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Mathis and Zech's 'Empirical Test' of Land Value Taxation: *A Critique of a Commendable but Unsuccessful Effort to Measure the Effects of a Basic Levy*

By BEN-CHIEH LIU*

ABSTRACT. The *Land Value Tax*, which proposes that governments raise their revenues largely from taxes on the annualized *economic rent* of land, has been projected into current debate by recent studies and by political debate in at least half a dozen *Pennsylvania cities*. An effort to measure its effects on building *construction* and *renovation* was made by two Pennsylvania economists, *E. J. Mathis* and *C. E. Zech*. Under criticism, they granted that their conclusion that there was no evidence that *urban development* was stimulated was tentative and debatable. The effort was valuable in that it highlighted some of the pitfalls of this kind of research. In this area, researchers must try to avoid mis-specification of variables, wrong choice of flow or stock data, employment of oversimplified economic hypotheses. Public decision makers should be informed about inappropriate model specification and structure, input data deficiencies, and inadequate *econometric analysis* for *urban policy* determination.

I

Introduction

THE "LAND VALUE TAX (LVT)," which suggests that governments should raise their revenues largely from taxes on land, was first introduced more than a century ago by Henry George, a Philadelphia-born economist and land reformer. Although this theoretically venerable and empirically controversial fiscal policy proposal has not had significant impacts on state and local government finance in this country, a variant of LVT—the differential tax—by taxing land much more heavily than buildings, has recently received a number of commendable, as well as non-negative, appraisals. Interestingly enough, most of them came from within the state of Pennsylvania.¹

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The advocates of the LVT argue that taxing only the value of the land would stimulate urban development and renewal, eliminate absentee landlords or any landlords for speculative purposes, and ensure an efficient utilization of such scarce urban resources as land. On the other hand, the opponents assert that the effects of LVT are financially insignificant and neutral at the very best, and distorted or biased most likely. With theoretical arguments both for and against LVT and its variant, the effects of the differential tax on urban development, be they stimulative, neutral, or adverse, boil down to an empirical question.

In view of that, Professors Mathis and Zech have recently published in *Growth and Change*, a quarterly specializing in development theory, a paper entitled "The Economic Effects of Land Value Taxation: An Empirical Test." In the paper, they concluded that:

Testing the differential tax for 27 Pennsylvania cities using multiple regression analysis, the authors found no evidence that the differential tax stimulates urban development.²

Challenged by Coffin and Nelson on the grounds of mis-specification of variables, use of flow rather than stock data and employment of oversimplified economic hypotheses, Mathis and Zech made a reply that withdrew certain conclusions. They said their study was an attempt to generate discussion on a possible technique for stimulating local economic development and therefore employment. The technique alluded to is land value taxation, applied in Pennsylvania as differential taxation.³

The effort to encourage study and discussion of this type of property tax reform is an important contribution on a topic (regardless of the immediate results) on which empirical work is so badly needed to bring a century of controversy to a conclusion. This is an area characterized not only by untested methodology but by sparse and unrefined data series. In the heat of traditional no-holds-barred scientific journal discussion, sight should not be lost of this contribution. *Growth and Change* added to its prestige by provoking this discussion, so squarely in its field of interest.

Mathis and Zech expressed the hope that others will be stimulated by this dialogue to pursue the analysis of land value taxation and other local economic development tools. This paper is in response to that invitation.

Since Mathis and Zech stated that other authors arrived at their conclusions without the benefit of sound empirical testing, our comments will be centered first on the empirical test, including the appropriateness of model specification and model structure, input data deficiencies, and then on results produced in their econometric analysis for public policy decisions and recommendations.

II

The Model: Structure, Specification, and Estimation Problems

THE MULTIPLE REGRESSION ANALYSIS used by Mathis and Zech is a static, single equation model with the dependent variable (Q_i) denoting either the mean or the median per capita value of construction in the period 1976–78 for the i th observation (city, town, or borough, in Pennsylvania). There are four common regressors in the model, and jointly they were supposed to represent the supply, demand, and institutional factors affecting the interregional variation in the per capita value of construction: INC_i is the medial level of income in “ i ” in 1970; VAC_i is the vacancy rate for rental units in “ i ” in 1970; WAG_i is the average wage of construction workers in “ i ” in 1977; and ASS_i is the ratio of government assessed to market value of real estate in “ i ” in 1977. The strategic variable employed to test the effects of the differential tax was either the ratio of the city tax rate on land to that on buildings or the combined ratio of the city and county tax rates on land to those on buildings, 1977 (TRC_i and CTR_i), respectively.

According to Mathis and Zech, TRC_i and CTR_i were the surrogates for LVT, and per capita construction value (Q_i) was that for urban development or investment. The hypothetical relationship of this simple regression model indicates that total variation in (Q_i) may be partially explained by the variations in (TRC_i) or (CTR_i), *ceteris paribus*. The direction and magnitude of the causal-effect relationship was explicitly assumed to be revealed by the sign and value of the coefficient estimated for this independent variable being investigated. The coefficients estimated for the independent variables are generally treated as the elasticities if a double-log model is employed and estimated. Mathis and Zech presented in this paper only the results estimated from two of a host of models tested with different structural formulation and specification.⁴

The model would have been better received if it were formulated as a simultaneous equation system, consisting of one equation each for the demand, supply, and institutional factors which would in turn affect the new construction and renovative investment activities independently. The per capita construction value variable (Q) would then be treated as an ex-post event set whose individual outcome value is jointly determined by the forces representing the supply, demand, and institutional factors; and the effects of LVT on Q would finally be estimated from the simultaneously determined system. Furthermore, the effects on the new construction should also be analyzed separately from those on the renovative activities. The two- or three-

stage least squares technique should have been used and properly adjusted in order to produce better and consistent estimates for the coefficients. The coefficients estimated by Mathis and Zech in their single equation model with the ordinary least squares (OLS) technique cannot and should not be used outrightly to reflect the effect of TRC_i (or CTR_i) on Q_i , let alone the effect of LVT on urban development.

In addition to the problem of model specification and the OLS technique employed, Mathis and Zech's empirical test is highly questionable in that two of the control variables used, namely VAC_i and INC_i , were lagged by seven years. The authors gave no explanation for using these lagged variables in their static, cross-city study. Even if they proved there had been a seven-year business cycle for the construction sector in Pennsylvania, which might put them on safer ground by assuming these two variables as exogenous, the model would still be questioned because of other econometric problems. That is, such problems as the multicollinearity among the regressors (meaning a tendency to expand or contract at the same time due to a common cause or a mutual dependency), and the heteroskedasticity inherent in the error term (that is, the error term does not possess a desirable characteristic: it is not orthogonal. The latter implies that the variance of the term may change from observation to observation; as a result, the estimated coefficients are not efficient in that they do not achieve the smallest variance.) The existence of these problems would violate the assumptions critical to the formulation and utilization of any single multivariate regression model, and the OLS technique could not generate the "best" linear unbiased estimates (BLUE).⁵

The wrong signs and statistically insignificant coefficients estimated for TRC_i and CTR_i in the Mathis and Zech model are likely attributable to such econometric problems as mis-specification, multicollinearity, and heteroskedasticity, or any such combinations.

III

Data Deficiencies and Hypothesis Testing Problems

THE OVERALL MODEL DEVELOPMENT and methodological limitations of Mathis and Zech's paper have been discussed in the preceding section. This section will examine the data deficiencies and comment on the pitfalls of the estimated effects of the strategic variables, *i.e.*, TRC_i and CTR_i , respectively.

Mathis and Zech used 1970 data on income and housing vacancies, but 1977 or 1976-1978 data on other variables in their study. Although they admitted that "the large difference in data years is an obvious problem," they

defended their results by asserting that "these were the best available data."⁶ In the paper, there was no evidence to substantiate this assertion or to demonstrate their scientific research efforts in data collection and data reliability assessment. Income data can be obtained through various public sources including the Bureau of the Census, the Regional Economics Division of the U.S. Department of Commerce; housing vacancy information is available from the Housing Survey of the U.S. Department of Housing and Urban Development (HUD) and from local and state real estate associations.

Mathis and Zech used data for a single year from 27 cities in Pennsylvania and made statistical inferences and drew conclusions from this cross-city empirical study. However, the most appropriate data set for testing the hypothesis should be those developed on a time-series basis for many past years and corrected for the serial correlation problem retained in the data set. In order to have enough sample observations, the authors could have tried a pooled approach with both time-series and cross-city data sets included in the model, if they must conduct such an empirical test at all!

The logical time-series data set should consist of information ranging from several years before to several years after the tax reform policy was in effect. Construction activities in any city tend to vary from time to time, and the effect of the differential tax policy on urban development may be theoretically hypothesized and statistically tested with a dummy variable that can clearly divide the time-series data set into two segments, before and after policy implementation. Thus, before one can speculate about the relative trends between one city and another, a great deal of information about each city and about each city's data series must be gathered. Without such data and information on each city's socioeconomic and institutional characteristics and real estate market conditions which are essential to policy effect estimation, any regression study, including this one being discussed, would not be considered scientifically sound or practically acceptable by users.

Among the 27 observations (cities) employed in Mathis and Zech's study, only three had actually introduced differential taxation: Pittsburgh, Scranton, and Harrisburg.⁷ Since Harrisburg's tax reform policy went into effect only one year before the study period, Mathis and Zech's data set actually consists of two cities with the tax reform and 24 cities without. The corresponding values for the two strategic variables being tested, (TRC_1) and (CTR_1) , are hence set to equal "unity" for all 24 cities and a ratio greater than "one" for Pittsburgh and Scranton.⁸

How could any researcher use and interpret the results for these two ratio variables in such a cross-section study? There were virtually little or no

variations in either of these two variables. They would indeed be represented by a column vector of "unity" if the data for Pittsburgh and Scranton were excluded from the set. That is to say that these two ratio variables are virtually two constants. In addition, Pittsburgh and Scranton are two very different second-class cities, and each differs from the other 24 third-class cities in very significant ways, including variations in spatial and demographic characteristics and in urban and industrial structures. Therefore, the comparison made by Mathis and Zech, even if it were a legitimate one, would then be a tale between 2 cities of one class against 24 of another. As a result, the causal-effect relationship between TRC (or CTR) and Q was neither scientifically hypothesized nor statistically tested because of input data deficiency and the measurement errors underlying the ratio variables of TRC, CTR, and others.

IV

Concluding Remarks and Suggestions

IT IS QUITE CLEAR that the empirical results produced by Mathis and Zech are neither highly relevant nor useful and appropriate as far as assessing the potential impacts of differential taxation on urban development in Pennsylvania is concerned. The authors' conclusion that they "found no evidence that the differential tax stimulates urban development"⁹ can be rejected, individually or collectively, on the grounds of model misspecification, data deficiency, and the inappropriate estimation techniques used. The policy recommendation made by Mathis and Zech, *i.e.*, "those third-class cities in Pennsylvania that are eligible to implement the differential tax do not do so,"¹⁰ was neither substantiated nor warranted, statistically or empirically.

Due to the paucity of data and insufficient sample observations, any empirical test on the empirical issue being studied should be executed with care and subsequently with skepticism regarding the statistical inferences drawn. To test adequately the direction and magnitude of the economic impacts of differential taxation, it is better to utilize a well constructed econometric model with sufficient time series data inputs and appropriate estimation techniques.

For the empirical question at hand, we would suggest that a set of historical data pertaining to the dependent and independent variables under consideration be collected and tested for Pittsburgh and Scranton individually. The intertemporal effect of the differential taxation variable could be evaluated through a dummy variable accounting for the before- and after-reform period. For a cross-city test, when experience permits, the third-class cities in Pennsylvania

with similar socioeconomic characteristics should be selected for a paired comparison between the ones with and the others without the tax reform.¹¹ Tests for the third-class cities should be postponed until there is enough information to warrant such an empirical task.

While the philosophical controversy over Henry George's land value taxation proposal has never seemed to end, the principle he espoused is just being implemented and tested in Pennsylvania. Although the Mathis and Zech test is not at all a scientifically good one, it is good for concerned students to start testing the principle empirically.

Notes

1. For the positive effects of the differential tax, see Gurney Breckenfeld, "Pennsylvanians Experiment with 'Incentive Taxation'," in *Fortune* (August 8, 1983) and for others, see R. V. Andelson (ed.), *Critics of Henry George: A Centenary Appraisal of Their Strictures on 'Progress and Poverty'* (Teaneck, N.J.: Fairleigh Dickinson Univ. Press, 1979); Bruce Yandle, "Henry George, His Advocates and Adversaries," *American Journal of Economics and Sociology*, Vol. 43, No. 1 (January 1984), pp. 125-27; and F. C. Genovese, "Why Everyone should Read George's 'Progress and Poverty,'" *ibid.*, pp. 115-21.

2. Edward J. Mathis and Charles E. Zech, "The Economic Effects of Land Value Taxation: An Empirical Test," *Growth and Change*, Vol. 13, No. 4 (October 1982), pp. 2-5.

3. Donald A. Coffin and Michael A. Nelson, "The Economic Effects of Land Value Taxation—Comment," *Growth and Change*, Vol. 14, No. 3 (July 1983), pp. 44-46 and Edward J. Mathis and Charles E. Zech, "The Economic Effects of Land Value Taxation—Reply," *Growth and Change*, Vol. 14, No. 3 (July 1983), pp. 47-48.

4. See Mathis and Zech, "The Economic Effects &c.," *op. cit.*, p. 5, fn. 12.

5. For econometric problems and techniques discussed in this and other sections, see Arthur Goldberger, *Econometric Theory* (New York: John Wiley & Sons, 1963) and Jan Kmenta, *Elements of Econometrics* (New York: Macmillan Publishing Co., 1971).

6. Mathis and Zech, "The Economic Effects &c.," p. 5, fn. 15.

7. There are now 7; since then, four other municipalities have adopted differential taxation.

8. Mathis and Zech, *op. cit.*, p. 3.

9. *Ibid.*, p. 4.

10. *Ibid.*, p. 5.

11. For a similar empirical test of this nature, see Ben-chieh Liu, "Evaluating a Hospital Cost-Containment Program in a Paired Experiment," *Journal of the American Statistical Association*, Vol. 78, No. 382 (June 1983), pp. 249-56; and for an alternative approach, see Milton Chen, "Developing Policy Impact Models," *Management Science*, Vol. 30, No. 1 (January 1984), pp. 25-36.

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