LINCOLN INSTITUTE
OF LAND POLICY

Split-Rate Taxation: Impacts on Tax Base

Working Paper WP21ZY1

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January 2021

Abstract

Municipalities debating land value taxation or split-rate taxation need empirical evidence to understand how the transition of property tax regimes will affect their tax base. Using a valuable data set on split-rate taxation from municipalities in Pennsylvania, this paper empirically estimates the impact of split-rate taxation on real property market values and land values. The estimated impact of switching from conventional property taxation to split-rate taxation on aggregate market values is significantly positive, but the average impact from changing split-rate tax parameters during the sample period is smaller depending on the empirical specifications and sample used. In addition, the impacts vary across property types. Commercial properties appear to benefit more from split-rate taxation compared to residential and industrial uses. The Pennsylvania experience also suggests that split-rate taxes have a negative impact on land values during the sample period, but it does not appear that land values would drastically fall.

Keywords: Land Value Taxation, Two-Rate Property Taxation, Tax Base

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Acknowledgements

We thank the Lincoln Institute of Land Policy for supporting this research. We are grateful to county assessment officers for their help with data collection. We also thank Mark Skidmore, Adam Langley, John Anderson, and Andrew Hanson for very valuable suggestions and comments. This research was funded by Invest Detroit.

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Split-Rate Taxation: Impacts on Tax Base

Introduction

Economists contend that land value taxes are more efficient than conventional property taxes. In *Progress and Poverty* (1879), Henry George proposed a land tax such that the state should tax the income from the use of vacant land but not from improvements on the land. Modern economists continue to show that land taxes are less distorting of economic behavior and encourage land development (Banzhaf and Lavery 2010; Brueckner 1986; Brueckner 2001; Brueckner and Kim 2003; Capozza and Li 1994; Mills 1998; Nechyba 1998; Oates and Schwab 1997; Plassmann and Tideman 2000; Yang 2014). In practice, a variant of land value taxation is more frequently implemented, a split-rate tax, which taxes the value of land at a higher rate than structures built upon that land. In the United States, approximately twenty municipalities in Pennsylvania have implemented split-rate taxes, including the cities of Pittsburgh and Scranton which adopted a split-rate tax in 1913. In more recent years, a number of smaller Pennsylvania cities implemented the tax as an effort to stimulate urban economic development and reverse economic decline by attracting new investment. The Pennsylvania experience provides researchers with an excellent opportunity to examine the impacts of split-rate taxation.

Existing research primarily focuses on the impacts of split-rate taxation on land development.[1] These studies provide valuable insights into the effects of split-rate taxation. An important question for policymakers considering implementation of a split-rate tax is how this tax affects the real property tax base. Theoretical research has shown that switching from a uniform property tax to a split-rate tax affects both land values and building values. Brueckner (1986) showed that the effect on structure values is expected to be positive, but the impact on land values depends on whether the split-rate tax is imposed in only a small part of the housing market or the entire housing market. If it is imposed in only a small part of the housing market, such as one city in a large metropolitan area, the impact is also expected to be positive. If it is imposed in the entire housing market, the impact on land values then depends on the elasticity of housing demand. It remains an empirical question whether switching to split-rate property taxation raises the real estate tax base overall.

This paper uses evidence from Pennsylvania municipalities that adopted split-rate taxation to investigate the impacts of a split-rate tax on the tax base, which has implications for changes in tax revenue. In addition, we can also learn from those split-rate tax municipalities about how to successfully implement split-rate property taxation as well as lessons or concerns with the implementation. In particular, the study estimates the impact of split-rate property taxation on total property market values using panel data from Pennsylvania municipalities. It also explores differential impacts across types of land use, such as residential, industrial and commercial properties. Further, the research separately examines the tax's impact on land values using a recently published data set.

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[1] See Anderson (2009) for detailed discussions.

The results show that the estimated impact of the initial implementation on total market values is significant and positive, but the average impact from further changing split-rate tax parameters on total market values during the sample period (1990–2018) appears to be smaller. This suggests that the tax base may rise after the implementation. As expected, the impacts differ across property types. Switching to split-rate taxation has significant and positive impacts on residential and commercial properties. Commercial properties seem to benefit the most among the three property types from split-rate taxation. In addition, the analysis on land values does not suggest land values would drastically fall; the effect is estimated to be no larger than a 2 percent reduction in land values, should a municipality implement a split-rate tax that taxes land at twice the millage of buildings.

Empirical Specifications

The empirical analysis consists of two parts. First, we estimate the impact of split-rate taxation on aggregate market values, followed by estimation of differential impacts by property type. Secondly, the study investigates the tax's influence on land values.

Analysis on Aggregate Market Values

Property values depend on various factors, including location attributes, property features, economic conditions, and housing demand, as well as tax policy. This study considers the following empirical model to estimate the effect of split-rate taxation on aggregate market values:

$$LnV_{ijt} = \alpha_0 + \delta Ln\tau_{it-1}^{LE} + \theta TR_{it-1} + \lambda_1 Lnclr_{jt-1} + \lambda_2 \Delta Lnclr_{jt-1} + +\varphi C_{jt} + \mu_i + Y_t + \varepsilon_{it}, \quad (1)$$

where LnV_{ijt} measures the natural logarithm of aggregate market values in municipality i in county j at time t. $Ln\tau_{it-1}^{LE}$ denotes the natural logarithm of the effective total level of taxation on land in the previous year, calculated by the statutory total tax rate (τ_{it-1}^{LS}) on land multiplied by the corresponding common level ratio which accounts for changes in assessment practices.[2] TR_{it-1} denotes the land-to-structure tax rate ratio in the previous year, capturing the split-rate tax structure. One would expect that it takes time to respond to changes in tax policy; thus, the tax variables are lagged one year to allow for delayed responses. $Lnclr_{jt-1}$ is the natural logarithm of the common level ratio for each county where the municipality is located and $\Delta Lnclr_{jt-1}$ is the change in the log of the common level ratio from $t-2$ to $t-1$. These last two variables are included as controls for differences in real estate market valuation practices. C_{jt} is a set of

[2] The total tax rate on land includes county, school district, and municipality tax rates on land. These taxes are included to help control for public services and school quality affecting property values, especially school district tax rates. In addition, including both the total tax rate on land and the tax rate ratio in the model allows us to relate our empirical test to Brueckner's (1986) theoretical predictions. For instance, holding the land-to-structure tax rate ratio constant, an increase in the land tax rate (coupled with an increase in the building tax rate by the same amount) depresses both land and building values.

county-level economic and demographic factors that influence real estate market values, including personal income per capita, unemployment rate, population, percentage of the population that are white, and percentage of population aged 65 and above.[3] The model also includes μ_i, a vector of municipality fixed effects, and Y_t, a set of year dummies. ε_{it} denotes a normally distributed error term. We discuss the specific definitions of each variable in the data section below.

One econometric concern with the model above is the endogeneity problem associated with the common level ratio.[4] The Pennsylvania State Tax Equalization Board (STEB) uses market values to determine the common level ratio for each county which creates an endogeneity problem. Note three variables in equation (1) are related to the common level ratio—it is used to compute the effective total tax rate on land ($\tau^{LE} = \tau^{LS} * clr$), and also separately serves as controls for variation in market valuation approaches. To reduce the total number of endogenous variables, equation (1) can be rewritten as follows:

$$LnV_{ijt} = \alpha_0 + \delta Ln\tau^{LS}_{it-1} + \theta TR_{it-1} + (\delta + \lambda_1)Lnclr_{jt-1} + \lambda_2 \Delta Lnclr_{jt-1} + +\varphi C_{jt} + \mu_i + Y_t + \varepsilon_{it}, \quad (2).$$

To cope with the endogeneity concern, this study employs two-stage least squares estimation. In particular, the log of the common level ratio in the previous year is instrumented with the log of the predetermined assessment ratio set by each county in the previous year and a dummy variable indicating whether the corresponding county changed the assessment base in the previous year.[5] Similarly, the change in the log of common level ratio is instrumented with the change in the log of the predetermined ratio and the dummy variable. The rationale for the set of instruments is that they are correlated with the common level ratio, but are not determined by the STEB and therefore, likely to be uncorrelated with the error term.

We estimate equation (2) via two-stage least squares to obtain the baseline regression results on total market values. To better understand the impacts of split-rate taxation, we consider two alternative specifications. First, we estimate a difference-in-differences (DID) style model in which a policy dummy variable indicating whether a municipality implements a split-rate tax in a given year is included. The policy dummy takes the value of one for municipalities during time

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[3] Municipality-level data are only available decennially for the majority of our sample period. Due to the data limitation, we include county-level controls as a way to account for other factors influencing property values. The model also includes municipality fixed effects to control for unobserved heterogeneity across municipalities. That said, one may still be concerned about time-varying municipality-level unobserved factors potentially affecting property values. To address this concern, we follow Banzhaf and Lavery (2010) and create geographic specific year effects to account for these time-varying impacts. In particular, three sets of interaction terms are used including interactions between the year effects and a municipality's location in terms of degrees latitude, degrees longitude, and the interaction of latitude and longitude. The results from this robustness check are consistent with our main findings.

[4] The common level ratio for a given county is the ratio of assessed values in the county to current market values last determined by the State Tax Equalization Board.

[5] Predetermined assessment ratios are set by each county in PA. It is the ratio of assessed values to base year market values established by each county.

periods they implemented a split-rate tax, and zero otherwise. This alternative specification is shown below:

$LnV_{ijt} = \alpha_0 + \delta Ln\tau^{LS}_{it-1} + \eta Dummy_{it-1} + (\delta + \lambda_1)Lnclr_{jt-1} + \lambda_2 \Delta Lnclr_{jt-1} + +\varphi C_{jt} + \mu_i + Y_t + \varepsilon_{it}$, (3).

The regression results from this alternative specification show the effect of switching from traditional property taxation to split-rate taxation. The estimated impact of adoption is averaged across all municipalities and remains the same over the time periods for which split-rate taxation is in place.

Secondly, we consider another alternative specification similar to equation (2) except that the tax rate ratio variable is replaced with the difference between the statutory land tax rate and the building tax rate (land tax rate-building tax rate). Note that the estimated effect of split-rate taxation from the dummy specification is identified from municipalities that adopt (or rescind) the split-rate tax during the sample period whereas the impact estimated using the other two specifications is identified from municipalities that change their tax rate ratio or tax rate difference during the sample period.

After estimating the impact on total market values, we replace the dependent variable with market values by property type to explore differential impacts among residential, industrial, and commercial real estate. As discussed above, three specifications for the tax policy variable are considered for the estimation of differential effects.

Analysis on Land Values

The empirical model is similar to equation (1) except that the dependent variable is replaced by the natural logarithm of land values in municipality i at time t and the set of proxies for property valuation practices ($Lnclr_{jt-1}$ and $\Delta Lnclr_{jt-1}$) are excluded from the equation. In addition, a set of municipality-level rather than county-level control variables (C_{jt}) are available during the land value sample period. In particular, the standardized land values at the county subdivision level are matched to other American Community Survey (ACS, 5-year averages) data for the control variables over the last 12 months. We use the National Historical Geographic Information System (NHGIS), a subdivision of IPUMS (which originally stood for Integrated Public Use Microdata Series) to extract the ACS data for each county subdivision. It is worth noting that the endogeneity problem resulting from the data generation process is not a concern for land value estimation. The source of the land value data is different and is not involved in the calculation of common level ratios; thus, we preform OLS regressions for land value estimation.

Data

The empirical analysis employs aggregate market values and land values as outcome measures. The market value data set was obtained from the STEB; it includes aggregate property market

values for all PA municipalities over the period 1990–2018.[6] In addition, the data set includes the breakdowns of total market values by property type, such as residential, industrial, and commercial types. We use this data set to examine the impact on the tax base.

The second data set is the land value data set from Davis et al. (2020), a Federal Housing Finance Agency working paper. The authors use over 14 million appraisals to derive estimates of land values. These yearly estimates of the average price of land and the average share of house value attributable to land provide the first comprehensive view of land values across the U.S. Specifically, the authors use data on cost-approach appraisals from the Uniform Residential Appraisal Report submissions collected by Fannie Mae and Freddie Mac. The study goes through several steps to reduce bias from appraisals with redevelopment concerns and when tied to biased tax assessments. The authors estimate two versions of land values: a standardized ¼ acre lot value and an "as-is" value. We use the standardized values in this study as the standardization method corrects for the tendency of price-per-acre to fall with size, known as the plattage effect, whereas the "as-is" values do not correct for this effect.

The Davis et al. (2020) data include a balanced panel from 2012 to 2018 at various levels of geography. This study uses the ZIP code level standardized land value data for Pennsylvania. We chose ZIP codes to optimize across several data limitations including sample size, geographic coverage, and fine geographic detail. The land value data panel includes 3,346 observations at the ZIP code-year level.

In order to match the land value data to the tax policy data, we aggregate the ZIP code data to the county subdivision geography. We use a Census crosswalk file to identify the intersections between each county subdivision and ZIP code. As these two geographies' borders do not align, the intersections have various amounts of corresponding areas; in other words, each intersection may contain all or only a portion of the county subdivision or ZIP code that constitutes the intersection. This implies the need to weight the ZIP codes' standardized land values that together constitute a county subdivision. We use the county subdivision housing unit percentage as our weights. For example, six ZIP codes intersect with Abington Township, a county subdivision of Montgomery County. These six ZIP codes each have different estimates of their standardized land values. We weight each ZIP code's land value by the share of Abington Township housing units that reside in each of the ZIP codes. Then, we sum these weighted values over all six ZIP codes. We use housing units as our preferred weight instead of another measure such as population percentage or land area percentage due to the nature of the property tax being applied to the housing unit.[7] The resulting aggregated land values data set includes

[6] According to STEB, "The market values are certified annually and sent to the Pennsylvania Department of Education and the respective school districts on or before July 1 of each year." The STEB-certified market values are aggregated valid sales prices of property. The STEB uses the sales comparison approach to determine the market value of a property type. The state uses these market values to determine the distribution of the state subsidies for school districts. That said, there are concerns with market value data, especially when it is difficult to find sales of a comparable property.

[7] The correlation between county subdivision housing unit percentage and county subdivision land area percentage is 0.9681 in our sample.

1,246 unique municipalities, roughly half of the 2,563 municipalities for which we have tax rate data. Of these municipalities, seven institute a split-rate tax.[8]

Our main variable of interest is the tax policy variable, land-to-structure tax rate ratio (land millage rate/building millage rate).[9] We update the split-rate tax data used in Yang (2014) by adding split-rate tax information for recent years. Separate tax rates on land and structures are collected for all split-rate taxing jurisdictions by hand. This involved searches on municipal websites or contacting county tax assessment offices directly. Corresponding county and school district property taxes for these split-rate taxing jurisdictions were obtained from the Pennsylvania Department of Community and Economic Development (DCED). In addition, we also obtained tax rates at all levels of government for municipalities with conventional property taxes (a uniform tax rate on land and structures) from DCED.[10] The summation of these rates on land (which is identical to the total tax rate on buildings for jurisdictions with traditional property taxes) enters the model, allowing us to control for the total level of taxation on land. The information on historical and current common level ratios was extracted from the STEB website.

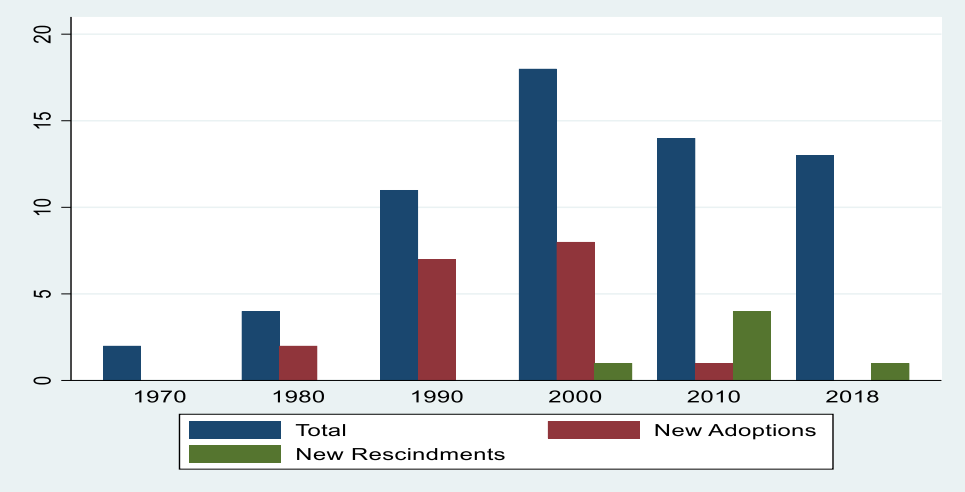
About 20 municipalities in PA implemented split-rate taxes over our sample period. Figure 1 shows the total number of municipalities with split-rate taxation as well as new adoptions and new rescindments by each specified year. By 1980, for instance, a total of four municipalities implemented a split-rate tax and two of them implemented between 1971 and 1980 (referred to as "new adoptions"). As displayed in the figure, the total number peaked in 2000. In general, our sample includes the period when the total number of split-rate jurisdictions peaked as well as recent rescindments of split-rate taxes, providing important variation for the empirical analysis.

[8] Altoona City implemented a pure land value from 2011 to 2016 and then instituted a standard property tax in 2017. The tax rate ratio cannot be computed for this municipality during this period, so it is dropped from the estimation leaving seven municipalities in the sample with a split-rate tax system.

[9] Alternative specifications are considered for the purposes of robustness checks, including a dummy variable indicating whether a municipality adopts a split-rate tax in a given year and the difference between the tax rate on land and the tax rate on structures.

[10] Each taxing jurisdiction is required by state law to submit tax rate information to the DCED. Unfortunately, split-rate tax municipalities reported a blended rate and there was inconsistency in reporting. The formula to compute a blended rate was unclear for years prior to 2016. For these reasons, we separately collect the tax rate information by hand for split-rate taxing jurisdictions. In addition, we noticed that there are entry errors in the DCED downloaded data files. We correct the errors to the best of our ability, but there may still be entry errors in the data set.

Figure 1: Implementation of Split-rate Taxation in PA



Source: Data collected by the authors.

Our data sample also shows significant variation in the main tax policy variable across municipalities and time. Table 1 shows a list of split-rate taxing jurisdictions with information on land-to-structure tax rate ratio. All of these split-rate municipalities are included in the analysis on market values; however, only the cities of Aliquippa, Allentown, Altoona, Clairton, DuBois, Harrisburg, Scranton, and Washington are included in the analysis on land values (due to land value data availability).

Table 1: Split-Rate Municipalities in PA

Municipality Name	County Name	Starting Year	Last Year	Land-to-Structure Tax Ratio Mean	Land-to-Structure Tax Ratio Max
Aliquippa	Beaver	1988	–	9.01	16.20
Allentown	Lehigh	1997	–	4.46	5.29
Altoona	Blair	2003	2016	16.73*	pure land value tax
Clairton	Allegheny	1989	–	11.54	22.95
Coatesville	Chester	1991	2005	2.13	2.54
Connellsville	Fayette	1992	2003	6.68	7.66
DuBois	Clearfield	1991	2018	24.24	44.00
Duquesne	Allegheny	1985	–	1.82	2.64
Ebensburg	Cambria	2000		3.46	3.91
Harrisburg	Dauphin	1975	–	5.03	6.00
Hazleton	Luzerne	1991	1992	3.30	3.44
Lock Haven	Clinton	1991	–	4.32	5.70
McKeesport	Allegheny	1980	–	4.20	5.26

New Castle	Lawrence	1982	–	3.66	3.98
Oil City	Venango	1989	2002	2.95	3.38
Pittsburgh	Allegheny	1913	2000	5.77	5.77
Scranton	Lackawanna	1913	–	4.88	5.50
Steelton	Dauphin	2000	2007	1.67	2.42
Titusville	Crawford	1990	–	3.36	4.09
Washington	Washington	1985	–	18.33	30.75

Notes: the statistics are based on the 1990–2018 data. The mean and max land-to-structure tax rate ratios are calculated over the effective period (implementation period). *The calculation for Altoona's mean value excludes the years when a pure land value tax was implemented (2011–2016).

Results

Estimated Impact on Market Values

Regression results on aggregate market values are reported in table 2. This set of results comes from the regressions using the land-to-structure tax rate ratio specification. The empirical model is estimated using the full sample (1); the sample with all municipalities in the counties where the split-rate municipalities are located, referred to as the split-rate counties sample (2); and the sample with split-rate municipalities only (3). Different samples are used to cope with potential concerns with the estimation. In particular, the sample with municipalities in split-rate counties uses municipalities with traditional property taxes in the same county where split-rate municipalities are located as the control group to mitigate potential confounding effects influencing the regressions using the full sample. The results are different across samples. An examination of the estimated coefficient on the total tax rate on land variable seems to suggest that the regression using the full sample may suffer from omitted variable bias since the sign is counterintuitive compared to the other two.[11] The estimates using the samples in split-rate counties and split-rate municipalities may provide a more accurate picture. The following analysis on aggregate market values will focus on the regression results for the latter two samples. That said, the results from these two samples suggest the estimated average impact on total market values is zero.[12]

Table 3 reports the set of results from the regressions using the tax rate difference specification. The results from the split-rate counties suggest that aggregate market values would rise by about 0.22 percent per unit increase in the tax rate difference. The impact is insignificant in regressions using the other two samples. The model with the full sample still appears to suffer from omitted variable bias for the same reason mentioned above.

[11] One may be concerned about unobserved time-varying factors affecting market values. One potential issue could be other local economic development policies, such as tax abatement programs. These may influence market values and not be indicative of changes in the split-rate tax policy.

[12] An alternative specification using the log of the tax rate ratio variable is also considered. The coefficient on the log tax rate ratio is significantly positive in the regression using the split-rate county sample. That said, the scatter plot of the data appears to support the log linear specification.

Table 4 displays the results from the models with the dummy variable, the difference-in-differences approach.[13] The estimated impact of switching from conventional property taxation to split-rate taxation is significantly positive using the sample in the split-rate counties. Again, the results from the full sample are likely to suffer from omitted variable bias.

To sum up, based on the split-rate counties sample, the results on aggregate market values suggest that the estimated impact of switching to split-rate taxation on total market values is large and positive, raising total market values by about 21.5 percent, indicated by the results from the difference-in-differences approach (policy dummy specification). After implementation, changes in the tax rate ratio do not seem to affect market values much during the sample period. Increases in the tax rate difference result in higher market values. To compare the estimates across specifications, one can make the estimates from the tax rate ratio and tax rate difference specifications comparable to the policy dummy specification (Banzhaf and Lavery 2010). That is, one can multiply the estimated coefficient on the tax rate ratio or tax rate difference variable by the difference between the average value of this variable for split-rate municipalities and the value for municipalities with conventional property taxation. Following this approach, the tax rate difference model would suggest that the estimated impact (evaluated at the mean) of split-rate taxation is positive, raising aggregate market values by about 12.2 percent.[14]

Table 2: Results on Total Market Values

Variables	Full Sample	Split-Rate Counties	Split-Rate Municipalities
	(1)	(2)	(3)
Lagged land-to-structure tax rate ratio	**-0.0057****	**-0.0005**	**0.0002**
	(0.0025)	(0.0021)	(0.0021)
Lagged Ln total tax rate on land	0.1895**	-0.4763***	-0.2318*
	(0.0805)	(0.0421)	(0.1231)
Lagged Ln CLR	1.0892***	0.4325***	0.6235***
	(0.0857)	(0.0465)	(0.1534)
Lagged change in Ln CLR	0.0328***	0.1019***	0.0931**
	(0.0069)	(0.0077)	(0.0366)
Population	0.0004**	0.0021***	0.0021***
	(0.0002)	(0.0001)	(0.0006)
Per capita income	0.0107***	0.0055***	0.0087
	(0.0011)	(0.0011)	(0.0068)
Unemployment rate	-0.0020	0.0188***	-0.0301
	(0.0029)	(0.0041)	(0.0216)
Percentage of white population	0.0023	-0.0036	0.0034
	(0.0017)	(0.0040)	(0.0193)
Percentage of population (65+)	0.0001	0.0012***	0.0012

[13] One exception is that the dummy variable specification for the split-rate municipalities sample is not a DID model but is included in the table in comparison with the results from alternative specifications.

[14] The mean of the tax rate difference for split-rate municipalities in our sample for the market value analysis is about 55.4 mills (excluding observations when Altoona had a pure land value tax); therefore, the estimated impact can be calculated as follows: 0.0022*(55.4-0)=0.12188.

	(0.0002)	(0.0003)	(0.0014)
Municipality Fixed Effects	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Observations	67,190	21,343	534
R-squared	0.829	0.852	0.863

Notes: Results are from the 2SLS estimation. Coefficient estimates are reported with robust standard errors in parentheses. ***, **, and * denote tests significant at 1%, 5%, and 10%, respectively.

Table 3: Results on Total Market Values (Alternative Specification 1)

Variables	Full Sample	Split-Rate Counties	Split-Rate Municipalities
	(1)	(2)	(3)
Lagged tax rate difference	**-0.0003**	**0.0022*** **	**0.0012**
	(0.0007)	(0.0005)	(0.0009)
Lagged Ln total tax rate on land	0.1890**	-0.4867***	-0.2926*
	(0.0806)	(0.0426)	(0.1600)
Lagged Ln CLR	1.0887***	0.4233***	0.5952***
	(0.0857)	(0.0469)	(0.1709)
Lagged change in Ln CLR	0.0328***	0.1020***	0.0932**
	(0.0069)	(0.0077)	(0.0367)
Population	0.0004**	0.0020***	0.0017***
	(0.0002)	(0.0001)	(0.0006)
Per capita income	0.0107***	0.0056***	0.0103
	(0.0011)	(0.0011)	(0.0071)
Unemployment rate	-0.0020	0.0191***	-0.0235
	(0.0030)	(0.0041)	(0.0217)
Percentage of white population	0.0023	-0.0034	0.0077
	(0.0017)	(0.0040)	(0.0192)
Percentage of population (65+)	0.0001	0.0011***	0.0007
	(0.0002)	(0.0003)	(0.0015)
Municipality Fixed Effects	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Observations	67,196	21,349	540
R-squared	0.829	0.852	0.852

Notes: Results are from the 2SLS estimation. Coefficient estimates are reported with robust standard errors in parentheses. ***, **, and * denote tests significant at 1%, 5%, and 10%, respectively.

Table 4: Results on Total Market Values (Alternative Specification 2)

Variables	Full Sample	Split-rate Counties	Split-rate Municipalities
	(1)	(2)	(3)
Lagged split-rate dummy	**-0.0820**	**0.2147*** **	**0.0108**

	(0.0579)	(0.0511)	(0.0597)
Lagged Ln total tax rate on land	0.1900**	-0.4799***	-0.1652
	(0.0808)	(0.0422)	(0.1339)
Lagged Ln CLR	1.0898***	0.4296***	0.6898***
	(0.0859)	(0.0465)	(0.1559)
Lagged change in Ln CLR	0.0328***	0.1013***	0.0899**
	(0.0069)	(0.0077)	(0.0353)
Population	0.0004**	0.0021***	0.0020***
	(0.0002)	(0.0001)	(0.0007)
Per capita income	0.0107***	0.0055***	0.0094
	(0.0011)	(0.0011)	(0.0071)
Unemployment rate	-0.0020	0.0192***	-0.0244
	(0.0029)	(0.0041)	(0.0228)
Percentage of white population	0.0023	-0.0026	0.0110
	(0.0017)	(0.0040)	(0.0209)
Percentage of population (65+)	0.0001	0.0011***	0.0018
	(0.0002)	(0.0003)	(0.0016)
Municipality Fixed Effects	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Observations	67,196	21,349	540
R-squared	0.828	0.852	0.849

Notes: Results are from the 2SLS estimation. Coefficient estimates are reported with robust standard errors in parentheses. ***, **, and * denote tests significant at 1%, 5%, and 10%, respectively.

Differential Impacts on Market Values by Property Type

We re-estimate the models with the three specifications mentioned above for three types of properties: residential, industrial, and commercial. As discussed above, we will focus on the results for the samples with all municipalities in the split-rate counties and only split-rate municipalities. Table 5 shows the regression results from the models using the tax rate ratio specification. The estimated impacts from the regressions using the split-rate counties vary across property types with a negative impact on residential and industrial properties, but no impact on commercial properties. It is worth noting that when we allow for nonlinear effects by adding the squared tax rate ratio variable, the negative impact becomes insignificant.[15] The results from the regressions using the split-rate municipalities sample indicate the impacts on all three types are zero.

Table 6 reports the set of results from the regressions using the tax rate difference specification. The results for the sample in split-rate counties suggest that there are positive impacts on residential and commercial properties, but no impact on industrial properties. Table 7 presents the results from the regressions using the dummy specification. The results for the sample in split-rate counties are generally consistent with table 6, indicating a positive impact on residential and commercial real estate with a slightly larger impact on commercial properties.

[15] The results do not support the existence of nonlinear effects. The coefficients on the tax rate ratio and its squared term are both insignificant.

In all, the impacts on market values differ by property type. Switching to split-rate taxation has significant and positive impacts on residential and commercial properties (as indicated by the results from the dummy specification). Residential properties are estimated to rise by about 11.9 percent whereas commercial properties are estimated to rise by about 19.9 percent. As discussed before, one can make the estimates from the tax rate ratio and tax rate difference specifications comparable to the policy dummy specification. Following this approach, the results from the first two specifications suggest the estimated impact of implementing split-rate taxes (evaluated at the sample mean of the split-rate tax variable) ranges from a reduction by 2.3 percent to an increase by 8.9 percent in market values.[16] The estimated impact for industrial properties (evaluated at the sample mean of the split-rate tax variable) ranges from a reduction by 3.8 percent to a zero impact.[17] Similarly, commercial properties are estimated to rise by no more than 10.6 percent after implementing the average split-rate tax policy.[18] Commercial properties appear to benefit more from the implementation.

Table 5: Differential Impacts by Property Type

Variables	Split-Rate Counties			Split-Rate Municipalities		
	Residential	Industrial	Commercial	Residential	Industrial	Commercial
Lagged land-to-structure tax rate ratio	**-0.0037***	**-0.0060****	**-0.0012**	**-0.0014**	**0.0037**	**0.0011**
	(0.0022)	(0.0029)	(0.0019)	(0.0023)	(0.0031)	(0.0024)
Lagged Ln total tax rate on land	-0.3360***	-0.0740	-0.3671***	-0.3168**	-0.3840**	-0.0405
	(0.0398)	(0.0993)	(0.0510)	(0.1301)	(0.1568)	(0.1206)
Lagged Ln CLR	0.5831***	0.7326***	0.5088***	0.5376***	0.4062**	0.8214***
	(0.0444)	(0.1077)	(0.0563)	(0.1605)	(0.1949)	(0.1511)
Lagged change in Ln CLR	0.1069***	0.0167	0.1443***	0.1097***	0.1092	0.0664
	(0.0078)	(0.0286)	(0.0115)	(0.0394)	(0.0791)	(0.0407)
Population	0.0021***	-0.0057***	0.0029***	0.0027***	-0.0103***	0.0029***
	(0.0001)	(0.0005)	(0.0002)	(0.0007)	(0.0010)	(0.0007)
Per capita income	0.0114***	0.0274***	0.0231***	-0.0019	0.0518***	0.0332***
	(0.0012)	(0.0035)	(0.0017)	(0.0071)	(0.0113)	(0.0073)
Unemployment rate	0.0052	0.0889***	0.0138**	-0.0155	-0.0563	-0.0203
	(0.0041)	(0.0144)	(0.0069)	(0.0228)	(0.0523)	(0.0244)
Percentage of white population	-0.0158***	0.0453***	-0.0504***	-0.0040	0.0424	-0.0177
	(0.0041)	(0.0116)	(0.0057)	(0.0206)	(0.0397)	(0.0211)

[16] The sample mean of the tax rate ratio for split-rate municipalities is 7.3 and the ratio is 1 for municipalities with conventional property taxes; therefore, the results from the tax rate ratio model suggest a reduction for residential properties by 2.3 percent (-0.0037*6.3). Similarly, the results from the tax rate difference model indicate an increase by 8.9 percent (0.0016*55.4).

[17] The results from the tax rate ratio model would suggest a reduction for industrial properties by 3.8 percent (-0.006*6.3). The tax rate difference model would indicate industrial property values would not be affected.

[18] The results from the tax rate difference model indicate an increase by about 10.5 percent (0.0019*55.4).

Percentage of population (65+)	0.0022***	0.0020*	0.0071***	-0.0010	0.0164***	0.0016
	(0.0003)	(0.0011)	(0.0006)	(0.0015)	(0.0046)	(0.0019)
Municipality Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	21,324	14,924	21,063	534	534	534
R-squared	0.850	0.446	0.762	0.858	0.648	0.855

Notes: Results are from the 2SLS estimation. Coefficient estimates are reported with robust standard errors in parentheses. ***, ** and * denote tests significant at 1%, 5% and 10% respectively.

Table 6: Differential Impacts by Property Type (Alternative Specification 1)

Variables	Split-Rate Counties			Split-Rate Municipalities		
	Residential	Industrial	Commercial	Residential	Industrial	Commercial
Lagged tax rate difference	**0.0016*** **	**-0.0006**	**0.0019*** **	**0.0015**	**0.0011**	**0.0006**
	(0.0005)	(0.0007)	(0.0005)	(0.0009)	(0.0011)	(0.0009)
Lagged Ln total tax rate on land	-0.3442***	-0.0721	-0.3776***	-0.3966**	-0.4274**	-0.0624
	(0.0403)	(0.1010)	(0.0516)	(0.1680)	(0.2094)	(0.1601)
Lagged Ln CLR	0.5759***	0.7343***	0.4994***	0.5025***	0.3833*	0.8119***
	(0.0448)	(0.1090)	(0.0568)	(0.1785)	(0.2234)	(0.1706)
Lagged change in Ln CLR	0.1069***	0.0163	0.1444***	0.1057***	0.1155	0.0697*
	(0.0078)	(0.0286)	(0.0116)	(0.0405)	(0.0802)	(0.0396)
Population	0.0021***	-0.0057***	0.0029***	0.0022***	-0.0106***	0.0027***
	(0.0001)	(0.0005)	(0.0002)	(0.0007)	(0.0010)	(0.0007)
Per capita income	0.0115***	0.0273***	0.0232***	-0.0004	0.0543***	0.0343***
	(0.0012)	(0.0035)	(0.0017)	(0.0073)	(0.0116)	(0.0075)
Unemployment rate	0.0056	0.0890***	0.0141**	-0.0055	-0.0540	-0.0179
	(0.0041)	(0.0144)	(0.0069)	(0.0229)	(0.0524)	(0.0244)
Percentage of white population	-0.0156***	0.0453***	-0.0502***	0.0013	0.0463	-0.0155
	(0.0041)	(0.0116)	(0.0057)	(0.0204)	(0.0396)	(0.0210)
Percentage of population (65+)	0.0022***	0.0020*	0.0070***	-0.0018	0.0162***	0.0015
	(0.0003)	(0.0011)	(0.0006)	(0.0016)	(0.0047)	(0.0020)
Municipality Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	21,330	14,930	21,069	540	540	540
R-squared	0.850	0.446	0.762	0.846	0.643	0.844

Notes: Results are from the 2SLS estimation. Coefficient estimates are reported with robust standard errors in parentheses. ***, **, and * denote tests significant at 1%, 5%, and 10%, respectively.

Table 7: Differential Impacts by Property Type (Alternative Specification 2)

Variables	Split-Rate Counties			Split-Rate Municipalities		
	Residential	Industrial	Commercial	Residential	Industrial	Commercial
Lagged split-rate dummy	**0.1194****	**-0.1334**	**0.1991*** **	**0.0056**	**-0.2235***	**0.0431**

	(0.0500)	(0.1051)	(0.0567)	(0.0614)	(0.1314)	(0.0666)
Lagged Ln total tax rate on land	-0.3377***	-0.0699	-0.3723***	-0.2354*	-0.1560	-0.0281
	(0.0400)	(0.0999)	(0.0511)	(0.1389)	(0.1829)	(0.1324)
Lagged Ln CLR	0.5819***	0.7365***	0.5043***	0.6222***	0.5892***	0.8367***
	(0.0445)	(0.1081)	(0.0563)	(0.1614)	(0.2059)	(0.1538)
Lagged change in Ln CLR	0.1065***	0.0167	0.1438***	0.1023***	0.1302*	0.0652
	(0.0078)	(0.0286)	(0.0116)	(0.0379)	(0.0765)	(0.0398)
Population	0.0021***	-0.0057***	0.0029***	0.0026***	-0.0108***	0.0029***
	(0.0001)	(0.0005)	(0.0002)	(0.0007)	(0.0011)	(0.0007)
Per capita income	0.0114***	0.0274***	0.0231***	-0.0016	0.0525***	0.0340***
	(0.0012)	(0.0035)	(0.0017)	(0.0073)	(0.0118)	(0.0075)
Unemployment rate	0.0056	0.0888***	0.0142**	-0.0070	-0.0668	-0.0164
	(0.0041)	(0.0144)	(0.0069)	(0.0239)	(0.0532)	(0.0254)
Percentage of white population	-0.0152***	0.0446***	-0.0495***	0.0043	0.0187	-0.0089
	(0.0041)	(0.0116)	(0.0057)	(0.0218)	(0.0406)	(0.0227)
Percentage of population (65+)	0.0022***	0.0020*	0.0070***	-0.0003	0.0207***	0.0014
	(0.0003)	(0.0011)	(0.0006)	(0.0017)	(0.0047)	(0.0021)
Municipality Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	21,330	14,930	21,069	540	540	540
R-squared	0.850	0.446	0.762	0.844	0.642	0.844

Notes: Results are from the 2SLS estimation. Coefficient estimates are reported with robust standard errors in parentheses. ***, ** and * denote tests significant at 1%, 5% and 10% respectively.

Estimated Impact on Land Values

Table 8 presents the regression results. The estimated impact of a split-rate tax on land values varies based on the sample used. The regressions highlight the importance of choosing a control group from which we can compare land values. The first regression uses the full sample of PA municipalities for which we have data. The second identifies counties for which at least one municipality within the county ever adopted a split-rate tax (referred to as the split-rate counties sample above). Municipalities with traditional property taxation in these counties are considered the control group. The third one identifies counties for which at least one municipality within the county had a split-rate tax during the 2012–2018 period. The final regression uses only the variation within the set of municipalities that had a split-rate tax during the 2012–2018 period to identify the effect. This estimation uses a small sample, so we report bootstrapped standard errors.

Across all models, the estimated sign of the effect is negative; the magnitude of the estimated impact ranges from -0.89 to -1.79 percent change in average land values per unit change in the tax rate ratio.[19] The estimates are all statistically significant except for the split-rate municipality

[19] We run several specification checks; the results indicate insignificant impacts on land values based on the tax rate difference specification; however, the results from the policy dummy specification show a positive impact on land values. It should be noted that this indicator variable specification is only identified by one municipality, Altoona, which rescinded their split-rate tax in 2017. These results in general support the interpretation we report. In addition,

sample. In combination, land values are estimated to remain unchanged or fall slightly, by no more than roughly 2 percent, should a municipality implement a split-rate tax that taxes land at twice the millage of buildings.[20] Assuming a linear impact, a municipality could expect land values to fall by at most 8 to 12 percent if the land was taxed at five or seven times the rate of buildings, respectively.[21]

There are important caveats. Given the data limitations surrounding land values, these results are based on seven municipalities in Pennsylvania. Further, no municipality adopted a split-rate tax during the 2012 to 2018 time period, though one municipality, Altoona City, does transition back to a standard property tax from a pure land value tax.[22] Further, only three municipalities altered their split-rate tax ratio during the sample; those that made a change did so by unconventionally reducing the ratio. In other words, these municipalities reduced the tax burden on land relative to structures, precisely the opposite of the desired implementation of split-rate taxation. The relevance of these impacts is important but should be kept in context with the differences between these localities and municipalities debating a split-rate tax.

The control variables in the model mostly agree with expectations. As the total level of taxation on land in a jurisdiction rises, land values fall. Land values are higher in municipalities with higher population and per capita income. Surprisingly, municipalities with higher unemployment rates appear to have higher land values, though the effect is small. The share of white residents does not seem to affect land values. Lastly, land values fall with higher percentages of an elderly population.

Table 8: Split-Rate Taxation Effect on Land Values in Pennsylvania (2012–2018)

	Full	Ever Split-Rate Counties	Split-Rate Counties	Split-Rate Municipalities
Lagged land-to-structure tax rate ratio[1]	**-0.0125*** **	**-0.0111*** **	**-0.0089*** **	**-0.0179**
	(0.0042)	(0.0033)	(0.0028)	(0.0970)
Lagged Ln total tax rate on land[1]	-0.0641***	-0.0722***	-0.0375**	-0.2937
	(0.0097)	(0.0200)	(0.0171)	(0.2292)
Population	0.0679***	0.0408**	0.0093	-0.0374

we also examined the effect of split-rate taxation using the total property values provided in the Davis et al. (2020) work. The general result is a positive and significant but small impact on single-family residential property values resulting from changes in the tax rate ratio.

[20] Using the split-rate county sample and evaluating the impact at the mean of the tax rate ratio for municipalities that implemented a split-rate tax during the 2011–2017 period, land values are estimated to drop by about 12.5 percent (-0.0089*14).

[21] We implement models using a squared term for the tax rate ratio to pick up non-linearity in the response. The full sample model is the only model that shows statistically significant results for either the level or squared tax rate ratio variable. We believe that this signals little support for a non-linear effect. Nevertheless, the non-linear full sample model implies a reduction in land values of 6.4 percent when implementing a 2:1 ratio split-rate tax.

[22] Again, Altoona City was dropped from the tax rate ratio specifications as the pure land value tax is undefined as a ratio.

	(0.0113)	(0.0203)	(0.0211)	(0.4038)
Per capita income	0.0021***	0.0017*	0.0009	-0.0260
	(0.0007)	(0.0009)	(0.0012)	(0.0724)
Percent of white population	0.0004	-0.0013	-0.0028**	0.0046
	(0.0008)	(0.0010)	(0.0013)	(0.0234)
Unemployment rate	0.0010	0.0042***	0.0038**	0.0116
	(0.0009)	(0.0014)	(0.0019)	(0.0297)
Percent of population 65+	-0.0017*	-0.0018	-0.0018	-0.0239
	(0.0009)	(0.0012)	(0.0014)	(0.0775)
Constant	10.4106***	10.7239***	10.8148***	14.9214
	(0.1352)	(0.2443)	(0.2625)	(11.0781)
Municipality Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	7,909	2,701	1,660	49
R-squared	0.081	0.140	0.196	0.340
Number of municipalities	1,231	433	264	7

Notes: [1]The tax rate data are available for 2011 to 2018, whereas the land values are only available from 2012 to 2018. This allows for the lagged tax variables to be included for the full sample of land value data. The table presents standard errors in parentheses and signifies statistical significance as *** p<0.01, ** p<0.05, * p<0.1. Note the table reports the bootstrapped standard errors for the split-rate municipalities sample as the sample size is small and robust standard errors for all other regressions.

Conclusion

The experience of Pennsylvania municipalities with split-rate taxation reveals important implications for cities debating implementing a change in their property tax regime. The results suggest that there is a significant impact on real property market values when switching from conventional property taxation to split-rate property taxation, but the average impact from further changing split-rate tax parameters on total market values during the sample period (1990–2018) appears to be smaller. As expected, the impacts differ across property types. Switching to split-rate taxation has significant and positive impacts on residential and commercial properties, but the average impact (evaluated at the sample mean) from changing split-rate tax parameters on residential properties ranges from a reduction of 2.3 percent to an increase of 8.9 percent in market values in our sample. Aggregate commercial property values are estimated to rise by no more than 10.6 percent after implementing the average split-rate tax policy. Commercial properties seem to benefit the most among the three property types from split-rate taxation. The findings may have important implications for jurisdictions attempting to revive commercial districts.

In addition, the study finds that the effect of split-rate taxation on land values is negative. At most, one may expect land values to fall by about 2 percent if a municipality implements a split-rate tax that taxes land at twice the millage of buildings. The findings suggest there is a potential need to adjust expectations of the tax base for land values when implementing a split-rate tax. It does not appear that land values would drastically fall, at least in the experience of Pennsylvania

municipalities with split-rate taxation from 2012 to 2018. That said, we recognize that the quality of market value and land value data affects our estimates. Using appropriate valuation methods is crucial for the implementation of split-rate taxation as well as for researchers examining the impacts.

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