

A Markov Chain Monte Carlo Analysis of the Effect of Two-Rate Property Taxes on Construction¹

Florenz Plassmann²

*Department of Economics, State University of New York at Binghamton,
Binghamton, New York 13902*

E-mail: florenz@binghamton.edu

and

T. Nicolaus Tideman

*Department of Economics, Virginia Polytechnic Institute and State University,
Blacksburg, Virginia 24061*

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The paper examines the effect of taxing structures at a lower rate than land on the level of construction in 15 Pennsylvania municipalities between 1972 and 1994. These municipalities are compared with 204 similar Pennsylvania municipalities that tax land and structures at the same rate. To reduce the standard errors of estimate below those of a quasi-maximum likelihood estimation, the model parameters are estimated with a Markov chain Monte Carlo method, the Gibbs sampler. In contrast to earlier tax analyses, the estimates indicate that cities with two-rate taxes enjoy significantly higher levels of construction than they would with one-rate taxes. © 2000 Academic Press

Key Words: Gibbs sampler; land value taxation; count data.

1. INTRODUCTION

Economic theory predicts that a revenue-neutral shift from a regime in which land and structures are taxed at equal rates (a one-rate tax) to a regime in which land is taxed at a higher rate (a two-rate tax) will lead to

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²Author to whom correspondence should be addressed.



an increase in construction activity. There is considerable disagreement among economists, however, about whether such a shift actually has a significant impact on construction in practice.

This paper uses construction data from Pennsylvania to show that cities that have adopted a two-rate tax actually enjoy significantly higher levels of construction activity than they would with one-rate taxes. This task is surprisingly complex. Visual inspection of the data does not reveal higher levels of construction in the two-rate cities. Earlier investigations by various authors did not show a statistically significant impact of two-rate taxes in Pennsylvania. However, peculiarities of the data indicate that distributional assumptions are of great importance in this case. Very often municipalities do not experience any new construction within a given year, and the distribution of the value of construction therefore has a single mass point at zero. This paper addresses the distributional problem by first analyzing the effect of two-rate taxes on the number of building permits, and then their effect on the value per permit; the product of the two estimates yields an estimate of the effect of two-rate taxes on the total value of construction.

Since the distribution of building permits is discrete, this requires a count data analysis. We first estimate the effect of two-rate taxes on the number of permits under the assumption that the number of permits follows a Poisson distribution. However, inspection of the data indicates that the true distribution is not Poisson, and although the quasi-maximum likelihood estimators of the regression coefficients remain consistent in this case (assuming that we specified the conditional mean correctly), it is necessary to adjust the estimates of the standard errors. We show that a Poisson-lognormal distribution describes the data better, and we estimate this model with a Markov chain Monte Carlo estimation method, the Gibbs sampler, which also yields consistent estimates, but with much lower standard errors of estimate than quasi-maximum likelihood.

The following three sections review previous work regarding the impact of two-rate taxes in Pennsylvania, motivate the use of count data analysis in general and of the Poisson-lognormal distribution in particular for the problem at hand, provide summary statistics on the data that were used for the analysis, and explain the setup of our model. Sections 5 to 7 describe our analysis of the number of building permits: Section 5 shows the results of the quasi-maximum likelihood analysis of the Poisson model, and Sections 6 and 7 explain the set-up of the Poisson-lognormal model and the estimation results of the Gibbs sampler. Section 8 describes our analysis of the value per permit and of the estimated effect of two-rate taxes on the total value of construction, and Section 9 summarizes.

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