

# Essays on Taxation and Space

Justin M. Ross

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Santiago Pinto, Ph.D., Chair  
John Blair, Ph.D.  
Brian Cushing, Ph.D.  
Stratford Douglas, Ph.D.  
Russell Sobel, Ph.D.

Department of Economics

Morgantown, West Virginia  
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## Abstract

### ESSAYS ON TAXATION AND SPACE

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This dissertation is composed of three essays in which each examine the response to taxation while carefully considering the role of space. In the first essay, I examine the behavior of property tax assessors among local governments to uncover sources of assessment bias. While typically not a formulator of policy, property assessors are likely sensitive to political incentives as they are either directly elected to their office or appointed by another elected official. This essay searches for sources of this pressure via its influence on the assessment-to-sale price ratio from Virginia cities and counties in 2004. Among the more significant findings are that elected assessors underassess property more than their appointed counterparts, that assessors attempt to export the property tax onto commercial property, fiscal stress tends to induce higher assessments, and positive spatial autocorrelation exists suggesting that residents look to their neighbors in determining the accuracy of their assessments.

The second essay examines the responsiveness of the rich to state income taxes. Since distance is likely a relatively small transaction cost for high-income groups, states with greater personal income taxes are likely assuming larger deadweight losses or shifting the burden to the corporate sector. We use MLB free agents who were named All-Stars at some point in their career and who signed with a U.S. team for the 1991 through 2002 seasons. This data set overcomes some of the previous difficulties encountered in similar studies but also has limitations representing the general rich population. We find evidence that the wages of this subset of players do adjust to offset the burden of state income taxes, specifically a one percent decrease in net-of-tax rate leads to a 3.3 percent increase in salary.

The final essay examines the spatial tenure choice decision, i.e. the dual decision of where to live as well as whether to rent or own. While previous literature has looked these decisions in isolation from each other, our work is the first to combine the decision without making assumptions about preferences, amenities, or zoning. Our model focuses on the trade-off between transportation costs, maintenance costs, the tax treatment of housing, and end-of-life wealth as points of consideration. We also extend the model to incorporate different income groups in which wealthier households receive larger tax savings from ownership. To contrast our model with reality, we offer an empirical analysis of the spatial tenure choice using a multinomial logit regression.

# Dedication

*I dedicate this dissertation to my wife, Lisa, whose love and support was vital to my completion of graduate school.*

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I wish to momentarily acknowledge and thank numerous people who have aided me in my progress to this point. I will try to be comprehensive without diminishing the value to those being mentioned. First I would like to thank all the members of my dissertation committee: Santiago Pinto, John Blair, Brian Cushing, Stratford Douglas, and Russell Sobel. Their guidance is highly sought among graduate students and I am honored to have every one of them on my committee. Each of them have provided useful comments and interesting insights at all points in my doctoral training, and especially on my dissertation. I especially want to thank Dr. Pinto who has yielded countless hours of his time over the past four years to me in the form of appointments, unannounced office visits, proofreadings, and course work. I will forever be grateful to him for his time and advice.

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good habits in preparing data for analysis. From him I also learned many of the intangibles necessary to have a successful career in academia.

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# Chapter 1

## Purpose and Agenda

The role of space forms the basis of the literature in urban and regional economics and is increasingly finding its way into public finance. Space is recognized among regional economists as a source of monopoly power for firms as well as a cost that constrains the mobility of individuals. Similarly, the public choice literature has cited restrictions on citizen mobility as the basis of constitutional strength in government to behave as a leviathan with redistributive taxes. It is only natural that the public finance literature should begin to devote more attention to the implications of taxation over space. It is in this manner that my dissertation will contribute to the science of economics.

In Chapter 2, I set out initially to discover if the appointment-type for assessors of property plays a role in the accuracy of the assessment. It is clear from descriptive analysis of the data that both assessor types are underassessing, but it is not clear if one type underassesses more than the other after controlling for various social and economic characteristics of the jurisdictions. While it seems that directly elected assessors would have a sufficiently strong incentive to underassess their constituents, it is also possible that assessors appointed by elected officials are not any less susceptible to political pressure. Alternatively, one could easily think of a model where appointed assessors serve as a convenient scapegoat for elected officials to raise tax revenue with higher assessments without changing the tax code. Virginia

serves as an excellent basis to test for differences in assessor type, as they are one of the few states that have a mix of appointed and elected assessors at the county level.

Assessor behavior likely has an important spatial dimension to it, however, as a map of the Median Assessment-to-Sales Price (A/S) Ratio among Virginia's counties demonstrates that there exists direct spatial correlation between the assessors' jurisdictions. Intuitively, it is appealing to think that if a homeowner does not observe rising property valuations in neighboring counties, then they will hold greater expectations for their own assessments to remain constant. This should translate into homeowners exhibiting greater pressure on their own assessor not to increase their assessment.

To test for assessor incentives in property assessment, I use the A/S Ratio for Virginia counties in 2004 calculated by the Virginia Department of Taxation (2006). This data allows for a direct comparison to be made for differences in the level of the A/S ratio after controlling for social and economic characteristics that may be correlated with political pressure on the assessor's office. In addition, this essay will also control for spatial autocorrelation with Bayesian estimation techniques. In the few previous papers that examine assessor type, this is a control that has either not been included or has been included improperly.

Chapter 3 looks at a labor response to taxation, specifically highly skilled labor responding to state-level income taxation. There is little dispute in public finance over the long-run inability of states to redistribute income with taxation. The intuition follows that if State A raises their income tax, labor will exit to state B until pre-tax income adjusts to where net income is the same in both locations. The reason this is an expected outcome of the long-run is because by definition the properties of space that serve as mobility constraints are non-existent.

Nonetheless, states not only engage in income taxation, but they pursue progressive taxation and often target the most affluent residents. In this chapter, Robert Dunn and I present evidence using Major League Free Agent All-Stars that the most affluent are highly

elastic to such taxes.<sup>1</sup> The difficulty with research on the rich is that by definition they are a small group, meaning limited sample sizes, and they can claim residency in many alternative locations come tax season. Thus, even if we observe a rich citizen living in a given state, it may not be where they file their taxes. As we will discuss, baseball players do not have this ability to claim residence anywhere other than the home city of their team. This means they will shift the burden of the income tax onto the signing team in the form of higher gross salaries and allows us to measure their aversion to taxation in those states.

In Chapter 4, Santiago Pinto and I present a new theoretical model where households make the joint choice of where to live and whether to own or rent, a decision we refer to as their spatial tenure choice. The preferential tax treatment of home ownership in the United States has received a great deal of criticism for merely encouraging the higher income groups to purchase more housing rather than increasing the home-ownership rate. It has also received part of the blame for urban density decline and suburban sprawl. The reasoning behind this criticism lies in the progressive marginal income tax brackets. Since higher income groups are taxed at higher rates on the margin, a given dollar of housing expenditure on mortgage interest has a larger tax savings than for a lower income group. Furthermore, the tax savings only accrues to those who choose to itemize their tax deductions, which is less likely for those in the lower income tax brackets. The expected result is high-income houses moving further from the city to purchase larger homes.

We model this behavior by considering a representative household maximizing utility over two income-earning periods. They must consume housing and may borrow against second-period income when choosing to own. While owning, they receive preferential tax treatment in the form of deducting their mortgage interest from taxable first-period income. However, they must pay maintenance costs to retain or improve housing quality. If they rent, they neither face maintenance costs nor receive tax savings. In addition, if they choose to locate in the suburbs over the city, they pay transportation costs.

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<sup>1</sup>I am the first author on this paper and Robert has agreed that the paper could be included in my dissertation.

In equilibrium, households will determine a reservation price for a unit of housing for each spatial-tenure choice that leaves them indifferent at all outcomes for a given level of income. The metropolitan layout by spatial tenure choice will then be determined by landlords who supply that tenure choice at each location according to the group whose reservation price is the highest. Once this baseline model is established, we may examine its comparative statics and discuss possible extensions. To help motivate possible extensions, we also provide empirical estimates from a multinomial logit regression on observed spatial tenure choice across metropolitan areas.

This dissertation concludes in Chapter 5 with a summary of the major results found in each of the essays. Furthermore, there will be a discussion of future recommendations for furthering the inclusion of space in considering tax policy.

# Chapter 2

## Assessor Incentives and Property

### Assessment

#### 1 Introduction

The taxation of property is one of the most important sources of tax revenue in local public finance. According to the U.S. Census of Governments, local governments collected 46.2 percent of their tax revenue from the taxation of their residents' property in the 2004 fiscal year. This is a much larger share than any other form of taxation, and is critical to the provision of local public goods such as education. Yet it's widely accepted that the property tax is among the most disliked of taxes.<sup>1</sup> This is particularly true during periods of rising real-estate prices when the level of taxation does not necessarily correspond with the income growth of the homeowners, leading them to express feelings of "being taxed out of their homes." Property tax assessors and their methodologies often become the target of this frustration, causing them to become the focus of taxpayer pressure to reduce the burden.<sup>2</sup> Furthermore, depending on the jurisdiction, property assessors may be elected directly by

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<sup>1</sup>See "The Worst Tax? A History of the Property Tax in America" by Fisher (1996) for arguments as to why property taxes carry so much disdain.

<sup>2</sup>For examples in the news, see Gardner (2006), Joravsky (2005) and Geist (1981) for coverage of homeowner's pressuring the assessor's office in periods of rising property values.

the local constituency or appointed to this office by another elected official which suggests there is an incentive for incumbent officials facing reelection to underassess property values to lower the effective tax burden of their constituency in a vote-seeking effort.

If assessors are not appraising property at their true market value and instead are appealing to a political constituency, there are a variety of implications. In terms of equity, assessors may discriminate between household or property types for underassessment and alter the incidence of the property tax burden along a dimension of political power. This would be particularly true if assessors compensate the underassessment of one household type with the overassessment of another, which they would have an incentive to do if they are required to comply with the International Association of Assessing Officer (IAAO) standards or other state rules of a similar nature.<sup>3</sup> Black (1977) has found that effective property taxes in 1960 Boston were more regressive than were previously thought after it was taken into account that assessors tended to understate the value of property at the higher end of the market.

Furthermore, underassessment creates distortions in the voters' choices when ordering preferences on statewide property tax legislation if they do not bear the full burden of the bill. Several states use the level of assessed property values as the measure of ability-to-pay in their school district aid formulas of state funding. For example, West Virginia's school-aid formula increases the level of state funding to the school district if they have a decrease in the value of their assessed property. So in West Virginia, which strictly uses elected assessors, if the assessor lowers his appraisal he not only culls favor from his constituency for reducing their individual tax burden but he also increases their state funding.

However, even if the assessor is appointed, it is not clear that they will not just be pressured by their elected appointer to underassess constituent property. In *The Role of the States in Strengthening the Property Tax*, the Advisory Commission on Intergovernmental Relations (1963) dismissed the issue of appointed versus elected assessors on the point that

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<sup>3</sup>The IAAO standards require that assessors error on average by no more than 10 percent above or below fair market value in their assessments (1999).

they may be equally susceptible to political pressure. Though indirect, it could be true that the voters would just take their complaints to the elected official that appoints the assessor, who then could pressure the assessor to lower property assessments. Alternatively, one could easily think of a model where appointed assessors serve as a convenient scapegoat for elected officials to raise tax revenue with higher assessments rather than increasing the property tax rate. These types of incentives have led other researchers, such as Johnson (1989), to view them as maximizing political support regardless of whether they are elected or appointed. For instance, they would like to receive the mayor's endorsement if they are running for office, which frequently implies providing enough revenue to support local public goods and services.

They also do not want to draw attention from the state, which gets involved when there is any centralized aspect of the property tax. The Advisory Commission on Intergovernmental Relation's (1963, Vol. 2, p.107) cite Jack Holmes, the Chief Tax Commissioner as stating the following:

If, as some claim the State again is in a finance crisis involving schools and local units of government, there would seem to be two alternatives. First, the State can continue as it has been to increase the percentage of funds derived by State taxation and administrative efforts. . . Or, second, it can move to bolster locally derived revenues. In this case it would inevitably have to remind the local units of government, that they must expend much more energy on the property tax.

The purpose of this paper is to test for sources of political pressure as well as a difference in the level of assessment between appointed and elected property tax assessors. To do this, I use the median assessment-to-sales price ratio (sales ratio) for Virginia counties and independent cities calculated by the Virginia Department of Taxation (2006b) as the dependent variable. Virginia is one of the few states that implements both appointed and elected assessors, which allows for a direct comparison of the types on the level of the sales ratio. The results indicate that elected assessors do underassess constituent property more

than their appointed counterparts by about four percent. In addition, it is discovered that higher shares of commercial property, and fiscal stress in a district lead to higher sales ratios. Higher assessment of business property is likely an attempt to export the tax burden onto non-voters. Unlike previous research, this paper controls for the presence of spatial autocorrelation with the Spatial Durbin Model, which implements a spatial lag on both the dependent variable and the regressors. This reveals that counties either engage in spatial competition or, more likely, that residents use neighboring counties as a basis of comparison for the accuracy of their own assessments. Also, a positive correlation between the sales ratio and spatially lagged commercial property demonstrates that the ability of assessors to export the property tax burden is severely limited by the presence of available commercial property in neighboring districts.

## 2 Previous Research

The political economy issues for local governments have by no means received a lack of attention from economists, especially concerning the role of local property taxes. Fischel (2001b) supplied what he termed a "homevoter model" where zoning combined with local property taxes that serve as benefit taxes lead to the most efficient provision of local public goods when compared with state level provision. Since present property values quickly capitalize the expected future value of amenities such as local public goods, Glaeser (1995) argues that even myopic politicians have the incentive to consider long-run implications of public goods that are funded by property taxes. What is interesting in the role of the assessor here is the ability of political pressure to undermine these incentives. While a local voter may vote for community level property taxes set to some ideal level that corresponds with their demand for local public goods, their individual incentive to minimize their personal tax burden can be achieved by pressuring the local assessors office. For this reason, there are a number of regulatory oversight groups, both state and local, that restrain the assessors

ability to drastically underassess property.

To illustrate these conflicting tensions, Johnson (1989) provides a behavioral model where the assessor maximizes wealth from office by gaining political support subject to those regulatory constraints. This is modeled differently for appointed and elected assessors because they are concerned with different constituent bases. In the case of the assessor appointed by someone in a different political office, they maximize political support by serving as scapegoats and assessing at higher values so that their appointers raise revenues without the political fallout of higher taxes. The elected assessors, on the other hand, maximize political support by providing as much tax relief as possible by lowering assessments among the parcels. In either case, the presence of commercial property allows for assessors to export the tax and allows them to further raise revenues and meet in compliance for regulatory constraints surrounding the level of assessment.

Interestingly, the Johnson (1989) model makes this assumption regarding differential treatment of elected and appointed assessors in spite of a long standing disregard of the issue. The Advisory Commission on Intergovernmental Relations (1963), whose report seems to have driven much of the research over the following decades, had disregarded any differences due to political pressure on the grounds that constituents could just as easily pressure the appointers for lower assessments. This view holds some empirical support in the previous literature. There has been considerable attention paid in the recent literature on the policy restraints on rising local property taxes during the rapid acceleration of housing prices around the U.S. at the turn of the 21<sup>st</sup> century (Bowman, 2006; Cornia and Walters, 2006). Since these policy changes are prescribed by lawmakers rather than assessors, there is likely some credence to the idea that appointers can request their assessors to lower the level of assessment. Since both conflicting propositions regarding the incentives of appointed assessors have intuitive appeal, their susceptibility to political pressure from the local constituency to underassess is primarily an empirical question.

When differences in the assessor type has risen in the empirical literature it has almost

entirely focused on its influence on horizontal equity via uniformity measures, almost exclusively the coefficient of dispersion (COD). Lowery (1984) found that uniformity erodes under fiscal stress and tax limitations when the assessor is elected, but strengthens under appointed assessors. Strauss and Sullivan (1998) tested the influence of several indicators of assessor authority, state requirements, the level of government responsible for assessment, and assessor type on the level of uniformity. They found that elected assessors had higher levels of uniformity, but that its effect diminished as the office moved further away from being elected at the local level to the county or state level. Bowman and Mikesell (1989) in testing for determinants of real property assessment uniformity in Virginia found the inclusion of an indicator variable for assessor type to be insignificant.

Unfortunately the COD tells us nothing about the proclivity of an assessor to engage in any form of systematic bias (Stewart, 1977). This is due to the fact that the COD serves a measure of dispersion around the localities' own median sales ratio, but does not indicate whether or not that median ratio is at the required level. In order to directly test for characteristics that influence the degree of underassessment, the sales ratio is the most relevant available measure. Literature using this statistic as the dependent variable is almost non-existent. Footnote 9 of Bowman and Mikesell (1989) mentions that an attempt to use the sales ratio instead of the COD carried an  $R^2$  of just 0.04 with no significance in any explanatory variables, including assessor type. Yet the intention of that work was to look for factors influencing the dispersion of the sales ratio, not the level of the sales ratio itself. As a result, the regressors consist of factors that might affect the ability of an assessor to accurately assess property, such as whether or not the assessor was full or part time, level of assessor certification, and availability of assessment maps. While we would expect these variables to affect the variance of a measure, it should not affect the expected value of the sales ratio absent any systematic bias. In other words, explanatory variables controlling for the level of difficulty do not explain why the degree of error always lands on the side of being *below* true market value.

Lowery (1982) is the only previous paper I am aware of that has used the sales ratio as the dependent variable. The regressions are based on a mail survey of Michigan assessors and employ ordinary least squares (OLS) on a variety of variables that primarily control for factors that proxy for the difficulty of assessment, as well as an indicator for whether or not the assessor was appointed. The overall work of the paper is insightful and very good, but the shortcoming of the paper is that the econometric model starts from the perspective that underassessment is the result of poor information. The author then starts searching for variables indicating information quality that might lead to higher sales ratios (i.e. certification, availability of tax maps, computers, etc). As in Bowman and Mikesell (1989), these are factors that would influence the dispersion of assessments, but not cause a systematic bias. Instead of variables that would improve information, there should be variables that constrain the ability of the assessor to maintain the mandated sales ratio. Secondly, the inclusion of a political “cuetaking” variable is described as the average sales ratio of neighboring jurisdictions. This is what a standardized spatial weight matrix accomplishes, but the spatial econometrics field was not well established among general practitioners at the time. It is now known that using the spatial lag of the dependent variable with OLS leads to biased and inconsistent estimates (Anselin, 1988).

The contribution to this literature in this paper is a proper specification of the econometric model by estimating the influence of political pressure indicators on the sales ratio. Also, I use recent advances in spatial econometrics to get an accurate read on the influence of neighboring jurisdictions.

### 3 Data and Methodology

The econometric model will be the Spatial Durbin model described in vector form by Anselin (1988) as

$$R = X\beta + (I - \rho W)^{-1}e$$

By imposing the restriction that  $\beta_2 = -\rho\beta_1$ , this can be rewritten into a more convenient form as equation (2.1).

$$R = \rho WR + X\beta_1 + WX\beta_2 + e \tag{2.1}$$

Here, the sales ratio ( $R$ ) will be the  $n \times 1$  dependent variable and a spatially lagged independent variable. The spatial lag matrix  $W$  is a  $n \times n$  matrix with zeroes on the diagonal with the non-zero elements designating neighboring jurisdictions and summing to unity on each row. This is a first order contiguity matrix, so that the neighbors are defined as jurisdictions that share borders with each other.<sup>4</sup> The other regressors previously discussed that would be expected to influence the level of the sales ratio an assessor chooses will be included in the  $n \times k$  matrix,  $X$ . At the county level within a state like Virginia, we would expect that some of these county characteristics included in the  $X$  matrix would also present with spatial dependence. Untreated this would show up as spatially dependent omitted variable bias (Pace and LeSage, 2007) in the other coefficients, which motivates the inclusion of the spatially lagged independent variables.<sup>5</sup>

The Spatial Durbin model first described in equation (2.1) is estimated here using Bayesian econometric techniques. The full specification is defined in equation (2.2), where the error term ( $e$ ) has mean zero but a non-constant variance.<sup>6</sup>

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<sup>4</sup>The weight matrix was created using the `xy2cont` function in Matlab (Pace, 2003).

<sup>5</sup>Prior to using the Spatial Durbin model, I estimated results using the Spatial Autoregressive model (SAR) and the Spatial Error model (SEM). Estimates of the SEM specification demonstrated omitted variable bias as the coefficients on  $X\beta$  differed from that of OLS. This suggested that the SAR model was the superior specification. However, the estimated spatial relationship in SEM was much larger than what was reported in SAR, which suggested there was still further spatial dependence to be explained. This was confirmed with the Spatial Durbin model and led to its application in this paper.

<sup>6</sup>The notation here follows that used by LeSage (1999).

$$\begin{aligned}
R &= \rho WR + X\beta_1 + WX\beta_2 + e \\
e &\sim N(0, \sigma^2 V) \\
V &= \text{diag}(v_1, v_2, \dots, v_n) \\
\rho, \beta_1, \beta_2 &\sim N(c, T) \\
r/v_i &\sim ID \chi^2(r)/r
\end{aligned} \tag{2.2}$$

The diagonal elements of  $V$  represent fixed but unknown parameters that are estimated in the Bayesian regression and arranged in an independent chi-square distribution around  $r$ . Several improper priors are defined in  $\rho$ ,  $\beta_1$ ,  $\beta_2$ , and  $r$ . For  $\rho$ , the parameter is a univariate normally distributed variable while  $\beta_1$  and  $\beta_2$  are distributed multivariate normal. In order to estimate equation (2.2), the following definitions of  $\beta_1$  and  $\beta_2$  in (2.3) are substituted into (2.2).

$$\begin{aligned}
\beta_1 &= (\tilde{X}'\tilde{X})^{-1}\tilde{X}'R \\
\beta_2 &= (\tilde{X}'\tilde{X})^{-1}\tilde{X}'WR \\
\tilde{X} &= [X \quad WX]
\end{aligned} \tag{2.3}$$

Following this substitution, the likelihood ratio for (2.2) is:

$$\begin{aligned}
L(\beta, \sigma, \rho, y, \tilde{X}) &= |I_n - \rho W| \sigma^{-n} \exp\{(e_1'e_1 - 2\rho e_2'e_1 + \rho^2 e_2'e_2)\} \\
e_1 &= R - \tilde{X}\beta_1 \\
e_2 &= WR - \tilde{X}\beta_2
\end{aligned} \tag{2.4}$$

The improper priors are defined as

$$\begin{aligned}
p(\rho) &\propto \text{constant}, & -1 < \rho < +1 \\
p(\sigma) &\propto \sigma^{-1}, & 0 < \sigma < +\infty
\end{aligned}
\tag{2.5}$$

Assuming these parameters to be independent diffuse priors in the joint pdf:

$$p(\rho, \sigma) \propto \sigma^{-1} \tag{2.6}$$

According to Bayes' Theorem, the product of these prior densities in (2.6) and the likelihood function in (2.4) produces the posterior density:

$$p(\rho, \beta_1, \beta_2, \sigma | R, W) \propto |I_n - \rho W| \sigma^{-(n+1)} \exp\left\{-\frac{1}{2\sigma^2}(e_1' e_1 - 2\rho e_2' e_1 + \rho^2 e_2' e_2)\right\} \tag{2.7}$$

The integration of the above posterior distribution to achieve the posterior marginal distributions for each of the parameters (i.e.  $p(\beta_{i=1,2})$ ,  $p(\rho)$ , and  $p(\sigma)$ ) are too complex to allow for closed-form solutions. To bypass this problem, Gibbs sampling is employed which repeatedly obtains random draws from the full conditional distributions for each parameter of interest given the other parameters. Specifically, the full conditional distributions  $p(\rho | \beta_{i=1,2}, \sigma)$ ,  $p(\beta_{i=1,2} | \rho, \sigma)$ , and  $p(\sigma | \beta_{i=1,2}, \rho)$  are sought. Derivations of the full conditional distributions from the posterior distribution in equation (2.7) needed to begin this sampling are described in Lacombe (2007). The sampling procedure will see this chain of full conditionals converge under weak regularity conditions.

The main philosophical difference here between the classical regression and the Bayesian approach to parameter inferencing is that rather than view the data as random and the parameters as fixed, the Bayesian approach treats the already observed data as fixed with random model parameters that can be described as a distribution. As a result, there is no need to make asymptotic assumptions regarding normality, the distribution of the parameters is what will be determined during estimation.

When estimated with maximum likelihood methods, the Spatial Durbin model has many desirable characteristics such as immunity to spatially dependent omitted variable bias (Pace and LeSage, 2007) as well as generally being less sensitive than OLS to other forms of omitted variable bias (Brasington and Hite (2005); Dubin (1988)). The biggest threat to its application in practice is its proclivity to multicollinearity (Anselin, 1988; LeSage, 1999). For Bayesian estimation, correlation among the independent variables can possibly prevent convergence in the parameter draws from occurring. Using the methods of Belsley et al. (1980), multicollinearity was found to exist in the other three years prior to 2004, typically in the reassessment lag variables with their spatial lag counterparts. Since I had difficulty achieving convergence in those years, that multicollinearity was likely the impetus. This is a limiting aspect of this paper, as the results may be year specific which creates a need for future research to overcome this problem.

For testing for sources of political pressure, comparisons across states would be problematic as there is considerable heterogeneity in the level of accountability, certification standards, and legal authority of the assessors (Strauss and Sullivan, 1998).<sup>7</sup> For this reason, studying assessors in a state with a mixed system of both appointed and elected assessors becomes appropriate. Very few states have a truly mixed system of assessor type, and even those that do allow for it usually employ one type overwhelmingly or otherwise determine it endogenously. For instance, New York has a mixed system but only allows for elected assessors in the cases of very small villages or other smaller municipalities.

Virginia has several attractive characteristics for determining the factors that influence the level of assessment. Virginia's constitution allows for a district to choose its own assessor type and as a result 48 of its 134 districts have appointed assessors, while the remaining districts leave the responsibility of maintaining assessment records to elected officials, typically the Commissioner of Revenue.<sup>8</sup> While few elected officials physically perform the assessments

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<sup>7</sup>It appears from observation of the tables presented in Strauss and Sullivan (1998) that states with predominantly elected assessors have more accountability standards, but I will leave that issue to future research.

<sup>8</sup>I use the term district to refer to Virginia's counties and independent cities. Over time, a city may

themselves, instead opting to employ private firms, they are responsible for the provision of final assessments as well as other important duties pertaining to the tax rolls and land books.

Virginia is unique in that the type of system chosen by a district is often written and formalized into the individual district's charter. Also there is no spatial or population size relationship to the type of assessor the county employs in the case of Virginia. While endogeneity of assessor type in Virginia cannot be definitively ruled out, it at least has no obvious source. There is also precedence for using Virginia, as assessor type's influence on the COD has been studied in Bowman and Mikesell (1989) to estimate differences between appointed and elected assessors.

The median sales ratio is reported in a study by the Virginia Department of Taxation that samples arms' length market sales of existing properties and comparing them to their most recent assessment. A sales ratio less than 1.0 would suggest the property was under-assessed while a value above would suggest overassessment. Virginia's tax code stipulates that assessors must demonstrate accurate assessment with sales ratios above 0.70 or else the state may withhold the localities share of the states profits from the sale of alcoholic beverages.<sup>9</sup> Figure 2.1 provides a kernel density estimate of this ratio overlaid with a normal density distribution for comparison. Figure 2.1 demonstrates that Virginia assessors are systematically underassessing property. In 2004, the year of study in this paper, it is clear that both types of assessors were underassessing property as the average median sales ratio for elected assessors was 0.755 versus 0.816 for appointed. Both the highest and the lowest sales ratio came from a district with an appointed assessor.

However, most counties do not conduct annual reassessments, so in periods of housing growth it could be that property has not been recently reassessed. Virginia's tax code also stipulates that reassessments may take place no less frequently than four years, with few

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become independent from its county should its population reach a minimum point. Similarly a city may be merged with its surrounding county if the population falls below a certain point. This happened most recently in 2001 when Clifton Forge's city status was downgraded to a town and merged into Alleghany County.

<sup>9</sup>Section 58.1-3259 of Virginia Tax Code.

exceptions for very small districts that may have up to six years. The governing bodies of these districts then pass local ordinances for their own frequency of assessment within that constraint. In 2004, 35 of the 134 jurisdictions reassessed property in the year of the study. Interestingly, districts with appointed assessors tend to have more frequent assessments. In 2004, the average reassessment lag for an appointed assessor was 1.1 years compared to 2.1 years for elected assessors. This paper corrects for such lags using fixed effects for year of last assessment. Also, properties reassessed in the same year as the ratio study may still be several months apart from the time of the sale if housing prices are rising quickly. This may lead to misleadingly low sales ratios in fast growing districts such those near Washington D.C. in northern Virginia. Since county level housing prices are not available during this period, to control for such growth effects I follow Bowman and Mikesell (1989) and include the four-year average annual population growth rate as a proxy variable. These controls should help minimize any measurement error in the dependent variable that would otherwise inflate the standard errors of the regressions.

If the assessor chooses a particular sales ratio, they likely would weigh the political pressure they receive from their constituency against the possible retaliation of withheld revenue from the state.<sup>10</sup> Therefore, district characteristics that would likely increase pressure on the assessor to change the level of assessment will need to be included, in addition to the lag fixed effects. Also a dummy variable indicating if the assessor is elected or appointed will be included. The definition and sources for these variables are listed in Table 2.1 while their descriptive statistics are displayed in Table 2.2.

The variables expected to be correlated with political pressure will include social and economic characteristics of the districts. One of the most common independent variables in the previous literature is the proportion of the population that is African American. To some degree this dates the literature, as fractionalization has increasingly become the control for

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<sup>10</sup>It should be noted the Virginia has “Truth in Taxation Laws” that require the constituency to be told that the assessors are not responsible for their tax burden, but rather just the assessment of their property.

minority effects in political economy issues.<sup>11</sup> Since there are several Virginia counties where blacks are in the majority, I follow the suit of the contemporary literature and use racial fractionalization calculated in the manner of the Herfindahl-Hirschman Index where larger values indicate a greater prominence of a single race. If assessors want to appease the state comptroller with higher median assessments while trying to please the median voter with lower valuations, then assessors might target minorities for higher assessments, in which case the expected sign on fractionalization would be positive. To illustrate this intuition, consider two districts, that differ in their racial fractionalization but are otherwise identical. Suppose one county has an equal split of four races while the other county has a population that is 99 percent white, giving the former county a comparatively high racial fractionalization score. An assessor in racially homogeneous county using race as a signal for preferences would likely see whites as the median voter to be underassessed, allowing them to compensate that lower assessment with higher assessments for the minority groups occupying the remaining one percent. Whereas in the diverse county no race would be any more likely to contain the median voter than any other, which would restrain the assessor from targeting any specific group for overassessment.

Senior citizens over the age of 65 would also be prime candidates for underassessment for several reasons. First, they are more likely to own their home and have paid off their mortgage leaving the property tax as their primary “rent” expense. Secondly, they are less likely to be earning income and thus do not reap any benefits from being able to deducting property taxes. They are also stereotyped as being more prevalent and informed voters that are likely to turn out on election day. Thus the intuition would be that the higher the proportion of senior citizens in the population, the more pressure the assessor would face and contribute to lowering the sales ratio.

The traditional view of high income households in the property tax assessment literature

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<sup>11</sup>For recent examples of fractionalization in the public economics literature, see Lind (2007) for an analysis on higher fractionalization leading to lower redistribution levels and Alesina et al. (1999) for its influence in reducing the provision of public goods.

has been that voters with more income are better informed and educated about their property taxes and would likely pressure their assessors for more accurate assessments. While this sits well with the uniformity literature, it is not as obvious of a translation into an argument for lower sales ratios because of the tax treatment of housing across income groups. Higher income groups are more likely to itemize and accept the deduction of property taxes from their taxable income whereas lower income groups are more apt to take the standard deduction. Itemization means that a higher assessment is more fully realized in the lower income groups than those of the higher because of its direct effect in the property tax bill. For illustration, suppose two individuals each receive an increase of \$100 in their property taxes and that the first person itemizes while the second takes the standard deduction. If the itemizer faces a marginal income tax rate of 35%, then their actual total decrease in after-tax income is  $\$65 = \$100(1 - .35)$ . The person taking the standard deduction, on the other hand, sees their after-tax income fall by the full amount of the tax increase of \$100. In this scenario, it would seem plausible that the person taking the standard deduction would be more likely to pressure for a lower assessment than the itemizer, *ceteris paribus*. Since there are two countering income effects, the sign of income is ambiguous.

If assessors see commercial property as a means of exporting the property tax burden to non-resident owners, then we would expect them to overassess that property relative to resident-owned property (Johnson, 1989). The ratio study done by the Virginia Department of Taxation provides a breakdown of the number of sales included that were commercial for each jurisdiction. Including this as a share of the total number of sales for the jurisdiction is included with the expectation that it will be positively correlated with the sales ratio.

If property owners are more sensitive to their assessments when they face a high nominal property tax rate (Bowman and Mikesell, 1989), then we would expect it to have an inverse relationship with the sales ratio. However, this is an issue that will require future research because the true relationship may be more complicated because local officials in Virginia are more apt to cutting the nominal property tax rate in periods of rising assessments.

Additionally, a composite measure of fiscal stress provided by the Virginia Department of Housing and Community Development is included as Lowery (1984) has found that fiscal stress has had eroding effects on uniformity in assessment. We might expect to find local politicians pressuring their assessors for higher levels of assessment as an alternative to raising taxes when budgets are tight, in which case the sign for this coefficient would be positive. A complication arises with using fiscal stress, as it is at least partially collinear with the jurisdiction's income and property taxes. To separate these effects, an auxiliary regression reported in Table 2.1 with stress as the dependent variable while income and property tax rate served as the explanatory variables. The residuals then would represent the fiscal stress in a jurisdiction unexplained by and orthogonal to income and property taxes. Thus the fiscal stress variable ultimately used in the estimation of the final results will be the residuals from this regression.

In Lowery (1982) a spatial lag was viewed as a political “cuetaking” variable, but its inclusion can be motivated by the visual spatial pattern that emerges when the median sales ratio by jurisdiction is viewed in Figure 2.2. The map can be interpreted as the median sales ratio of the district rising as it becomes darker. Clearly, there exists some kind of spatial relationship in Figure 2.2 as similar ratios tend to cluster together. The dispersion of the reassessment year fixed effects does not match the map in this manner. Part of the explanation, particularly for areas in northern Virginia, would lie on spatial dependence in property value growth. It is fairly intuitive to believe that there would be some spatial dependence in the ratio itself. It is likely that a positive correlation would exist spatially because residents would judge the accuracy of their own assessment level growth to that of their neighboring counties. If their assessments rise while their neighbors do not, they would be more likely to appeal to the assessor. It is also possible, albeit less likely, that districts may engage in strategic property tax competition in a similar manner described by Brueckner and Saavedra (2001). Regardless of the mechanism, the map in Figure 2.2 motivates the inclusion of a spatial lag of the dependent variable among the regressors.

## 4 Estimation

The Matlab function `sdm_g` from LeSage (1997) was employed to carry out the estimation with the prior  $r$  value for the chi-square distribution of the diagonal elements of  $V$  set to four, which seemed to be the value that best handled the heteroscedasticity. Convergence diagnostics set forth by Geweke (1992) confirmed that 100 omissions and 1,100 draws was more than sufficient to reach convergence in the parameter estimates from the Gibbs sampling. Additionally, the results were almost identical when the number of draws was increased to 5,100 and with the 1,100 omitted, further suggesting successful convergence. The final results of the regression are reported in Table 2.3 and carry an  $R^2$  of 0.52. Remember that Bayesian estimates describe the distribution of the parameter and are not point estimates. The reported statistics include the mean of the distribution and its standard deviation. Bayesian distributions are rather definitive, and so statistical significance in the manner in which frequentists think of a parameter being “different from zero” does not apply. The Bayesian p-level, reported in the last column of Table 2.3 represents the share of the  $\beta$  draws during Gibbs Sampling that were zero or had the opposite sign of the mean. So a coefficient being “significant” in a Bayesian sense means to have the draws having the same sign of the mean a certain percentage of the time.

The posterior estimates in Table 2.3 indicate that even after controlling for other forms of political pressure, elected assessors underassess their constituents property by a larger amount than their appointed counterparts. The p-level effect is significant at the five percent level, meaning that less than five percent of the draws contained in the distribution were zero or positive in value. The mean of this coefficient is -0.04, which suggests that elected assessors on average have a four percent lower level of assessment. The coefficient was normally distributed with a standard deviation of 0.02. To put this number in perspective, the 2000 Census reported Virginia’s median owner occupied house price to be \$125,400, the regression suggests that a given house of this value would receive a \$5,016 lower assessment from an elected assessor than an appointed one. According the Virginia Department of

Taxation (2006b), the state nominal property tax rate in 2004 was \$0.99 per \$100 of assessed value, meaning this lower assessment costs the state \$49.66 in revenue for a home of that value to elected assessor vote-seeking. Using the Virginia Department of Taxation's county aggregate estimates of real estate property, this vote seeking cost state and local governments \$52.1 million in 2004, approximately one percent of the \$7.7 billion in total property taxes it took in that fiscal year according to the Census.

The spatial lag of the sales ratio suggests that the behavior of neighboring assessors has a considerable effect. Since the spatial weight matrix is row-stochastic, the interpretation of the spatial lag coefficient is that a 0.1 decrease in the *average sales ratio* of neighboring jurisdictions correlates with a 0.037 decrease in the home jurisdiction. Intuitively, it makes sense that if your neighbors' assessments rise then you would be more likely to accept that all assessments are rising, including your own. Similarly, you would be less likely to accept a higher assessment if your neighbors' property values were not raising under different assessors.

One of the more interesting effects was the strength of the effect of business property, as it initially seems to have the strongest direct effect on the sales ratio as assessors appear to try and export the tax burden to non-residents. However, this is more than offset by the spatial lag of the commercial property, as the greater the presence of commercial property in a neighboring jurisdiction the lower the home jurisdiction's assessments. I argue this reveals an element of property tax competition among the jurisdictions, as the availability of nearby commercial property enhances the ability of firms to exit when being overassessed. If firms begin entering neighboring jurisdictions, say an increase in the share of all property by 0.1, the sales ratio would fall by 0.189 in the home jurisdiction.

Interestingly, the community characteristics of racial fractionalization and the proportion of the population over age 65 had the expected signs but had a insignificant share of its distribution less than zero in absolute value. The median income, which as discussed was ambiguous in its expected sign, was found to be positive and fairly significant, with 86 percent

of the draws being greater than zero with a mean of 0.03. Higher income among neighbors was nearly significant and negative, suggesting that higher incomes among neighbors will lower assessments in the home jurisdiction. The intuition for this is may be a “keeping up with the Joneses” effect where residents feel pressure to have similar levels of disposable income. Higher nominal property tax rates appeared to have the opposite of the expected sign, but was insignificant. Additionally, the presence of fiscal stress apparently spills over into the assessors office in the need for higher assessments.

The controls for assessment-to-sale lags in time, population growth and year of last assessment fixed effects), behaved in the expected manner for a period marked by rising house prices. High population growth was negative and significant, while the year effects (which are not reported but available upon request) become more negative as they move away from the year of the study.

## 5 Discussion

This paper provides evidence that elected assessors are more responsive to political pressure than their appointed counterparts with approximately four percent lower assessment-to-sale price ratios. I estimate the cost of this behavior to Virginia in 2004 was approximately \$52.1 million, or about one percent of its property tax revenue that year. There is also a significant positive spatial correlation between neighboring assessors. It is likely that constituents look to their neighbors’ change in assessment to judge the validity of their own assessment that accounts for this relationship. Assessors also appear to try and export this tax burden to commercial property but are severely restricted by competing with neighboring jurisdictions for commercial property. Higher fiscal stress induces assessors to increase their assessments, likely due to pressure from other elected officials.

There are several limitations that require future research before definitive policy recommendations can be advised. First, this analysis is based strictly on Virginia data and may

not apply to other states that have different constitutional constraints on the assessors' office. The methodology used is a Spatial Durbin Model is prone to multicollinearity issues that restrict its application. In the case of Virginia, between the period of available data from 2001 to 2004, only 2004 did not have multicollinearity in the reassessment year fixed effects, which was likely the source of difficulty in achieving convergence in posterior estimates. Therefore, it is possible that the results are year specific and may not hold in other periods. For instance, there may be election cycle effects and the effect may be stronger or weaker depending on the proximity to an election year. The last election for Commissioner of Revenue, who is usually responsible for assessments when an assessor is not appointed, took place in 2002.

It also cannot be entirely ruled out that the assessor type is determined endogenously in some manner. While there is no obvious link between population or space, there still may be some underlying characteristic of the jurisdiction that makes them prone to elected assessors. It may be that areas historically prone to strongly opposing taxes chose to implement an elected assessor system as a constraint on their property taxes.

Another limitation of these results is a common one in the spatial econometrics literature known as the boundary value problem (Anselin, 1988). This occurs when spatial dependence exists to areas outside the area of analysis and creates spatially dependent omitted variable bias. It is possible that assessors in Virginia bordering another state are influenced by their assessment practices as well as their own in-state assessors. While several treatments have been proposed, such as those in Griffith (1983), they tend to carry their own problems as well (Anselin, 1988). The Spatial Durbin model's insensitivity to omitted spatial dependent variable bias likely limits this problem and if the nature of its omission reflects in the variance of the disturbance term then it would have been picked up and corrected in the Gibbs sampling.

Figure 2.1: Kernel Density Plot of Median Sales Ratio (A/S)

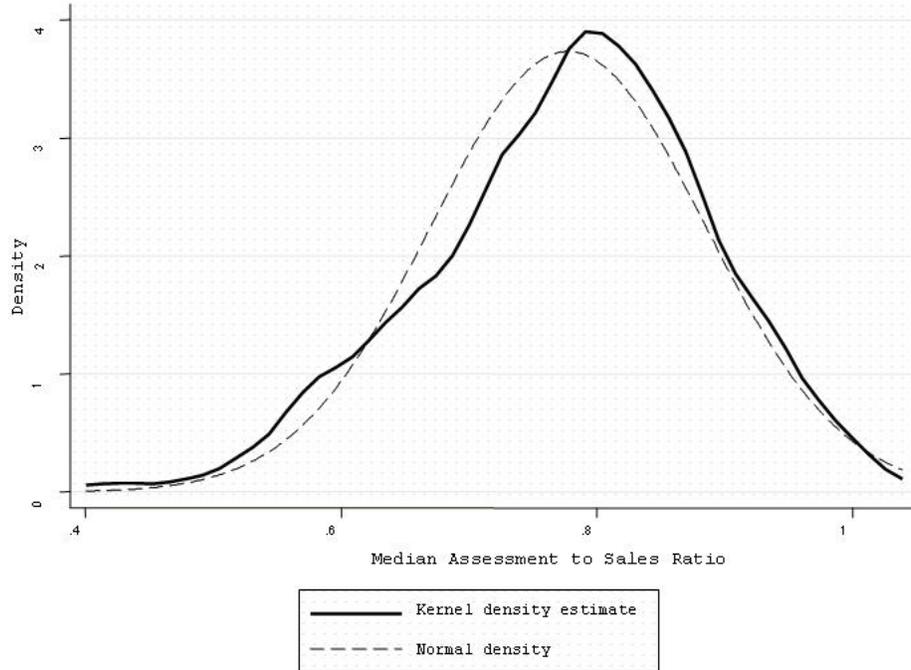


Figure 2.2: Median 2004 Sales Ratio by Virginia District

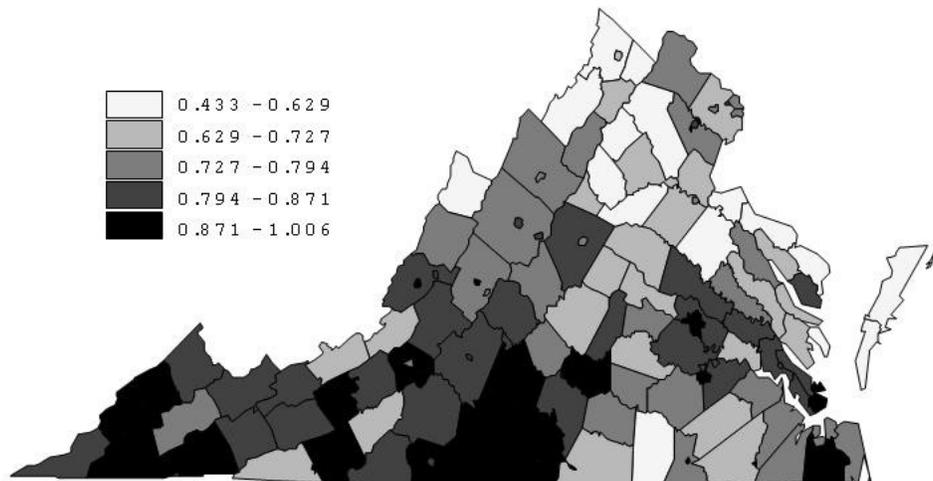


Table 2.1: Variable Definitions and Source

Variable Name	Definition
Median Sales Ratio <sup>1</sup>	The median sales ratio of a jurisdiction. Sales ratio calculated by dividing the assessed value on the books of a property and dividing it by the sale price in a fair market transaction.
Assessor is Elected = 1 <sup>2</sup>	Indicator variable where a jurisdiction with an appointed assessor takes a zero value, else takes a value of one.
Racial Fractionalization <sup>3</sup>	Author's calculation: $= (\% \text{ White})^2 + (\% \text{ Black})^2 + (\% \text{ Asian})^2 + (\% \text{ Indian})^2 + (\% \text{ Miscellaneous})^2$
Share of Population Over Age 65 <sup>3</sup>	$= \frac{\text{Residents Age 65 \& up in 2004}}{\text{2004 Total Population}}$
Income <sup>4</sup>	The 2004 median adjusted gross income on all state tax returns.
Average Annual Population Growth, 2000-2004 <sup>3</sup>	$= \sqrt[4]{\frac{\text{2004 Population}}{\text{2000 Population}}} - 1$
Share of Assessments Commercial <sup>1</sup>	The number of property sales classified as commercial divided total number of sales of all property types.
Nominal Property Tax Rate <sup>1</sup>	The total local real estate levies divided by the total taxable real estate value.
Fiscal Stress <sup>4</sup>	<p>The error term (<math>e_i</math>) from the regression:</p> $\text{Stress}_i = 1.90 - 0.14\text{Income}_i + 0.16\text{NPTR}_i + e_i$ <p style="text-align: center;">(94.9)    (-21.5)                      (8.0)</p> $R^2 = 0.78$ <p>The t-statistics are reported in the parentheses. <math>\text{Stress}_i</math> is a composite measure of revenue effort, revenue capacity, and to quantitatively measure the burdens of fiscal administration in a district. <math>\text{Income}_i</math> and <math>\text{NPTR}_i</math> are the Income and Nominal Property Tax Rate variables described above.</p>
Last Reassessed in yyyy <sup>1</sup>	Dummy variable where 1 indicates 'yyyy' was the year of last assessment in sales ratio.

Sources: 1. Virginia Department of Taxation (2006b); 2. Author's research with aid of Virginia Association of Assessing Officers jurisdiction directory ([www.vaaao.org](http://www.vaaao.org)); 3. U.S. Census Bureau; 4. Virginia Department of Housing and Community Development (2006a).

Table 2.2: Summary Statistics

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Median Sales Ratio	0.778	0.107	0.433	1.006
Assessor is Elected = 1	0.642	0.481	0.000	1.000
Racial Fractionalization (tens. Thous.)	0.703	0.163	0.437	0.992
Share of Population over Age 65	0.146	0.042	0.052	0.296
Median Income (tens. Thous.)	2.766	0.776	1.758	5.989
Average Annual Population Growth, 2000-2004	0.010	0.017	-0.039	0.082
Share of Assessments Commercial	0.030	0.026	0.000	0.118
Nominal Property Tax Rate	0.790	0.241	0.370	1.420
Fiscal Stress	0.000	0.053	-0.311	0.176
Last Reassessed in 2003	0.209	0.408	0.000	1.000
Last Reassessed in 2002	0.224	0.418	0.000	1.000
Last Reassessed in 2001	0.164	0.372	0.000	1.000
Last Reassessed in 2000	0.119	0.325	0.000	1.000
Last Reassessed in 1999	0.015	0.122	0.000	1.000

Table 2.3: Bayesian Spatial Durbin Model Posterior Estimates

**Dependent Variable: Sales Ratio**

Variable	Mean	Std	p-level
W - Sales Ratio	0.37 ***	0.12	0.00
Assessor is Elected = 1	-0.04 **	0.02	0.01
Racial Fractionalization	0.04	0.10	0.33
Share of Population over Age 65	-0.19	0.29	0.26
Median Income	0.03	0.02	0.14
Population Growth	-1.01 *	0.69	0.07
Commercial Share of Assessed Units	1.62 ***	0.33	0.00
Nominal Property Tax Rate	0.05	0.05	0.17
Fiscal Stress	0.25 *	0.16	0.06
W - Assessor is Elected = 1	0.02	0.05	0.36
W - Share of Population African-American	0.01	0.13	0.50
W - Share of Population over Age 65	0.05	0.64	0.49
W - Income	-0.05	0.04	0.10
W - Population Growth	-0.92	1.79	0.31
W - Commercial Share of Assessed Units	-1.84 **	0.85	0.02
W - Nominal Property Tax Rate	-0.03	0.09	0.37
W - Fiscal Stress	0.42	0.51	0.21
Intercept	0.63 ***	0.22	0.00

Note: Bayesian p-levels are indicated as \*\*\* at 1%, \*\* at 5%, and \* at 10%. Year Effects and Spatial Year Effects not reported but available upon request.

# Chapter 3

## The Income Tax Responsiveness of the Rich: Evidence from Free Agent MLB All-Stars.

### 1 Introduction

Policy revolving around the taxation of the rich is frequently a topic of both positive and normative debate.<sup>1</sup> On the normative side, the issues of tax code progressiveness and tax burden equity typically dominate the discussion of the appropriate income tax rate(s) that the affluent should face. The role of economics has been to provide positive analysis with both theoretical understanding and empirical evidence to the outcomes of policies that have resulted from these debates.<sup>2</sup> While there is a robust literature researching the effects of income taxes in general, the area that has received much less attention has been the ability of individual states to levy income taxes on the rich.

The traditional literature in public finance has been of the perspective that progressive

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<sup>1</sup>This essay is based on a collaboration with Robert Dunn that was published in the October 2007 *Contemporary Economic Policy*.

<sup>2</sup>Slemrod (1998) provides a summary of both the positive and normative issues at hand in taxing the rich.

redistributional taxes by the state will be undermined by the ability of high-income earners to exit their jurisdiction and be replaced by those from the lower end of the income distribution (see Tiebout, 1956; Musgrave, 1959; Oates, 1972). Yet we still observe a considerable amount of taxation of the rich among the states. According to the Internal Revenue Service, 54.9 percent of the taxes due to state governments in 2004 were retrieved from individuals with more than \$200,000 in adjusted gross income.<sup>3</sup> This is despite the fact that this group represented just 2.3 percent of the tax returns and 45.3 percent of the total tax liability in those states. Clearly this group serves as a very important component of the tax base of a state, not to mention the role they likely play in the local economy. The fact that we observe rich tax payers remaining in high tax states likely reflects heterogeneous preferences, some mobility constraints, political economy issues, and some preference for redistributional government.

Still, very little empirical evidence exists about the responsiveness of the rich to state income taxes, with the only prior research to our knowledge being that of Bakija and Slemrod (2004). The primary reason for the empirical absence is likely the difficulties of data pertaining to this group. The term "rich" is rather arbitrarily defined in a relative context to some group, and can vary considerably from person to person. A 2003 Gallup Poll reported that to be "rich" meant an annual income around \$120,000 or \$1 million in total financial assets (Moore, 2003). Regardless of the actual cut-off point in determining this group, it is by definition that they are small relative to the size of the population of interest. Empirically, this problem manifests as small sample sizes and few degrees of freedom available for hypothesis testing. In addition to a lack of sufficiently large data sets, there are difficulties in both observing their income and their true residence. Groups like business executives commonly accept alternative forms of payment, such as stocks, in addition to their salary that makes it difficult to estimate their true income (Goolsbee, 2000a,b). Since it is possible for the rich to own housing in multiple states, their reported residence and their true residence

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<sup>3</sup>These figures are based on authors' calculations from data on state individual income tax statistics provided by the Internal Revenue Service.

may differ, resulting in difficulties estimating their state income tax responsiveness (Bakija and Slemrod, 2004).

The aim of this paper is to contribute to the literature on the state income tax responsiveness of the rich using data from Major League Baseball (MLB). Specifically, we use a set of 235 free agent All-Stars who signed a contract to play on a U.S. team for the 1991 through 2002 seasons. Professional baseball players serve as an appealing target for estimating state income tax responsiveness because of some special treatment they receive from state legislatures. Beginning in 1991, states around the country with professional sports teams began implementing what are popularly known as "jock taxes." These were not new taxes, but rather the states' recognition that they frequently had millionaire nonresidents earning income within their borders not paying taxes, and as a result they began to more aggressively capture them as a tax base.<sup>4</sup> As a part of this, players are considered residents of the jurisdiction where their team is based or headquartered. Thus we can be reasonably certain they negotiate their salary with the signing team's state income tax rates in mind so that our results are not sensitive to any difference between the true state of residence and the reported residence. Secondly, there is a reasonably accurate reporting of their income, as their salaries are well known and paid in cash form.

Table 3.1 lists the 20 highest paid players in MLB on U.S. teams for the 2002 season sorted from highest to lowest gross income. The table demonstrates that state income tax rates are very important to their net income, making it something they are likely taking into consideration when negotiating with signing teams. For instance, while Sammy Sosa and Barry Bonds had the same gross income, Sosa's total tax bill was more than \$600,000 lower by playing in comparatively low-tax Illinois instead of California.

To estimate the state income tax responsiveness of free agent All-Stars, the player's signing salary is regressed on the net-of-tax rate as well as other player, team, and location characteristics. Our least-squares estimate indicates that free agent All-Stars require a 3.3

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<sup>4</sup>For a full discussion of jock taxes, see Hoffman and Hodge (2004).

percent higher salary for a one-percent decrease in the net-of-tax rate. This is significantly greater than one at the ten-percent level. This result does appear to be sensitive to outliers, as a quantile regression around the median revealed a lower estimate that was still greater than one in absolute value, but was not statistically different from one. These results lend credence to the traditional view in public finance that states will have difficulty implementing progressive income taxes.

## 2 Literature Review

The question of tax incidence with respect to state income taxes has been addressed by Feldstein and Wrobel (1998). Using wage data from the March Current Population Survey (CPS) for the years 1983 and 1989, the authors find that state and local governments are unable to redistribute income and conclude that any attempt needs to be undertaken at the federal level or by a sufficiently large group of states.<sup>5</sup> When interjurisdictional migration is possible, gross, or pre-tax wages, will adjust to a change in state income tax until net, or post-tax wages, are equal. While this adjustment has conventionally been recognized in the long run, the authors find that adjustment is rapid over this time period and even short-run effects of redistribution are very small. Additionally, changes in progressivity can result in deadweight efficiency losses as resources are reallocated spatially. The cost of high-skilled labor to firms will increase, reducing employment in this group, and the cost of low-skilled labor will decrease, expanding the employment of this group.

Our paper most closely follows that of Bakija and Slemrod (2004), which estimates aversion to high state taxes by the rich elderly using federal estate tax returns and a tax burden calculator. They use a fixed-effects logit probability model where an individual migrates to the state that provides the highest utility, and find that state income taxes are estimated to have a significant negative correlation with the number of reported income tax

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<sup>5</sup>If the number of states raising income tax progressivity was large enough, individuals would have fewer migration opportunities and pre-tax wages may not fully adjust.

returns in that state. Specifically, they estimate the percentage decline in estate tax returns for the state ranges from 1.5 to 2.7 percent given a one percent increase in the effective state average income tax rate.<sup>6</sup> However, as the authors note, the results depend upon the earnest of the filer to report from their actual state of residence. Our data on MLB players overcomes this problem because professional athletes are recognized as residents of the state in which their team resides. The authors also provide an alternate, political economy, interpretation of the Feldstein and Wrobel (1998) conclusion by suggesting that progressive state income taxes may be a response to increasing wage inequality rather than a cause of the inequality.

Examining wage inequality more directly, Leigh (2005) employs an index of redistribution based on the Gini-coefficient for the years 1977 through 2002 and does not find a statistically significant relationship between more redistributive state taxes and pre-tax inequality. As noted above, the expected increase in pre-tax wage inequality was suggested by Feldstein and Wrobel (1998). However, Leigh's evidence on the migratory behavior is mixed, and he finds no evidence that total state personal income is negatively affected by a more progressive state income tax. Finally, he reports limited evidence that states with more inequality are likely to implement more progressive tax systems. This lends some support to the political economy hypothesis of Bakija and Slemrod (2004).

Looking specifically at the migration literature, Linneman and Graves (1983) have established that the migration decision is affected by location specific characteristics such as climate or state and local public finance. Using microdata from the National Longitudinal Survey of Youth (NLSY), Knapp and White (1992) show that individuals do respond to state and local tax and expenditure policies when making a migration decision. Conway and Houtenville (2001) conclude that elderly migrants are attracted to states characterized by lower personal income taxes and lower death taxes. However, the magnitude of the estimates are small and sensitive to model specification. Cebula (1990) finds that just the existence of

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<sup>6</sup>Bakija and Slemrod (2004) compute this tax burden using their own tax calculator that gives them essentially the economic cost of the tax, which is the combined federal and state income tax liability as a share of income, minus their income tax liability in a state without an income tax.

a state income tax system may act as a deterrent to elderly in-migrants, and Saltz (1998) reports similar findings for individuals between 20 and 40 years of age.

### 3 Data and Methodology

The motivation for the econometric model comes from the classic hedonic pricing model used for differentiated goods. The suggestion is that teams located in less desirable environments, particularly those with higher income taxes, will have to offer higher salaries to attract better players. In essence, the teams' demand for high-skill players is less elastic than the supply of that talent, shifting the incidence of the tax burden onto the team. Therefore, letting subscript  $i$  represent an observed transaction, a player's salary ( $Y_i$ ) will depend nonlinearly on their own characteristics ( $Z_i$ ), the signing team's characteristics ( $X_i$ ), the location's characteristics ( $L_i$ ), and the relevant income tax rate ( $T_i$ ). The random error term  $e_i$  reflects the individual heterogeneity of team and player preferences in the transaction while  $D$  is a vector of dummy variables and the constant term.

$$Y_i = T_i^\beta Z_i^\delta X_i^\gamma L_i^\rho \exp[\alpha D + e_i] \quad (3.1)$$

For the econometric specification, we take the log of equation (3.1). Letting the lowercase letters represent the variables in equation (3.1) in their log form, and letting  $\tau_i = \ln(1 - T_i)$ , we specify the model for estimation as:

$$y_i = \beta\tau_i + \delta z_i + \gamma x_i + \rho l_i + \alpha D + e_i \quad (3.2)$$

The coefficient of interest will be the net-of-tax rate elasticity,  $\beta$ , and will be interpreted as the percentage increase in income required to compensate the player for a one percent decrease in the net-of-tax rate for playing in that state. The actual specification of this tax rate will be discussed shortly, but the expected sign of  $\beta$  is negative if free agent all-stars

require higher compensation to play in states with higher income taxes. The closer  $|\beta|$  is to one, the more fully compensated the players are for the tax rate. If  $|\beta| > 1$ , then it is interpreted that the players require compensation for non-baseball and capital income. Therefore, it should be noted that non-salary income, such as endorsement contracts or capital income, is not included in the current analysis.

Most of the player and team data is extracted from *The Lahman Baseball Database, Version 5.3*, a commonly used source for studies that draw on MLB data.<sup>7</sup> It is likely that from the standpoint of the American public, even the lowest paid MLB player is rich. However, what is needed for this study is to select players whose talents would give them market power that is similar to that of the general rich population. Presumably, the general rich population have a skill-set that allows them at least some flexibility in choosing where to live. The desired group of MLB players we want to analyze have the power to negotiate salaries, with the idea being that any team would be willing to sign them if the price was right.<sup>8</sup>

Within the Lahman database, we were able to construct an indicator variable that signaled if a given player had ever been voted to play in an All-Star game at any point in his career. This All-Star indicator was used to determine whether or not the player had any bargaining power, as arbitrarily choosing a particular salary or performance statistic would be more likely to lead to a sample-selection bias. For instance, a young promising player may have some market power even if his performance statistics are low and similarly for a player on the tail-end of his career.

This topic also brings up an important limitation of the use of MLB All-Stars as representative of the rich population. It may be expected that the labor supply of MLB All-Stars to a state is more elastic with respect to taxes compared with the general rich population,

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<sup>7</sup>Recent examples of studies using the Lahman Database include Abel and Kruger (2006) and Bradbury and Drinen (2006).

<sup>8</sup>Ideally, we would like to have an estimate of the present value of the contract at signing. This is not data available to us, but Slemrod (1992) has pointed out that empirically a snapshot of annual income is not a bad representation of income averaged over several years and generally does not provide misleading results.

due to greater mobility among baseball players. Their baseball earnings are relatively front-loaded in their lifespan and concentrated in a small number of years. Players may be willing to relocate temporarily to gain large rewards and move to a preferred location in retirement. Additionally, the labor market for the MLB free agents is presumably better organized than other markets for highly skilled labor to find available positions in alternative locations that are close substitutes. Similarly, player performance is not constrained by agglomeration economies that may affect other highly skilled workers, and spousal working decisions are not likely to be an issue.<sup>9</sup> According to the Current Population Survey (CPS) produced by the Census Bureau, the probability of a interstate move from March 1990 to March 1995 by individuals over age 15 and earning more than \$100,000 in 1994 was 8.9 percent. By comparison, the probability that an All-Star MLB player in 1990 was playing in a different state in 1995 was 47.6 percent. This heightened mobility of MLB all-stars will weigh against the trade-off that players cannot easily choose alternative locations for reporting their residence.

The All-Star indicator variable was then merged with a list of free agent transactions from 1991 into the 2002 season, which we used to exclude any player who was never on an All-Star team. We then limited the list to include only non-pitchers because of the significantly different features of the position that make it an altogether different labor market (see Hylan et al., 1996). This list was then merged together with the players' previous season performance statistics, as well as the signing teams' previous season revenues and performance. Additionally, we added various other characteristics of the Metropolitan Statistical Area (MSA) the team resided in, such as population and housing prices. The resulting dataset has 235 observations, for which the summary statistics are presented in Table 3.2 with the descriptions of the variables in Table 3.3.

The final variable to discuss is the state tax rate, which is a point of discussion. The measure of the players' tax rate is what we will refer to as the average tax rate, calculated using NBER Taxsim (see Feenberg and Coutts, 1993) to estimate federal and state tax

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<sup>9</sup>We appreciate an anonymous referee's contributions to some of the limitations of using MLB free agents.

liability and dividing it by total income.<sup>10</sup> This measure captures the interaction of state and federal taxes since the taxes paid to the state are deductible from federal taxable income for itemizers. The problem that arises from this is the average tax rate is an increasing function of income, making it endogenous. To correct for the endogeneity, we created an instrument variable (IV) that was the total tax burden from an arbitrarily high level of income that was constant across players, states, and time.<sup>11</sup> Since the deductibility of state taxes is a sunk benefit in the location choice and the players have a high enough income that they are located in the highest tax bracket, the correlation coefficient  $\beta$  should capture the effect of differences in the state's top marginal tax rate. Still, year dummies will be included to capture spurious correlation from other changes in the tax code over the period.

## 4 Results

The estimation of equation (3.2) was carried out with an IV for the average tax rate in a two-stage least squares (2SLS) regression with robust standard errors. The estimation of the first stage of the regression can be found in Table 3.4, while the results of the second stage regression can be found in Table 3.5 with the robust standard errors reported in parentheses.<sup>12</sup>

The first column of Table 3.5 reports final results of the IV with 2SLS and finds the income elasticity to the net-of-tax rate to be -3.3 percent, which is significantly greater than one in absolute value at the ten-percent level. The interpretation is that we are 90 percent confident that a one-percent decrease in the net-of-tax rate will mean that players would

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<sup>10</sup>There is no Canadian counterpart to the NBER Taxsim model that we know of, and since we were unable to devise a similar method to estimate an average tax rate for the Canadian provinces during the time period, those players were dropped from the model. However, there were just 17 transactions between Canadian teams and free agent All-Stars. The inclusion of their top bracket provincial marginal tax rate as a proxy for their average income tax rate did not change the results in any significant way, and those results are available upon request from the authors.

<sup>11</sup>We choose \$10 million as our arbitrarily high level of income to serve as the instrument variable. We thank an anonymous referee for suggesting the use of this measure of tax rate.

<sup>12</sup>In both Tables 3.4 and 3.5, the year dummies are not reported but are available upon request from the authors.

require a greater than one-percent increase in their salary to offset those higher taxes. The second column of Table 3.5 demonstrates the results of a quantile regression around the median observation in the second stage.

The philosophical distinction between classical linear regression and that of a quantile regression lies the measurement of errors that the coefficients are to minimize. The least squares minimizes the sum of the squared deviations from a mean that is a parametric function of the data and the coefficient. The quantile regression on the other hand minimizes an error function conditional on a chosen sample quantile,  $k$ , which is also a parametric function of the observed data and a coefficient. Using the notation of Koenker and Hallock (2001) this is expressed mathematically as

$$\min_{\beta \in \mathbb{R}^p} \sum \rho_k(y_i - x_i' \beta).$$

which can be estimated for any  $k \in (0, 1)$ . Here  $\rho_k(\cdot)$  is a piecewise linear and continuous loss function tilted around quantile  $k$ :

$$\rho_k(u) = u(\tau - I(u < 0))$$

It is often simpler to think of this function graphically, as in Figure 3.1. A  $\beta$  conditional on quantile  $k$  may be found as to minimize this function. If  $k = 0.5$ , the same number observations will appear both above and below  $k$ , making it serve as the median. The resulting estimate of  $\beta$  will be insensitive to outliers in that, if we were to double the value of the maximum  $y$ , the coefficient that minimizes the above equation would remain the same. While quantile regressions do not have a convenient looking closed form solution like ordinary least squares does, the problem can be formulated into a linear programming model as:

$$\min_{(\beta, u, v)} \{k1_n^T u + (1 - k)1_n^T v \mid X\beta + u - v = y\}$$

The solution will be a  $\hat{\beta}$  where  $X$  will be non-singular and  $y_i - x_i'\beta = 0$ . At the locations where this latter condition is true, the function has a directional derivative for all directions in real space, and the function will be increasing in all directions if you were to move away from  $\hat{\beta}$ . Interestingly, this regression is interpolated on the observations surrounding the chosen quantile, with the number of observations being no smaller than the column rank of  $X$ . Every observation in the sample is included in determining the location of  $k$ , thus avoiding sample selection bias, but only those select observations at the quantile determine the value of  $\hat{\beta}$ .

The quantile regression indicates that estimation of equation (3.2) does appear to be sensitive to outliers, which exist on both ends of the distribution of real salaries. While the net-of-tax rate is still statistically different from zero at the five-percent level, it is not statistically different from one. The remainder of the variables seem to take the expected signs. Defensive put outs is positive and significant, as is the sum of on-base and slugging percentages that is advocated by Hakes and Sauer (2006). Age takes the quadratic form that indicates a turning point at approximately 27 years. While individually the coefficients on the age variables are statistically insignificant, they are jointly significant at the five-percent level in the IV/2SLS and at the one-percent level in the quantile regression. There also does not appear to be significant barriers to signing with a new team, as the salary players are willing to accept to stay with the same team is lower by a statistically insignificant amount.

We found the median house price served as the best proxy for amenities, and that players do accept lower salaries in amenity rich states.<sup>13</sup> It also seems that teams are willing to pay slightly more for a player who was born in the state the team is located in. This is probably capturing a marginal revenue effect where local fans would like to see former prep stars return to the area and play professionally.

To control for teams that highly value a player's marginal product the adjusted popula-

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<sup>13</sup>For a discussion of the use of housing price as a sole proxy of amenities, see Graves (1983) and Knapp and Graves (1989).

tion, the team's previous year revenues and winning percentage were included.<sup>14</sup> They were consistent in having the expected signs but were significant in only the quantile regression.<sup>15</sup> Cross-correlation and variance inflation factors did not indicate the presence of collinearity between the three variables.

## 5 Discussion

The evidence provided here supports the traditional view of public finance regarding the inability of states to redistribute income with progressive taxation on the rich. Since professional baseball players are largely incapable of hiding their salary income or reporting their residence in a lower tax state, those players with a highly elastic labor supply will shift the burden of the tax onto the teams and provide some insight into how strong this impact is among the rich. According to our estimates, a one percent decrease in the net-of-tax rate requires a 3.3 percent higher gross salary to sign a free-agent All-Star. This is significantly greater than one at the ten-percent level, albeit that significance is sensitive to outliers as evidenced by a quantile regression. These results complement the work on state taxation of the rich elderly by Bakija and Slemrod (2004), in which they found the elasticity of higher state income tax rates to reduce the number of federal tax returns filed from 1.5 to 2.7 percent, depending on the specification of the model.

It could still be true that a state could increase its total tax revenue from increasing the marginal tax rate on the top income bracket, our results do not rule this out. To the extent the results are representative of the general rich population, it suggests that states will bear the larger share of the burden of deadweight losses from this form of taxation. Of course there could be other factors to consider from a normative standpoint since the discussion of

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<sup>14</sup>We would like to thank an anonymous referee for suggesting revenue to control for this effect.

<sup>15</sup>Other variables were tested but found to be insignificant in controlling for the teams' valuation of a player's marginal product. The revenue control appears to be driven by teams like the New York Yankees and the Boston Red Sox. Without revenue, dummies for these teams were significant but the standard errors were much higher across the regression. Once the revenue was included, these dummies and an interaction term were insignificant. We also tried the age of the stadium and the stadium's ball-park factor, which is an estimate of how favorable the stadium is to batters, but in both cases were insignificant.

minimizing deadweight loss alone comes from a normative background (see Sandmo, 1998).

There are also some possible implications for MLB itself, as it seems from our results that teams that are located in higher tax states are put at somewhat of a disadvantage in the bidding process for the best players. This would be an important consideration in other sports that have salary caps as a team in a high-tax state would not be able to purchase as much free agent talent. It also would follow that different taxes across states would distort the baseball player labor market since a team in a low-tax state could outbid another team in a high-tax state even if their valuation of the player was lower.

Table 3.1: Income Tax Burden of 20 Highest Paid Players on U.S. Teams in 2002

	Name	Team	Gross		State		Federal		State		Net		N.I. Rank	Average Tax Rate
			Income	Income	Marginal Tax Rate	Liability	Liability	Liability	Income	Income				
1	Rodriguez	Alex	Texas Rangers	\$22,000,000	0.00 %	\$8,466,384	\$0	\$13,533,616	1	38.48%				
2	Brown	Kevin	Los Angeles Dodgers	15,714,286	9.30	5,659,014	1,459,274	8,595,998	4	45.30				
3	Ramirez	Manny	Boston Red Sox	15,462,727	5.30	5,806,145	818,999	8,837,583	2	42.85				
4	Bonds	Barry	San Francisco Giants	15,000,000	9.30	5,400,670	1,392,845	8,206,485	6	45.29				
4	Sosa	Sammy	Chicago Cubs	15,000,000	3.00	5,731,468	449,879	8,818,653	3	41.21				
6	Jeter	Derek	New York Yankees	14,600,000	6.85	5,393,463	999,517	8,207,020	5	43.79				
7	Martinez	Pedro	Boston Red Sox	14,000,000	5.30	5,254,519	741,475	8,004,006	7	42.83				
8	Green	Shawn	Los Angeles Dodgers	13,416,667	9.30	4,828,007	1,245,595	7,343,065	10	45.27				
9	Johnson	Randy	Arizona Diamondbacks	13,350,000	4.79	5,036,169	637,647	7,676,184	8	42.50				
10	Maddux	Greg	Atlanta Braves	13,100,000	5.83	4,888,891	763,116	7,447,993	9	43.15				
11	Walker	Larry	Colorado Rockies	12,666,667	4.77	4,777,528	603,869	7,285,270	11	42.48				
12	Belle	Albert	Baltimore Orioles	12,368,790	4.75	4,665,555	587,142	7,116,093	12	42.47				
13	Williams	Bernie	New York Yankees	12,357,143	6.85	4,561,051	845,882	6,950,210	13	43.76				
14	Vaughn	Mo	New York Metts	12,166,667	6.85	4,490,358	832,834	6,843,475	14	43.75				
15	Jones	Chipper	Atlanta Braves	11,333,333	5.83	4,226,188	660,106	6,447,039	17	43.11				
16	Bagwell	Jeff	Houston Astros	11,000,000	0.00	4,220,384	0	6,779,616	15	38.37				
16	Gonzalez	Juan	Texas Rangers	11,000,000	0.00	4,220,384	0	6,779,616	15	38.37				
16	Mussina	Mike	New York Yankees	11,000,000	6.85	4,057,362	752,917	6,189,721	18	43.73				
19	Piazza	Mike	New York Metts	10,571,429	6.85	3,898,303	723,560	5,949,566	19	43.72				
20	Giamì	Jason	New York Yankees	10,428,571	6.85	3,845,283	713,774	5,869,514	20	43.72				

Table 3.2: Descriptive Statistics

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Real Signing Salary	235	\$2,773,129	\$1,874,022	\$124,140	\$9,624,601
Effective State Marginal Tax Rate	235	0.06	0.03	0.00	0.11
Average Tax Rate	235	0.41	0.04	0.26	0.47
Tax Instrument Variable	235	\$4,264,271	\$339,449	\$3,094,464	\$4,719,885
Put Outs	235	252	344	0	1,458
On-Base+Slugging Percentage	235	0.759	0.136	0.125	1.137
Age	235	33.5	3.5	25.0	46.0
Age2	235	1,132.8	244.0	625.0	2,116.0
Re-Signed with Same Team = 1	235	0.3	0.4	0.0	1.0
Signing Team located in Birth State=1	235	0.1	0.3	0.0	1.0
Lagged Signing Team's Revenues (mills)	235	\$84.8	\$36.1	\$26.6	\$207.6
Lagged Signing Team's Winning Pct	235	0.509	0.071	0.327	0.716
MSA's Median House Price	235	\$149,741	\$58,087	\$73,705	\$384,130
Adjusted MSA Population	235	4,797,333	3,255,051	1,449,760	13,155,584

Table 3.3: Variable Definitions and Sources

Variable Name	Description
Real Signing Salary <sup>1</sup>	The player's real salary in the first year with the signing team. Salary deflated to 2000 dollars with personal consumption expenditures chain-type price index from the St. Louis Fed.
Average Tax Rate <sup>2</sup>	Federal tax liability plus state tax liability divided by gross income.
Tax Instrument <sup>2</sup>	The federal plus state tax burden on \$10 million in income.
Put Outs <sup>1</sup>	A put out occurs when a defensive player is involved in preventing a player from safely reaching a base.
On-Base + Slugging Percentage <sup>1</sup>	On-base percentage is the sum of hits, walks, and hit-by-pitches divided by the sum of at-bats, walks, sacrifice flies, and hit-by-pitches. Slugging percentage is total bases divided by at bats.
Age <sup>1</sup>	Year of transaction minus year player was born.
Re-Signed with Same Team <sup>1</sup>	Dummy variable where one indicates the signing team and the previous team were the same, else zero.
Signing Team Located in Birth State <sup>1</sup>	Dummy variable where one indicates the signing team is located in the same state the player was born in, else zero.
Lagged Signing Team's Revenues <sup>4</sup>	The signing team's total revenues for the previous season in millions of 2000 dollars, deflated with personal consumption expenditures chain-type price index from the St. Louis Fed. For the 1994 season, a hypothetical estimate from Financial World that assumed no strike was used.
Lagged Signing Team's Winning Pct <sup>1</sup>	The signing team's percentage of games won in the previous season.
Median House Price of Team's MSA <sup>3</sup>	The median house price of an owner-occupied housing unit for the MSA the team is located in as reported by the 2000 Census. This price was then extrapolated over the time-series using the MSA housing growth rates from the OFHEO and then deflated to 2000 dollars with personal consumption expenditures chain-type price index from the St. Louis Fed. This method was also employed by Bakija and Slemrod (2004).
Team's Adjusted Population <sup>5</sup>	The adjusted population is calculated by taking the population of the MSA and dividing it by the square root of the number of teams in the MSA, as used in Hylan et al. (1996).
Free Agent transactions <sup>4</sup>	Free agents were not limited to six-year free agents or to those awarded free agency by an arbitrator.

**Data Sources:** 1) The Lahman Baseball Database, Version 5.3; 2) NBER Taxsim Version 5.1 (Feenberg and Coutts, 1993). 3) Median House Price: U.S. Census Bureau; House Price Index: Office of Federal Housing Enterprise Oversight. 4) Doug Pappas, Business of Baseball Committee. 5) U.S. Census Bureau

Table 3.4: First Stage Least Squares Estimates

<b>Dep: ln(1 – Average Tax Rate)</b>	Coefficient	s.e.	p-value
Tax Instrument IV	-1.890 ***	0.129	0.00
ln(Put Outs)	-0.004 ***	0.001	0.00
ln(On-Base Pct + Slugging Pct)	-0.047 ***	0.010	0.00
Age	-0.006	0.008	0.48
Age <sup>2</sup>	0.001	0.001	0.45
Re-Signed with Same Team = 1	-0.005	0.005	0.32
Signing Team located in Birth State=1	-0.001	0.007	0.89
ln(Lagged Signing Team’s Revenues)	-0.007	0.009	0.44
ln(Lagged Signing Team’s Winning Pct)	0.038 **	0.018	0.04
ln(Median House Price of Team’s MSA)	0.024 **	0.009	0.01
ln(Team’s Adjusted Population)	-0.004	0.004	0.28
Time Trend	0.002 *	0.001	0.10
Constant Term	-4.192	2.662	0.12
Sample Size	235		
$R^2$	.7747		

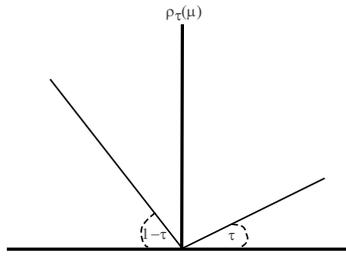
Note: \*\*\* significant at 1%, \*\* significant at 5%, and \* significant 10%. Year Fixed Effects not reported but available upon request.

Table 3.5: Estimation Results

<b>Dep: ln (Real Signing Salary)</b>	IV/2SLS		Quantile	
ln(1-tax rate)	-3.3497	**	-1.2011	**
	(1.45)		(0.59)	
ln(Put Outs)	0.1181	***	0.1199	***
	(0.02)		(0.01)	
ln(On-Base Pct + Slugging Pct)	0.6904	*	0.8580	***
	(0.37)		(0.09)	
Age	0.1295		0.0817	
	(0.15)		(0.07)	
Age2	-0.0024		-0.0015	
	(0.00)		(0.00)	
Re-Signed with Same Team = 1	-0.0118		-0.0579	
	(0.11)		(0.04)	
Signing Team located in Birth State=1	0.1451		0.2432	***
	(0.16)		(0.06)	
ln(Lagged Signing Team's Revenues)	0.1742		0.1716	**
	(0.16)		(0.08)	
ln(Lagged Signing Team's Winning Pct)	-0.3489		-0.6599	***
	(0.37)		(0.16)	
ln(Median House Price of Team's MSA)	-0.5198	***	-0.2777	***
	(0.19)		(0.07)	
ln(Team's Adjusted Population)	0.0768		0.0812	**
	(0.08)		(0.03)	
Time Trend	0.0572	**	0.0615	***
	(0.03)		(0.01)	
Constant Term	-99.4828	*	-109.2985	***
	(0.07)		(21.83)	
Sample Size	235		235	
$R^2$	.4879		.2261	

Note: \*\*\* significant at 1%, \*\* significant at 5%, and \* significant 10%. Year Fixed Effects not reported but available upon request.

Figure 3.1: Quantile Regression Loss Function



# Chapter 4

## Tenure Choice, Location, and the Tax Treatment of Housing.

### 1 Introduction

While income taxes and the tax treatment of housing are aspatial in design, they carry spatial implications. Our intention is to develop a theoretical model that combines the location decision with tenure choice *and* incorporates the preferential tax treatment of ownership with the additional costs of maintaining the property. While each of these key characteristics - maintenance costs, tax treatment, tenure choice, and location - have been explored in-depth by previous literature our model is the only one we are aware of that examines the interplay between them all. This model allows us to draw several spatial implications by comparing the conditions of our results with what is observed in reality.

There are several manners in which U.S. policy treats housing differently from all other assets and goods. Both mortgage interest and property taxes are deductible from federal taxable income, and owner-occupiers are not taxed on their imputed rent income. Additionally if you sell your house at a profit you may be exempt from the capital gains tax, but not so if you come out ahead when selling shares of your mutual fund or IBM stock.

This special treatment of housing has received much of the blame for the trend of increased suburbanization and urban sprawl over the last several decades (Gyourko and Voith, 1997). Additionally, the progressive tax system in place increases the incentive for those in the higher tax brackets to purchase larger and more expensive homes. This creates an arbitrage opportunity for a low-income family to sell their home to a landlord in a high-income tax bracket who then could rent it back to them at a lower rate by sharing some of their incremental tax savings. Empirical support for this low-to-high income housing market tax arbitrage has come from Narwold (1992) and Narwold and Sonstelie (1994).

These attributes of housing and their differential treatment in the tax code have recently led others to observe the spatial distribution of these housing subsidies (via tax savings). Gyourko and Sinai (2003) estimate the distribution of housing subsidies over space and discover that the largest beneficiaries are concentrated within a few Metropolitan Statistical Areas (MSAs). These authors find that 87.3 percent of the net-benefits to metropolitan areas are concentrated in just five locations. For instance, Gyourko and Sinai (2003) single out the Honolulu, HI MSA as the largest beneficiary at \$12,362 in benefit per owner, whereas the McAllen-Edinberg, TX MSA is the lowest at \$745.<sup>1</sup> When Gyourko and Sinai (2003) compare central city census tracts to all other census tracts, housing subsidies represent a net transfer from the cities to the suburbs in the order of \$18.2 billion.

Many models of tenure choice between renting and owning include an analysis of taxation. However, tenure models tend to be in an asset-portfolio context (e.g. Henderson and Ioannides, 1983). The models that do look at the decision of where to rent and where to own usually assume some type of externality, regulatory constraint, or credit market imperfection that entices the wealthy households to own in the suburbs and poor households to rent in the city. This is the observational reality in the pattern of income residence and has been described by Rosenthal (2006). While these assumptions fit with our notions regarding the practice of zoning, it assumes that these restrictions are binding in some way, holding back some

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<sup>1</sup>Gyourko and Sinai (2003) identify these five areas are Los Angeles-Riverside-Orange County, New York-Northern New Jersey, San Francisco-Oakland-San Jose, Boston-Worcester-Lawrence, and Washington, D.C.

underlying forces that the previous literature has not modeled. For instance, Gyourko and Voith (1997) examine the impact of subsidies on decentralization and residential sorting along income lines. The workers have identical preferences for numeraire consumption, housing, and location-specific exogenous amenities but have idiosyncratic preferences for suburban or urban location. They also assume that the city location is fully developed and is therefore inelastic in housing supply, while the suburb has an elastic supply of housing. The effect of the subsidy then is to increase city rents and entice some households of both high and low income to relocate to the suburbs, hence no sorting effects manifest among income groups. In their extension, sorting only occurs in this model when binding zoning constraints are introduced that exclude low-skill workers.

Yet it is likely that zoning is endogenously determined by risk-averse homeowners (Fischel, 2001a) and it could be that this pattern would emerge even without such restrictions. Figure 4.1 demonstrates the share of housing units that are occupied by renters by census tract in Houston, Texas. The shading of the figure is such that the darker the shade, the higher the concentration of rented units. Houston appears to take the same pattern observed in every other U.S. city, with the concentration of rented units declining as you move toward further into the suburbs. For comparison, Figure 4.2 demonstrates the same scale the share of renter occupied units for another Texas metropolitan area, Austin. Indeed, Houston has not been spared from urban sprawl, and a lack of zoning restrictions has not induced an abundance of suburban rental property. Admittedly, Houston is just a single observation and there may be other policies to substitute zoning to mimic this appearance. The Houston example does demonstrate the need to provide a theoretical underpinning for zoning restrictions that would keep poor-renters in the city and rich-owners in the suburbs a binding one.

We will present a model in which bid-rent functions are compared for a representative agent among two locations, the city and the suburb. The agent may rent or own, but they incur maintenance costs when owning and transportation costs when living in the

suburbs. In equilibrium, household utility must be equal at all locations for all tenure choices with prices adjusting to eliminate any utility differentials. This model is analogous to the traditional monocentric city model approach with bid-rent functions for modeling consumer demand in that we have homogeneous preferences by using a representative agent. This also ignores potential life-cycle effects that create differences among households. Eventually these issues can receive theoretical attention in an extension of the model, and they do receive acknowledgement in the empirical estimation. Such an extension might use distributions of agents that exist along a continuum of different preferences or carry different preferences in each period of the life-cycle.

We also follow the monocentric approach by treating the supply of housing as naively producing the type of housing for which consumers offer the highest per-foot price. As previously discussed, the supply-side may have growth controls, zoning, or a variety of factors influencing it at any given time. Once a better understanding of consumer demand in the spatial-tenure choice is gained, the supply of housing may have firms operating in different market types or face legal constraints.

The next section derives the theoretical model and will be followed with a section providing estimates for a multinomial logit regression on spatial tenure choice before concluding.

## 2 Theoretical Model

The model in this section is a variant of the work by Hoff and Sen (2005). A city consists of a central business district (CBD), which is the only employment center, and the suburbs. A generation of households moves into the city at the beginning of each period and moves out at the end of the period. The number of households in each generation remains constant. A household with income  $y$  residing in the suburbs has a disposable income  $y - \tau$ , where  $\tau$  represents commuting costs. Households are identical except for their current endowed income  $y$ , distributed across households according to the distribution function  $F(y)$ , where

$y \in [\underline{y}, \bar{y}]$ . In the second period, all households have identical income  $w$ .

Households derive utility from the consumption of a numeraire good and from housing. Housing units are ex-ante identical at both the CBD and suburbs, and provide one unit of housing quality. All housing units are owned by real estate companies. Households can either purchase a housing unit from a real estate company by paying the price  $\beta$ , or they can rent it afterwards for  $\rho$ . Once households decide whether to become a renter or owner, they determine the amount of effort they will spend on improving the quality of the house. Let  $q$  denote the level of “home improvement”, then the utility derived from housing in the first period is  $v(1+q)$ , with  $v' > 0, v'' < 0$ . The cost of exerting effort is captured by the function  $c(q)$ , with  $c' > 0, c'' < 0$ . In period two, the housing unit depreciates by  $\gamma$ , which means that the quality level ends up being  $(1+q-\gamma)$ , so that the value of the house is  $\beta(1+q-\gamma)$ .

## 2.1 Homeowner’s Problem

As in Hoff and Sen (2005), the utility function employed throughout the analysis specifies a minimum consumption level, set at zero, below which the utility becomes unboundedly low. Given  $\beta$ , each household chooses a level of home improvement  $a$ , and borrowing  $b$ , to maximize the utility

$$u^o = \begin{cases} y - \tau x - \beta + b + [v(1+q) - c(q)] \\ \quad + \delta\{w(1-t) - [1+r(1-t)]b + \beta(1+q-\gamma)\}, & \text{if } y - \tau x - \beta + b \geq 0; \\ -\infty, & \text{otherwise,} \end{cases} \quad (4.1)$$

where  $\delta$  is the common discount factor, and  $x = 1$  if the household resides in the suburbs and  $x = 0$  otherwise. Suppose that housing depreciation after one period is  $\gamma = 1$ . Additionally, assume that  $\theta \equiv \delta[1+r(1-t)] - 1 > 0$ . Thus, there are two possible cases: (i) if  $y - \tau x \geq \beta$ , then there are no incentives to save, i.e.,  $b = 0$ ; and, (ii) if  $y - \tau x < \beta$ , a household has to borrow  $b = \beta - (y - \tau x) > 0$  for subsistence. Note that the amount borrowed is fully employed to pay for the housing unit.

The optimal level of  $q$  is implicitly defined by

$$du^o/dq \equiv v'(1+q) - c'(q) + \delta\beta \leq 0, \quad q \geq 0, \quad (du^o/dq)q = 0. \quad (4.2)$$

Equation (4.2) defines  $q^o \equiv q^o(\beta, \delta)$ . At an interior solution, it is straightforward to obtain  $\partial q^o/\partial \beta > 0$ .

Hence, as a homeowner, a household obtains the following utility

$$u^o = \begin{cases} y - \tau x - \beta + v(1+q^o) - c(q^o) + \delta\beta q^o + \delta w(1-t), & \text{if (i) } y - \tau x - \beta > 0; \\ v(1+q^o) - c(q^o) + \delta\beta q^o \\ \quad + \delta\{w(1-t) - [1+r(1-t)][\beta - (y - \tau x)]\}, & \text{if (ii) } y - \tau x - \beta < 0. \end{cases} \quad (4.3)$$

The rest of the analysis focuses on case (ii), i.e., a situation where disposable income in the first period is not enough to pay for the full price of the house, in which case a homeowner would need to borrow  $b = \beta - y - \tau x$ .

## 2.2 Renter's Problem

As a renter, the household utility becomes

$$u^r = y - \tau x - \rho + v(1+q^r) - c(q^r) + \delta w(1-t), \quad (4.4)$$

where  $q^r$  is implicitly defined by

$$du^r/dq \equiv v'(1+q) - c'(q) \leq 0, \quad q \geq 0, \quad (du^r/dq)q = 0. \quad (4.5)$$

Throughout the analysis, we assume that  $q^r = 0$ , i.e., renters do not find it optimal to put any effort in improving the quality of the house.

### 2.3 Locational Equilibrium and Tenure Choice

The goal is to find the equilibrium values of  $\beta$  and  $\rho$  at the CBD and in the suburbs. In equilibrium every household should be indifferent between residing at any location. Letting  $u_c^o$  denote the utility of a homeowner at the CBD and  $u_s^o$  the utility of a homeowner in the suburbs, in equilibrium

$$\bar{u}^o = u_s^o = u_c^o. \quad (4.6)$$

From (4.6), we obtain  $\beta(y, t, \delta, \tau; x)$ , with  $\beta_c \equiv \beta(y, t, \delta, \tau; 0)$  and  $\beta_s \equiv \beta(y, t, \delta, \tau; 1)$ . The variables  $\beta_c$  and  $\beta_s$  represent the maximum price households are willing to pay to become owners at the CBD and suburbs, respectively.

A similar result holds for households that decide to become renters. Renters are indifferent between renting a house at the CBD or in the suburbs if

$$\bar{u}^r = u_c^r = u_s^r. \quad (4.7)$$

In order to satisfy (4.7), we should have

$$\rho_c = \rho_s + \tau. \quad (4.8)$$

At the same time, in equilibrium, households should also be indifferent between owning or renting at all locations, i.e.

$$u_c^o = u_s^o = u_c^r = u_s^r. \quad (4.9)$$

Our goal is to find the equilibrium values of  $\beta_c, \beta_s, \rho_c$ , and  $\rho_s$  that satisfy these conditions. However, the previous equations only determine a set of three independent conditions. Thus, we can arbitrarily fix the value of one of the unknowns. In this case, we fix the value of  $\rho_s$ ,

and express  $\beta_c, \beta_s, \rho_c$  in terms of  $\rho_s$ .

Recall that real estate companies own all housing units throughout the city. They will sell or rent each unit to the household type that offers the highest bid. When a household offers to buy the house, the real estate company will receive  $\beta$  in the first period. As a renter, a household is willing to pay  $\rho$  in the first period, but the real estate company retains the housing unit which has a value equal to  $\beta q^r$ . Thus, when the unit is rented, the real estate company receives  $\rho + \delta\beta q^r$ . Under the present assumptions  $q^r = 0$  because renters provide no maintenance that offset depreciation, so the real estate company ends up receiving  $\rho$ . In conclusion, real estate companies will sell their properties if  $\beta > \rho$ , and rent them if  $\beta < \rho$ . Moreover, this decision rule applies for real estate companies that own housing units at both the CBD and in the suburbs. From the previous equilibrium conditions, we obtain the following results:

$$\beta_c = \rho_c + D(\beta_c) - \theta(\beta_c - y), \quad (4.10)$$

$$\beta_s = \rho_s + D(\beta_s) - \theta(\beta_s - y - \tau), \quad (4.11)$$

$$\rho_c = \rho_s + \tau, \quad (4.12)$$

where

$$D(\beta) \equiv [v(1 + q(\beta)) - c(q(\beta)) + \delta\beta q(\beta)] - v(1) \geq 0. \quad (4.13)$$

Expression (4.13) reflects the difference between the utility a homeowner obtains when housing quality is increased by  $q(\beta)$  and the utility that a renter obtains from a housing unit with quality 1.

On one hand, a household becomes a homeowner or a renter at the CBD (respectively, suburbs) depending on the relative values of  $\beta_c$  and  $\rho_c$  (respectively,  $\beta_s$  and  $\rho_s$ ). Specifically, units will be sold to a household located at the CBD if  $D(\beta_c) > \theta(\beta_c - y)$ . In other words, when the net benefits of homeownership at the CBD, given by  $D(\beta_c)$ , outweighs the net cost

of borrowing the amount  $(\beta_c - y)$ , a household will be willing to pay a higher price as a homeowner than as a renter. In the suburbs, on the other hand, housing units will be sold to households residing there if  $D(\beta_c) > \theta(\beta_c - y - \tau)$ , in which case  $\beta_s > \rho_s$ .

How are the previous results affected when income  $y$  rises? By differentiating (4.10), (4.11), and (4.12) with respect to  $y$ , we obtain

$$\frac{\partial \beta_c}{\partial y} = \frac{\theta}{\theta + 1 - \delta q_c^o}, \quad (4.14)$$

$$\frac{\partial \beta_s}{\partial y} = \frac{\theta}{\theta + 1 - \delta q_s^o}, \quad (4.15)$$

$$\frac{\partial \rho_c}{\partial y} = 0. \quad (4.16)$$

The previous results suggest that the likelihood of becoming a homeowner increases as income goes up at both the CBD and suburbs. However,  $\beta_c$  and  $\beta_s$  do not increase uniformly with  $y$ .

### 3 Empirical Review

In order to gain a richer empirical context to our theoretical model, an examination of available data from the U.S. Department of Housing and Urban Development (HUD) is undertaken. The concentration of the housing subsidy by high income groups living in the suburbs can be examined using data from HUD's 2001 Residential Finance Survey of Owners (RFS). The survey includes vital information for obtaining a reasonable estimate of an individual's tax liability and allows us to calculate the amount of the subsidy per household. The survey gathers data regarding personal characteristics of the owner and their family, income sources, mortgage details, property taxes, and location within an MSA (city, suburbs, rural area). We were able to run this data through the NBER Taxsim model (Feenberg and Coutts, 1993) to obtain estimates of state and federal tax liabilities. By running these individuals through Taxsim a second time, this time setting their mortgage

and property tax payments to zero we obtain an estimate of their projected tax liabilities without the option of deductibility. Differencing these two estimates we are able to obtain the total subsidies to these individuals for choosing ownership, the results of which are presented in Table 4.1. While this of course makes the naive assumption that these households would not change their asset holdings if they did not own property, it gives us a picture of how the housing subsidy is directed among income groups and location.<sup>2</sup>

As can be seen in Table 4.1, it is clear that the subsidy is concentrated to the higher income groups living in the suburbs. Of all federal tax savings in the sample, 81.3 percent went to households with more than \$100,000 in income, and 82 percent of that money is located in the suburbs. Meanwhile, low-income homeowners tend to stick to the standard deduction and thus receive little of the subsidy, particularly in the rural areas. The table is consistent with the claims made by critics of the subsidy, mainly that it primarily encourages existing homeowners to purchase larger and more expensive homes as well as propagate urban sprawl.

What we cannot glean from the Residential Finance Survey is significant insights into the tenure choice decision, as those surveyed have already made the decision to own. To examine this issue, we turn to the 2004 American Housing Survey of Metropolitan areas. This survey covers 13 Primary Metropolitan Statistical Areas (PMSA) and includes both owners and renters of property in addition to many of the income, household, and housing characteristics. They also encode in the 2004 survey whether the household being surveyed is located in the urban or suburban area of the MSA, which allowed us to construct a indicator variable of spatial tenure choice: Own in the city, own in the suburb, rent in the city, or rent in the suburb. This indicator variable will serve as the basis for a random utility logistic regression.<sup>3</sup>

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<sup>2</sup>While state tax treatment of housing is taken into consideration by the Taxsim model, the state tax savings from housing are not reported here since the manner in which housing is treated may vary.

<sup>3</sup>We have been directed by a number of reviewers to consider the American Community Survey (ACS) as an alternative. While the ACS data has a number of advantages, unfortunately for our purposes it lacks our most critical variable: the households' location (city, suburb, rural).

For the AHS of 2004, the Census Bureau interviewed 62,005 households across 13 PMSAs. For the empirical analysis we excluded observations with missing values for location (city/suburban), PMSA, and other important demographic characteristics (income, race, marital status, age, educational attainment) as well as those living in mobile homes. The demographic characteristics were based on the attributes of the person who was assigned “head of household” status. Since we ultimately choose to use a random utility model, we had to exclude those households residing in the two PMSAs that occupied more than one state (Memphis and St. Louis). Had we included them, their behavior may have been distorted by having different state-level tax treatment options for housing in the suburbs. This still left us with a total of 26,553 observations, whose breakdown according to spatial tenure choice is demonstrated in Table 4.2. From the table it can be seen that roughly two-thirds of those interviewed remaining in our final sample owned their housing unit and resided in the suburbs. Descriptives of the variables to be used in the regressions are listed in Table 4.3, while the specifics of their definition and source can be found in Table 4.4.

To examine the factors that influence the spatial tenure choice decision we employ a random utility model where it is assumed that living in any mixture of the four possible spatial tenure choices within a PMSA yield to households some positive level of utility. It is then assumed that households chose the observed outcome based on the expectation that it would yield the highest level of utility among the four choices. This utility level for household  $i$  in spatial tenure choice  $j$  can be viewed in a random utility model as

$$U_{ij} = x_i\beta_j + L_i\gamma_j + \epsilon_{ij} \tag{4.17}$$

where  $x_i$  is the individual characteristics of household  $i$  and  $L_i$  are the MSA specific characteristics faced by household  $i$ . Reformulating this into the observed behavior,  $y_{ij}$ , to be regressed in a multinomial logit econometric model, the probability of a household choosing

spatial tenure choice  $j$  over reference choice  $k$  as:

$$P(y = j|x, L) = x_i\beta_j + L_i\gamma_j + e_{ij} = \frac{\exp(x\beta_j)}{1 + \sum_{k=1}^J \exp(x\beta_k)} \quad j = 1, 2, 3 \quad (4.18)$$

Equation (4.18) is estimated using maximum likelihood estimation on

$$\ln L = \sum_{i=1}^n \sum_{j=1}^3 d_{ij} \ln P(y = j). \quad (4.19)$$

where  $d_{ij}$  is an indicator set equal to one if the individual chooses  $j$  and zero if not. Numerical methods can find the  $\beta$  vectors that satisfy the derivatives of equation (4.19). The log-odds ratios  $\ln P_j/P_0 = \beta'_j x_i$  are then reported in Table 4.5. The reference case ( $j = 0$ ) here is renting in the city, so that each of the columns report the change in the log-odds that a household will choose the spatial tenure choice reported in the column header over renting in the city. The intercept here reflects a non-white, non-black, unmarried household in the Seattle PMSA that does not have at least a bachelor's degree and occupies the lowest federal marginal income tax bracket in 2004. The coefficients best deserving of attention in Table 4.5 are the income tax bracket indicators, of which the top five of the six federal tax brackets are reported. These indicators give us a more complete picture of the income and tax effects at play in the model.<sup>4</sup>

By interpreting income tax bracket coefficients our intention is to recall equations (4.14) through (4.16). These equations illustrate the modeled response to increases in income were not uniform for owning across location and had no impact on renting. Contrasting these predictions with observed empirical differences will help motivate future modeling of the spatial tenure choice decision.

The log-odds ratios become positive and significant for changing spatial tenure choice from renting in the city to any other choice starting in the third income tax bracket. Inter-

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<sup>4</sup>See Table 4.3 for complete descriptions of the variables. Attempts to include income as an interaction variable to the bracket dummies were tested for inclusion, but were insignificant.

estingly, within a spatial tenure choice, the income effect of moving up a tax bracket seems to peak in the fifth bracket. The sixth bracket, those with more than \$316,100 in gross income, seem to be indifferent between renting in the suburbs or the city. As for the remaining variables listed in Table 4.5, they seem to take the expected sign when one clearly exists.

It should be noted that there is no clear sign of property tax rate following from the theoretical literature regarding spatial expansion of the city (see Brueckner and Kim, 2003; Song and Zenou, 2005). Here, the effective property tax rate of the MSA seems to discourage moving to the suburbs, but the calculation of this variable includes the suburban areas. The theoretical literature typically deals with property tax rate in the city. Some surprising signs emerge, as having a bachelor's degree increases the probability a household will own in the city, but decrease the probability they will live anywhere else. However, being married increases the probability of owning and locating to the suburbs. Larger household size seems to suggest a push towards renting in the city over all other locations, but it is not clear what this means. The dataset is not clear if the household size is composed of children or of roommates to the household head.

Interpretation of the coefficients in a multinomial logit regression is difficult across the different choices when they are all related to a reference case. In order to gain a bit clearer interpretation of their impact on the probability of making a given choice, the marginal effect of a change in  $x$  on the predicted probability value is calculated using the formula:

$$\frac{\partial P_j}{\partial x_i} = P_j[\beta_j - \sum_{k=0}^3 P_k \beta_k] = P_j[\beta_j - \bar{\beta}] \quad (4.20)$$

The reports of these calculations for the income tax brackets are demonstrated in Table 4.6. Notice that horizontal summation across the columns of the coefficients sum to zero, the intuition of which is that an increase in the probability of choosing one location reduces the probability of choosing another. Again, the variables of primary interest to the theoretical model are the changes in the household tax bracket. The marginal effect of each bracket

reported in Table 4.6 are in reference to locating in the first income tax bracket. To compare the marginal effects to the theoretical model's equations (4.14) through (4.16), we could restate them in terms of probabilities. According the equations, an increase in income will raise the bid-rent price for owning in both the city and in the suburbs, thus enhancing the probability that we will observe them at that location. It necessarily follows then that increasing income decreases the probability of renting at either location.

What we can glean from this table is the income tax bracket a household in a given spatial tenure choice is likely to belong to. For illustration, these coefficients are plotted in Figure 4.3 for each spatial tenure choice. We can see that the probability of owning is greater than renting as income increases beyond the second tax bracket. However, neither owning in the suburbs or the city is increasing monotonically. We can see that owners locating in the suburbs are least likely to come from the second income tax bracket, and most likely to come from the fourth bracket. Though it should be noted that the drop in probability of owning in the suburbs is statistically insignificant in the second tax bracket.

While all marginal effects are statistically insignificant, we can also see that increasing income to the second bracket increases the probability of owning in the city but decreases the probability of owning in the city. Figure 4.3 illustrates a bimodal distribution of income for owners living in the city, as they are most likely to come from the second or the fifth income tax bracket. They are least likely to come from the middle income groups, hitting the minimum in the fourth income tax bracket.

In order to validate the use of the multinomial logit regression, a Hausman test was conducted over the results to test the Independence of Irrelevant Alternatives (IIA) assumption. In essence, this assumption stipulates that excluding one spatial tenure choice should not affect the probabilities of locating in another. This is done by eliminating a possible choice comparing the new multinomial logit results to Table 4.5. Statistically significant differences in the coefficients and standard errors in a  $\chi^2$  distribution rejects the null hypothesis of a satisfied IIA assumption. Since the result can be sensitive to the choice of reference case,

we repeated this exercise with each location having a turn as the reference case for a total of 12 test statistics. In 11 of those 12 tests, we were unable to reject the null hypothesis of a satisfied IIA condition.

Regardless of an absence of statistical evidence, it seems intuitively unlikely that if we were to exclude the possibility of choosing one spatial tenure choice, that it would not affect the probability to choose another. So as a measure of robustness we treated the spatial tenure choice as a sequential problem where the location and the tenure were made in an order. Following a logit regression on the first decision, we split the sample according to households that made that choice and conducted another logit regression on the second choice. For example, in Table 4.7 we treated the own or rent decision as the first choice and computed the marginal effects over the full sample, the results of which are presented in first column. We then split the full dataset into two separate sets of renters and owners and conducted another regression to examine the proclivity to locate in the suburbs. In the second column, we have the marginal effects of choosing to locate in the suburbs conditional on the renter dataset, while the third column is conditional on the owner subset.

The results in Table 4.7 seem to support the previous findings. In the third column representing the results conditional on having owned, those locating in the suburbs were most likely to have come from the fourth bracket, and least likely to have come from the second bracket, the same outcome as in Figure 4.3. It also suggests that the owners living in the city were most likely to have come from the lowest two brackets and the fifth, just as in the previous results. Renters, however, do not as clearly follow the previous results. Conditional on having chosen to rent, a household is most likely to have come from the fifth tax bracket in Table 4.7, rather than the second bracket in Table 4.6. In fact, the income effect appears to be rather strong among renters until the sixth bracket.

The marginal effects for treating the location decision as the first choice are reported in Table 4.8, with the second and third columns conditional on the location choice. Owning in the suburbs continue to have consistent results, as they are most likely to be drawn from the

fourth income tax bracket and least likely to be drawn from the second. Owners in the city, rather than coming from the first and fifth bracket, tend to be drawn from the third, fourth, and fifth income tax bracket. City renters are still likely to be coming from the first tax bracket, and suburban renters from the second. Collectively, Tables 4.7 and 4.8 generally support the earlier findings in Table 4.5 and conclude that if the IIA assumption is being violated, it is not wrecking havoc on the multinomial logit results.

## 4 Discussion

Our intention has been to provide a baseline theoretical model of the spatial tenure choice decision, that is, the joint decision of where to live and whether to own. In doing so, we accounted for trade-offs in maintenance costs, transportation costs, and tax-savings in a two period model. Much of the previous literature has relied on exogenous zoning constraints or special suburban amenities that result in income sorting by spatial tenure choice. While this view fits with many subjective observations of reality it is possible that these factors were endogenously determined by this sorting. If this is the case, then reliance on assumptions of binding zoning constraints or amenities to result in sorting are unwarranted, as sorting would occur anyway.

By comparing our baseline model, which makes no such assumptions that bind specific household types to locations, to empirical observations we can gather insights as to what manner of constraints may be binding. Our theoretical model seems to suggest that the effect of increasing income should be much stronger for increasing the bid-own price in the city, and thus should make rich owners more prevalent in the city. Along the same lines, this should concentrate housing subsidies in the city, whereas our estimates from the 2001 Residential Finance Survey of Owners suggests subsidies are distributed more heavily to the suburbs.

The extensions from this model will deal in trying to explain the observational reality of

the spatial tenure patterns. Our intention is to endogenize the constraints such as zoning, property taxation, and amenities that are usually taken as given to achieve such sorting effects.

Figure 4.1: Houston (TX) Share of Renter-Occupied Units in 2000

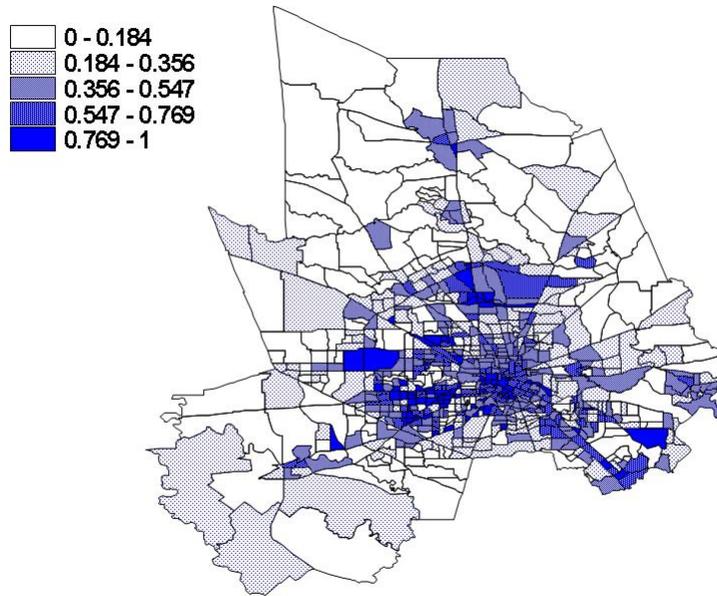


Figure 4.2: Austin (TX) Share of Renter-Occupied Units in 2000

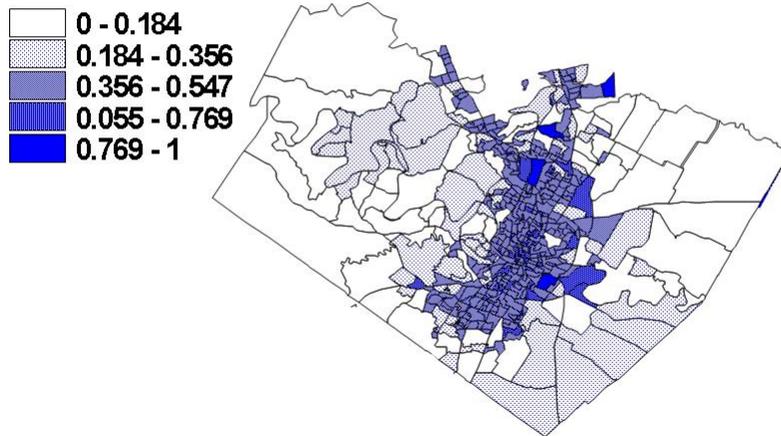


Table 4.1: Distribution of Federal Housing Subsidy Dollars by Income Group and Location.

Income Group	City		Suburbs		Rural	
	Sample	Mean	Sample	Mean	Sample	Mean
Under \$20,000	263	1.16	450	1.08	139	0.11
\$20,000 to \$40,000	403	16.22	772	3.39	182	0.00
\$40,000 to \$60,000	336	9.20	850	26.98	156	12.56
\$60,000 to \$100,000	358	89.78	1,288	129.08	143	11.76
Over \$100,000	269	643.41	1,000	847.61	74	174.27

Notes: Subsidy calculated using NBER TAXSIM 5.1 by differencing the amount if this taxpayer was a renter from their actual tax burdens. Data Source: 2001 Residential Finance Survey of Owners, HUD.

Table 4.2: Distribution of AHS 2004 data by Spatial Tenure Choice.

<b>Spatial Tenure Choice</b>	<b>Income Tax Bracket</b>	<b># of Obs.</b>	<b>Percent of Spatial Tenure Choice</b>	<b>Percent of N</b>
Own CBD	Bracket 1	296	5.47	1.11
	Bracket 2	1,396	25.79	5.26
	Bracket 3	2,537	46.86	9.55
	Bracket 4	801	14.79	3.02
	Bracket 5	254	4.69	0.96
	Bracket 6	130	2.40	0.49
	Total	5,414		20.39
Own SBD	Bracket 1	779	4.33	2.93
	Bracket 2	3,541	19.67	13.34
	Bracket 3	8,548	47.49	32.19
	Bracket 4	3,453	19.18	13.00
	Bracket 5	1,207	6.71	4.55
	Bracket 6	471	2.62	1.77
	Total	17,999		67.79
Renter SBD	Bracket 1	160	8.32	0.60
	Bracket 2	771	40.07	2.90
	Bracket 3	828	43.04	3.12
	Bracket 4	123	6.39	0.46
	Bracket 5	32	1.66	0.12
	Bracket 6	10	0.52	0.04
	Total	1,924		7.25
Renter CBD	Bracket 1	146	12.01	0.55
	Bracket 2	584	48.03	2.20
	Bracket 3	418	34.38	1.57
	Bracket 4	50	4.11	0.19
	Bracket 5	5	0.41	0.02
	Bracket 6	13	1.07	0.05
	Total	1,216		4.58
N	26,553			

Table 4.3: Descriptive Statistics

Variable	Mean	Std. Dev.
Own	0.882	0.323
Rent	0.118	0.323
City	0.250	0.433
Suburbs	0.750	0.433
bracket 1	0.052	0.222
bracket 2	0.237	0.425
bracket 3	0.464	0.499
bracket 4	0.167	0.373
bracket 5	0.056	0.231
bracket 6	0.024	0.151
Property Tax Rate	11.044	4.486
At Least a Bachelor's Degree	0.355	0.479
White	0.855	0.352
Black	0.089	0.285
Married	0.636	0.481
Household Size	1.083	1.279
Age	49.834	15.689
Age <sup>2</sup>	2,729.570	1,688.170

Table 4.4: Variable Definitions and Source

Variable Name	Definition
Own <sup>1</sup>	Dummy variable where 1 indicates the housing unit is owned by its residents, else 0.
Rent <sup>1</sup>	Dummy variable where 1 indicates the housing unit is rented by its residents, else 0.
City <sup>1</sup>	Dummy variable where 1 indicates the housing unit is located within the central city of the metropolitan area.
Suburbs <sup>1</sup>	Dummy variable where 1 indicates the housing unit is located in the suburbs of the metropolitan area.
bracket# <sup>1</sup>	Dummy variable to indicate the federal income tax bracket of the household according to gross household income. If the resident is married, is assumed to file as head of household.
Property Tax Rate <sup>2</sup>	The effective property tax rate per \$1,000 of property value in the metropolitan statistical area.
At Least Bachelor's Degree <sup>1</sup>	Dummy variable where 1 indicates the head of household has at least a Bachelor's degree or more, else 0.
White <sup>1</sup>	Dummy variable where 1 indicates the head of household identifies themselves as a member of the caucasian race.
Black <sup>1</sup>	Dummy variable where 1 indicates the head of household identifies themselves as a member of the African-American race.
Married <sup>1</sup>	Dummy variable where 1 indicates the household head is married, else 0.
Household Size <sup>1</sup>	The number of residents reported to live as a member of the housing unit minus the household head and spouse (if applicable).
Age of Household Head <sup>1</sup>	Age reported as of last birthday at the time of the survey.

Sources: 1. The 2004 American Housing Survey of Metropolitan Areas, U.S. Census Bureau; 2. National Association of Home Builders;

Table 4.5: Log Odds Ratio Coefficients for Spatial Tenure Choice.

	Own CBD	Own Suburbs	Rent Suburbs
Intercept	-1.614 *** (0.351)	-0.553 * (0.335)	0.154 (0.381)
bracket2	0.091 (0.124)	0.044 (0.118)	0.211 (0.135)
bracket3	1.190 *** (0.127)	1.272 *** (0.121)	0.470 *** (0.139)
bracket4	1.991 *** (0.190)	2.169 *** (0.185)	0.583 *** (0.215)
bracket5	2.922 *** (0.471)	2.976 *** (0.467)	1.397 *** (0.502)
bracket6	1.055 *** (0.321)	1.124 *** (0.313)	-0.639 (0.446)
Property Tax Rate	0.017 * (0.009)	-0.123 *** (0.009)	-0.077 *** (0.012)
At Least Bachelor's Degree= 1	0.489 *** (0.086)	0.258 *** (0.084)	-0.349 *** (0.100)
White= 1	-0.098 (0.135)	0.324 ** (0.131)	0.116 (0.149)
Black= 1	-0.544 *** (0.154)	-1.708 *** (0.152)	-1.298 *** (0.176)
Married= 1	0.873 *** (0.072)	1.266 *** (0.070)	0.234 *** (0.082)
Household Size	-0.140 *** (0.025)	-0.135 *** (0.024)	-0.061 ** (0.027)
Age of Household Head	0.025 * (0.013)	0.043 *** (0.012)	0.007 (0.014)
Age <sup>2</sup> of Household Head (100s)	0.034 ** (0.014)	0.016 (0.013)	-0.001 (0.015)
Pseudo R <sup>2</sup>	0.20		
N	26,553		
Log Likelihood Ratio	-19,480.3		

Note: \*\*\* significant at 1%, \*\* significant at 5%, and \* significant 10%. MSA specific Fixed Effects not reported but available upon request.

Table 4.6: Marginal Effects of Tenure and Location Choice.

	Own in City	Own in Suburbs	Rent in Suburbs	Rent in City
bracket2 ( $\Delta 1$ )	0.005 (0.011)	-0.012 (0.013)	0.008 (0.005)	-0.001 (0.002)
bracket3 ( $\Delta 1$ )	-0.001 (0.011)	0.058 *** (0.012)	-0.037 *** (0.005)	-0.020 *** (0.002)
bracket4 ( $\Delta 1$ )	-0.011 (0.012)	0.083 *** (0.012)	-0.051 *** (0.003)	-0.020 *** (0.002)
bracket5 ( $\Delta 1$ )	0.003 (0.015)	0.059 *** (0.016)	-0.044 *** (0.003)	-0.018 *** (0.001)
bracket6 ( $\Delta 1$ )	0.000 (0.019)	0.055 *** (0.019)	-0.044 *** (0.004)	-0.011 *** (0.002)

Marginal Effects are computed for a discrete change from zero to one.

Figure 4.3: Marginal Effects for Spatial Tenure Choice by Income Tax Bracket

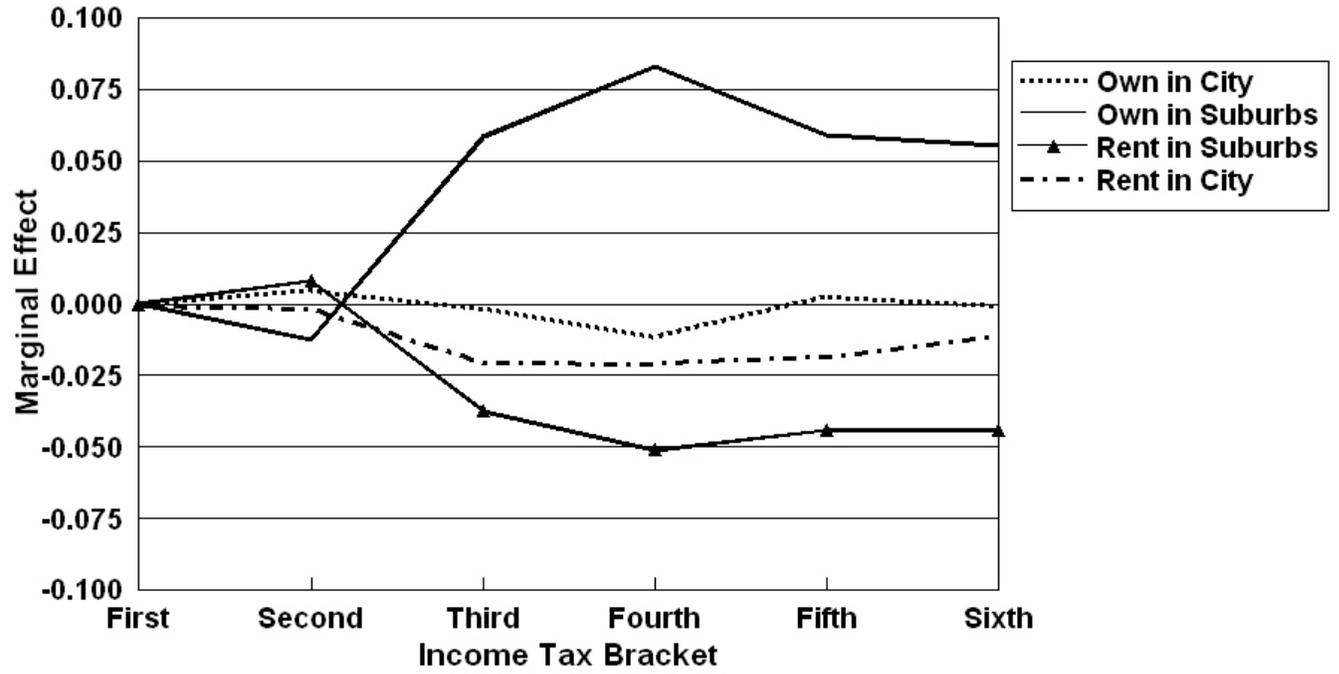


Table 4.7: Marginal effects of logistic regression with tenure-location sequence.

	$P(Own)$		$P(Suburbs Rent)$		$P(Suburbs Own)$	
bracket2 ( $\Delta 1$ )	-0.004 (0.005)		0.046 (0.033)		-0.004 (0.012)	
bracket3 ( $\Delta 1$ )	0.061 *** (0.005)		0.115 *** (0.033)		0.011 (0.012)	
bracket4 ( $\Delta 1$ )	0.073 *** (0.003)		0.134 *** (0.042)		0.023 ** (0.012)	
bracket5 ( $\Delta 1$ )	0.064 *** (0.003)		0.257 *** (0.048)		0.007 (0.015)	
bracket6 ( $\Delta 1$ )	0.053 *** (0.004)		-0.241 ** (0.121)		0.012 (0.018)	

Marginal Effects are computed for a discrete change from zero to one.

Table 4.8: Marginal effects of logistic regression with location-tenure sequence.

	$P(Suburbs)$	$P(Own City)$	$P(Own Suburbs)$	
bracket2 ( $\Delta 1$ )	0.003 (0.011)	0.019 (0.013)	-0.012 (0.006)	*
bracket3 ( $\Delta 1$ )	0.033 *** (0.011)	0.119 *** (0.014)	0.042 *** (0.006)	***
bracket4 ( $\Delta 1$ )	0.047 *** (0.011)	0.121 *** (0.008)	0.057 *** (0.004)	***
bracket5 ( $\Delta 1$ )	0.034 ** (0.014)	0.121 *** (0.006)	0.048 *** (0.003)	***
bracket6 ( $\Delta 1$ )	0.022 (0.018)	0.079 *** (0.013)	0.047 *** (0.004)	***

Marginal Effects are computed for a discrete change from zero to one.

# Chapter 5

## Conclusion

This dissertation has addressed various spatial issues in public finance. The policies examined in each essay progressed among the level of government in ascending order - from the local assessors, to state income taxation, and finally to the federal tax treatment of housing. The manner in which space was influential was completely different for each of the three essays.

For property tax assessors, it is demonstrated in Chapter 2 that their constituents likely use the level of assessment in neighboring areas to guide their expectations regarding how their own assessments should change. Among the Virginia counties, this translates into spatial dependence in the Assessment-to-Sales price ratio. If the average sales ratio among neighboring counties falls by 10 percent, there will be an accompanying 3.7 percent decline in the home districts' sales price ratio. This is the first work on assessor behavior that I am aware of that correctly controls for such spatial autocorrelation.

The use of the spatial Durbin model also controlled for spatial dependence in the independent variables. This revealed one of the more important and interesting insights of assessor behavior with respect to assessing commercial property. If assessors view commercial property as being held by non-residents, then they may try and maintain their mandated assessment levels by overassessing business property and underassessing residential property held by local voters. In the estimation of the model, the presence of commercial property

led to much higher assessments. However, mobility serves as a binding constraint on this behavior. The presence of commercial property available in neighboring counties lowered assessments and more than offset the tendency to increase them in the presence of own commercial property. Intuitively, it follows that if local firms could easily move to property available in neighboring counties, then attempts to export the property tax on them via higher assessments would result in firms' relocating across borders.

In Chapter 3, the income tax responsiveness of the rich to state income taxes is estimated. Highly skilled workers are likely to be very mobile, and not find space to serve as severe of a constraint as their lower skill counterpart. Therefore, attempts to capture additional tax revenues at the state level with progressive income taxes may suffer from severe deadweight losses. By estimating this response using professional athletes, we were able to overcome some survey biases that the previous literature had to accept. Since these types of citizens are capable of having multiple homes, they can live and work in one state but claim residency in another for tax purposes. Since professional athletes are required to file their tax claims out of their team's headquarters, we can get a good fix on their true response to income taxation.

The estimates conclude that free agent MLB All-Stars require a 3.3 percent higher gross income for a one percent decrease in their net-of-tax rate. This is significantly greater than one at the ten-percent level. The regression does appear to be sensitive to outliers, as a quantile regression around the median revealed a lower estimate that was still greater than one in absolute value, but was not statistically different from one. This evidence suggests that the working rich population is unlikely to bear the burden of progressive taxation, thus hindering the ability of the state to capitalize on mobility constraints and redistribute income. We also find no statistically significant evidence MLB players are willing to accept lower wages for resigning with the same team, further suggesting that mobility is a weak constraint. This lends credence to the traditional view in public finance that states will have difficulty implementing progressive income taxes.

A further spatial implication of these findings that could warrant future research is if the burden of progressive state income taxation falls on firms, then we should see firm aversion to *personal* as well as corporate income taxes. This would not be evidence of a principle-agent problem with executives trying to duck higher tax burdens, but a profit maximizing approach to high-skill labor management.

In the third essay, presented in Chapter 4, a theoretical framework is developed that will allow for the study of the spatial distribution of housing subsidies, among other things. The model suggests that even in the case of a flat income tax a spatial concentration of housing subsidies would begin to manifest itself. However, the observed concentration of subsidies is in the suburbs (see Table 4.1) while the model seems to suggest that it should be occurring in the city. This runs counter to the popular claim that the mortgage interest deduction by itself encourages urban sprawl. Also, empirically we do not observe a monotonic relationship with spatial tenure choice decisions and income, which the theoretical model predicts.

Much of the previous literature has made use of assumptions that force the observational outcome of high income groups sorting into the suburbs as owners and low income groups sorting into the city as renters. The differences between our theoretical and empirical outcomes in spatial tenure choice and the distribution of housing subsidies provide strong motivation for future extensions that can endogenize these assumptions. Additionally, we plan extend the model to reflect the progressiveness of the U.S. income tax code.

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# Justin M. Ross

Department of Economics

Phone: (304) 685-7646

West Virginia University, P.O. Box 6025

E-Mail: JMRoss@mail.wvu.edu

Morgantown, WV 26506-6025

Webpage: www.justinmross.com

## Education

Ph.D., Economics, West Virginia University, January 2008

B.S., Business Economics, Wright State University, (*cum laude*) June 2004

## Professional Experience

08/2004-08/2006 **Research Assistant**, Bureau of Business and Economic Research (WVU)

07/2005-05/2008 **Instructor**, Department of Economics (WVU)

Introduction to Business Statistics (ECON 225)

Principles of Microeconomics (ECON 201)

Principles of Macroeconomics (ECON 202)

Intermediate Microeconomics (ECON 301)

## Peer-Reviewed Publications

*"The Income Tax Responsiveness of the Rich: Evidence from Free-Agent MLB All-Stars."*  
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“West Virginia Economic Outlook 2006.” Hammond, G.W., Scott Murdoch, Justin M. Ross, and Kevin P. Speaker, (2006).

### **Book Contributions**

“When it Comes to Taxes: Focus on Being Competitive.” Ross, Justin M. and Joshua C. Hall, 2007. Chapter 5 in *Unleashing Capitalism: Why Prosperity Stops at the West Virginia Border, and How to Fix it*. Edited by Russell S. Sobel.

### **Funded Projects:**

“Evidence of Racial Discrimination in Cincinnati-Wells Fargo’s Lending Practices.” Ross, Justin M. and John P. Blair, (2004). Prepared for Ohio Civil Rights Commission.

“Recent Developments.” Ross, Justin M., in *Consensus Oil and Gas Forecast for West Virginia 2006*. by Hammond, George W. (2006). Prepared for the West Virginia Office of Oil and Gas.

### **Honors and Awards**

Vickers Doctoral Student Research Paper Award Winner, 2007

Jon Vilasuso Doctoral Student Publication Award, 2007

WVU Distinguished Doctoral Student Fellowship Award, 2007-2008

Swiger Fellow Supplement Award, Department of Economics, WVU, 2004-2008

Dadisman Graduate Assistant Supplement Award, 2006-2008

### **Professional Affiliations**

American Economics Association

Southern Economic Association

Southern Regional Science Association

### **Other Professional Experience**

*Referee:*

Journal of Regional Analysis and Policy

Contemporary Economic Policy

Education Economics