Wealth Distribution and the Provision of Public Goods: Evidence from the United States

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Abstract

This paper examines the role of inequality in the provision of public goods. County level data from the U.S. in 1890 provides comparable units of analysis operating with similar property tax systems, ensuring that we do not empirically confuse differences in tax systems with differences in public goods provision. Climatic data is used as an instrument for land inequality to provide identification of the effect of inequality. The results indicate that land inequality caused significantly lower overall property tax rates. This effect is driven almost exclusively by the effect of land inequality on taxes related directly to schooling. In contrast, non-school funding was not significantly affected by inequality. While informative about the effect of land inequality on public goods provision, an examination of the details of the tax system suggests that these results should not necessarily be taken as a rejection of median voter predictions.

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1 Introduction

The aim of this paper is to provide a careful empirical test of the relationship between public goods provision and inequality, and to consider what conclusions can usefully be drawn regarding the median voter model. County level data on property taxes and inequality from the U.S. in 1890 provides the context for the test, and it has three features that separate it from previous empirical work. First, the structure of the tax system is homogenous across counties in this period, in that they all relied almost exclusively on property taxes to fund their public goods. Second, the property tax is a wealth tax, and this matches the theoretical structure of median voter models better than data based on income taxation. Third, the historical record allows one to distinguish redistribution from public goods provision, two concepts that are often taken to be synonymous in models but differ in reality. Prior empirical work has relied primarily on cross-country data and aside from concerns on the comparability of this data, there is not sufficient knowledge of the tax systems themselves to draw useful conclusions regarding inequality and redistribution.

An additional contribution is to clearly identify the role of inequality for the provision of public goods. Wealth inequality is measured by a Gini coefficient of farm sizes within counties, and I adopt the historical arguments of Engerman and Sokoloff (1997) and Sokoloff and Engerman (2000) to generate a set of instruments for this measure of inequality.[1] They argue that initial climatic conditions were central to differences in inequality across the Western Hemisphere. I create county-level instruments for the farm Gini from several climatic variables and use this to provide exogenous variation in inequality.[2]

The empirical analysis focuses on explaining variation in property tax *rates*, as opposed to property tax revenues per capita (as in Ramcharan, 2007). This is because tax revenues per capita depend not only on the political decision of what tax rate to set, but on the tax base, or wealth. Inequality may be associated with lower property taxes per capita, but this may simply be because

[1] 60% of all wealth in 1890 consisted of farmland, according to the U.S. Census report on Wealth, Debt, and Taxation of 1895. Thus land inequality captures a large proportion of inequality in wealth. Additional support for the use of the Gini coefficient for farm size comes from Leland (1928), Benson (1965), and Seligman (1895). All three note that total wealth of individuals in this period was closely correlated to their farm land holdings in all but the most urbanized areas.

[2] Work by Easterly (2001, 2007) and Ramcharan (2007) uses a similar strategy to obtain exogenous variation in inequality.

unequal places are also poor. To address the role of inequality in the political economy of taxation it is necessary to concentrate on the tax rates specifically.

The results show that there is a negative effect of land inequality on property tax rates across counties in the U.S. in 1890. A one standard deviation increase in the Gini coefficient of farm sizes would lower the property tax rate from 1.3% to 1.1% when evaluated at the median, a fifteen percent drop.

Beyond this, the data give us the opportunity to explore how inequality affected taxation associated with specific public goods, namely schooling. If we examine only the tax rates levied specifically to support schooling, then the negative effects of inequality are even larger, both in statistical significance and in the size of the estimates. A one standard deviation increase in the Gini lowers the property tax rate for schooling from 0.41% to 0.32%, a decline of over twenty percent. In comparison, if we look at taxes used to fund all non-educational public goods (e.g. roads), then we find no significant relationship with inequality. Land inequality was acting strongly to lower school funding while it had no contemporary effect on other types of public goods.

These findings have implications for several lines of research. First and foremost, they highlight the fact that land inequality acted to depress the accumulation of a factor complementary to industrial production: human capital.[3] At the same time, the evidence shows that this same land inequality did not significantly influence the provision of other public goods that were complementary to all sectors. This accords with work by Galor, Moav, and Vollrath (2008), who predict this kind of relationship at early levels of development. The results also provide empirical support for the historical work of Engerman and Zolt (2005), who documented distinct differences in taxation levels between countries in the Western Hemisphere, and associated these differences to their initial inequality in land holdings.

Additionally, the results offer some insight into the median voter model of public goods provision, as in Alesina and Rodrik (1994). Previous research by Lindert (1996), Perotti (1996), Partridge (1997), Gouveia and Masia (1998), and Rodriguez (1999) found a negative relationship between

[3]Other papers have documented an empirical relationship of land inequality and agggregate development levels, such as Deininger and Squire (1998), Birdsall and Londono (1997), and Frankema (2006). However, these papers do not offer any evidence that this relationship operates through public finance.

government spending and inequality, and they conclude that the median voter model does not hold.[4] However, most studies have used cross-country data in their work, and this introduces serious concerns about the comparability of tax systems. It implicitly assumes that the mechanisms of taxation are similar, and the only major differences are in the actual tax rates. This seems very unlikely to be true. A major advantage of this paper is that the units of analysis all operate with a similar tax system, described in more detail below. All counties in 1890 financed nearly 100% of their spending through the general property tax, and there was little variation in the implementation of this tax across counties. An additional feature of the property taxes studied in this paper is that they are, by definition, direct taxes on wealth. Median voter models generally focus on wealth taxes, but most of the existing empirical work is based upon countries that utilize some form of income tax to fund public goods and redistribution.

With the advantage of consistent data and more detail on the historical context, the results in this paper can be shown to be compatible with a median voter model once we carefully distinguish redistribution from public goods provision. Historical evidence shows clearly that in 1890 in the U.S. the property tax was highly regressive, and this operated through the assessment process. The assessed value of property did not rise one for one with the market value of estates, so that richer individuals paid a lower effective tax rate. If the tax system is regressive enough, then as inequality increases (and the median voter becomes poorer) the implemented tax rate will actually down. So it would be incorrect to suggest that the evidence presented in this paper shows the median voter model to be incorrect. The median voter model may be perfectly consistent with a negative inequality/tax relationship once we account for the actual nature of the tax system the voters have available. Why property taxes themselves are regressive is beyond the ability of the data in this paper to answer, but Benabou (2000, 2005) offers a theoretical structure that rationalizes regressive taxation while still maintaining a median voter assumption.

The results here also provide some insight into the low local and municipal tax rates observed within many developing countries (Tanzi, 1987; Burgess and Stern, 1993). In these countries, where land remains a significant source of wealth, an unequal distribution of this resource combined

[4]Figini (1998) finds a non-linear relationship between spending and inequality, and Pineda and Rodriguez (2006) use time-series evidence from the U.S. to argue against the median-voter interpretation of public education funding.

with structural issues that lead to regressive systems could lead to low levels of taxation and therefore a limited ability to provide growth-enhancing public goods. Additionally, this paper adds to the current literature examining institutions within countries in more detail. Banerjee and Iyer (2005) study the impact of land inequality on differential development across India, while Naritomi, Soares, and Assuncao (2007) examine Brazilian municipalities and the development of their internal institutions in light of their experience with sugar or gold extraction. Acemoglu, Bautista, Querubin, and Robinson (2007) examine both political inequality and land inequality in determining long run outcomes for education and public goods across districts of a state in Colombia. Examining regional evidence across the Western Hemisphere, Bruhn and Gallego (2007) find evidence for the importance of institutional quality within countries that mirrors the cross-country results. The current paper provides further evidence of the importance of initial conditions for the long-run development of institutions, suggesting that geographic conditions, through their influence on inequality, acted as a drag on human-capital enhancing public goods.

The paper proceeds as follows. Section 2 describes in more detail the property tax system and presents the cross-sectional county level regressions using data from 1890. Section 3 discusses how to interpret the findings in light of the median voter model and section 4 concludes.

2 The Relationship of Inequality on Public Goods Provision

Before addressing the empirical issues surrounding the identification of the relationship of inequality and property taxation, it will be useful to consider how exactly we measure property taxes. Tax revenues per capita might be attractive as a measure, but note that this potentially confounds multiple mechanisms through which inequality may exert an influence. To see this, note that we can break down taxes per capita as

$$\frac{T}{L} = \frac{T}{V} \times \frac{V}{L} \tag{1}$$

where T is total property tax revenue, L is population, and V is the market value of property. The first ratio, T/V, captures the tax *rate*, while wealth per capita V/L is the tax *base*. Any effect that inequality has on taxes per capita (T/L), has to operate through one of these two channels.

If we take logs of (1), we have

$$\ln\frac{T}{L} = \ln\frac{T}{V} + \ln\frac{V}{L} \tag{2}$$

which shows that the log of taxes per capita are simply a linear combination of two terms. Given this decomposition, it will be the case that the coefficients $\hat{\beta}$ of a linear regression of $\ln T/L$ on explanatory variables X will have to be equal to the sum of the coefficients from the regression of each right-hand side term on the same explanatory variables X. More explicitly, the coefficient on inequality in the regression of $\ln T/L$ on X will have to equal the sum of the coefficients on inequality found in regressions of $\ln T/V$ and $\ln V/L$ on X (Wong, 2007). What this will allow us to do is examine whether the tax rate (T/V) or wealth per capita (V/L) was the most important element in determining the level of tax revenue per capita and its relationship with inequality.

This decomposition is informative, but we must keep in mind two issues while working with it. First, the political economy of inequality is concerned with tax *rates*, and therefore our primary object of interest should be T/V, not taxes per capita, T/L.[5] Drawing conclusions from regressions using tax revenues per capita alone would be inappropriate. The second issue is that the decomposition of tax revenues per capita does nothing to solve the problem of identification. A set of instruments for inequality is described below that will give us confidence we are finding the causal effect of inequality on taxation.

2.1 Property Taxes in the United States, 1860-1920

Before proceeding, it will be useful to provide some background on the property tax system in the United States in this period. The industrialization and modernization of the American economy between the middle of the 19th century and the Great Depression coincides with what has been called "The Era of Property Finance and Municipal Government" by Wallis (2000, 2001). Public provision of education and infrastructure was an integral element of the rapid development experi-

[5] This points out a significant difference of the current work with that of Ramcharan (2007), who examines tax revenues per head in the same period. He finds inequality negatively related to tax revenues per head, but it is not clear whether this is driven by tax rates or by wealth differences, and so it is difficult to draw conclusions. Additionally, while I will argue later that geographic controls can usefully serve as an instrument for inequality when tax *rates* are the dependent variable, it is not clear that they are suitable instruments when using taxes per capita, due to the direct effects of climate characteristics on wealth in a heavily agricultural economy.

enced in this era. Between 1902 and 1932 two categories of spending, roads and schools, accounted for half of all growth in government expenditure. The funding of these projects was provided almost exclusively by taxes on property. In 1890 almost 72% of state revenues and 92% of local government revenues came from general property taxes.[6]

The evolution of property tax rates over time can be seen in figure 1. This plots the mean property tax rate by level of government across the whole U.S. As can be seen, the property tax rate charged by states is just under 50 cents for every $100 dollars of assessed value for this whole period. In contrast, county level property tax rates jump to about 75 cents per $100 in 1870 and then fluctuate around this value for the rest of the time frame. Municipal taxes take off explosively in 1890, reaching $1 per $100 in assessed value in that year and are nearly $1.75 per $100 by 1920. Municipal governments, which include school districts, city governments, and "special" districts such as irrigation districts, were the dominant source of property taxation by the early 20th century.

The receipts of this tax were predominantly used for the purchase of public goods such as roads and schools. Direct redistribution accounted for only 7% of total state, county, and municipal expenditures in 1890 (U.S. Dept. of the Interior, 1895).[7] As Wallis (2001) points out, the success and longevity of the property tax at the local level is mainly due to the fact that it carefully matches the beneficiaries of public goods with the those paying for them. For many states and localities, the implicit redistribution involved in many projects led to political objections that could only be overcome by a clear assignment of taxes to those who would benefit from the projects (Wallis, 2003). Thus the public goods that these taxes financed were not directly redistributive, but rather were intended to be productive.

2.2 Data and Initial Analysis

The cross-sectional regressions involve a main sample of 1966 counties, and summary statistics for all variables are in table 1. The property tax data is from a special supplement to the U.S. Census

[6] "Local" includes all county, city, municipal, school district, and other sub-state level jurisdictions.
[7] The category of expenditure is reported as "Charities and Gratuities".

of 1890 on wealth, debt, and taxation (U.S. Department of the Interior, 1895). Tax revenues are the total reported amount of ad valorem property taxes collected within a county. This total is broken down into several categories based on the taxing authority: state, county, or local (cities, towns, school districts). In addition, information is provided on taxes levied directly by school districts or levied by the state specifically for school funding. This allows us to distinguish between property taxation done specifically for education purposes versus taxation to fund the remainder of public goods and government activity. The assessed value of all property (real and personal) is reported for each county, obtained by the Census from state tax rolls. As different states employed different definitions of what constituted real vs. personal property, only their total is utilized. The true value of property is an estimate of the market value of all real and personal property (which includes financial holdings and industrial capital), and the Census obtained this at a county level through official state reports, surveys of counties, and their own estimates. Details of this data can be found in the appendix.

The measure of inequality is a Gini coefficient calculated over farm sizes, obtained from Census data on the distribution of farms by size. The Agricultural Census of 1890 reports the number of farms in each of several categories (e.g. 10-19 acres, 20-49 acres, etc.) and this information can be used to construct a Lorenz curve from which the Gini is calculated. See the appendix for further details of this calculation.

Additional controls incorporated into some of the regressions are log income per capita, where output is the sum of county level measures of total farm output and total manufacturing output from the Census. These two categories are likely to understate total output due to the exclusion of services, but given the large share of agriculture and manufacturing in total economic output for the U.S. at this time, the measure surely provides a suitable proxy for output per capita in 1890. As well, the percent of total population that was black, residing in urban areas (defined as places with more than 2,500 persons), and children (defined as between 5-20 years of age) are included. Finally, Mulligan and Shleifer (2004) propose that the absolute size of a political unit will influence its willingness to fund public goods with large fixed costs. Therefore, the log of total population is included in the regression analysis.

To begin the analysis, table 2 presents OLS regressions relating the various components of property taxes per person to farm size inequality. The first three columns of the table include only the farm Gini as an explanatory variable, as well as state level dummies. All regressions use clustering at the state level to calculate standard errors.

Column (1) uses the log of tax revenues per capita ($\ln T/L$) as the dependent variable, while column (2) uses the log of the tax rate ($\ln T/V$) and column (3) uses the log of wealth per capita ($\ln V/L$). Reading down the table, it is divided into four panels that correspond to different definitions of what tax revenue is used in the calculation of taxes per capita and the tax rate. Panel A uses the total property tax revenue collected from residents of the county, whether levied by state, county, or local authorities. Panel B uses only property taxes collected explicitly for the support of education, whether by the state, county, or local authorities. Panel C measures T/L and T/V using only locally levied school taxes as the measure of T. Finally, panel D measures taxes as the total amount of property tax collected, by all authorities, that was not explicitly collected to support education.[8]

Looking at panel A, column (1), we see that inequality was positively, but insignificantly, correlated with tax revenues per capita. This result, though, hides more interesting relationships between inequality, tax rates, and wealth. Column (2) of panel A shows that the farm Gini was negatively, and very significantly, related to the tax rate. Column (3), on the other hand, shows a positive, but insignificant, relationship of inequality with wealth per capita. The *combination* of these two effects yields the insignificant positive association of inequality and taxes per capita, but this is not because unequal counties levied high taxes. Rather, unequal counties also tended to be rich counties, and despite the fact that tax rates were low in these unequal counties, on net they had slightly higher tax revenues per capita.

From a political economy perspective, the results in column (2) are of greatest interest. These link inequality to lower tax *rates*, the choice variable typically lying at the heart of models of inequality, redistribution, and growth. The negative association would seem to be *prima facie* evidence against the median voter model.

[8]It is possible that some of the taxes in this "Other" category may have been used for education, but it is not possible to break this category down any further given the data.

This negative relationship is found again in column (2) of panels B and C of table 2. Here the definition of tax revenue is limited to only taxes explicitly collected to fund schools (panel B), and further to only local taxes collected to fund schools (panel C). The size of the coefficient estimates are about twice as large as found in panel A, indicating that inequality and school funding have a particularly severe inverse correlation in the data.

Contrast this result with that of panel D, where tax revenues are measured as all funds *not* explicitly collected for schools. This tax revenue would have funded police forces, sewer projects, roads, bridges, courts, and all other non-educational public goods. As can be seen, in this case there is a negative association of inequality and tax rates, but the coefficient estimate is only one-fifth of that found using school funding, and the estimate is not close to significance at typical levels.

Note that in column (3), the estimated relationship of inequality and wealth is identical across panels. This is due to the fact that regardless of how we define tax revenues, the base of wealth in a county remains constant.[9] Combining the results for wealth in column (3) with the tax rate results in column (2) yields the coefficient estimates found in column (1). In none of the panels is there a significant correlation of inequality and taxes per capita, despite the strong inverse correlation of inequality and tax rates.

Turning to the remainder of the table, columns (4)-(6) replicate the regressions in the first three columns. Added to these regressions are the five control variables discussed above: log of output per capita, the percent urban, the percent black, the percent children, and the log of total population. As can be seen, the general pattern of results is similar to columns (1)-(3), but with several notable differences.

First, examining column (5), we see that the absolute value of the estimated coefficient has risen as compared to column (2). That is, once we control for these additional factors, the inverse correlation of inequality and tax rates actually gets stronger. The significance of this remains very high. In particular, in panel D, column (2), we see that inequality is now significantly and negatively related to the tax rate associated with "other" public goods aside from schools. The coefficient size,

[9] More importantly, the wealth subject to taxation was uniform regardless of the taxing authority or the purpose of the tax. For example, if a farm was assessed at $1000, then the local school district, the county, and the state all used $1000 as the basis upon which they levied their taxes.

though, remains smaller than the coefficients found for the tax rates associated with school funding in panels B and C. Statistically, one can reject the hypothesis that the coefficient in panel D (-0.517) is the same as the coefficient found in panel B (-0.846).

The second important point in columns (4)-(6) comes from the regression for wealth per capita. Now we see that inequality is significantly, and positively, associated with wealth per capita. This correlation is interesting in its own right, but the OLS results cannot identify whether this means that inequality caused wealth to go up, or whether high wealth generated high inequality.

Finally, note again in column (4) that the simple correlation of inequality and taxes per capita is not significantly different from zero. Even if these estimates were significant, it would be incorrect to interpret the positive coefficients as supportive of median voter predictions. From columns (5) and (6) we see that the positive association of inequality and taxes *per capita* is driven by the relationship of inequality and wealth, and in fact those counties with high inequality also tended to have low tax *rates*.

Table 2 offers several preliminary results that will be addressed further in the subsequent sections. It establishes that there is a negative correlation between inequality and the tax rate on wealth in the United States in 1890. In addition, there appears to be a difference between taxation that funds schooling and taxation funding other government activities. In particular, there is evidence that inequality was worse for school funding than for other types of public goods. Last, the strength of the relationship between inequality and tax rates appears to be stronger once we control for several other broad economic and demographic variables.

The major drawback in table 2 is that we cannot say whether inequality actually caused lower tax rates. Better evidence on the role of inequality in public goods provision requires identifying exogenous variation in inequality, and the next section discusses the instrumental variable strategy used to do just that.

2.3 Identifying Exogenous Variation in Inequality

As proposed by Engerman and Sokoloff (1997) and Sokoloff and Engerman (2000), initial geographic conditions are expected to be significant predictors of land inequality. This relationship is thought to arise from differentials in scale between types of agriculture, with cash crops such as sugar and cotton requiring larger farms to achieve the scale necessary to be profitable.

For geographic conditions to be useful as an instrument, they need to possess two properties. First, the geographic instruments should have explanatory power for the endogenous variable, the farm size Gini. As will be seen, the first stage results are quite powerful, and the instruments do explain a significant portion of the variation in land inequality.

The second property the instruments must possess is to be unrelated to the residual in the main specification. To be clear, if $y = X\beta + \varepsilon$ is the specification of interest, then the matrix of instruments, Z, must satisfy $E[Z'\varepsilon] = 0$.

If our dependent variable, y, is the tax rate, then it seems possible that this condition might hold. Tax rates are a political choice, and geographic characteristics such as rainfall or temperature do not appear to have much direct bearing on this choice. However, the public goods being funded may be a reaction to geographic characteristics – for example, irrigation projects in areas with low rainfall and high temperatures – and we cannot simply assume that $E[Z'\varepsilon] = 0$.

With an over-identified specification, as will be the case here, then we can at least test that the condition $E[Z'\varepsilon] = 0$ using the Hansen test. The results will show that it is impossible to reject the null hypothesis that $E[Z'\varepsilon] = 0$. While there is no way to assert absolutely that the geographic instruments are uncorrelated with the error term, the tests suggest that the chosen specifications are suitable.[10]

The actual climatic data is from the GEOECOLOGY database of Olson, Emerson, and Nungesser (2003), who provide average monthly temperature, total annual rainfall, latitude, and length of the growing year in days from the years 1964-1979.[11] Logs are taken of rainfall, temperature, and growing period as this was found to improve the fit of all regressions.

The four geographic measures are highly correlated with each other, and a concern is that their

[10]Note that this would not be the case if one used wealth per capita as the dependent variable. In this situation geographic characteristics quite naturally affect wealth directly, and it would be incorrect to them as instruments. For this reason, it would also be problematic to claim that geographic instruments are appropriate to identify the role of inequality on tax revenues per capita, as these are closely tied to wealth per capita.

[11]While the climatic data is from nearly 100 years after the observation of the land distribution data, it seems plausible to assume that the weather has not altered radically over that period. In addition, the climatic data on temperature and rainfall are not incredibly sensitive to human activity, making it unlikely that the agricultural activities of the last 100 years have altered the conditions.

joint insignificance is simply a result of multi-collinearity. In results available from the author upon request, one can exclude each geographic variable in turn from the set of instruments for inequality, but includes it as a control variable in the second stage, and each is found to be insignificant in this type of specification. Overall, the use of the geographic instruments appears suitable for identifying the role of land inequality in determining public goods spending.

2.4 The Effect of Inequality on Tax Rates

Table 3 presents the results of two-stage least squares regressions of the log of the tax rate on the farm Gini, using the log of annual rainfall, the log of the average temperature, the log of the growing period, and latitude as instruments. Panel A of the table includes only the farm Gini as an explanatory variable, while panel B also includes log output per capita, the percent black, the percent urban, the percent children, and the log of total population.

Before discussing the effects of inequality, consider the diagnostic statistics reported for all regressions. There are more instruments (4) than endogenous variables (1), so the regressions are all over-identified. The Hansen test of over-identifying restrictions is performed, with both the statistic and its p-value reported in the table. In no case can we reject the joint null hypothesis that all four instruments are uncorrelated with the error term, and the p-values show this result is quite strong.

In addition, the F-statistic testing the joint significance of the four excluded instruments is reported for each regression along with the p-value for the null hypothesis that the joint effect of the instruments is equal to zero. In panel A, without the additional controls, this statistic is 27.15, showing how strongly the geographic instruments predict variation in the farm Gini. In panel B, the F-statistic is smaller, but at 12.86 it remains significant at less that one-tenth of one percent. It seems clear that the instruments have sufficient first stage strength.

Turning to the results of interest, column (1) in panel A uses all tax revenues to calculate the tax rate. Inequality is seen to have no significant effect on this overall tax rate. Contrast this to the results when we examine only school taxes. Column (2), looking at the effect of inequality on the taxes levied solely for school purposes, shows a significantly negative effect. This is similar to column (3), where we consider only taxes levied by local authorities to support schools. The estimate for local school funding is only significant at 10%, but is similar in size to the coefficient estimate in column (2). Finally, column (4) looks at taxes used to fund all other public goods, and finds a negative, but insignificant, result.

Panel B of table 3 replicates the previous regressions, but now includes the five control additional control variables. The inclusion of these controls, similar to the OLS results in table 2, increases the size and significance of the estimated effect of inequality on tax rates. Column (1) shows that now inequality has an effect even on overall tax rates, while columns (2) and (3) provide evidence again that inequality had a strong negative effect on the willingness of counties to fund education. In column (4), we see again that inequality had a much smaller effect on the provision of public goods besides education, although statistically one cannot reject the hypothesis that the coefficient estimates in columns (2) and (4) are the same.

The practical size of inequality is quite significant as well. Moving from the 25th to the 75th percentile in the farm Gini is an increase of about 0.15. Given the results in Panel B, this would result in a decrease in the overall tax rate of about one-third of one standard deviation. For the same change in the Gini, the total school tax rate would drop by one-half of one standard deviation, and the local school tax rate by about one-fourth of a standard deviation.

If we compare these estimates in table 3 to the estimates for tax rates in table 2, we see that in every case the instrumental variables estimate is larger in absolute value than the OLS. In other words, the OLS estimates appear biased downward. This suggests several possibilities. First, this attenuation is consistent with measurement error in the farm size Gini. The Gini is constructed from Census reports on the number of farms by size categories, but this calculation involves several assumptions about average farm size within each category. To the extent that counties vary idiosyncratically in their average size within categories, the IV method may be providing a correction for this problem.

Alternatively, the attenuation of the OLS results could be due to a positive correlation between the farm Gini and the residual term. Whether this is due to an omitted variable or to reverse causality is beyond the ability of the data to indicate. If it is reverse causality, then it indicates that an increase in tax rates is acting to increase inequality.

2.5 Local School Funding

The sample used to this point consists of 1966 counties, within which some local authority (city, town, or school district) levied taxes explicitly to support schools. However, not every county in the U.S. in 1890 had local school taxation. For an additional 337 counties that we have data for, schools were funded from the state or county level only. The purpose of this section is to examine whether the addition of these counties changes our conclusions regarding the relationship of inequality and public goods spending.

The 337 counties differ substantially from the original sample. The average farm Gini in the 337 counties is 0.605, while it is just 0.529 in the larger sample. Per capita income in the 337 counties is only \$52, while in the larger sample it is \$86. The counties without local school funding are predominantly Southern.[12] So it is of some interest whether they fit within the pattern established so far that higher inequality leads to lower public spending on education.

To address this it is necessary to alter the specification slightly. Previously the dependent variable was the log of the tax rate, $\ln T\ V$. This obviously is undefined for counties where local school taxes are zero. So in this section we will consider the level of the tax rate, T/V, as the dependent variable.

Table 4 reports two-stage least squares regressions of the tax rate on the farm Gini, using the same four geographic variables as instruments. Column (1) includes all 2303 counties, and defines taxes, T, as the total tax revenue collected specifically for schools, whether local, county, or state. Panel A reports the results when no control variables are included, and Panel B reports results with them included. As can be seen, there is a significant negative relationship of inequality on the overall school tax rate. This effect is, as before, larger when the control variables are included.

Column (2) replicates these specifications, but limits the sample to only those 337 counties within which there was no local school funding. As can be seen, without controls there is a positive,

[12]The breakdown of the 337 counties is as follows: Alabama (51), Georgia (106), Kentucky (2), Louisiana (19), Minnesota (2), North Carolina (72), South Carolina (8), South Dakota (2), Tennessee (1), and Texas (74).

but insignificant relationship of inequality to school funding. However, once we control for the other characteristics of counties in panel B, we see a significant negative relationship. The absolute value of the point estimate is smaller than in column (1), indicating that the effect of inequality is less in those counties without local funding.

By comparison, column (3) shows the strong negative effect of farm inequality on school taxation for the original sample of 1966 counties. Comparing the results in column (3) to column (1), it does not appear that restricting the sample to the original 1966 counties is the reason for the negative relationship observed. Even allowing for the presence of the 337 counties with no local funding we obtain similar estimates.

Column (4) limits the definition of taxes to only locally levied school taxes, but includes all 2303 counties in the regression. Thus the 337 observations without local funding all have a dependent variable equal to zero. In this framework, we see again a strongly significant negative impact of inequality on school funding. It does not appear that the 337 additional counties, despite their many inherent differences with the main sample, are operating with a different relationship between inequality and school funding.

Finally, column (5) considers the results when all counties are included, and the tax rate is based on all non-school taxes. In this case, we see negative but very insignificant relationships between inequality and tax rates. Similar to previous results, inequality is not relevant to the determination of taxes funding public goods other than those of schools.

3 Property Taxation and the Median Voter

The empirical results indicate that property taxes were lower when land inequality was higher. This held most strongly for education as compared to spending on non-educational public goods. These results suggest one reason places with high inequality lagged in the provision of education and ultimately in economic growth. The fact that the results differ so significantly between education funding and non-education funding supports work by Galor, Moav, and Vollrath (2008), who predict that land inequality will delay education reform, but not public goods spending that benefits both the agricultural and manufacturing sectors (e.g. roads).

To the extent that land inequality proxies for overall wealth inequality (and in 1890 this seems like a fair assumption to make), these results also appear to contradict the predictions of simple median voter models.[13] Does this evidence offer further evidence against the median voter model, or is there another explanation that can reconcile the theory with the evidence?[14]

The median voter model typically assumes that all wealth is taxed uniformly. However, in the U.S. during this period the actual implementation of the property tax meant that all wealth was not taxed at the same rate. In fact, property taxes tended to be quite regressive. This was noticed and argued against throughout this era. Seligman (1969), originally writing in 1895, described the general property tax as "one of the worst taxes known in the civilized world," (p. 62) and led him to conclude that, "It is the cause of such crying injustice that its alteration or its abolition must become the battle cry of every statesman or reformer." (p. 62) The defects of the general property tax, as argued at the time, included the following: a) a lack of uniformity, or an inequality of assessment across individuals and counties, b) a lack of universality, primarily the failure to reach personal property, and c) regressivity, as wealthier individuals tended to hold a greater proportion of personalty as opposed to realty, and their total wealth was therefore taxed at a lower rate than poor individuals (Seligman, 1969; Leland, 1928; Fisher, 1996).[15]

[13] The primary references connecting inequality and public goods are Alesina and Rodrik (1994) or Persson and Tabellini (1994). Variants of the median voter model that focus specifically on inequality and redistribution through education funding include Glomm and Ravikumar (1992), Saint-Paul and Verdier (1993), Benabou (1996), and Fernandez and Rogerson (1998).

[14] An alternate explanation would be that within the U.S. in 1890, the median voter assumption is not correct because suffrage was limited by wealth. However, at this point in U.S. history, voting was relatively widespread. Most importantly for our purposes, suffrage was not limited by property rights. Generally speaking, those who paid taxes could vote on taxes. Williamson (1960) documents that by 1860 property tests had essentially disappeared, and that the demise of these rules was an outgrowth of the Jacksonian democracy movement of the early 1800's. Keyssar (2000) presents a detailed assessment of the various restrictions in force and they can be summarized into several main categories. First, citizenship requirements generally meant that a male had to have been resident in a state for one year before he received the right to vote, and these waiting periods were often shorter for municipalities. Secondly, many states and localities required that a person be current on their taxes in order to vote. Finally, literacy tests were common, especially in the South where they served primarily to disenfranchise black voters. Given that we controlled for the black population percentage in the empirical work, it does not appear that the negative effect of inequality was just a proxy for limited black voting rights. The other restrictions did not, in practice, disenfranchise many voters, according to Keyssar and Willamson.

[15] To try and achieve uniformity, between 1840 and 1900 twenty-two states inserted uniformity provisions into their state constitutions, which added to the five states with existing provisions in force in 1840 (Benson, 1965). Uniformity was often seen as symbolizing something beyond property taxation, and was linked to the very concept of democracy itself and the urge for equality of all citizens (and their property) before the law (Benson 1965). Similar to uniformity, many states included universality clauses in their constitutions. The main intention of the clauses was to

One of the main structural issues that led to these objections was the increasing share of personalty in total wealth as the economy developed and financial capital rose in proportion to the value of land. While capital and financial goods were generally easy to value given market prices, they were easy to hide. Thus Benson (1965) notes that in 1850 the total assessed value of all property in the U.S. was equal to 84.4% of the estimated true value of property. By 1870 already this share was down to 47.2% and in 1890 it was only 39.2%. In fact, while the assessed value of real estate more than doubled between 1860 and 1880, the assessed value of personalty actually decreased by 24% over the same period. Some of this could be attributed to the Civil War, but Benson suggests this is hardly sufficient to explain the entire amount. Consider that in 1884, Cook County, Illinois (consisting of Chicago and environs) reported a total of less than $383,000 in personal property, despite bank deposits reported well into the tens of millions of dollars (Benson, 1965). By 1911 the reported value of all real estate in New York City was over nine and half billion dollars, while the total reported value of all personal property (which included all financial assets as well as household goods) was well under one-half of a billion dollars (Seligman, 1969).

These trends can be seen in figure 2. The log total value of all property (real and personal) per capita is plotted between 1860–1920, along with the log of assessed realty value per capita and the log of assessed personalty value per capita. As can be seen, the value of personalty actually dips in 1870 and 1880 before climbing slowly through 1920. The value of realty dips very slightly in this period and then continues its general upward drift. Overlaying this information is the overall assessment rate, or the assessed value of all property relative to its true value, as estimated by the Census bureau. This rate declines from nearly 80% in 1860 and drops dramatically to around 40%, where it stays throughout most of this time period.

A result of the problem of assessing personal property was the inequality in assessments that existed across individuals. It was generally true that, "the property of the small owner, as a rule, is valued by a far higher standard than that of his wealthy neighbor," (Seligman, 1895, p.29).

include personalty or intangible property (e.g. financial assets and industrial capital) in the tax base alongside realty (e.g. land). Benson (1965) notes that this universality movement was primarily a phenomenon of the South and West, areas in which real estate was the dominant form of wealth and landowners were anxious to find other sources of revenue. Twenty-one states added constitutional provisions for universality into their constitutions between 1840 and 1900, many of them specifically identifying bank notes, money, investments, and personal property as objects of the general property tax.

Leland (1928) documents that in Wisconsin in 1912, farms valued at under $1000 were assessed at 100% of their market value, and that this assessment decreased steadily by the size of estate until estates of more than $500,000 in value were assessed at only 28%. Similarly in Virginia in 1914, the assessment to sales price of rural properties was 46.7% for those under $500, but only 28% for those greater than $10,000. This type of pattern held for personal property as well, and there was also a distinction between rural and urban areas. In cities, assessments were closer to the sale value of real estate in both Virginia and Kansas (Leland, 1928). Figure 3 graphs the data given by Leland for Wisconsin and Virginia, and shows distinctly that the assessment rate is negatively, and in a convex manner, related to the size of the estate.

This evidence shows quite clearly that property taxes during this period were regressive. Those at the lower end of the wealth distribution were paying higher effective tax rates than those at the top due to the declining assessment rate. Thus a basic assumption of the median voter model does not hold in this context, and it would be incorrect to use these results to indict the basic forms of such models.

A simple way of understanding the inverse relationship between inequality and property taxation is to consider the taxes not as redistributive tools, but rather as the source of public goods that are shared by all individuals. This interpretation seems to fit with John Wallis' characterization of property taxation in this period as a method of public good funding used explicitly because it did *not* redistribute between regions or individuals (Wallis, 2001).

In a suitably modified version of the median voter model of Alesina and Rodrik (1994), it can be shown that the actual relationship between inequality and tax rates depends upon the redistributive nature of the tax itself (see the Appendix). With regressive taxation the median voter will absolutely predict a negative relationship between inequality and tax rates.

This highlights the issues that arise when attempting to empirically assess the median voter model. Prior work has essentially regressed the tax rate (often approximated as government spending relative to GDP) on inequality. If the authors found a negative relationship between the two, they interpreted this as a rejection of the median voter model. But without knowing the nature of the tax system, this negative relationship may actually be perfectly consistent with median voter predictions. Beyond this issue, cross-country evidence seems likely to be plagued by the fact that countries will differ in how regressive their taxation is, and if this is the case then the evidence presented cannot be usefully interpreted at all.

The current paper finds that inequality and public goods spending are negatively related, conditional on there being a regressive tax structure. This is perfectly consistent with the median voter model. Given the advantages this data has over cross-country studies, this suggests that we should not dismiss the median voter model too quickly. Of course the regressive nature of the tax system itself should be subject to median voter considerations. Benabou (2000, 2005) provides a model in which inequality is operative in determining the tax system itself, and there is nothing in his model to preclude regressive taxation under certain circumstances. To examine this in the data, though, would require one to regress measures of *regressivity* on measures of inequality. The point of this is that we cannot usefully interpret evidence on public goods and inequality unless we have knowledge of the tax structure in the first place. The evidence presented in this paper shows that inequality acted to lower tax rates across U.S. counties, providing some explanation for why unequal areas of the U.S. lagged in education and growth. It does not necessarily, though, provide evidence against the median voter hypothesis.

4 Conclusion

The distribution of wealth is often through to have ramifications for the process of development. In particular, research has suggested that inequality may be important for the provision of growth-enhancing public goods such as schools and roads. The period between 1860 and 1920 in the U.S. is an ideal environment within which to test such hypotheses because taxation on wealth (property) was the primary source of funding for the vast expansion in public spending that took place alongside industrialization.

A cross-sectional analysis of U.S. county-level data in 1890 provides several clear conclusions on the effect of inequality on public goods provision. First, inequality did lower overall property tax rates. Second, this effect was driven almost entirely by the effect of inequality on school funding, while there was no effect of inequality on non-school funding. The identification of these relationships was achieved through the use of geographic variable as instruments for inequality, inspired by the historical arguments of Engerman and Sokoloff, and verified empirically.

The effect of inequality was dramatic. The difference between the a county at the 90th and the 10th percentile of the inequality distribution was a decrease in tax rates by one half. The findings lend empirical weight to the previous work of Sokoloff and Zolt (2005) on historical tax mechanisms in the Western Hemisphere, as well as the work of Galor, Moav, and Vollrath (2008) on the impact of land inequality on human capital formation.

The general finding that inequality lowered tax rates on wealth would appear to be in conflict with simple median voter models. Historically, though, property tax assessments were highly regressive and incorporating this fact into a median voter model shows that the empirical results are consistent with this type of political system. The results suggest several interesting questions. Why were property taxes so regressive to begin with? Was inequality responsible for this feature? Why was inequality so detrimental to schooling relative to other types of public goods? How did the further development of the economy, by increasing the value of capital relative to land, affect the provision of public goods? The importance of these public goods for the subsequent development of the U.S. makes the answers to these questions an intriguing area of research.

Appendices

A Land Distribution Measures

Farm Land Distribution

The method of measuring land inequality follows the methodology used by Deininger and Squire (1998) in their study of cross-country inequality. From the Agricultural Census of 1890 distribution of farms by size is available. The categories of size are as follows: under 10 acres, 10-19 acres, 20-49 acres, 50-99 acres, 100-499 acres, 500-999 acres, and greater than 1000 acres. This distribution, combined with assumptions about the average area of farms within each category, allows for the estimation of a Gini coefficient.

A more formal definition is as follows. There are eight size categories, including a placeholder category that measures farms of size zero (set equal to zero), numbered from 1 to 8 in order of increasing size of farms. Let f_i be the share of all farms that are in category i. Let a_i be the share of all acreage that is in category i. Now let $F_i = \sum_{s=1}^{i} f_s$, which denotes the share of farms that are of size i or smaller. Similarily, $A_i = \sum_{s=1}^{i} a_s$. By definition, $F_8 = A_8 = 1$. It can be shown that the Gini coefficient, G, can be calculated as follows

$$G = 1 - \sum_{i=1}^{8} \left(F_{i+1} - F_i\right)\left(A_{i+1} + A_i\right). \tag{3}$$

This method requires data on the share of acreage in each farm size category, which is not actually reported in the census of 1890. In the absence of this data, it is assumed that each farm within a category is the average number of acres for that category. Therefore, the size of all farms in the 10-19 acre category is assumed to be 14.5 acres. This method conforms to the evidence found in the 1920 Agricultural Census, which actually reports acreage data by category. This leaves the category of farms greater than 1000 acres. For these farms, it is assumed that each farm is actually 1000 acres. Various values for this category were tested, and there were never significant changes in the Gini coefficients.

B Public Finance Data

1860. Data comes from the U.S. Department of the Interior (1866). The assessed value of both real estate and personal property was recorded by state in Table 1 of the Miscellaneous section. In this table, as is the case for all subsequent years, the value of property belonging directly to the United States or to an individual state itself is not counted. Tax values are reported in an unnumbered table (page 511) in the Miscellaneous section. The values reported are total taxes received, and it is not specified what amount is accounted for by property taxes. Taxes are distinguished by purpose or level of collection: state, county, city, town, school, poor, road, and miscellaneous. For the purposed of this paper, state and county taxes are exactly as reported, while municipal taxes is the sum of all other categories reported. For a variety of observations, no number is reported. For example, in Florida no poor taxes or road taxes are reported. This does not mean that taxes were not collected for these purposes, only that Florida did not distinguish these funds from more general categories like state, county, city or town taxes.

1870. Data is again from the U.S. Department of the Interior (1872) in the subsection "Wealth, Taxation and Public Indebtedness in the United States." Table 1 of this section lists the assessed value of both real estate and personal estate, as well as an estimate of the true valuation of total real and personal estate. The true valuation is an estimate by the marshals assigned to conduct the census of the market value of the property being counted. Taxes are not specifically reported as property taxes, but the total values for 1870 match the aggregates reported in later Census publications that refer to ad valorem taxation of property, so it is assumed that this report reflects property taxation. Breakdowns are given by state, county, and "town, city, etc.". This final category is treated as municipal taxes in this paper.

1880. The U.S. Department of the Interior, Census Office (1884) reports in Table II a summary of the assessed valuation and taxation by level of government. Assessed valuation is given for real estate and personal property. Taxation is reported for state, county, and "minor civil divisions less than counties exclusive of school districts" and school districts. For state, count, and the minor divisions, a distinction is made between taxes levied for schools and taxes levied for other purposes. Similar to 1870, taxes are not denoted as property taxes, but later reports of the Census suggest that these totals are in fact ad valorem property taxes. In each case, both the minor division and school taxes are combined to arrive at municipal taxes.

There are several adjustments necessary given notes to Table II. In particular, the values in Table II do not include amounts of tax collected in several states (Indiana, Illinois, Wisconsin, Iowa, Minnesota, and Kansas) that were reported by townships but included school taxes. Footnotes to the table report the total value of these taxes, and these are added to the municipal tax category used in this paper. Table XVI of the same report lists estimated true valuation of property by state, which is taken directly for use in this paper.

1890. U.S. Department of the Interior, Census Office (1895) in table 3 reports the true valuation of real and personal property by state. Table 5 of the same report offers the assessed value of real estate and personal property. In addition, it contains data on the ad valorem taxation done on property. The total levy, except for schools, is reported for state, county, and municipal units of government. For schools, a state total and a "county and minor division" total is reported. For this paper, state taxes are the total state taxes levied, county taxes are the non-school county taxes levied, and municipal taxes are the municipal taxes levied exclusive of schools combined with the county and municipal taxes levied for schools. The combination of the county school taxes with municipal taxes is felt to be acceptable given the generally low level of county school taxation that took place across states during this period.

1900. U.S. Department of Commerce, Bureau of the Census (1907) is a similar report to that of 1890. The major note to this data is that it is from 1902, not from 1900. Table 8 reports the assessed value of real property, personal property and "other" property. For the purposes of this paper, personal property and "other" property are lumped together as personal property. This table also reports a breakdown of ad valorem taxes on property similar to that found in 1890. Levies other than for school purposes are reported by state, county, and municipal levels. Levies for schools are reported for state and "county and minor civil divisions". The total state tax is the sum of the state values, county tax is solely the non-school county taxes, and municipal taxes are the sum of municipal non-school levies and the "county and minor divisions" school taxes. Similar to 1890, the combination of county school taxes in the municipal aggregate is not felt to be significant given the small size of county school taxes at this time. Table 15 reports the estimated true valuation of all property, broken down by real and personal.

1910. The U.S. Department of Commerce, Bureau of the Census (1915) reports on public finances for the year of 1912. Table 7 in the section on the assessed value of property reports the value of real property, personal property, and "other" property. For several states (Ohio, Indiana, Alabama) the total of other property is included with personal property. As this is how personal property is calculated in this paper for all states, this does not create an issue. For Maryland, personal property is included with real property. All results in the paper are robust to the exclusion of Maryland in 1910 from the sample. For Arkansas, other property is divided up between real and personal property categories. The results are not affected by the exclusion of Arkansas from the sample either. This same table also includes ad valorem taxation on property for states (both school and non-school), counties (both school and non-school) and other civil division (both school and non-school). These fall directly into the categories used in this paper: state, county and municipal.

1920. The report of the U.S. Department of Commerce, Bureau of the Census (1924) is for 1922. The report on Taxation lists in table 4 the estimated true value of real property and improvements by state. Assessed valuation of real, personal, and other property is found in table 7, along with levies of property taxes for states, counties, and all other civil divisions. No distinction is made here regarding school versus non-school taxation. The other civil divisions category includes school districts. True value of property is from the National Wealth report, table 7.

1930. From the Statistical Abstract of the U.S. (1935), which obtained data from the U.S. Department of Commerce, Bureau of the Census (1933) and has values for 1932. Table 212 lists the assessed value of real and personal property by state. Table 214 lists the revenue receipts of counties, from which I select the totals for "general property taxes". From the same table a similar value can be obtained for municipal governments, defined as "cities, towns, villages, and boroughs". Table 215 allows for the collection of the same variable at the state level. Data on the true valuation of property was not available.

C Regressive Taxes and Median Voters

Consider a very simple model along the lines of Alesina and Rodrik (1994). Population is normalized to one, and aggregate (as well as per capita) output is

$$y = Ak^{\alpha}g^{1-\alpha} \tag{4}$$

where k is the aggregate capital stock and g is the amount of public goods provided. The economy consists of one firm operating under perfect competition, taking g as given, so that the wage rate and the rate of return on capital are

$$\begin{aligned} w &= (1-\alpha)\,Ak^{\alpha}g^{1-\alpha} && \text{(5a)} \\ r &= \alpha Ak^{\alpha-1}g^{1-\alpha} && \text{(5b)} \end{aligned}$$

The public good is funded by a tax rate of (τ) on the assessed value (a) of the capital stock so that $g = \tau a$. Note that the assessed value will not necessarily be exactly equal to the capital stock.

An individual's income depends on their wage income, which is identical across all individuals, plus the return to their personal capital, minus the tax on the assessed value of their personal capital,

$$y_i = w + rk_i - \tau a_i. \tag{6}$$

If the assessed value of personal capital is exactly equal to k_i, then this simply reduces to the model as originally written by Alesina and Rodrik. The net return on capital for an individual is then $r - \tau$, and as this is identical across all individuals, all individuals make the same choice of savings rates, and so there is no change in the distribution of capital across individuals over time.

To introduce redistribution into this analysis, let us assume that the assessed value of capital is related to the actual value of capital in the following manner,

$$a_i = k_i^{\gamma+1} \tag{7}$$

and the value of $\gamma \in (-1, 1)$. The aggregate assessment is simply $a = \sum_i a_i$ and the aggregate capital stock is $k = \sum_i k_i$. To see the effect of different values of γ, consider the assessment rate of capital, or a_i/k_i,

$$\frac{a_i}{k_i} = k_i^{\gamma}. \tag{8}$$

As can be seen, if $\gamma > 0$ then the assessment rate on personal property is progressive, or increasing in the amount of personal capital. However, if $\gamma < 0$, then assessment rates are regressive and an increase in the amount of personal capital results in a lower assessment rate. A value of $\gamma = -1$ implies a simple head tax. In the specific case that $\gamma = 0$ then each person has an assessment of $a_i = k_i$, as in the original Alesina and Rodrik model.

So what is the optimal tax rate from the perspective of individual i? Let us assume only that the individual is interested in maximizing income. The individual is presumed to be inconsequential enough to ignore the effect of their choice on the level of k or the assessment rate a/k. Using $g = \tau a$ along with (5a) and (5b) in equation (6) we get

$$y_i = (1-\alpha) A k^{\alpha} (\tau a)^{1-\alpha} + \alpha A k^{\alpha-1} (\tau a)^{1-\alpha} k_i - \tau k_i^{\gamma+1}. \tag{9}$$

Maximizing over τ yields the following solution for τ_i^*, the individual's optimal tax rate,

$$\tau_i^* = \left[\frac{(1-\alpha)^2 A k^{\alpha} a^{1-\alpha}}{k_i^{\gamma+1}} + \frac{\alpha (1-\alpha) A k^{\alpha-1} a^{1-\alpha}}{k_i^{\gamma}} \right]^{1/\alpha} \tag{10}$$

and the relationship of τ_i^* to k_i depends on the size of γ.

In the median voter model, the tax rate implemented will be equal to the optimal tax rate of the median individual, who holds k_m in assets. Assuming that there is some inequality in the distribution of assets, then it must be the case that $k_m < k$, or the median individual has fewer assets than the average individual. A natural measure of inequality is then the ratio k/k_m. Increasing values of k/k_m indicate increasing inequality.

The question now is how the optimal tax rate changes with inequality. Holding k constant, it can be shown that the relationship of k/k_m to the implemented tax rate, τ^m, depends crucially on regressiveness of the tax itself. If $\gamma = -1$ then we have a head tax, and τ^m declines as inequality (k/k_m) increases. If taxes are regressive and $-1 < \gamma < \alpha - 1$ then taxes will decline with inequality up to a point. As long as $k/k_m < \gamma\alpha/((1-\alpha)(-\gamma-1))$ then taxes fall as inequality increases. Once inequality is high enough to cross this threshold, then the median voter has so little wealth that the punitive tax rate does not offset the gains they get to wages from voting for more public goods. Finally, if $\gamma > \alpha - 1$, then taxes increase with inequality no matter initial inequality.

The important point is that for some combinations of γ and k/k_m, the relationship between inequality and taxes is negative, even though there is full voting and the median voter decides the tax rate.

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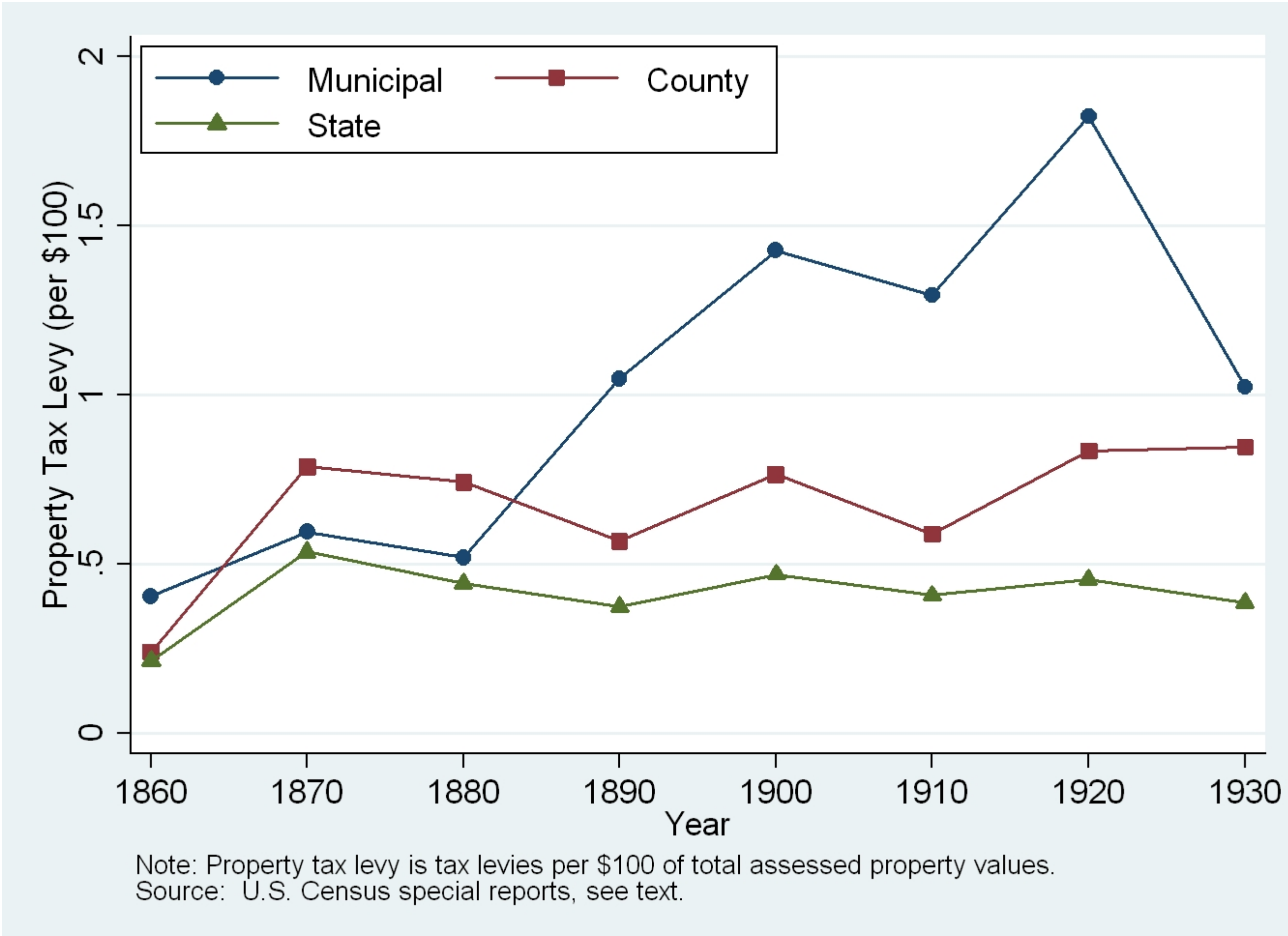

Figure 1: Property Tax Rates, by Level of Government, 1860-1930

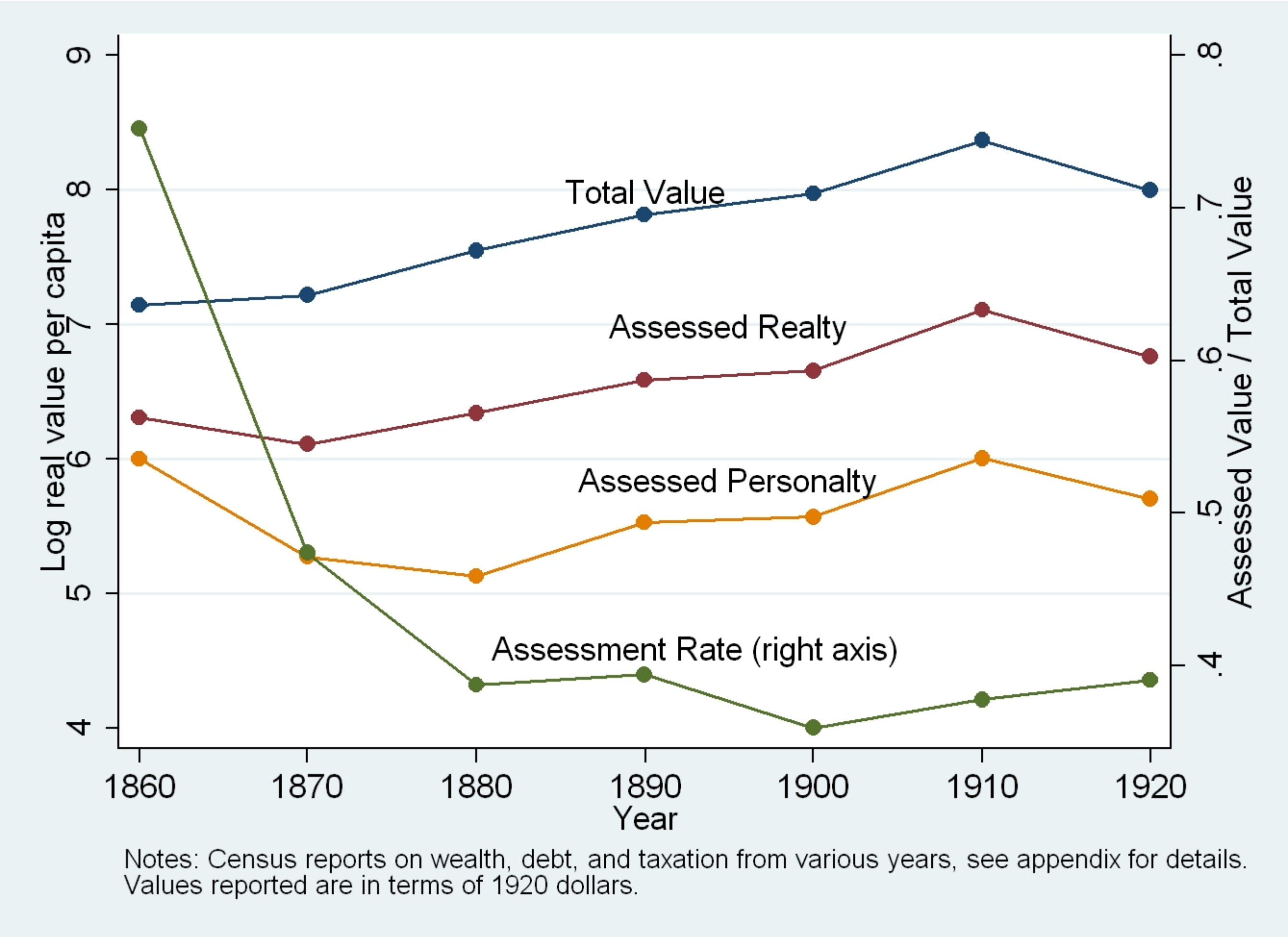

Figure 2: Real and Assessed Property Values, 1860-1920

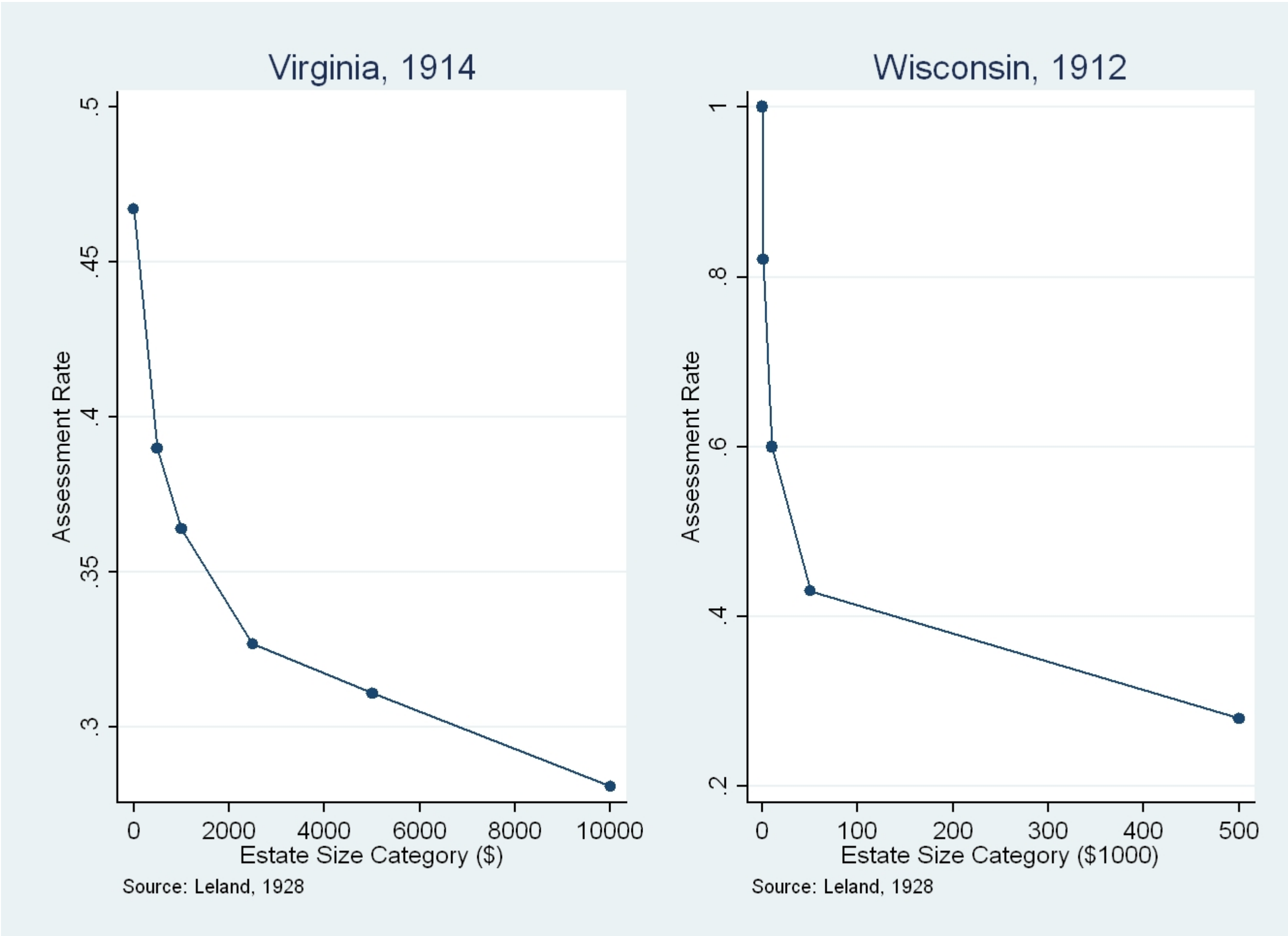

Figure 3: Assessment Rates as a Function of Estate Size

Table 1: County Level Summary Statistics, 1890

Variable	Mean	Std. Dev.	Min	Max
Property tax and wealth data:				
Total taxes per capita ($)	5.900	4.782	0.441	73.203
All school taxes per capita ($)	1.942	1.577	0.102	16.068
Local school taxes per capita ($)	1.628	1.465	0.002	10.885
Other taxes per capita ($)	3.957	3.529	0.059	57.135
Total tax rate	0.013	0.006	0.001	0.093
School tax rate	0.004	0.003	0.000	0.040
Local school tax rate	0.003	0.003	0.000	0.037
Other tax rate	0.008	0.004	0.000	0.086
Total wealth per capita ($)	501.199	489.242	61.627	9182.882
Inequality and other control data:				
Farm Gini	0.529	0.147	0.033	0.926
Log output per capita	4.455	0.648	2.220	6.986
Proportion black	0.118	0.199	0.000	0.940
Proportion urban	0.134	0.211	0.000	1.000
Proportion children	0.379	0.044	0.209	0.466
Log of total population	9.706	0.927	4.890	14.231
Geographic controls:				
Avg. annual temperature (C)	12.150	3.982	3.000	23.800
Total annual rainfall (cm)	98.140	24.842	19.100	175.100
Length growing period (days)	180.426	39.808	81.000	345.000
Latitude (degrees)	38.929	4.200	25.535	48.794

Notes: All variables have 1966 observations. Property tax and wealth data is from the U.S. Census *Report on Wealth, Debt, and Taxation*, U.S. Department of the Interior (1895). Total taxes per capita are the total of all ad valorem taxes collected within a county, by any level of government, divided by county population. School taxes are the subset of taxes collected explicitly to fund education. Local school taxes are a subset of school taxes collected only by municipal or school district authorities. The other taxes are simply total taxes minus school taxes. Tax rates are calculated as the total tax revenue in the county divided by total wealth. The farm Gini is calculated from farm size information in the U.S. Census of 1890. Output per capita is the sum of manufacturing output and agricultural output, as reported in the U.S. Census of 1890. Demographic variables are from the U.S. Census. Geographic variables are obtained from the GEOECOLOGY database of Olson et al (2003). See the appendix for more detail on the construction of all variables.

Table 2: OLS Regressions for County Property Taxes on Inequality, 1890

	Dependent Variables: (1)	(2)	(3)	(4)	(5)	(6)
	$\ln T/L$ (Taxes p.c.) = (2)+(3)	$\ln T/V$ (Tax rate)	$\ln V/L$ (Wealth p.c.)	$\ln T/L$ (Taxes p.c.) = (5)+(6)	$\ln T/V$ (Tax rate)	$\ln V/L$ (Wealth p.c.)
Panel A: T = Total Property Tax Revenue						
Farm Gini	0.274	-0.337**	0.611	0.284	-0.634***	0.918***
	(0.440)	(0.159)	(0.374)	(0.278)	(0.125)	(0.256)
R-squared	0.634	0.348	0.529	0.810	0.390	0.718
Panel B: T = All School Property Tax Revenue						
Farm Gini	-0.138	-0.749***	0.611	0.072	-0.846***	0.918***
	(0.442)	(0.221)	(0.374)	(0.315)	(0.224)	(0.256)
R-squared	0.734	0.539	0.529	0.830	0.552	0.718
Panel C: T = Local School Property Tax Revenue						
Farm Gini	-0.078	-0.689***	0.611	0.027	-0.891***	0.918***
	(0.461)	(0.246)	(0.374)	(0.321)	(0.244)	(0.256)
R-squared	0.753	0.661	0.529	0.816	0.665	0.718
Panel D: T = Other Property Tax Revenue						
Farm Gini	0.460	-0.151	0.611	0.401	-0.517***	0.918***
	(0.441)	(0.156)	(0.374)	(0.278)	(0.122)	(0.256)
R-squared	0.550	0.266	0.529	0.747	0.323	0.718
Controls	No	No	No	Yes	Yes	Yes

Notes: All regressions have 1966 observations and include state fixed effects. Standard errors, clustered at the state level, are reported in parentheses. * denotes significance at 10%, ** denotes 5%, and *** denotes 1%. The panels vary on the measure of property tax revenue used, and the categories are discussed in the text. Note that results for wealth per capita (V/L) do not vary by panel as the wealth is not contingent on the type of tax collected. Tax and wealth data are from U.S. Census special reports, and the Farm Gini is calculated from U.S. Census data on farm sizes (see text). The final three columns include additional control variables: the log of output per capita, the percent urban, the percent black, the percent of children, and the log of total population. See the appendix for the sources of these variables.

Table 3: Instrumental Variable Regressions for Log Property Tax Rates on Inequality, 1890

	Dependent Variable is the log of the tax rate: $\ln T/V$			
	(1)	(2)	(3)	(4)
	All taxes	All School Taxes	Local School Taxes	Other Taxes
Panel A: No additional controls				
Farm Gini	-0.524	-1.013**	-0.948*	-0.240
	(0.437)	(0.507)	(0.542)	(0.438)
Hansen J-stat	0.408	1.822	2.315	0.157
Hansen p-value	0.939	0.610	0.510	0.984
First stage F-stat	27.146	27.146	27.146	27.146
First stage p-value	< 0.001	< 0.001	< 0.001	< 0.001
Panel B: All additional controls				
Farm Gini	-1.178**	-1.540**	-1.446**	-0.871
	(0.509)	(0.628)	(0.655)	(0.538)
Hansen J-stat	0.526	2.222	2.687	0.671
Hansen p-value	0.913	0.528	0.442	0.880
First stage F-stat	12.863	12.863	12.863	12.863
First stage p-value	< 0.001	< 0.001	< 0.001	< 0.001

Notes: Standard errors, clustered at the state level, are reported in parentheses. * denotes significance at 10%, ** denotes 5%, and *** denotes 1%. All regressions have 1966 observations and include state fixed effects. The excluded instruments in each regression are the log annual rainfall, the log of annual temperature, the log of the growing period, and latitude, all obtained from the GEOECOLOGY database of Olson et al (2003). Panel B includes log output per capita, the percent urban, the percent black, the percent children, and the log of total population as additional controls. See the appendix for the source of these control variables. The dependent variable in each column is the effective tax rate, T/V, where T is the total amount of tax collected, and V is total wealth. T varies over the columns based on which taxes are used in the calculation. Tax and wealth data are from special U.S. Census reports, see the text for details. For both panels, the Hansen J statistic is distributed $\chi^2(3)$ and the first stage F statistic is distributed $F(4, 35)$.

Table 4: Instrumental Variable Regressions for Property Tax Rates on Inequality, Expanded Sample, 1890

	Dependent Variable is the level of the tax rate: T/V				
	(1)	(2)	(3)	(4)	(5)
	All School Taxes	All School Taxes	All School Taxes	Local School Taxes	Other Taxes
Panel A: No additional controls					
Farm Gini	-0.0057**	0.0018	-0.0079***	-0.0063***	-0.0008
	(0.0025)	(0.0013)	(0.0025)	(0.0023)	(0.0052)
Hansen J-stat	2.754	0.692	2.072	2.390	1.232
Hansen p-value	0.431	0.874	0.557	0.495	0.745
First stage F-stat	21.724	40.800	27.145	21.724	21.724
First stage p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Panel B: All additional controls					
Farm Gini	-0.0115***	-0.0029**	-0.0103***	-0.0127***	-0.0088
	(0.0040)	(0.0012)	(0.0031)	(0.0040)	(0.0075)
Hansen J-stat	1.923	3.642	2.313	1.672	3.730
Hansen p-value	0.588	0.302	0.509	0.643	0.292
First stage F-stat	5.253	12.576	12.862	5.253	5.253
First stage p-value	0.002	0.001	< 0.001	0.002	0.002
Sample Information					
Included counties	All	Local school taxes = 0	Local school taxes > 0	All	All
N	2303	337	1966	2303	2303

Notes: Standard errors, clustered at the state level, are reported in parentheses. * denotes significance at 10%, ** denotes 5%, and *** denotes 1%. All regressions include state fixed effects. The excluded instruments in each regression are the log annual rainfall, the log of annual temperature, the log of the growing period, and latitude, all obtained from the GEOECOLOGY database of Olson et al (2003). Panel B includes log output per capita, the percent urban, the percent black, the percent children, and the log of total population as additional controls. See the appendix for the source of these control variables. The dependent variable in each column is the effective tax rate, T/V, where T is the total amount of tax collected, and V is total wealth. T varies over the columns based on which taxes are used in the calculation. Tax and wealth data are from special U.S. Census reports, see the text for details. For all regressions, the Hansen J statistic is distributed $\chi^2(3)$. The first stage F statistic is distributed $F(4,35)$ in columns (1),(3)-(5), and $F(4,9)$ in column (2).

Table 5: Regressions for Assessment Rate, 1890

	Dep. Variable is log of the assessed prop. val.:			
	(1)	(2)	(3)	(4)
Log true prop. value (β)	0.894***	0.891***	0.596***	0.599***
	(0.021)	(0.020)	(0.049)	(0.050)
Farm Gini		0.066		-0.075
		(0.154)		(0.198)
Additional controls?	No	No	Yes	Yes
F-test stat for $\beta = 1$	25.18	30.34	66.78	64.91
F-test p-value	< 0.001	< 0.001	< 0.001	< 0.001

Notes: Standard errors, clustered at the state level, are reported in parentheses. * denotes significance at 10%, ** denotes 5%, and *** denotes 1%. All regressions are estimated using OLS, have 1966 observations and include state fixed effects. Additional controls are log output per capita, the percent urban, the percent black, the percent children, and the log of total population as additional controls. See the appendix for the source of these control variables. The dependent variable is the log of total assessed property value, while the "true" value is the reported market value of property. Assessment and wealth data are from special U.S. Census reports, see the text for details. The F-test tests the hypothesis that the coefficient on the log of true value, β, is equal to one. The statistic is distributed $F(1, 35)$.