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## **Inequality and School Funding in the United States, 1890**

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### ABSTRACT

This paper examines the relationship of inequality to school funding within counties of the U.S. in 1890. Inequality, measured here on the basis of farm-size distributions, is found to significantly decrease property tax revenues used specifically for education across the entire sample of 2124 counties. However, the relationship is non-monotonic within the sample. For counties with the highest inequality, the effect of inequality on school taxation is actually positive. In contrast, counties with the lowest inequality display a negative connection of inequality and taxation. The non-linear relationship can be explained within a median-voter model once the nature of the property tax assessment process in this period is incorporated. Specifically, with assessment rates declining in wealth, the non-monotonic relationship of inequality and school taxation is predicted by the median-voter model.

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# 1 Introduction

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 by John J. Wallis “The Era of Property Finance and Municipal Government.” (Wallis 2000, 2001). Public provision of education and infrastructure was an integral element of the rapid development experienced in this era. However, the level of funding, for education in particular, was not uniform across the country. In 1890, combined state and local school tax revenues were as low as \$0.08 per person in several counties in Georgia, while at the same time many counties in states like Iowa, Kansas, and Wisconsin collected over \$5.00 per person for education.<sup>1</sup>

Tax revenues in the late 19th century U.S. were provided mainly by the general property tax. In 1890 almost 72% of state revenues and 92% of local government revenues came from these taxes.<sup>2</sup> Some of the difference in observed school tax revenues per capita is due to differences in per-person wealth. Even so, a significant portion of the variation in revenue per capita is due to differences in the effective tax rate. While there are problems that will be discussed below regarding the measurement of property value, school tax revenues as a percent of assessed property varied from less than 0.2% in many parts of the South to greater than 1.5% parts of the Old Northwest.<sup>3</sup>

The aim of this paper is to examine the role that inequality played in determining this variation in public goods spending in 1890, specifically in the context of funding schools. The property tax was typically meant to be equally levied against the total wealth of individuals, including not just real estate but financial wealth and personal property.<sup>4</sup> Thus the distribution of this wealth

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<sup>1</sup>Authors calculations from U.S. Census *Wealth, Debt, and Taxation* of 1895.

<sup>2</sup>Authors calculations from U.S. Census *Wealth, Debt, and Taxation* of 1895. “Local” includes all county, city, municipal, school district, and other sub-state level jurisdictions.

<sup>3</sup>Author’s calculations from the U.S. Census *Wealth, Debt, and Taxation* of 1895. The assessed value includes both real and personal property.

<sup>4</sup>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, see Benson (1965). Einhorn (2001) attributes this movement in part to the motivation of slave-holders to prevent high rates of tax on slaves. The uniformity clauses, in many cases, were enacted alongside incorporation and debt limitation clauses as part of a package of reform to the funding of infrastructure improvements, see Wallis (2005). Similar to uniformity, many states included universality clauses in their constitutions. The main intention of the clauses was to include personalty or intangible property (e.g. financial assets and industrial capital) in the tax base alongside realty (e.g. land). 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, Benson (1965).

within a political unit (counties, in this paper) was potentially important in determining the tax rate. An advantage of this time period is that, because the property tax was a wealth tax, the results map very cleanly onto theoretical models of inequality and public goods provision such as the median-voter models of Alesina and Rodrik (1994) or Epple and Romano (1996).

County level data from the U.S. Census special report on *Wealth, Debt, and Taxation* of 1895 is obtained for property tax revenues, assessed property values, and an imputed value of real estate values. As individual wealth data is not available from 1890, farm size distribution data from the Agricultural Census is the basis for the measurement of inequality. Several adjustments to this data and the counties in the sample are made to account for the fact that the farm size data excludes both non-farm wealth and information on farm values.

From an overall sample of 2,124 counties, several results emerge. Inequality had a significant negative relationship with the tax revenues of local school districts. This holds under all the different specifications of inequality and is robust to the potential issues involved in competitive under-assessment of property values between counties. An increase in the Gini coefficient for land inequality of 0.16 (roughly the same as moving from the 25th to the 75th percentile) implied a drop in local school revenues per capita of nearly \$1.16, against a mean of \$1.46.<sup>5</sup> The overall negative relationship, though, masks a differential effect that depends on the level of inequality itself. The sub-samples of counties with the *lowest* levels of inequality do show a similar negative relationship between inequality and taxation. However, the sub-samples with the *highest* levels of inequality show a positive relationship. In line with their average levels of inequality, this shows up as a negative relationship of inequality and taxation in Northern counties, but a positive relationship for counties in the South. School taxes and inequality do not have a simple linear relationship.

Standard redistributive median-voter models predict that inequality should lead to *larger* tax revenues, and do not allow for such a non-monotonic relationship. However, the standard model makes the assumption that taxes are uniformly applied to all income or wealth, and this does not appear to be the case with property taxes in 1890. Once we allow for assessment rates to decline with wealth, as appears to be the case in this period, the redistributive model provides a richer set

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<sup>5</sup>The mean value of total school tax revenues per capita, state plus local, was \$1.74.

of predictions.<sup>6</sup> In particular, the relationship between inequality and taxation changes depending on the level of inequality. The predictions of a suitably modified median-voter model are entirely consistent with the empirical results that show the relationship of inequality and taxation changing with the level of inequality.

The finding of this non-monotonic relationship in 1890 adds a link between work looking at school funding in the mid-nineteenth century and work focused on the early 20th. Christiana Stoddard (2009) has found that increasing inequality lowered publicly provided education funds in 1850 and 1860, while also showing that these funds significantly raised attendance rates at public schools. Looking at the political economy of this funding, Peter Lindert and Sun Go (2007) document that a wider franchise was associated with greater taxation in support of education as well as enrollments.

From the early 20th century, Claudia Goldin (1998) and Goldin and Lawrence Katz (1997) have proposed that two significant reasons for the variation in the spread of secondary schooling were the level and distribution of wealth. The current work shows a significant positive effect of property values on school revenues, while also providing evidence that the distribution of land was an important factor. While the U.S., relative to many other countries, had a very open and egalitarian education system, it does appear that inequality had a significant effect on school financing within counties from the mid-19th century through 1890, and into the secondary school movement of the early 20th century.<sup>7</sup>

While the era studied is in the past, the results have relevance for current discussions of school funding, or public finance in general. One reason for this is that the funding decisions in 1890 appear to be related closely to future economic success. Figure 1 plots log income per capita in the year 2000 for U.S. states against the overall property tax rate from 1890, controlling for log wealth per capita. As can be seen, those states that supported higher tax rates in 1890 remain significantly more wealthy today. Examining the nature of public finance in 1890 may give us some clues as to what causes the persistent variation in income per capita across the U.S. today.

These results also provide information for several lines of research. They are complementary to the work of Kenneth Sokoloff and Eric Zolt (2005) of the distinct differences in taxation levels

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<sup>6</sup>See Leland (1928) and Fisher (1996) for a discussion of how assessment rates declined with wealth.

<sup>7</sup>See Goldin and Katz (1997, 2003) and Goldin (2001) on the general features of the U.S. education system.

between countries in the Western Hemisphere, and the association of these differences with initial land inequality. More broadly, the results can provide some insight into current issues in taxation in developing countries that rely on wealth taxation to fund improvements, as discussed by Vito Tanzi (1987) and Robin Burgess and Nicholas Stern (1993). The apparently regressive nature of these taxes means that more information on the tax system is necessary before we can identify the impact of inequality on public finance.

Prior research by Lindert (1996), Perotti (1996), Partridge (1997), Gouveia (1998), and Rodriguez (1999) found a negative relationship between government spending and inequality, and from that conclude that the median-voter model does not hold. However, most of these studies rely on cross-country data and thus there is some concern regarding the comparability of the data on spending and taxes. In particular, it is not clear whether the tax system used to finance the government spending is levied evenly on wealth, or whether it is a wealth tax versus an income tax or some other form of tax. The advantage of the current study is that the data are all comparable across units, and we have detailed knowledge of how the property tax system actually operated. With that information, the non-monotonic relationship of inequality and school taxation in this study implies that the median voter model can still be a valuable theory for explaining differences in public financing.<sup>8</sup>

To proceed, I discuss the data available, its potential issues, and the methods I adopt to deal with the issues. Following that, the results for the overall sample are presented and then the non-monotonic relationship is shown to hold by dividing the sample. Finally, I provide a modified version of the median-voter model and show that it can easily explain the empirical regularities found in this data.

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<sup>8</sup>Ramcharan (2009) uses a similar set of data on U.S. counties to this paper and finds a negative relationship between inequality and public revenues per capita. However, his study does not provide controls for wealth per capita so the interpretation of his results is not straightforward. The non-monotonic relationship also fails to show up without the wealth controls.

## 2 Property Taxation and Inequality in 1890

The practice of property taxation in this period has several features that bear on the analysis in this paper. To begin, the nature of the assessment process worked against the uniform taxation of all property within states. While different levels of government could levy taxes on property, it was local officials who were responsible for making the assessments of property values used by all levels of government. This led to a strategic problem. A county assessor, for example, would under-assess the property in his county in order to minimize the burden of state property taxes. The county, given the low assessment, would simply raise its own tax *rate* in order to meet its funding needs. As this was occurring in each county, a process of competitive under-assessment took place and assessment values within a state would generally be well below the true property value.<sup>9</sup>

The main problem was that the local assessors were not subject to any state control. Glenn Fisher's (1996) study of property taxation in Kansas during this period points out that even in if courts declared a specific assessment value illegal, they could do nothing to remedy it. County level boards of equalization were not able to exert much of an influence because they faced the same strategic logic as the assessors, and in addition they typically did not have access to appropriate information.

These problems with competitive under-assessment led to many states implementing state boards of equalization. Massachusetts had a form of state equalization as early as 1694, while several states (Connecticut, Maine, Ohio, Vermont, and Virginia) made sporadic attempts to equalize assessments across counties during the early 1800's. Regular equalization begins in the 1850's in several states of the Old Northwest as well as New York. By 1890, 26 states had implemented some form of state equalization.<sup>10</sup>

Despite the spreading prevalence of state equalization, the boards were not able to accomplish much. Fisher reports that in Kansas the state board had only a limited ability to adjust the aggregate value of real estate in a county but had no detailed data on which to make informed

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<sup>9</sup>This phenomenon was noted during this period and used by some as an argument against property taxation. See Leland (1928), Lutz (1918), and Seligman (1969).

<sup>10</sup>Lutz (1918). See also the 1895 U.S. Census report on *Wealth, Debt, and Taxation* which summarizes state equalization efforts.

decisions.<sup>11</sup> In general, the boards were not able to arrest the process of under-assessment and this is attributed by Harley Lutz (1918, p. 149) to their lack of authority over the local assessors. It is only with the implementation of the state tax commissions, beginning with Indiana in 1891, that states took firmer control of the assessment process.

Empirically, this assessment problem creates several issues. States varied not only in the presence of a state equalization board, but the equalization boards varied across states in their responsibilities and authority in 1890. An advantage of using county level data in the regressions is that state fixed effects can be included, controlling for state level assessment and equalization practices.

The under-assessment process also indicates that looking at state-level taxes may be uninformative. Counties and municipalities, regardless of their preferred local tax rate, would see an advantage in lowering their state tax burden. To examine the effect of county-level inequality on property taxation, we will therefore focus on property taxes levied only at the local level.<sup>12</sup>

## 2.1 Property Tax and Valuation Data

The level of taxation will be captured by tax revenues per capita. The 1895 Census report on *Wealth, Debt, and Taxation* provides data on property taxes collected by all levels of government. For each county, the report lists the total tax revenue, as well as breaking this total into several categories based on the taxing authority: state, county, or municipal. A separate accounting is given for taxes collected by the state for education purposes. Additional information is provided on taxes levied within counties for school purposes, which combines taxes levied by the county itself with those levied by municipalities and/or school districts. This total of county, municipal, and school district taxes will be referred to as local school taxes, and will be the measure of school funding used in the empirical work to follow.

To focus on inequality and school taxation, we want to control for the possibility that inequality and property *values* are related. If we hold property values per capita constant, then any estimated

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<sup>11</sup>Fisher (1996), p. 113.

<sup>12</sup>This does not imply that state-level taxes are irrelevant, as they would play a part in localities' decision regarding tax rates. As noted below, though, controlling for state tax revenues do not appear empirically relevant to local school taxes.

effect of inequality on taxes per capita could more clearly be interpreted as an effect on the tax rate applied to property.<sup>13</sup> Some measure of property values is necessary.

The tax data was obtained from returns of county and municipal officers involved in the assessment of property values. In addition to the tax data, these officers returned the total assessed value of real estate in their county as well as their opinion of the ratio of the assessed value to the true value of that real estate. As an additional source of data on the true value of real estate, the Census also solicited the opinions of roughly 25,000 persons believed to be experts in real estate values in their respective areas that it used to corroborate the ratios received from the local officials.<sup>14</sup> The value of real estate is calculated by the Census by inflating the assessed value of real estate according to the opinion of the local assessors.

There are several issues with this measure of property values. As noted, this value is based off of estimates from local assessors, and not necessarily on market prices for the real estate. One possible source of better information is the Census of 1890, which reports farm values by county. This excludes urban plots of land, though, so it is not an ideal substitute. Regardless, including farm values in the regressions below does not change the results meaningfully.

A second issue is that real estate value reported by the 1895 report reflects property that the local official has the power to assess for taxation. Real estate exempt from taxation for various reasons (schools, churches, etc..) is not included. Estimates by the Census office of the total real estate value versus the value subject to taxation are available, but do not yield significantly different results.

Finally, the value of real estate reported by the 1895 Census report ignores completely the value of personal property, such as financial assets and the capital stocks of railroads and other corporations. Because of this absence, we are under-estimating property values. The potential biases this introduces into the empirical work is discussed below along with several variations in the specifications that attempt to deal with the problem.

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<sup>13</sup>This interpretation will be a loose one, though, as there will remain the possibility that inequality is related to the *types* of property in a county. If different types are taxed at different rates, then inequality may lower taxes per capita even though it isn't lowering tax rates *per se*.

<sup>14</sup>U.S. Census, *Wealth, Debt, and Taxation: 1895*, p. 7. Special reports from Wisconsin and Pennsylvania commissions on property values were also consulted.

In addition to the real estate value, the Census also reports the total assessed value of all property in a county. This includes both real estate and personal property, but this does not necessarily solve the problems noted above. Assessed values were typically well below market values, and this was particularly pronounced for personal property.<sup>15</sup> There are also several issues regarding the relationship of inequality and assessed property values that will be dealt with following the main results. The wealth measures are thus imperfect, and so the possibility remains that regressions are showing an effect of inequality on wealth, rather than an effect of inequality on tax *rates* themselves.

Summary statistics of local school taxes per capita and real estate values can be found in table 1. Mean local school taxes are about \$1.47 per person for the whole sample of 2,124 counties. This declines to \$1.33 for the 1,346 counties that report zero population in towns greater than 2,500 persons, classified for the purposes of this paper as “Rural”. Real estate values are about \$445 per person in the whole sample, dropping to \$371 for the rural counties. Assessed property values are only about \$273 per person, well below the value of real estate (and recall that this assessed value includes the value of personal property).

On a regional basis, table 2 shows how some of the variables vary over the United States. As can be seen, the local school taxes collected per capita range from a high of \$2.83 in the West North Central to a low of \$0.30 in the East South Central region. This variation appears to be due, in part, to differences in real estate values per capita. Real estate values per capita were over \$600 per person in the North Central regions, but under \$250 per person in the three Southern regions.

For the assessed property values, note that in New England assessed property values are actually higher than real estate values. This could be explained by a larger value of personal property per person in this region, or possibly by better techniques in finding and assessing that property in these states. For the other regions, the combined assessed value of *total* property is below the estimated value of real estate alone.

From the table, it is apparent that several regions of the U.S. are not included in the analysis, particularly those in the Western portion of the U.S. The 2,124 counties cover a total of 35 states. These include all states east of the Mississippi as well as Arkansas, Iowa, Kansas, Louisiana,

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<sup>15</sup>Fisher (1996), p. 88, Leland (1928), p. 19, Lutz (1918), p. 28.

Minnesota, Missouri, North Dakota, Nebraska, and South Dakota. The exclusion of the remaining states is due to a lack of some data as well as concerns about accurately measuring inequality, which is discussed more below.

One thing that is not apparent from either summary table is the fact that there are a large number of counties that have zero reported local school taxes collected. Of the total 263 counties in this category, most are in Georgia (106), North Carolina (72), and Alabama (51), and Louisiana (19).<sup>16</sup> This likely has as much to do with state-level institutions as with local conditions, and is consistent with the idea that fiscal responsibility was more centralized in the Southern states.<sup>17</sup> State fixed effects in the regressions will be able to control for the common effect on all counties within these states, but additional results below show that the results are not dependent on these specific counties. An additional point this raises is that school funding was not provided exclusively by local government units, with states collecting taxes specifically for education purposes in 31 states in 1890.<sup>18</sup> Local school taxes may well vary due to differences in state-level funding. Data on state-level funds *received* within a county are not available, but we do have data on the state property taxes *paid* in a county for the purposes of school funding. Inclusion of this as an additional control has no effect on the subsequent results. However, if there were redistributions of state school funds across counties, then this could possibly explain low levels of local school funds in some counties.

## 2.2 Measuring Inequality

The main source of information on inequality is the distribution of all farms by size reported in the Agricultural Census of 1890. The Census 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 a Gini is calculated. The appendix gives the full details of the calculation, but the method is similar to the one used by Lee Soltow (1975) for the U.S. in the 19th century and by Klaus Deininger and Lyn Squire (1998) for a set of countries in the 20th.

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<sup>16</sup>The remaining counties with no reported local school tax revenues are in Kentucky (2), Minnesota (2), South Carolina (8), South Dakota (2), and Tennessee (1).

<sup>17</sup>See Einhorn (2006) for a discussion of this tendency.

<sup>18</sup>*Wealth, Debt, and Taxation* report of 1895, p. 102.

The Census only reports the size distribution of farms in operation, and therefore does not perfectly capture the distribution of land *ownership*. Despite this issue, Soltow (1975, p. 132) concludes that inequality measured by these distributions are useful indicators of relative wealth-holdings in this period. This is due, in part, to the fact that renting and share-cropping were not prevalent in most areas. For the counties included in the present study, the median proportion of farms rented was only 6.1%, while the median share-cropping proportion was 16%. However, there are certainly areas where renting and share-cropping were the main form of tenure, so that in some counties the share of farms rented was as high as 75% and in others those share-cropped made up over 60% of all farms. In the empirical work, controls for these shares can be included but do not appear to materially impact the results.

With these caveats in mind, the Gini coefficient calculated across all farms (denoted  $G$ ), regardless of tenure, is used as the primary measure of inequality within counties. From this baseline, several additional issues can be addressed. First, the Gini does not consider the issue of propertyless farm workers, and is likely under-estimating inequality. To partially correct for this, an adjustment to the farm Gini can be made that incorporates the number of males aged 21 or more. If we let  $p$  indicate the ratio of farms to males, then an adjusted farm Gini ( $G^A$ ) can be calculated as  $G^A = pG + (1 - p)$ .<sup>19</sup> The fewer farms there are relative to adult males the lower is  $p$ , and the larger is  $G^A$  relative to  $G$ . This adjusted Gini will allow us to distinguish counties on the extent of land-holding in the population, rather than simply on the size distribution of farms.

A second issue with the Gini (adjusted or not) is that it does not measure inequality in the *value* of farms, only in their size. As property taxes were based on assessed values, this is an important omission. For 1860, Lee Soltow (1975, p. 128) calculated that the elasticity of real estate holding value with respect to acres was 1.28. This indicates a magnification of inequality over and above that measured by the Gini coefficient. If we believe that a similar effect was at work in 1890, then the Gini coefficients are under-estimating wealth inequality. Unfortunately, individual level data on wealth is not available from 1890, and so a more accurate adjustment is not possible. It should be kept in mind that all the measures of land inequality used here are likely understating wealth

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<sup>19</sup>This adjustment is mathematically identical to that used in Soltow (1971), p. 124.

inequality. An additional aspect of this problem is that the farm size Gini likely gets less accurate as one moves into the ranching states of the West.<sup>20</sup> This is one of the main reasons that the counties under consideration were limited to those along or east of the Mississippi river, where this issue should be limited.

The final issue to discuss with respect to the Gini is the absence of information on non-farm wealth. While in 1890 the U.S. Census calculated that 60% of all wealth consisted of farmland, there is still a significant proportion of wealth that the Gini coefficients based on farm size are not incorporating.<sup>21</sup> Soltow (1971, p. 123) calculates that for Milwaukee county, Wisconsin in 1860, the actual Gini coefficient of wealth inequality was 0.89 while the Gini measured only over farmers was 0.73. This is due to a large amount of non-farm wealth held by non-farmers, consisting of personal property such as financial holdings. As might be surmised, it appears that the issue of non-farm wealth is more pronounced in large urban areas.<sup>22</sup> Again, without individual data from 1890 it is not possible to accurately correct the farm size Gini coefficients for this. But we can look at restricted samples of counties in which the role of non-farm wealth should be less important. To that end, the empirical work will consider a sample consisting of rural counties, defined as those without any persons living in towns greater than 2,500 persons. The idea is that the Gini coefficients will be more accurate indicators of inequality in these areas because farmland will be a larger component of their wealth. An additional advantage is that in these counties the issue of over-estimating tax rates due to the lack of personal property data should be less severe.

Table 1 shows summary statistics for the inequality variables. The farm size Gini averages 0.42 across the whole sample, and this does not vary much when we exclude the urban counties. The adjusted Gini, as expected, is significantly higher than the farm size Gini, but this adjustment is not quite as severe in the most rural counties. Regionally, table 2 shows that the West North Central region had much lower inequality than the rest of the U.S. There was some tendency for the southern regions to have higher inequality in farm sizes, but slightly lower adjusted Gini's due to a smaller population of adult males relative to the number of farms. From the table it is apparent that

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<sup>20</sup>Soltow (1971), p. 132.

<sup>21</sup>U.S. Census, *Wealth, Debt, and Taxation, 1895*.

<sup>22</sup>Soltow (1975), p. 107.

those regions with the lowest average inequality also had the highest tax rates for local schooling. The state fixed effects included in the regressions will be picking this up, and the results are not driven by these broad regional differences.

### 3 Specifications and Results

The initial specification estimated is

$$(T/L)_{ij} = \alpha + \beta G_{ij} + \gamma \ln W_{ij} + \delta X_{ij} + w_j + \epsilon_{ij} \quad (1)$$

where  $(T/L)_{ij}$  is the local school tax revenue per capita, and  $G_i$  is the farm size Gini. The log of  $W_{ij}$  is the log of property values. Logged values are used because of the wide variation in this variable, and the results for inequality are not sensitive to using levels.  $X_{ij}$  represents the set of additional control variables,  $w_j$  is a fixed effect common to each county in a given state  $j$ , and  $\epsilon_{ij}$  is an error term.

The  $X_{ij}$  controls incorporated into the regressions include output 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 should provide a suitable proxy for output per capita in 1890. The inclusion here is to control for the possibility that land inequality and property tax rates may be jointly driven by income levels.<sup>23</sup> Additionally, Casey Mulligan and Andrei 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 total population (in thousands) is included in  $X_{ij}$  in the regression analysis.

As school taxes will be the main object of interest, a control for the percent of population made up of children (defined as those 5-20 years of age) is included as well. In addition, the percent of population that is black is incorporated to control for the possibility that property taxes were

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<sup>23</sup>See Eastwood et al (2008) for evidence that farmland becomes more concentrated as economies develop.

influenced by a desire to limit public goods for this group.<sup>24</sup>

The share of population in small urban areas (defined as places with more than 2,500 persons) is included in  $X_{ij}$ . As noted previously, the sample of counties included will be limited based on this value to examine only those counties with no significant urban areas, as the land inequality measure should be more meaningful for them. In these cases, the control for urban percentage is excluded from  $X_{ij}$ .

### 3.1 Identifying Exogenous Variation in Inequality

Even with the inclusion of the  $X_{ij}$  control variables, there is still the possibility that the estimation of  $\beta$  in equation (1) is biased. This may be due to other omitted variables associated with the land inequality measure  $G_{ij}$ , measurement error in  $G_{ij}$ , or it may be due to a direct effect of local school taxes on the distribution of land. To address these issues, a set of instrumental variables based on geographic conditions are used.

Stanley Engerman and Kenneth Sokoloff (2002) suggested that geographic conditions in the Western Hemisphere were an important element in the initial allocation of land. 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.<sup>25</sup> More generally, geographic conditions are a major input into decisions regarding farm size and the type of agriculture practiced.<sup>26</sup>

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 variables, the farm size Gini and the adjusted 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 based on either measure.

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<sup>24</sup>This need not be for purely racial reasons. Gavin Wright (1986), p. 79 discusses how many southern landowners were wary of providing education because this would provide their tenants with the ability to leave the agricultural labor force. There is a high correlation of the percent of population that is black with the percent of farms that are rented or share-cropped in this sample, so the percent black is picking up, to some extent, the nature of farm tenure within a county.

<sup>25</sup>Work by William Easterly (2001, 2007) and Rodney Ramcharan (2009) uses a similar strategy to obtain exogenous variation in inequality.

<sup>26</sup>See Eastwood, Lipton, and Newell (2008) for an overview of the determinants of farm sizes.

The second property the instruments must possess is to be unrelated to the residual in the main specification in equation (1). To be clearer, the matrix of instruments,  $Z_i$ , must satisfy  $E[Z'\epsilon] = 0$ , where  $\epsilon$  is the vector of error terms from specification (1).

If our dependent variable,  $(T/L)_{ij}$ , is tax revenues per capita, then it seems possible that this condition might hold, assuming that we are successfully controlling for property values. With this control,  $\beta$  should be picking up the effect of inequality on the willingness of residents to pay for local schools. However, we cannot simply assume that  $E[Z'\epsilon] = 0$  because geographic conditions may be associated with property values that we cannot accurately measure.

With an over-identified specification, as will be the case here, we can at least test that the condition  $E[Z'\epsilon] = 0$  using the Hansen test. The results will show that it is impossible to reject the null hypothesis that  $E[Z'\epsilon] = 0$ . 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.

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.<sup>27</sup> Logs are taken of rainfall, temperature, and growing period as this was found to improve the explanatory power of the first stage regressions. Using levels of these three instruments does not materially affect the results for inequality.

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

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<sup>27</sup>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.

### 3.2 The Effect of Inequality on Property Taxes

Table 3 presents results of estimating equation (1). The 2124 observations are individual counties, but recall that the measure of taxes are those levied by counties or sub-county governments (e.g. school districts) explicitly for the purpose of supporting schooling.

Column (1) considers the effect of the farm Gini ( $G$ ) on local school taxes per capita. As can be seen, inequality is highly significant and has a negative coefficient. The size of the effect is quite large. A drop from the 75th percentile of the farm Gini (a value of about 0.51) to the 25th (a value of about 0.35) would increase local school tax revenues by \$1.54. Referring back to the regional comparisons, this difference in revenues is bigger than the gap observed between New England and the three Southern regions.

Real estate property values are significant and positive. A 10% increase in real estate values implies an increase of only about six cents in school revenues per capita. Doubling real estate per capita is estimated to increase school tax revenues by just about 40 cents.

Before moving on to subsequent regressions, consider the specification tests in column (1). The Hansen test statistic is insignificant, meaning that we cannot reject the hypothesis that the instruments are uncorrelated with the residuals in the second stage. As noted previously, this gives us some confidence that the instruments are correctly excluded from the second stage. The F-test of the first stage can be seen to soundly reject the null hypothesis that the instruments have no explanatory power for the farm Gini. Together, the tests indicate that the instruments are strong enough to be useful and can safely be excluded from the second stage.

Now, one of the concerns regarding the data was the use of the farm size distribution to capture inequality. One issue was that this does not incorporate information on non-farm wealth and therefore is an inaccurate picture of inequality, particularly in urban areas where non-farm wealth was more prevalent. Without individual wealth data we cannot correct this, but we can examine a subset of counties for which this problem is hopefully less severe. Column (2) excludes the 778 counties that reported any persons living in cities greater than 2,500 in size, on the presumption that the bias in the farm Gini coefficient is likely to be the worst for them. As can be seen, the

estimated effect of the farm Gini is only slightly smaller than for the full sample, and remains highly significant.

A second issue with the farm size Gini is that it does not capture the breadth of land-holding. As discussed above, an adjusted Gini ( $G^A$ ) can be calculated that incorporates information on farms relative to the number of adult males. Columns (3) and (4) of table 3 replicate the prior specifications except they use the adjusted Gini as the measure of inequality.

As can be seen in those columns, regardless of whether the sample is limited to rural counties or not, there remains a significant negative effect of inequality on local school tax rates. The size of the estimated coefficient is smaller in absolute value. For the adjusted Gini the difference between the 25th and 75th percentiles is from 0.63 to 0.79, and a shift in inequality along these lines would lower the local school taxes per capita by about \$1.25. While this is smaller, recall that the mean value of taxes per capita is \$1.47. Inequality retains a large influence on school taxes.

One important caveat should be attached to these results. As noted previously, the value of real estate understates total property values in a county for several reasons. If inequality were systematically related to this under-statement, then the results could be picking up this rather than a direct effect of inequality on tax rates. Assuming that property values per capita are positively related to school taxes per capita, for this to be explaining the results it would have to be that higher inequality is significantly related to lower property values per capita. Including controls from the Census of 1890 on manufacturing capital and the value of farm implements and livestock do not alter the results significantly, but without a true measure of property values the caveat remains.

### **3.3 Assessment Rates and Property Taxes**

While the previous section established a significant relationship between land inequality and local school taxation, these results were obtained using the real estate values found in the Census report of 1895 to control for property values. As discussed previously, this variable does not necessarily capture property values in total. In addition, it elides the issue of how inequality was related to assessed property values.

The property tax was levied on the assessed value. Therefore inequality could have been influ-

encing school tax revenues either through a) the tax rate or b) the assessment rate on property. There is a strong reason to think that inequality may in fact be related to assessment rates. A commonly cited feature of the general property tax in this era was that it assessed wealthier individuals at a lower rate. Edward Seligman, writing in 1895, argued for the abolition of the property tax, in part because “the property of the small owner, as a rule, is valued by a far higher standard than that of his wealthy neighbor.”<sup>28</sup> More concretely, Simeon Leland (1928) documents that in Wisconsin in 1912, farms valued at under \$1000 were assessed at 100% of their market value, but the assessment rate decreased steadily in the size of estate until those valued at more than \$500,000 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. Figure 2 plots the data given by Leland for Wisconsin and Virginia and shows distinctly that the assessment rate is negatively related to estate size. Glenn Fisher (1996, p.116) also provides evidence from Kansas in 1897 of this type of effect. There, farms worth less than \$500 were assessed at 56%, while farms over \$5,000 faced only a 25% assessment rate, and those over \$10,000 a rate of 17%.

These relationships create the possibility of a positive relationship between county-level inequality and the assessed value of property in that county. To see this, consider the following example that uses the assessment rates documented by Fisher from Kansas. If a county has four farms with a real value of \$5,000 each, then the aggregate assessment rate in the county is exactly 25% and the assessed value of real property is \$5,000. If we instead have one farm of \$10,000, and 20 farms of \$500 each (so that the total real value is the same), the aggregate assessment rate is actually 36.5% and the total assessed value is \$7,300. The increase in inequality has raised the aggregate assessment, even though the total value of property has not changed.

If this kind of relationship is at work within all counties, then across counties we would expect to see a positive relationship between inequality and assessment rates. Combined with the competitive under-assessments, this would mean that inequality is mechanically related negatively to the tax *rate* on assessed property.

To address this the following regressions will include the county-level aggregate assessed value

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<sup>28</sup>Seligman (1969), p. 29.

of property as an additional control variable along with the value of real estate. The estimated coefficient on the Gini will show the effect of inequality on tax revenues after having accounted for whatever inequality/assessment relationship exists in the data. Note that this control is not perfect, as we only have a measure of actual real estate values, while we have the assessed value of *all* property.

In table 3, columns (5) and (6) present the results of these regressions. The measure of inequality is the adjusted Gini ( $G^A$ ), and again separate regressions are run after excluding more urbanized counties. In both cases, inequality remains highly significant and negative in sign. The size of the effect has shrunk again, so that for the rural counties only the distinction between the 25th and 75th percentiles of the adjusted Gini is \$1.06 in local school tax revenues.

The coefficient on real estate value has declined, so that now a 10% increase in real estate wealth (holding the assessed value constant) increases school taxes by about three cents per person. A 10% increase in the assessed value of property raises school tax revenues by between five and seven cents per person.

### 3.4 Counties without Local Funding

As noted previously, a significant portion of the counties in the sample had zero local school financing reported to the Census, relying on state-level funding. Do these counties have particularly unequal distributions, and is this driving the overall result? Table 4 presents results that show the effect of inequality is not solely due to the binary difference between counties that have no local school taxes and those with some positive taxation.

Columns (1) and (2) of table 4 replicate the earlier specifications including both measures of property values, but exclude the 263 counties with no local school funding. As can be seen, the estimates for inequality (measured here as the adjusted Gini) are nearly identical to those found in table 3. The estimates on the real estate value and assessed property value are also similar to what was seen before.

We can also look more specifically at whether land inequality is associated with the presence of any local school taxation. A dummy was created that equaled zero for the 263 counties with

no taxation for schools, and a one for the remaining counties with positive local school taxes. In columns (3) and (4), this dummy is regressed on the same variables as before. As can be seen, in neither the full sample nor in the rural sub-sample is there anything like a significant effect. Inequality does not appear to be making its influence felt by eliminating local school funding completely, but rather by limiting the local school taxation rate conditional on having local school funding. The lack of local funding in those counties (which were located primarily in Alabama, Georgia, North Carolina, and Louisiana) seems to be primarily a function of state-level institutions as opposed to local conditions.

## 4 Political Economy in the Funding of Schools

A negative relationship of inequality to school funding holds for the whole sample, but is this consistent across regions of the U.S.? In table 5, the first two columns replicate the prior regressions but dividing the sample into those counties in the South, and those in the North.<sup>29</sup> As can be seen, the estimated effect is actually *positive* for the South, although insignificant. In contrast, column (2) shows that for the 1189 remaining counties in the north of the U.S. there was a significant negative relationship, similar to the overall results. Note that these results hold despite the inclusion of state-level fixed effects, so this is not simply driven by some type of regional fixed-effect.

Rather than focusing on a regional break-down, we can split the sample up by the measure of inequality itself. Columns (3) through (8) cut the sample at different percentiles of the distribution of the adjusted Gini. In column (3), only the 212 lowest-inequality counties are included. Here, the estimated effect of inequality is negative, but insignificant. As we move to the 25% of the counties with the lowest inequality the effect becomes strongly negative and highly significant, with a coefficient size larger in absolute value than the U.S.-wide results.

The results for the lowest-inequality half of counties in the U.S. in column (5) are similar in both significance and coefficient size. For low inequality counties, there is a negative relationship between inequality and taxation. This can be contrasted with the results in columns (6) through (8), where

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<sup>29</sup>The South is defined as the South Atlantic, East South Central, and West South Central Census regions. The North is the remaining regions.

the splits look at only the highest inequality counties. For the counties above the 50th percentile in inequality, the estimated effect of inequality is positive, but insignificant. Similarly, the top quarter of counties in inequality have a positive relationship of inequality and taxation, but again this is insignificant. Note, though, that even if the relationship of inequality and taxation is truly zero for these counties, that is still significantly different from the negative relationship found for the low-inequality counties. The pattern of results from columns (3) through (7) is consistent with the model presented in figure 3. The final column shows that for the 213 most unequal counties, there is a strongly significant positive relationship between inequality and taxation.

One issue with the results in columns (3) through (8) is that the Hansen tests of over-identification are very weak, indicating that there is some correlation of the instruments with the residuals in the second stage. This raises a concern that the pattern found is spurious. For comparison, the final rows of table 5 show the estimated coefficients for the OLS estimation of each regression (including all the same covariates). While we are sacrificing strict identification, the pattern of results across the different samples still has information. As can be seen, for the lowest-inequality counties there is still a strongly negative relationship between taxes and inequality. For the high-inequality counties, there is a positive relationship. The OLS results show again that the relationship of inequality and taxes are consistent with a median-voter model that includes a declining assessment rate as found in the U.S. in this period. The one outlier in this result is the positive, but insignificant relationship found for the most equal 212 counties in column (3).

What table 5 shows is that the relationship of inequality and school taxation is not monotonic. The effect of inequality depends crucially on what the general level of inequality is to begin with. Given that such a non-linear relationship exists, can we explain this in terms of standard models of political economy?

There are several theories that relate inequality and public goods spending, in many cases referring directly to education funding. Perhaps the simplest is the redistributive median-voter model, in which public goods such as schooling are a mechanism for voters to redistribute wealth to themselves. In this type of model, each individual benefits from the public good equally, but the taxes supporting the good are proportional to wealth (or income). This means that the poorer an

individual, the lower is their individual tax price. If we assume that the median voter selects the actual tax rate, then as in the work of Alberto Alesina and Dani Rodrik (1994) or Dennis Epple and Richard Romano (1996), an increase in inequality (implying a poorer median voter) will increase the tax rate.<sup>30</sup> In this way, the standard redistributive model predicts that inequality should have a positive relationship to school taxation, something we only see for the highest-inequality counties in the U.S. in 1890. Does this mean that the median-voter model is inappropriate to apply to low-inequality situations or to the northern states of the U.S.?

A major assumption involved in these theories is that the tax rate is applied uniformly to all wealth or income. However, as discussed in the previous section, the assessed value of property did not necessarily increase one-for-one with the real value of property for individuals. We can consider the implications of these declining assessment rates and what they predict for the relationship of inequality and taxation. I assume that individuals take the nature of the assessment process as a given, and are not concurrently making a choice regarding it. An open question remains why the property tax system functioned this way in 1890, but given the commonality of this across states and counties in that period, it appears that this is something less amenable to short-run politics that is the tax rate. Future work will be necessary to understand the origin of the declining assessment rates.

Think of individuals deciding whether to enact a tax of  $\tau$  on assessed property values that will provide some benefit to them. This benefit is positive for those with zero wealth, and then increases with wealth. Let  $a_i$  be the assessed value of an individual's property and  $k_i$  the actual value. If we relax the typical assumption that  $a_i = k_i$ , let us assume that instead  $a_i = k_i^\gamma$ , where  $0 < \gamma < 1$ . In this case the assessed value of property rises with the value of that property, but at a decreasing rate.<sup>31</sup>

Plotting the tax burden in figure 3 against the benefits of the tax shows that there are potentially

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<sup>30</sup>Other variants of the redistributive model include Torsten Persson and Guido Tabellini (1994); Gerhard Glomm and Ravikumar (1992); Gilles Saint-Paul and Thierry Verdier (1993); Roland Benabou (2000) and Raquel Fernandez and Richard Rogerson (1998). Oded Galor, Omer Moav, and Dietrich Vollrath (2009) provide a theory of why land inequality, in particular, is detrimental to education funding.

<sup>31</sup>This section sketches out the features of a median-voter model with declining assessment rates. See the appendix for a fully specified model that provides the same conclusions while allowing for a general level of declining assessments and allows taxes to take on any value.

two critical values of  $k_i$ . Below the value of  $\hat{k}_L$ , individuals are so poor that despite their relatively high assessment rate they still are net beneficiaries from enacting the tax. Between  $\hat{k}_L$  and  $\hat{k}_H$ , though, individuals oppose the tax. Above  $\hat{k}_H$ , the assessment rate has dropped so much that the tax burden for these individuals is less than the received benefits.

Regarding inequality, the relationship with taxation depends on where we are looking on the figure. Consider a set of counties that have high inequality, meaning their respective median voters have low wealth centered around  $\hat{k}_L$ . For these counties, there should be a positive relationship of inequality and taxation. As inequality goes up, median voter wealth goes down, and near  $\hat{k}_L$ , this makes the median voter more likely to support taxation. This situation matches the positive relationship seen in table 5 for the high-inequality counties.

In contrast, counties with low inequality have median voters with wealth in the neighborhood of  $\hat{k}_H$ . For these counties, an increase in inequality implies that the median voter is less likely to support taxation. In other words, there should be a negative relationship between inequality and taxation, and this is exactly what we see in the regressions using the low-inequality counties in table 5.

Table 5 tells us that simply looking at the overall sample of U.S. counties is not sufficient for explaining how inequality influenced school taxation in 1890. In counties where land (and likely wealth) were equally distributed, the results are consistent with the redistributive model once we allow for declining assessment rates. For highly unequal counties, the standard redistributive model predictions still hold, consistent with the data. The simple modification that takes into account the structure of the assessment process suggests that redistributive models are appropriate for explaining school funding in this period.

While providing a simple explanation, the modified median-voter model is not necessarily the only way of explaining the results. Another possibility is that inequality was related to how local governments were organized. As noted by Wallis (2001, 2003), the property tax was useful in funding public goods such as education because it helped match up those paying the tax with those receiving the benefits. If a small group of individuals interested in education can organize themselves into a school district, they can raise property taxes on themselves to fund a school even

if they are a minority within a given county. If high inequality was associated with limits on the number or taxing authority of lower levels of government, this could explain the observed negative results. In the South states and counties were relatively powerful, but to the extent that this was common to all the counties in these states, the fixed effects included in the regressions should have accounted for these differences. However, it is not clear why the effect of inequality of funding would be positive in the South, but remain negative in the North, or be different depending on the level of inequality.

In a similar vein, Peter Lindert and Sun Go (2007) have documented a relationship between the breadth of political voice and the funding of schools in 1850. They argue that one of the reasons for the rapid spread of public schooling in rural, Northern areas was due to their relatively wide franchise. They present evidence supporting this view, but by 1890, suffrage was not as significantly limited by property rights as in 1850.<sup>32</sup> More broadly, Robin Einhorn (2001) has argued that uniformity requirements of the property tax system were driven, in part, by the interests of slaveholders. In Einhorn (2006) this argument is extended to suggest that tax systems retained the feature that they benefitted the interests of the elite even after slavery was abolished. One issue here is that Einhorn's argument is based on a lingering effect of slave-holders on the structure of taxation, but the inverse relationship of inequality to local school taxation appears to hold only in the North and fails to hold in the South where inequality levels were highest.

## 5 Conclusion

In 1890, the general property tax was the primary source of revenue for counties, municipalities, and school districts within the United States. The tax rates varied greatly, and this contributed

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<sup>32</sup>Generally speaking, those who paid taxes could vote on taxes. Chilton Williamson (1960) documents that by 1860 property tests had essentially disappeared, 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 both Keyssar and Williamson.

to variation in funding for public schools. This paper shows that inequality, measured by the distribution of farm sizes within counties, is a significant predictor of the taxes raised for local school funding. Geographic instruments provide exogenous variation to control for omitted variable and endogeneity bias.

Several different means of measuring inequality and sub-samples of counties are used to control for the fact that farm size distributions are not perfect measures of wealth inequality, and the results are robust in each case. Results control for the value of real estate in a county, as estimated by the Census. The possible biases introduced because of declining assessment rates and competitive under-assessment are controlled for by including the total assessed value of property (both real and personal) in a county.

For the overall sample of U.S. counties, there is a significant negative effect of inequality on tax revenues meant for school funding. However, the negative relationship turns out to be a feature of only those counties with the most equal distributions of wealth, while the most unequal counties display a positive relationship. Taking into account that assessment rates decline with wealth *within* counties, the non-monotonic relationship can be explained within the context of a standard redistributive median-voter model.

What follows from this work is additional support for the median-voter model of public finance, but support that requires us to be knowledgeable regarding the nature of the tax system within which the financing decisions are made. The biggest outstanding question is why the property tax system in this era was organized so that assessments were declining in wealth? Whether this was an intentional or unintentional feature of the tax system remains to be seen.

# Appendices

## A: Land Distribution Measures

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. Similarly,  $A_i = \sum_{s=1}^i a_s$ . By definition,  $F_8 = A_8 = 1$ . It can be shown that the Gini coefficient,  $G$ , can be calculated as follows

$$G = 1 - \sum_{i=1}^8 (F_{i+1} - F_i)(A_{i+1} + A_i). \quad (2)$$

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: 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

$$y = Ak^\alpha g^{1-\alpha} \quad (3)$$

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

$$w = (1 - \alpha) Ak^\alpha g^{1-\alpha} \quad (4a)$$

$$r = \alpha Ak^{\alpha-1} g^{1-\alpha} \quad (4b)$$

The public good is funded by a tax rate of ( $\tau$ ) 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,

$$y_i = w + rk_i - \tau a_i. \quad (5)$$

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,

$$a_i = k_i^{\gamma+1} \quad (6)$$

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  $\gamma$ , consider the assessment rate of capital, or  $a_i/k_i$ ,

$$\frac{a_i}{k_i} = k_i^\gamma. \quad (7)$$

As can be seen, if  $\gamma > 0$  then the assessment rate is increasing in the amount of personal capital. However, if  $\gamma < 0$ , then 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 (4a) and (4b) in equation (5) we get

$$y_i = (1 - \alpha) Ak^\alpha (\tau a)^{1-\alpha} + \alpha Ak^{\alpha-1} (\tau a)^{1-\alpha} k_i - \tau k_i^{\gamma+1}. \quad (8)$$

Maximizing over  $\tau$  yields the following solution for  $\tau_i^*$ , the individual's optimal tax rate,

$$\tau_i^* = \left[ \frac{(1 - \alpha)^2 Ak^\alpha a^{1-\alpha}}{k_i^{\gamma+1}} + \frac{\alpha (1 - \alpha) Ak^{\alpha-1} a^{1-\alpha}}{k_i^\gamma} \right]^{1/\alpha} \quad (9)$$

and the relationship of  $\tau_i^*$  to  $k_i$  depends on the size of  $\gamma$ .

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,  $\tau^m$ , depends crucially on nature of the assessment process. If  $\gamma = -1$  then we have a head tax, and  $\tau^m$  declines as inequality ( $k/k_m$ ) increases. If in the range  $-1 < \gamma < \alpha - 1$  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. Therefore, if inequality is high enough the relationship of inequality and taxation will be positive.

Finally, if  $\gamma > \alpha - 1$ , then taxes increase with inequality no matter initial inequality.

We do not have actual data on the value of  $\gamma$ , but the non-monotonic empirical results can be explained within the context of the median voter model assuming that assessment rates decline quickly enough with wealth.

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Figure 1: Property Tax Rates, 1890, and Income per capita, 2000

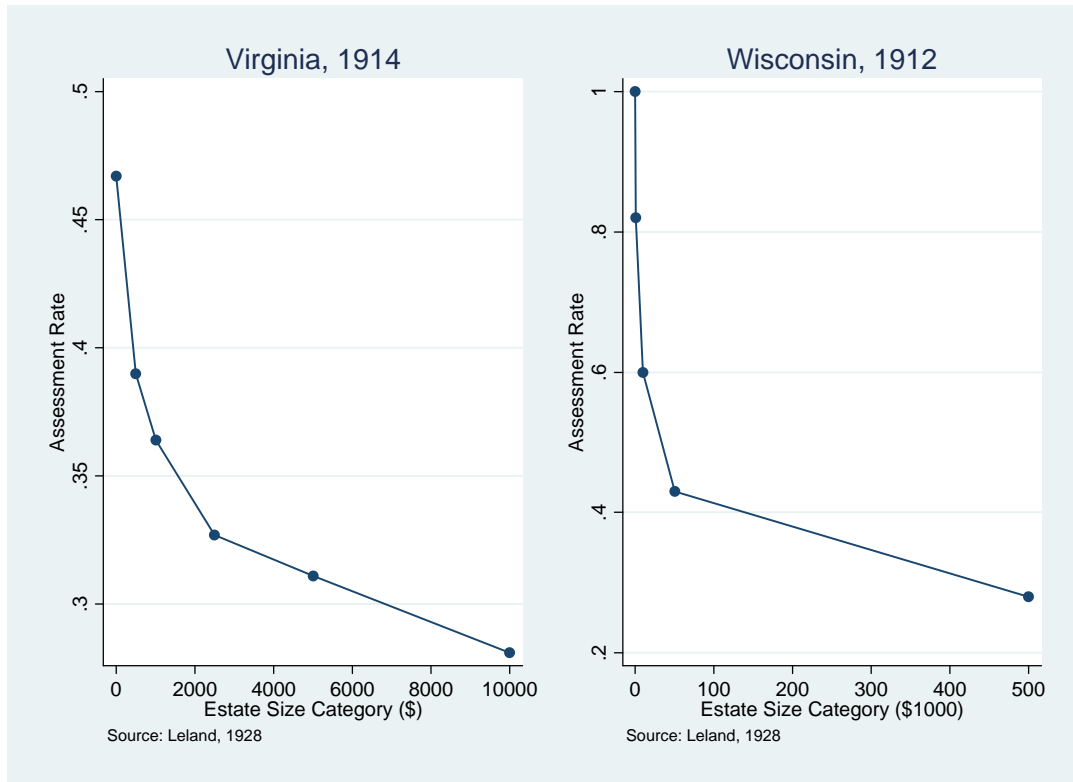


Figure 2: Assessment Rates as a Function of Estate Size

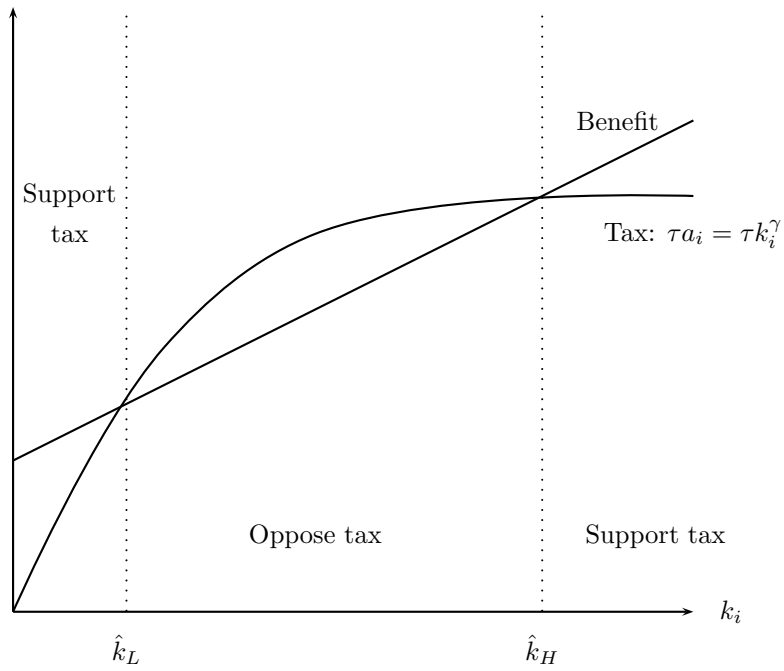


Figure 3: Support for Taxation with Decreasing Assessment Rates

Note: The figure shows taxes paid increasing with wealth ( $k_i$ ) but at a decreasing rate because the assessment rate is declining:  $\gamma < 1$ . Given the assumed benefits from the tax are as drawn, then individuals between  $\hat{k}_L$  and  $\hat{k}_H$  in wealth will oppose the tax. Individuals with very low wealth or relatively large wealth will support the tax.

Table 1: County Level Summary Statistics, 1890

Variable	All		Rural	
	Mean	SD	Mean	SD
Local Sch. Tax p.c.	1.467	1.473	1.328	1.652
R.E. Value p.c. (x\$1,000)	0.445	0.460	0.371	0.474
Assd. Value p.c. (x\$1,000)	0.273	0.205	0.223	0.193
Farm Gini ( $G$ )	0.418	0.143	0.408	0.158
Adj. Gini ( $G^A$ )	0.738	0.141	0.686	0.139
Output p.c. (\$)	102.8	82.3	72.3	41.0
Percent black	0.150	0.223	0.174	0.234
Percent urban	0.121	0.204		
Percent children	0.383	0.045	0.398	0.040
Population (x1,000)	26.1	60.2	13.3	7.8
Annual temp (C)	12.38	3.94	12.99	4.08
Annual rain (cm)	102.7	25.6	104.6	28.6
Growing days	183.1	40.1	188.1	41.8
Latitude (deg)	38.7	4.2	38.0	4.3
Observations	2124		1346	

*Notes:* Property tax and wealth data is from the U.S. Census *Report on Wealth, Debt, and Taxation*, U.S. Department of the Interior (1895). “R.E. value p.c.” is the reported value of real estate, and “Assd. value p.c.” is the reported assessed value of all property (both real and personal). The farm Gini is calculated from farm size information in the U.S. Census of 1890. The adjusted Gini modifies the farm Gini by incorporating information on the number of 21+ aged males relative to the number of farms, see text. 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). The rural sample is defined as counties that report zero population in towns with more than 2,500 persons.

Table 2: County Level Summary Statistics, by Census Region, 1890

	Region:						
	New England	Mid Atl.	East N. Cent.	West N. Cent.	South Atl.	East S. Cent.	West S. Cent.
Local Sch. Tax p.c. (\$)	1.78	1.53	2.07	2.83	0.39	0.30	0.45
R.E. Value p.c. (x\$1,000)	0.53	0.59	0.62	0.63	0.24	0.22	0.18
Assd. Value p.c. (x\$1,000)	0.57	0.41	0.35	0.30	0.18	0.18	0.15
Farm Gini ( $G$ )	0.45	0.45	0.41	0.26	0.52	0.49	0.51
Adj. Gini ( $G^A$ )	0.86	0.87	0.79	0.62	0.77	0.73	0.75
Observations	67	148	427	547	473	341	121

*Notes:* Local school taxes per capita are from the U.S. Census *Report on Wealth, Debt, and Taxation*, U.S. Dept. of the Interior (1895), with population data from the U.S. Census. “R.E. value p.c.” is the reported value of real estate in the Census report, and “Assd. value p.c.” is the reported assessed value of all property (both real and personal). The farm Gini and adjusted Gini are based on farm size distribution data and the population of males 21 and over, see text for details.

Table 3: Instrumental Variable Regressions for Local School Taxes

	Dep. variable is local school tax revenues per capita:					
	(1)	(2)	(3)	(4)	(5)	(6)
	All Counties	Rural Only	All Counties	Rural Only	All Counties	Rural Only
Farm Gini ( $G$ )	-9.607*** (3.170)	-9.222*** (3.328)				
Adj. Gini ( $G^A$ )			-7.822*** (2.208)	-7.048*** (2.429)	-7.306*** (2.009)	-6.603*** (2.180)
ln R.E. value p.c.	0.570*** (0.135)	0.649*** (0.185)	0.614*** (0.116)	0.613*** (0.154)	0.313*** (0.091)	0.220** (0.100)
ln Assd. value p.c.					0.532*** (0.178)	0.710*** (0.249)
Output p.c.(\$)	0.000 (0.001)	0.001 (0.002)	0.002*** (0.001)	0.005*** (0.001)	0.002*** (0.001)	0.004*** (0.001)
Percent urban	0.363 (0.357)		1.331** (0.556)		1.207** (0.515)	
Percent black	2.177*** (0.813)	2.264** (0.892)	1.629*** (0.520)	1.635*** (0.610)	1.464*** (0.464)	1.459*** (0.523)
Percent children	-2.221 (1.802)	-0.481 (3.230)	-12.396*** (3.604)	-12.130*** (4.545)	-10.011*** (3.416)	-9.081** (3.982)
Population (1,000)	0.002*** (0.000)	-0.009 (0.006)	0.000 (0.000)	-0.010 (0.007)	-0.000 (0.000)	-0.009 (0.006)
Hansen j-stat	1.007	2.135	1.705	2.055	2.633	2.757
Hansen p-value	0.800	0.545	0.636	0.561	0.452	0.431
1st stage F-stat	13.669	10.415	4.294	6.153	4.548	6.447
1st stage p-value	< 0.001	< 0.001	0.006	0.001	0.005	0.001
Observations	2124	1346	2124	1346	2124	1346

*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. For all regressions, the Hansen J statistic is distributed  $\chi^2(3)$ . The first stage F statistic is distributed  $F(4, 34)$  in columns (1),(3),and (5), and  $F(4, 32)$  in columns (2),(4), and (6).

Table 4: Instrumental Variable Regressions for Local School Taxes, Accounting for Zero-value Counties

	Dep. variable:			
	(1)	(2)	(3)	(4)
	Taxes	Taxes	Tax	Tax
	p.c.	p.c.	Dummy	Dummy
Adj. Gini ( $G^A$ )	-7.056*** (2.094)	-6.378*** (2.307)	-0.014 (0.126)	0.063 (0.224)
ln R.E. value p.c.	0.329*** (0.102)	0.237* (0.123)	0.026 (0.020)	0.007 (0.023)
ln Assd. value p.c.	0.546*** (0.195)	0.764*** (0.267)	0.044* (0.025)	0.013 (0.017)
Output p.c.(\$)	0.001** (0.001)	0.003** (0.001)	-0.000 (0.000)	0.000 (0.000)
Percent urban	1.088** (0.536)		0.133 (0.086)	
Percent black	1.154** (0.466)	1.221** (0.504)	0.064 (0.040)	0.007 (0.067)
Percent children	-11.750*** (3.904)	-11.961*** (4.636)	0.505 (0.351)	0.546 (0.448)
Population (1,000)	0.000 (0.000)	-0.012* (0.007)	-0.000* (0.000)	0.002 (0.001)
Hansen j-stat	3.417	3.611	4.176	4.084
Hansen p-value	0.332	0.307	0.243	0.253
1st stage F-stat	6.467	7.576	4.548	6.447
1st stage p-value	0.001	0.000	0.005	0.001
Local School Taxes Counties	> 0 All	> 0 Rural	$\geq$ 0 All	$\geq$ 0 Rural
Observations	1861	1108	2124	1346

*Notes:* Standard errors, clustered at the state level, are reported in parentheses. \* denotes significance at 10%, \*\* denotes 5%, and \*\*\* denotes 1%. The dependent variable in columns (3) and (4) is a dummy coded 0 if local school tax revenues are equal to zero, and 1 otherwise. 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. For all regressions, the Hansen J statistic is distributed  $\chi^2(3)$ . The first stage F statistic is distributed  $F(4, 34)$  in columns (1),(3) and  $F(4, 32)$  in columns (2),(4).

Table 5: I.V. Regressions for Local School Taxes, Sub-samples by Inequality Level

Dep. variable is local school tax revenues per capita:								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Region:		Adj. Gini in:					
	South	North	Bottom 10%	Bottom 25%	Bottom 50%	Top 50%	Top 25%	Top 10%
Adj. Gini ( $G^A$ )	1.304 (0.798)	-7.494*** (2.442)	-1.189 (9.171)	-9.344*** (3.485)	-9.568*** (2.489)	1.992 (2.138)	2.416 (2.217)	7.002*** (2.657)
ln R.E. value p.c.	0.157** (0.071)	0.860*** (0.180)	1.613*** (0.495)	1.272*** (0.298)	0.916*** (0.198)	0.398*** (0.102)	0.447*** (0.161)	0.546*** (0.129)
Output p.c.(\$)	0.000 (0.001)	0.002** (0.001)	0.001 (0.006)	0.005 (0.003)	0.005** (0.002)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Percent urban	0.001 (0.367)	1.447** (0.719)	4.918** (2.133)	2.446** (1.162)	1.888*** (0.620)	-0.400 (0.412)	-0.350 (0.336)	-0.571*** (0.198)
Percent black	-0.403** (0.201)	1.110 (1.209)	0.770 (0.850)	1.684*** (0.580)	1.734*** (0.540)	-0.228 (0.174)	-0.317* (0.179)	-1.002*** (0.339)
Percent children	-0.945 (1.002)	-11.116*** (3.773)	-10.975*** (3.149)	-6.788*** (2.168)	-3.961* (2.380)	-3.171** (1.395)	-2.228 (2.236)	0.300 (2.368)
Population (1,000)	0.001 (0.001)	-0.000 (0.000)	-0.093** (0.038)	-0.004 (0.016)	0.004 (0.007)	0.001*** (0.000)	0.000* (0.000)	0.000* (0.000)
Hansen j-stat	1.525	4.740	2.825	7.897	8.559	5.071	11.083	8.120
Hansen p-value	0.677	0.192	0.419	0.048	0.036	0.167	0.011	0.044
1st stage F-stat	4.381	29.655	7.133	23.061	16.385	6.903	12.683	9.621
1st stage p-value	0.017	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Observations	935	1189	212	534	1059	1065	534	213
OLS Estimates								
Adj. Gini ( $G^A$ )			0.406 (1.567)	-2.485** (1.135)	-3.429** (1.278)	1.804** (0.873)	2.314*** (0.822)	5.047*** (1.766)

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. For all regressions, the Hansen J statistic is distributed  $\chi^2(3)$ . The first-stage F statistic is distributed  $F(4, 14)$ ,  $F(4, 20)$ ,  $F(4, 18)$ ,  $F(4, 24)$ ,  $F(4, 30)$ ,  $F(4, 35)$ ,  $F(4, 34)$ ,  $F(4, 31)$  respectively. The OLS results reported are for regressions that include an identical set of control variables as the 2SLS regressions.