Property appraisal for tax purposes is conducted by county governments in Florida, meaning that municipalities do not have any influence over appraisal ratios or effective tax rates.) However, effective tax rates are the ones that determine property owners' tax payments and are, therefore, the ones with the most economic significance. Consequently, we are agnostic about which of the two measures might be preferable from a theoretical point of view and compare results based on both as a robustness check, while giving some emphasis to the results for the model with the best fit.

Our basic model is (in matrix notation):

$$t_i(or\overline{\tau}_i) = Z_i\beta + \varepsilon_i, \tag{1}$$

where $t_i$ and $\overline{\tau}_i$ are the nominal tax rate and mean effective tax rate (for single-family houses and condominiums), respectively, in municipality $i$, $Z_i$ are municipal characteristics, $\beta$ is a vector of parameters to be estimated, and $\varepsilon_i$ is the error term. The municipal characteristics were measures of single-family, commercial, and industrial zoning, population, mean household income (or, alternatively, the percentage of college graduates in the 25 or older population), the percentage of children, and the property tax as a percentage of government fund revenue.

As discussed above, some empirical papers have pointed out that a local jurisdiction's tax rate is a function of the tax rates in neighbouring or nearby jurisdictions. Hence, we rewrote Equation (1) by including the weighted tax rate in nearby jurisdictions:

$$t_i = Z_i\beta + \rho Wt + \varepsilon_i, \tag{2}$$

substituting $\overline{\tau}$ for $t$ to specify the corresponding models with the mean effective tax rate as dependent variable. This is in effect a spatial autoregressive (SAR) model [23]. Here $\rho$ is the coefficient for the spatial lag variable and $W$ is a spatial weights matrix. We specify $W$ by focusing on the five nearest neighbours of each municipality. The weights are the inverses of the distance between municipality centroids. The values for the diagonal of the matrix and all but the five nearest neighbours were set to zero. This approach has the advantage of down-weighting the tax rates of large nearby jurisdictions, which were less likely than smaller municipalities to be engaged in tax competition or mimicking within a metropolitan region (although they were more likely to do so across regions). We also experimented with a weights matrix that includes positive weights for all municipalities, defined as the inverse of the distances. When this matrix was used, the spatial lag coefficient was insignificant, implying that the reaction function involves nearby municipalities, but not distant ones.

It could also be the case that the error term was spatially autocorrelated. In a spatial error model (SEM), the spatial lag term in Equation (2) would drop out and the error term would be replaced by $\varepsilon_i = \lambda W\varepsilon + \eta_i$, where $\lambda$ is the coefficient for the spatial error term, $W$ is the same spatial weights matrix as in Equation (2), and $\eta_i$ is the error term. In our case, both $\rho$ and $\lambda$ were significant in their respective models, although neither was significant when both were included in the same model. (To identify the model that combines the spatial lag and spatial error terms, either the two spatial weights matrices need to differ, or the error term needs to be redefined as $\varepsilon_i = \lambda W\eta + \eta_i$, resulting in a spatial autoregressive moving average (SARMA) model. We estimated the latter because the weights matrices were the same.) Based on a common factor test [14], we concluded that the SAR model in Equation (2) was the correct specification. In any case, our SAR and SEM estimates were virtually the same, with no significant differences for any coefficients. We also note that the AIC statistics for the SAR models were lower (i.e., better) than those for the corresponding SEM models.

Another important econometric issue is raised by the possibility that one or more of the variables in the model may be endogenous. For example, a study of tax mimicking in Belgian municipalities found that the income variable was endogenous [16]. However, after correcting for this using an instrumental variables approach, they found that their results were mostly unchanged. Focusing on the OLS version of our model with the effective property tax rate as dependent variable, we conducted Hausman tests for our income and zoning variables and found no evidence of endogeneity.

As mentioned above, the jurisdiction specific characteristics, $Z$, include three fiscal zoning measures. The first is single-family residential property value as a percentage of single- plus multi-family property value. The second and third are commercial and industrial property value, respectively, as a percentage of all taxable property value excluding condominiums. We excluded condominiums from the denominator of the single-family percentage calculation as they played an ambiguous role. On one hand, they were multi-family housing but, on the other hand, they sometimes had relatively high market values, comparable to single-family homes. Hence, they did not fit neatly within either category. Condominiums were also excluded from the denominator of the commercial and industrial percentages due to their ambiguous role in that context. In dense urban areas, condominiums may be viewed as a desirable complement to commercial uses. On the other hand, they housed residents who consumed public services. For the zoning variables, we focused on property value rather than land area, as the former is more directly related to property tax revenue than the latter. In other words, property value is a better measure of fiscal zoning. We experimented with a measure of median single-family property value, but this was consistently insignificant in all estimations. All three zoning percentages are expected to be negatively related to property tax rates.

Measures of population, household income (or the percentage of college graduates), percentage of children, and reliance on the property tax capture other implications of the Tiebout literature. Municipal population and the percentage of children are expected to be positively related, while household income and the percentage of college graduates are expected to be negatively related, to property tax rates. Reliance on property taxes as a source of municipal revenue is expected to be positively related to property tax rates.

### 2.3. Case Study Area and Data

The Miami MSA was well-suited for this study because it contained a large number of diverse municipalities with relative autonomy in setting property tax rates. The Miami MSA consisted of three counties: Miami-Dade, Broward, and Palm Beach. Together, these three counties contained 104 general purpose municipalities as well as significant unincorporated areas. Consistent with the Tiebout model, it appears to be relatively easy to form new jurisdictions. In 2016, the city of Westlake was established in Palm Beach County based on the votes of its five residents [24]. An earlier example, Islandia, which consisted of 33 islands accessible only by boat, was formed in 1961 by the votes of a small number of optimistic property owners seeking to develop the area [25]. Despite a lack of development, the municipality survived for over 50 years until it was abolished in 2012 by the Miami-Dade County Commission; at that time, it had only five residents. One of the wealthiest municipalities in our sample, Pinecrest, was formed out of an unincorporated part of Miami-Dade County in 1996. Due to its newness and corresponding lack of data, Westlake was omitted from our analysis, along with two other Palm Beach County jurisdictions, Cloud Lake and Glen Ridge. The latter were very small municipalities (with 2010 populations of 135 and 219, respectively) that did not levy their own property taxes, relying instead on the county for taxation and services.

The remaining 101 municipalities had a wide range of nominal property tax rates ranging from a low of 1.73 mills in Aventura to a high of 10 mills in Briny Breezes (summary statistics are provided in Table 1; Appendix A gives detailed statistics for each municipality for selected variables). These rates were for property taxes levied in 2018 and include general purpose municipal rates as well as rates set specifically for debt repayment. They exclude rates for taxes imposed by other jurisdictions, such as the county governments or school districts (which are contiguous with the counties). The tax rates of these other jurisdictions were not relevant to the present study as those jurisdictions could not employ fiscal zoning as a tool for restricting entry. The tax rates were obtained from the offices of the property tax appraiser in each county. We follow tradition by expressing the rates in mills (i.e., per thousand dollars of assessed value).

**Table 1.** Summary statistics ($n$ = 101).

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Nominal tax rate (mills) | 5.70 | 2.15 | 1.73 | 10.0 |
| Mean effective tax (mills) | 3.68 | 1.30 | 1.15 | 7.46 |
| Single-family property value (%) | 82.3 | 15.4 | 0.0 | 99.5 |
| Commercial property value (%) | 18.0 | 12.7 | 0.0 | 71.3 |
| Industrial property value (%) | 6.7 | 13.8 | 0.0 | 90.8 |
| Population | 38,136 | 55,522 | 24 | 399,457 |
| Household mean income ($) | 108,026 | 89,401 | 27,953 | 722,906 |
| College graduates (%) | 37.6 | 18.3 | 5.3 | 80.6 |
| Children (%) | 21.2 | 8.1 | 0.0 | 37.9 |
| Property tax revenues (%) | 37.6 | 16.5 | 8.0 | 79.5 |

Note: See the text for a detailed explanation of each variable and data sources.

The municipalities also vary substantially in other respects. The smallest municipalities in the sample were Lazy Lake and Indian Creek, with 24 and 86 residents in 2010, respectively, while the largest were Miami and Hialeah, with 399,457 and 224,669 residents, respectively [26]. Mean household income ranged from $27,953 in Opa-locka to $722,906 in Indian Creek; the percentage with a college degree ranged from 5.3% and 5.8% in the largely agricultural communities of South Bay and Florida City, to 74.4%, 75.9%, and 80.6% in the exclusive municipalities of Key Biscayne, Gulf Stream, and Golf; and the percentage of children in the municipal population ranged from zero in Lazy Lake (which, as noted above, had a 2010 population of only 24) to 37.9% in Florida City [27]. We use household mean income because median income was not reported for all the municipalities in our sample. The percentage with a college degree refers to the population 25 and older, while the percentage of children was defined as the percentage 19 years or younger.

Property value represented by single-family residential uses as a percentage of the total value of single-family plus multi-family uses varied from zero in Briny Breezes (where the only residential use is mobile homes) to 99.5% in Sea Ranch Lakes. Property value represented by commercial and industrial uses as percentages of the value of all taxable land uses excluding condominiums varied from zero for both types of use in multiple municipalities to as much as 71.3% for commercial uses in Aventura, home to one of the largest shopping malls in the country, and 90.8% for industrial uses in Medley.

Mean assessed market values of single-family houses and condominiums ranged from $69,057 in South Bay to $16,997,413 in Indian Creek. Assessment ratios ranged from 0.466 in Opa-locka to 0.877 in Bal Harbour and Pembroke Park. The assessment ratio was calculated as the ratio of the assessed taxable value to the assessed market value of the property. Because the market value itself is an assessed value, it may not be accurate; however, for properties that transacted recently, the market values were much closer to the sales prices than were the taxable values. Effective tax rates, which were calculated as the assessment ratio multiplied by the nominal tax rate, averaged as low as 1.15 mills in Royal Palm Beach to as high as 7.46 mills in Pembroke Park.

The Save Our Homes Amendment (SOHA) to the Florida Constitution went into effect in 1995. The amendment limits growth in taxable assessed values of homestead properties to 3% per year or the increase in the Consumer Price Index, whichever is lower [28]. Homestead properties are those occupied by their owners as primary residences. Once a homestead property is sold, any reduction in assessed value due to SOHA no longer applies. The law provides for some portability of SOHA reductions in assessed value. In effect, SOHA allows for substantial variation in effective tax rates depending on when a homestead property was purchased and if the purchaser relocated from another homestead property in Florida [29].

Property taxes as a percentage of "government fund" revenue in 2017 averaged 37.6% and ranged from 8% in South Bay to 79.5% in Indian Creek [30]. Government funds include general funds and other categories such as special revenue, debt service, and capital projects funds [31]. They exclude proprietary funds, such as for enterprises, and fiduciary funds, such as for pensions.

The property data used to calculate the zoning variables were obtained from the Florida Department of Revenue, which makes county tax appraisers' property roll and sales data available to researchers free of charge [32,33]. The appraisers' data were for the calendar year 2017 and served as the basis for property tax bills that were issued in 2018.

## 3. Results

The estimation results are reported in Table 2. The high significance level for the spatial lag variable indicates that the SAR models are preferred. Of the SAR models, the one with the mean effective tax rate as a dependent variable has the lowest AIC statistic, indicating the best fit. For the preferred model, all the variables, including the spatial lag term, have the anticipated signs and all are significant, except for the industrial percentage variable. All the variables, including the industrial percentage, are significant with the expected signs in the nominal tax rate model. This suggests a somewhat ambiguous conclusion regarding industrial zoning, which is perhaps unsurprising given that the theory regarding such zoning is also somewhat ambiguous.

**Table 2.** Regression results ($n$ = 101).

| | **Nominal Tax Rate** | | **Mean Effective Tax Rate** | |
|---|---|---|---|---|
| **Variable** | **OLS** | **SAR** | **OLS** | **SAR** |
| Intercept | 9.070 ***<br>(1.556) | 6.733 ***<br>(1.472) | 5.516 ***<br>(1.018) | 4.093 ***<br>(0.952) |
| Single-family property value (%) | −0.044 ***<br>(0.014) | −0.044 ***<br>(0.013) | −0.038 ***<br>(0.009) | −0.037 ***<br>(0.008) |
| Commercial property value (%) | −0.056 ***<br>(0.016) | −0.056 ***<br>(0.014) | −0.033 ***<br>(0.011) | −0.034 ***<br>(0.009) |
| Industrial property value (%) | −0.034 **<br>(0.017) | −0.032 **<br>(0.014) | −0.016<br>(0.010) | −0.014<br>(0.009) |
| Population (1000 s) | 0.007 **<br>(0.003) | 0.005 *<br>(0.003) | 0.006 ***<br>(0.002) | 0.005 ***<br>(0.002) |
| Household mean income ($1000 s) | - | - | −0.004 **<br>(0.002) | −0.003 **<br>(0.001) |
| College graduates (%) | −0.066 ***<br>(0.014) | −0.056 ***<br>(0.012) | - | - |
| Children (%) | 0.081 ***<br>(0.026) | 0.073 ***<br>(0.022) | 0.042 **<br>(0.017) | 0.038 **<br>(0.015) |
| Property tax revenues (%) | 0.053 ***<br>(0.016) | 0.045 ***<br>(0.014) | 0.035 ***<br>(0.010) | 0.029 ***<br>(0.009) |
| $\rho$ | - | 0.419 ***<br>(0.101) | - | 0.425 ***<br>(0.102) |
| Adjusted $R^2$ | 0.371 | - | 0.273 | — |
| Akaike Information Criterion | - | 391.5 | - | 305.1 |

Note: The SAR models were estimated using maximum likelihood; $\rho$ is the spatial autoregressive parameter. Standard errors are in parentheses. * $p < 0.1$, significant at the 10% level. ** $p < 0.05$, significant at the 5% level. *** $p < 0.01$, significant at the 1% level.

The single-family variable had by far the largest impact on the effective tax rate. The estimated coefficients from the SAR model suggest that a municipality with the average single-family property value percentage (82.3%) would have a −3.03 effect on the effective tax millage rate. In contrast, a municipality with the average commercial property value percentage (18.0%) would have a −0.60 effect. The second most important variable was the property tax's percentage contribution to government fund revenues; a municipality with the mean contribution (37.6%) would have a 1.09 effect. As for the other explanatory variables, a municipality with average population (38,136) would have a 0.19 millage point effect, one with the average mean household income ($108,026) would have a −0.36 effect, and one with the average percentage of children (21.2%) would have a 0.80 effect. Finally, the spatial lag term had a substantial impact on the adjusted effective tax rate. A percentage point increase in the weighted average tax rate of the five nearest neighbours was associated with a 0.42 increase in the municipality's millage rate.

## 4. Discussion

Our empirical findings are consistent with expectations derived from the literature on the Tiebout model. We found that single-family zoning was associated with lower property tax rates. We also note that single-family zoning was positively correlated with mean household income ($r$ = 0.31). This finding implies that wealthier households sort themselves into higher-income communities consistent with Tiebout's theory and then use single-family zoning to restrict entry consistent with Hamilton's elaboration of Tiebout. This in turn allows higher-income municipalities to set lower property tax rates than would otherwise be required for the level of public services provided.

Commercial zoning, on the other hand, was negatively correlated with household income ($r$ = −0.35), implying that the two fiscal zoning strategies were used by different kinds of communities. The results for industrial zoning were ambiguous, which is consistent with the uncertainty about the impacts of negative externalities generated by that kind of land use.

The positive coefficient on population is consistent with the idea that larger municipalities are less able to behave strategically to lower tax rates with respect to their neighbours. The negative coefficient on household income is consistent with the idea that higher income households can outbid other households for locations in desirable municipalities, resulting in lower property tax rates even in the absence of restrictive zoning. The positive coefficient on the percentage of children is consistent with the idea that households with children will demand more local public services. Finally, the positive coefficient on the property tax contribution as a percentage of government fund revenue is consistent with the idea that municipalities that can diversify their revenue sources will have less need to rely on the property tax and can therefore set lower tax rates.

Our focus was on identifying the factors affecting property tax rates and not on whether those tax rates allow for an efficient or equitable provision of local public services. However, our findings do raise questions about equity, particularly the question of whether it is fair for wealthier households to benefit from lower property tax rates due to their ability to buy into exclusive municipalities. Oates and Fischel argued that the incidence of the property tax was not that relevant under the benefit view of the tax as a fee for services (as in the Tiebout model). However, they pointed out that public education is a special case as "many believe that access to public education should not depend on willingness to pay for it via the housing market" [34] (p. 423). One could argue that the same kind of reasoning should be applied to other expensive public services, such as public safety. In any case, the issue goes well beyond tax incidence. Socio-economic, racial, and ethnic segregation resulting from fiscal and exclusionary zoning may cause members of disadvantaged groups to have limited options and pay relatively high prices for local amenities [35,36]. Segregation may also result in poor outcomes for disadvantaged groups with respect to education, employment, and other characteristics [37]. As Hamilton noted in concluding his seminal paper: "As a final disclaimer, I am not prepared to argue, on equity grounds, that local public services 'ought' to be distributed in accordance with market criteria" [3] (p. 211).

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## Appendix A

Selected Statistics for Individual Municipalities.

**Table A1.** Selected statistics by municipality.

| Municipality | Population | Nominal Property Tax Rate (mills) | Assessment Ratio | Effective Property Tax Rate (mills) | Single-Family Assessed Market Value ($) | Single-Family Property Value (%) | Commercial Property Value (%) | Industrial Property Value (%) |
|---|---|---|---|---|---|---|---|---|
| Atlantis | 2005 | 7.72 | 0.740 | 5.71 | 312,216 | 99.2 | 16.9 | 1.9 |
| Aventura | 35,762 | 1.73 | 0.848 | 1.46 | 377,016 | 69.9 | 71.3 | 1.4 |
| Bal Harbour | 2513 | 1.97 | 0.877 | 1.72 | 1,533,200 | 86.4 | 48.7 | 0.0 |
| Bay Harbor Islands | 5628 | 3.72 | 0.716 | 2.66 | 512,626 | 70.2 | 23.4 | 0.0 |
| Belle Glade | 17,467 | 6.54 | 0.508 | 3.32 | 99,254 | 66.4 | 23.0 | 8.4 |
| Biscayne Park | 3055 | 9.70 | 0.517 | 5.01 | 384,147 | 83.6 | 0.2 | 0.0 |
| Boca Raton | 84,392 | 3.68 | 0.749 | 2.76 | 495,620 | 87.7 | 24.2 | 3.2 |
| Boynton Beach | 68,217 | 7.90 | 0.647 | 5.11 | 162,401 | 82.1 | 19.8 | 7.0 |
| Briny Breezes | 601 | 10.00 | 0.696 | 6.96 | 150,731 | 0.0 | 15.3 | 0.0 |
| Coconut Creek | 52,909 | 6.54 | 0.618 | 4.04 | 196,615 | 77.8 | 17.1 | 4.4 |
| Cooper City | 28,547 | 7.23 | 0.604 | 4.37 | 368,522 | 97.4 | 5.9 | 1.1 |
| Coral Gables | 46,780 | 5.56 | 0.720 | 4.00 | 898,914 | 90.5 | 20.7 | 0.6 |
| Coral Springs | 121,096 | 6.14 | 0.649 | 3.98 | 274,093 | 86.4 | 15.2 | 2.9 |
| Cutler Bay | 40,286 | 2.43 | 0.608 | 1.48 | 225,068 | 95.9 | 13.6 | 0.0 |
| Dania Beach | 29,639 | 6.18 | 0.656 | 4.05 | 203,853 | 65.6 | 31.3 | 14.8 |
| Davie | 91,992 | 6.01 | 0.614 | 3.69 | 341,479 | 86.7 | 13.4 | 6.2 |
| Deerfield Beach | 75,018 | 6.50 | 0.647 | 4.20 | 174,914 | 79.0 | 21.1 | 15.7 |
| Delray Beach | 60,522 | 6.97 | 0.676 | 4.71 | 315,155 | 83.9 | 19.0 | 3.3 |
| Doral | 45,704 | 1.90 | 0.867 | 1.65 | 301,340 | 74.3 | 30.1 | 34.7 |
| El Portal | 2325 | 8.30 | 0.508 | 4.22 | 337,515 | 89.9 | 5.9 | 1.1 |
| Florida City | 11,245 | 7.19 | 0.550 | 3.95 | 115,193 | 63.9 | 44.3 | 7.7 |
| Fort Lauderdale | 165,521 | 4.18 | 0.688 | 2.88 | 438,702 | 79.5 | 28.2 | 5.2 |
| Golden Beach | 919 | 8.40 | 0.637 | 5.35 | 3,667,397 | 89.0 | 0.0 | 0.0 |
| Golf | 252 | 6.38 | 0.843 | 5.38 | 922,224 | 94.9 | 16.9 | 0.0 |
| Greenacres | 37,573 | 6.40 | 0.598 | 3.82 | 139,821 | 87.5 | 17.9 | 0.8 |
| Gulf Stream | 786 | 4.05 | 0.796 | 3.22 | 1,919,220 | 96.7 | 1.7 | 0.0 |
| Hallandale Beach | 37,113 | 6.74 | 0.785 | 5.29 | 241,977 | 67.1 | 32.5 | 5.0 |
| Haverhill | 1873 | 4.50 | 0.564 | 2.54 | 199,305 | 94.8 | 6.6 | 5.5 |
| Hialeah | 224,669 | 6.30 | 0.550 | 3.47 | 187,975 | 78.1 | 16.4 | 14.5 |
| Hialeah Gardens | 21,744 | 5.16 | 0.503 | 2.60 | 197,033 | 85.6 | 18.2 | 24.4 |
| Highland Beach | 3539 | 3.72 | 0.845 | 3.14 | 647,702 | 94.2 | 3.0 | 0.0 |
| Hillsboro Beach | 1875 | 3.50 | 0.834 | 2.92 | 614,932 | 86.5 | 7.2 | 0.0 |
| Hollywood | 140,768 | 7.70 | 0.623 | 4.80 | 282,610 | 84.2 | 21.7 | 6.3 |
| Homestead | 60,512 | 6.45 | 0.672 | 4.34 | 150,801 | 82.4 | 21.4 | 3.2 |
| Hypoluxo | 2588 | 3.25 | 0.774 | 2.52 | 189,979 | 99.1 | 12.9 | 6.7 |
| Indian Creek | 86 | 6.40 | 0.566 | 3.62 | 16,997,413 | 78.3 | 1.1 | 0.0 |
| Juno Beach | 3176 | 2.10 | 0.807 | 1.69 | 524,359 | 83.2 | 30.6 | 0.0 |
| Jupiter | 55,156 | 2.67 | 0.730 | 1.95 | 391,277 | 93.8 | 12.2 | 3.4 |
| Jupiter Inlet Colony | 400 | 4.90 | 0.671 | 3.29 | 1,967,404 | 97.4 | 0.0 | 0.0 |
| Key Biscayne | 12,344 | 3.10 | 0.850 | 2.64 | 1,305,180 | 95.0 | 12.9 | 0.0 |
| Lake Clark Shores | 3376 | 6.28 | 0.570 | 3.58 | 272,393 | 98.9 | 6.0 | 0.0 |

**Table A1.** *Cont.*

| Municipality | Population | Nominal Property Tax Rate (mills) | Assessment Ratio | Effective Property Tax Rate (mills) | Single-Family Assessed Market Value ($) | Single-Family Property Value (%) | Commercial Property Value (%) | Industrial Property Value (%) |
|---|---|---|---|---|---|---|---|---|
| Lake Park | 8155 | 5.35 | 0.591 | 3.16 | 153,892 | 67.4 | 32.9 | 17.4 |
| Lake Worth | 34,910 | 6.63 | 0.595 | 3.95 | 160,720 | 75.2 | 13.5 | 8.9 |
| Lantana | 10,423 | 3.50 | 0.622 | 2.18 | 250,061 | 88.1 | 17.1 | 3.9 |
| Lauderdale Lakes | 32,593 | 9.70 | 0.630 | 6.11 | 97,176 | 80.2 | 20.8 | 4.4 |
| Lauderdale-by-the-Sea | 6056 | 3.60 | 0.829 | 2.98 | 441,837 | 76.9 | 22.8 | 0.0 |
| Lauderhill | 66,887 | 9.94 | 0.607 | 6.03 | 127,175 | 80.5 | 15.1 | 3.8 |
| Lazy Lake | 24 | 4.79 | 0.766 | 3.67 | 609,877 | 98.0 | 0.0 | 0.0 |
| Lighthouse Point | 10,344 | 3.76 | 0.653 | 2.46 | 597,855 | 95.8 | 5.8 | 0.0 |
| Loxahatchee Groves | 3180 | 3.00 | 0.561 | 1.68 | 302,838 | 87.6 | 12.4 | 0.3 |
| Manalapan | 406 | 3.03 | 0.810 | 2.45 | 2,470,725 | 92.7 | 8.5 | 0.0 |
| Mangonia Park | 1888 | 9.80 | 0.594 | 5.82 | 71,296 | 61.5 | 20.7 | 62.6 |
| Margate | 53,284 | 7.06 | 0.548 | 3.87 | 167,593 | 88.3 | 15.9 | 3.8 |
| Medley | 838 | 6.30 | 0.547 | 3.45 | 170,411 | 50.1 | 8.6 | 90.8 |
| Miami | 399,457 | 8.03 | 0.740 | 5.94 | 361,548 | 54.7 | 43.7 | 4.8 |
| Miami Beach | 87,779 | 5.89 | 0.810 | 4.77 | 699,613 | 75.7 | 44.7 | 0.2 |
| Miami Gardens | 107,167 | 7.91 | 0.489 | 3.86 | 170,600 | 92.0 | 13.7 | 11.4 |
| Miami Lakes | 29,361 | 2.31 | 0.639 | 1.48 | 322,943 | 89.0 | 17.3 | 9.4 |
| Miami Shores | 10,493 | 8.32 | 0.581 | 4.83 | 455,640 | 96.6 | 6.5 | 0.0 |
| Miami Springs | 13,809 | 7.35 | 0.572 | 4.21 | 328,734 | 90.6 | 18.9 | 0.4 |
| Miramar | 122,041 | 7.12 | 0.621 | 4.42 | 275,741 | 91.7 | 10.4 | 7.3 |
| North Bay Village | 7137 | 6.15 | 0.804 | 4.94 | 273,870 | 66.5 | 17.9 | 1.5 |
| North Lauderdale | 41,023 | 7.40 | 0.520 | 3.85 | 152,658 | 81.9 | 13.5 | 2.5 |
| North Miami | 58,786 | 7.50 | 0.555 | 4.16 | 221,483 | 79.9 | 17.3 | 3.5 |
| North Miami Beach | 41,523 | 7.02 | 0.586 | 4.11 | 234,604 | 85.0 | 28.1 | 2.4 |
| North Palm Beach | 12,015 | 7.50 | 0.682 | 5.11 | 361,462 | 92.8 | 15.6 | 0.7 |
| Oakland Park | 41,363 | 6.00 | 0.583 | 3.50 | 191,708 | 84.2 | 20.4 | 13.1 |
| Ocean Ridge | 1786 | 5.35 | 0.797 | 4.26 | 798,183 | 93.4 | 0.2 | 0.0 |
| Opa-locka | 15,219 | 9.80 | 0.466 | 4.57 | 139,874 | 68.3 | 11.1 | 45.0 |
| Pahokee | 5649 | 6.54 | 0.476 | 3.12 | 76,171 | 78.6 | 17.0 | 2.0 |
| Palm Beach | 8348 | 3.13 | 0.800 | 2.51 | 1,986,488 | 92.8 | 9.1 | 0.0 |
| Palm Beach Gardens | 48,452 | 5.60 | 0.732 | 4.10 | 402,675 | 92.4 | 19.4 | 0.9 |
| Palm Beach Shores | 1142 | 6.35 | 0.805 | 5.11 | 384,091 | 73.2 | 12.2 | 0.0 |
| Palm Springs | 20,201 | 3.88 | 0.594 | 2.30 | 127,629 | 73.4 | 29.5 | 4.4 |
| Palmetto Bay | 23,410 | 2.24 | 0.662 | 1.48 | 437,902 | 97.8 | 12.0 | 0.1 |
| Parkland | 23,962 | 4.40 | 0.794 | 3.49 | 585,728 | 96.2 | 1.9 | 0.0 |
| Pembroke Park | 6102 | 8.50 | 0.877 | 7.46 | 106,746 | 31.7 | 22.5 | 60.2 |
| Pembroke Pines | 154,750 | 6.14 | 0.620 | 3.81 | 258,450 | 89.9 | 14.4 | 1.6 |
| Pinecrest | 18,223 | 2.40 | 0.699 | 1.68 | 909,595 | 95.8 | 10.7 | 0.1 |
| Plantation | 84,955 | 6.26 | 0.611 | 3.82 | 298,273 | 85.6 | 19.5 | 1.2 |
| Pompano Beach | 99,845 | 5.60 | 0.674 | 3.78 | 231,322 | 79.5 | 17.3 | 23.3 |
| Riviera Beach | 32,488 | 8.45 | 0.679 | 5.74 | 282,597 | 82.2 | 15.6 | 21.3 |
| Royal Palm Beach | 34,140 | 1.92 | 0.600 | 1.15 | 224,740 | 95.3 | 18.7 | 4.9 |
| Sea Ranch Lakes | 670 | 7.25 | 0.694 | 5.03 | 1,412,120 | 99.5 | 6.1 | 0.0 |
| South Bay | 4876 | 6.31 | 0.598 | 3.77 | 69,057 | 72.0 | 21.6 | 9.1 |
| South Miami | 11,657 | 4.30 | 0.624 | 2.68 | 449,657 | 87.5 | 29.7 | 0.7 |
| South Palm Beach | 1171 | 3.79 | 0.817 | 3.10 | 217,869 | 57.7 | 0.0 | 0.0 |
| Southwest Ranches | 7345 | 4.83 | 0.628 | 3.04 | 690,524 | 94.2 | 2.9 | 0.5 |
| Sunny Isles Beach | 20,832 | 2.20 | 0.875 | 1.92 | 641,122 | 54.6 | 64.1 | 0.2 |
| Sunrise | 84,439 | 6.36 | 0.584 | 3.71 | 182,546 | 86.8 | 29.1 | 7.3 |
| Surfside | 5744 | 4.50 | 0.758 | 3.41 | 797,360 | 85.4 | 32.6 | 0.0 |
| Sweetwater | 13,499 | 3.99 | 0.528 | 2.11 | 183,253 | 44.3 | 42.0 | 21.3 |
| Tamarac | 60,427 | 7.29 | 0.562 | 4.09 | 155,382 | 91.3 | 14.1 | 6.0 |
| Tequesta | 5629 | 6.29 | 0.686 | 4.32 | 406,600 | 98.2 | 12.9 | 0.1 |
| Virginia Gardens | 2375 | 5.10 | 0.566 | 2.89 | 238,850 | 80.7 | 29.0 | 3.8 |
| Wellington | 56,508 | 2.48 | 0.714 | 1.77 | 361,885 | 91.3 | 9.6 | 1.0 |
| West Miami | 5965 | 6.89 | 0.559 | 3.85 | 284,814 | 68.5 | 17.5 | 0.2 |
| West Palm Beach | 99,919 | 8.47 | 0.688 | 5.83 | 234,768 | 77.9 | 31.3 | 4.9 |
| West Park | 14,156 | 8.65 | 0.481 | 4.16 | 169,961 | 94.1 | 9.3 | 10.3 |
| Weston | 65,333 | 3.35 | 0.728 | 2.44 | 432,606 | 97.7 | 8.6 | 3.2 |
| Wilton Manors | 11,632 | 5.96 | 0.625 | 3.72 | 323,693 | 80.7 | 12.4 | 1.0 |
| Mean | 38,136 | 5.70 | 0.664 | 3.68 | 625,863 | 82.3 | 18.0 | 6.7 |
| Median | 17,467 | 6.15 | 0.65 | 3.77 | 298,273 | 85.6 | 16.9 | 2.0 |
| Minimum | 24 | 1.73 | 0.466 | 1.15 | 69,057 | 0.0 | 0.0 | 0.0 |
| Maximum | 399,457 | 10.00 | 0.877 | 7.46 | 16,997,413 | 99.5 | 71.3 | 90.8 |

Note: See the text for a detailed explanation of each variable and data sources.

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