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Oil Discoveries and Education Spending in the Postbellum South

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Abstract
This paper studies the effect of oil wealth on the provision of education in the early 20th century United States. Using information on the location and discovery of major oil fields, I find that oil wealth increased local revenue and education spending. The quality of white teachers increased, and oil-rich counties were more likely to participate in the Rosenwald school building program for blacks. In addition, student-teacher ratios for black school children declined substantially. However, I do not find increased school enrollment rates for either race.

Key words: oil, education, race, Rosenwald, local public finances, resource booms, teachers
JEL: I2; N3; Q3

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1 Introduction

During the first half of the 20th century, black children in the American South experienced a remarkable convergence in basic schooling. In 1900, the school attendance rate for a black in the South aged 10-14 was nearly 18 percentage points below that of a white Southerner of the same age; by 1940, this difference had shrunk to below 4 percentage points (Collins and Margo 2006). The quality of education provision also increased: Around 1910, average class sizes for black students in Louisiana were nearly 66% larger than for white students, while by around 1950, this had decreased to 24% (Margo 1990). Economic historians have indentified several important drivers of this catch-up that include the work of Northern philantropists (Donohue et al 2002, Aaronson and Mazumder 2011, Carruthers and Wanamaker 2013, Kreisman 2017), litigation by the NAACP (Donohue et al 2002) and moving out of child labor intensive cotton production (Baker 2015).

In this paper, I study the role of an additional factor: the discovery of major oil fields in the Southwestern United States and the ensuing economic development and tax revenue inceases. Starting in Texas in the late 19th century, many regions in the Southern and Southwestern United States discovered large oil fields and experienced oil booms that led to structural transformation and urbanization (Pratt 1980, Michaels 2011, Maurer and Potlogea 2017). This new wealth also greatly increased local governments' tax revenue and thus the means available to invest in education. The question of this paper is whether this additional tax revenue increased the provision of education, and how it affected the educational differences between whites and black.

Using exogenous variation in resource wealth provided by a series of staggered oil discoveries in the early 20th century and a difference-in-differences strategy, I find that oil wealth led to increases in education spending per capita of around 9-15%. I further find that at least part of this additional spending went towards fostering black education: Oil-rich counties were more willing to participate in the Rosenwald school building program that was targeted at rural black children. They spent more public money on Rosenwald schools, built more schools, and hired more teachers for them, increasing the share of black children theoretically covered.

Given this increased spending, the question arises whether local education outcomes improved. Using the richness of the full count census, I find that the quality of education improved, but along different margins for the two races: White teachers became on average more educated and earned higher (nominal) wages. Black teachers do not display such changes, but black student-teacher ratios decreased considerably. However, I do not find any effect of oil discoveries on the school attendance rates of either black or white children. Thus, while oil discoveries improved the quality of edcation, they did not further contribute to blacks' catch-up in school attendance rates.

A priori, oil wealth is an unlikely candidate to boost education spending. Previous studies on a variety of countries around the globe have typically not found that oil wealth translates into substantial improvements in public goods provision (Gylfason 2001, Vicente 2010, Caselli and Michaels 2013, Martinez 2016, Farzanegan and Thum 2017). In addition, resource wealth might bring about a lot of other negative effects[1]: it fuels interstate wars (Caselli et al 2015) as well as internal armed conflict (Lei and Michaels 2013); it might impede democratic development (e.g. Ross 2012, Caselli and Tesei 2016), and worsen employment and political prospects for women (Ross 2008, 2012, Kotsadam and Tolonen 2016). My findings stand in marked contrast to these negative results. They are in line, however, with several papers that have documented positive or less negative effects of oil wealth in the case of the United States (Michaels 2011, Allcott and Keniston 2015, Maurer and Potlogea 2017). In addition, my results further support Martinez's (2016) finding that internally raised taxes do lead to increased public spending.

A closely related paper to mine in a modern setting is Marchand and Weber (2017) who analyze the effect of the recent shale gas boom in Texas on education spending and

[1]For a recent review of the literature on this "resource curse"hypothesis, see van der Ploeg 2011. A recent study with more positive effects of resources on growth and schooling is Smith (2015).

outcomes. They find that in spite of increased local revenue and school spending, average student test scores in counties that benefited from the shale gas boom declined. The likely reason for this is that the additional revenue went largely to capital and debt expenses, and to a reduction in property tax rates. Teacher wages were not raised and thus did not keep up with local wage growth, and as a result teacher turnover increased, and more experienced teachers left. In my historical setting, on the other hand, it seems that the additional revenue was more likely to be used to hire more and better teachers, and to benefit from the Rosenwald program's matching contributions. Michaels (2011) also finds positive effects of oil wealth on the fraction of the population with at least a high school degree, indicating improved education. My results add to his by studying the effect of oil wealth on the quality of education provided, and by analyzing the implications for the racial education gap. Finally, using a panel set-up with a difference-in-differences strategy, I am able to relax the identifying assumptions of his paper, which relies on cross-sectional variation in oil endowments.

2 Historical Background

2.1 Oil discoveries and regional transformation

With the end of the American Civil War and the ratification of the Thirteenth Amendment, black slaves in the US South finally gained their freedom. However, their economic and political position remained weak. The basic economic and political forces did not change; The South remained a predominantly agricultural economy and continued to focus on cotton production. Former Slave-owners became landlords, and former slaves became sharecroppers and tenant farmers. Due to their continued control over land, the ruling planter elite maintained political control over the South, and Southern legislation reflected their interests. At the beginning of the 20th century, the American South thus was still a predominantly agricultural society based on cheap labor that underinvested in education and had low levels of mechanization and productivity. For the region as a whole, it would still take many decades until it started to catch up with the rest of the United States (Wright 1986, Caselli and Coleman 2001, Acemoglu and Robinson 2008*a*, 2008*b*, Ager 2013).

In several regions, however, oil discoveries soon led to substantial transformations and economic changes. Beginning in Texas in the 1890s, large oil fields were discovered in many places in the South, especially in the Southwest, in Texas, Louisiana, and Oklahoma. Oil discoveries led to local booms: The oil drilling industry paid great wages, attracting skilled and unskilled workers from elsewhere. Landowners could lease out their land, sometimes for rents as high as 250-1,000 dollars per acre, and local businessmen enjoyed great demand. In some places, population exploded: Burkburnett in Texas, for example, rapidly grew from below 300 inhabitants to 20,000, and Panhandle City in the same state increased its population tenfold within three years. Moreover, these booms were not short-lived; Industries linked to oil extraction (such as refining) soon followed, and the whole region developed (Moore 1971, Pratt 1980). In an area heretofore governed by agriculture, as Richard R. Moore put it in his study of West Texan oil booms "twentieth-century industrial cities were born"(1971, p.43). Modern econometric studies support this view of the historians: Far from constituting a "resource curse", oil-wealth led to counties experiencing growth in population and manufacturing. They became more urbanized, and their residents enjoyed higher incomes per capita and better infrastructure (Michaels 2011, Maurer and Potlogea 2017). Local governments also enjoyed substantial benefits from oil discoveries, as the petroleum industry quickly became a prime contributor of taxes. In the late 1940s, it paid around 1.3 billion dollars in federal, state, and local taxes, and regionally, its importance could be even greater. Half of the revenue of the Louisianan state government, for example, came from taxing petroleum companies. In addition, oil greatly increased the tax revenues that local county governments collected in order to finance education: Across the whole of Texas, the Petroleum industry paid nearly one third of all the local property taxes that paid for common schools, independent school districts and rural high schools in the school year 1947/48 (Rister, 1949). However, while oil windfalls in general are prone to rent-seeking and elite capture (Caselli and Michaels 2013, Martinez 2016), the political economy of the South at this time made it particularly questionable whether these additional education tax revenues would benefit the most needy, i.e. the poor rural black population.

2.2 Separate and far from equal: black education in the South

Black slaves in the South had been set free by the ratification of the Thirteenth Amendment in 1865. However, the white majority of the South was in no way willing to give blacks equal political and social rights. Congressional Reconstruction had allowed the freed slaves some political participation, but its end in 1877 and the return of the Democratic "Redeemer"governments to power turned the wheel backwards: blacks became disenfranchised and socially segregated, the latter being cemented by the US Supreme Court's 1894 decision in *Plessy v. Ferguson*, which ruled that "separate but equal"provision of facilities for blacks and whites was not unconstitutional. In practice, segregation was "part of a complex system of white domination, in which each component- disenfranchisement, unequal economic status, inferior education- reinforced the others."(Foner 2006, p. 208)[2]

The education prospects of black children followed a similarly trajectory as blacks' political influence.[3] The emancipated slaves were eager to learn to read and write and to send their kids to school, and during Reconstruction, some progress was made. Texas, for example, created a state-level general schooling program in 1870 (Moneyhon 2004, p.146ff.). However, with the return of the old elites to power, further development of uni-

[2]See Foner (2006) for an account of Reconstruction and its undoing. Kousser (1974) describes the evolution of Southern politics and especially disenfranchisement during the last quarter of the 19th century.

[3]For comprehensive treatments on the history of black education in the South, see Bullock (1967) and Anderson (1988). Naidu (2012) provides empirical evidence for the negative effect of disenfrachisement on public goods provision and black schooling.

versal schooling for both races stalled. General education was clearly not in the interest of Southern planters, who relied on child labor and feared that education might reduce their workers' suitability for agricultural work. Krousser (1974, p. 17) cites a local adage according to which educating a former slave meant "to spoil a good field hand". Low- and middle class white farmers could have benefited from public schooling, but they had faced substantial tax increases during Reconstruction and therefore initially supported more frugal, fiscally conservative policies (Thornton 1982). By the time poor whites were demanding education, in the late 19th century, blacks were already considerably disenfranchised, and instead of enacting public school programs for everybody, white planters and small farmers agreed on increased public school provision for whites only. As a result, universal education for their children remained an unachievable goal for blacks until well into the 20th century. Even as whites gradually began to see that giving blacks some basic and industrial training could be economically advantageous for the whole South, mobilizing public funds for this purpose proved difficult. The conditions of black education in the early 20th century were still, in the words of historian Henry Allen Bullock, "pitiable inadequate"(1967, p. 122). Schools were few and scattered, terms short, and poor families often had to rely on their children helping in the cultivation of cotton. As a consequence, school attendance of black kids was low. Across the South in 1900, 22% of all black children aged five to nine attended school (as opposed to 37% of white children of the same age), whereas for children aged ten to fourteen, the corresponding number was 52% (75% for whites) (Anderson 1988, pp. 148-151).

Things slowly began to change, however, in the first quarter of the twentieth century, when Northern philanthropists put their weight, and even more importantly, their money behind the issue. As Southern public opinion slowly moved towards supporting basic and industrial training for blacks, the offer of rich Northerners to financially support this goal was met with acceptance. The Peabody Fund and donations by John D. Rockefeller supported education in the South, some of which trickled down to blacks, and both the Slater

Fund and programs financed by Pennsylvanian Anna T. Jeanes promoted industrial education and supported rural schools (Bullock 1967, p. 122f.). The most important change, however, was the Rosenwald school-building program, which, according to Bullock (1967, p. 138), "permeated the educational experiences of the Negro more deeply than [...] any other fund."Between 1914 and 1932, this program co-financed the construction of 4,977 schools for rural blacks in 883 different counties across the South, providing theoretical capacity for 663,615 students. The principle of the fund, however, was to not simply give away money, but to match the provision of local donations. Rosenwald schools thus could only be built where either the local counties were willing to provide funds, or where the local black community had both the willingness and the ability to raise enough funds on their own (Anderson 1988, p. 153-158). Rosenwald contributions often crowded out public funds and diverted them towards white schools and therefore did not increase the *relative* schooling quality of blacks. However, they still increased the *absolute* inputs into the production of black education and therefore led to significant increases in black school attendance, literacy and cognitive test scores (Aaronson and Mazumder 2011, Carruthers and Wanamaker 2013).

3 Data and Key Variables

In order to analyze the effect of oil wealth on public spending and education provision, I use the county-level dataset compiled by Guy Michaels (2011), which identifies all counties that are situated above an oil field of 100 million barrel or more before any oil was extracted. I will refer to these counties simply as oil-rich counties. In addition, the dataset also contains information on when oil extraction began for each oil-rich county. Figures 1- 5 show the geographical and temporal distribution of oil discoveries, based on county shapefiles from NHGIS (Minnesota Population Center 2016). There are only relatively few oil discoveries in the early years, most discoveries happen in the 1920s and 1930s. In terms of the geographic scope, I follow Michaels (2011) and include all counties within 200 miles of an oil-rich county.

Data on educational attainment and spending are unfortunately not readily available for the first half of the 20th century. Because of this, I draw on a variety of sources. For 1890, 1932, and 1957, Paul W. Rhode and Koleman S. Strumpf (2003) have collected data on county-level education spending from various census records. Since these come from very different points in time, I convert all values to 1940 US dollars using CPI data from the Federal Reserve of Minneapolis (2016). I further use decadal population data from Haines and ICPSR (2010) in order to interpolate county populations in 1932 and 1957 and thus create per capita education spending. In order to see whether oil discoveries led to increased spending on blacks specifically, I use data from the Rosenwald school building program discussed in section 2. A particularly attractive feature of this program was its "buy-in"nature: The Rosenwald fund at most matched local contributions- absent these, no schools were built. In addition, the fund kept track whether the original contributions came from the local black community, the local white community, or from local public funds. This allows me not only to assess whether oil-rich counties were more likely to participate in the Rosenwald program, but also to see whether any changed participation likelihood came from more generous whites, blacks or from additional public fund allocation. Aaronson and Mazumder (2011) have compiled a complete database of all 4,972 Rosenwald schools. Their database contains several outcome variables. The ones I will use in this paper are: Whether a county has a Rosenwald school or a Rosewald teacher at all; The number of Rosenwald schools and teachers; The share of black students who can theoretically be offered a place in a Rosenwald school; and the total construction cost, broken down by source (Rosenwald fund, local whites, local blacks, local public funds).[4]

[4]Schools, teachers, and costs are measured as cumulative up until year t. For the share of black students theoretically covered, Aaronson and Mazumder have created a measure based on the program's standard class size of 45 pupils per teacher and the number of black students aged 7 to 17 in the county,

The staggered nature of oil discoveries across space and over time lends itself quite naturally to a difference-in-differences research design. The basic regression I run is of the form

$$y_{ct} = \alpha_c + \tau_t + \beta DiscoveredOilField_{ct} + X_c' \gamma_t + u_{ct} \tag{1}$$

where y denotes the outcome variable in county c and year t. $DiscoveredOilField$ is an indicator variable that is 1 if county c is oil-rich and if at least one of of its major oil fields has already been discovered by year t, and 0 otherwise. τ and α are year- and county fixed effects. X is a vector of control variables that vary at the county level. In line with Michaels (2011), I control for time-varying effects of several geographic features that might be spuriously correlated with oil wealth: Longitude, latitude, aridity, annual rainfall, distance to the closest navigable river, and distance to the ocean. In some specifications, I additionally include state by year fixed effects and remove counties without discovered oil wealth that border counties with discovered oil fields.[5]

The key identifying assumption of this empirical strategy is that conditional on controls, oil discoveries are exogenous. I thus have to assume that in the absence of oil discoveries, the outcomes in discovering and non-discovering counties would have evolved in the same way over time. I will assess this assumption in more detail in section 5. I always cluster standard errors at the county level to address serial correlation in the error terms (Bertrand et al 2002).

As a further measure of the quality of education provided, I look at teachers' education

and I use this measure. However, Aaronson and Mazumder additionally multiply the number of students by the ratio of rural black students to get the share of rural black students. Since my interest is in the whole county, I omit this last step. My variable thus measures the fraction of all black students in a county that could theoretically be seated in a Rosenwald school. For schools, teachers, and costs, I only focus on newly-built schools, omitting rebuilt schools and additions to schools. The reason is that detailed cost data are only available for new construction projects. However, following Aaronson and Mazumder, rebuilds and additions are used in the creation of the share of students theoretically covered.

[5]One potential issue is that especially in the Western part of the sample, population was growing and counties therefore often changed, split up, or were newly created. In order to address this, I compare the area of each county in each census decade to its area in 1940, and drop all observations from a given county-year cell if the absolute difference of the county's area in that year compared to 1940 exceeds 5%. I also drop Oklahoma in 1900, since it was still largely unorganized. This approach has also been used by Maurer and Potlogea (2017).

levels and wages, which are available in the 1940 Census. Unfortunately, wage and education level data are not available before 1940, requiring a more demanding cross-sectional specification:

$$y_c = \alpha + \beta DiscoveredOilField_c + X_c'\gamma + s_c + u_c \quad (2)$$

Where y_c is the outcome, i.e. either average education levels or average log income of all teachers in county c. In this case, $DiscoveredOilField_c$ codes whether county c has an oil field which was already discovered by 1940. X is the same vector of control variables as above, and s are state fixed effects. The more demanding identification assumption behind this specification is that counties without oil wealth and counties that had not yet discovered their oil wealth by 1940 are a valid counterfactual for those counties with already discovered oil fields in 1940. I could run this regression also at the individual level, using the outcome of individual i in county c, y_{ic}. Instead, I average the data at the county-level and weight my regression by the number of observations that contributed to this average (i.e. the number of white/black teachers with non-missing education/wage information, respectively). With standard errors clustered at the county level, these weighted county-level regressions produce exactly the same point estimates and standard errors as the individual-level regressions, but they are faster to run.

I further exploit the richness of the US census to construct a measure of average student-teacher-ratios per county and year: Using the full count census data for 1910-1940 and a nationally representative 5% sample for 1900 (Ruggles et al 2017), I count the number of students aged 5-16 in each county and census decade and divide it by the number of individuals that have the IPUMS 1950 occupation code 93, *Teachers not elsewhere classified*.[6] I calculate this ratio separately for both races. This assumes that white children were only taught by white teachers, and black children only by black teachers, which seems like a reasonable assumption in the Jim Crow South and should

[6]This removes art, dancing and music teachers, who are categorized in other occupation codes, together with artists, dancers, and musicians.

introduce at most minor measurement error. Additionally, as a most basic measure of education, I look at school enrollment, which can also be obtained from IPUMS US census data. As with the measures of teacher quality, I use the individual-level census data to calculate county-year means for both races and then run county-level regressions of the same form as in equation 1, weighting by the number of white or black school children aged 5 to 16 (or, in the case of student-teacher ratios, by the number of black or white school children). As before, an alternative would be to run these regressions with individual data, which would yield exactly the same results. As before, however, running the regressions at the county level with frequency weights is considerably faster than running the regressions with several million individual observations. [7]

Table 1 gives an overview over the summary statics over the whole sample at the county-level (unweighted). As can be seen, education for whites and blacks is generally improving over this time period, both in terms of outputs (school enrollment) and inputs (spending per capita, student-teacher ratios). The one exception seem to be black-student teacher ratios, which increase from 1900 to 1920 and then decrease again. The reason for this is that in 1900, where only a 5% sample of the population is available, the ratio of students to teachers is often not defined, since no teacher was sampled, in particular for blacks. As a consequence, the 1900 student-teacher-ratios are relatively noisy and less reliable: I have data on black student-teacher ratios for only 151 counties, and these counties show a value that is lower than for 1910, 1920, 1930, or 1940, even though the future years display a downward trend. In my main analyses, I nevertheless include data from 1900, but I show in the appendix that this is not crucial for my results.

[7] In calculating the county means and counts, I also weight observations by the probability weights provided by IPUMS. These code how many persons a sampled person represents and thus only matter for 1900, since for the later years I observe the whole population.

4 Results

In columns 1-3 of table 2, I examine the effect of oil discoveries on county finances. At least anecdotally, oil booms greatly increased the value of assessed property and thus the tax base of affected counties. In Graham, Texas, for example, taxable values nearly doubled between 1920 and 1922. Panhandle City, also in Texas, even experienced a tenfold increase, from 1 million dollars in 1921 to 10 million in 1924 (Moore 1971, p. 64, p.70). As the point estimates in column 1 of table 2 show, this positive relationship between oil wealth and county revenues is both statistically and economically significant: Oil discoveries increase county revenue per capita by around 19 log points. In column 2, I drop counties that border counties with discovered oil fields but have not (yet) discovered their own oil wealth. The point estimate is even larger, which is consistent with the effect of oil on property values having limited spillover effects to adjacent counties. Including state by year fixed effects (column 3) on the other hand, does not change estimates by much.

Counties that discover oil thus benefit from increased local revenue. While such effects have been found in other contexts (e.g. Caselli and Michaels 2011 for Brazil, Martinez 2016 for Colombia), previous papers have typically not found that oil windfalls translate into improved provision of public goods. In order to assess this for the case of the US South, I next turn to the effect of oil discoveries on education spending. In this respect, the South was considerably lagging behind the rest of the nation. At the beginning of the 20th century, Southern states had generally low education expenditures. In 1900, the per-pupil education spendings of Louisiana were around 38% of the national average; In Texas, the corresponding value was 56%, in Alabama only 17% (Wright 1989, p.80). However, basic education during this time was mostly funded through property taxes. As oil discoveries increased the value of assessed property, they might have made more funds available for education. Table 3 shows that this is indeed the case: On average, oil discoveries increase the amount of money a county spent on education per capita by around 15%. Including state x year fixed effects reduces the point estimate a bit, but does not change the qualitative conclusion. Through increasing counties' revenues, oil discoveries thus led to more educational spending. The education spending response is smaller than the revenue response, indicating that the additional revenue did not just "scale up"education spending by the same factor, but went up less. Nonetheless, education spending did increase after oil discoveries.[8]

Who benefited from the additional education spending? In particular, did blacks reap any benefits, or was the money spent on white children only? Unfortunately, data on education spending by race is not available at the county level. However, thanks to the Rosenwald school building program, we have data on at least one large-scale educational program that aimed at helping blacks. In table 4, I use my basic difference-in-differences set-up to analyze whether oil discoveries increase counties' propensity to participate in the Rosenwald program. I focus on the time from 1920-1931, since the few schools built before 1920 cannot be dated exactly. In Column 1, the outcome variable is the share of black students that could theoretically be seated in a Rosenwald school, which provides the best overall summary of exposure to the program. The effects of oil discoveries are positive and economically sizable, albeit somewhat imprecisely estimated: Oil wealth increases the fraction of students with a place in a Rosenwald school by nearly 7 percentage points. As can be seen from columns 2-4, this effect seems to come both from the intensive and the extensive margin: Oil counties are 6 percentage points more likely to have any Rosenwald participation, and they have more schools and more teachers on average.

One concern with these results is that they reflect a mere income effect of black parents. Local black communities often went (and had to go) to great lengths in getting the necessary funds to make the Rosenwald fund support their project- they donated money, land, labor, lumber and more (Anderson 1988). Because of this, an increased partici-

[8]Racial heterogeneity is often associated with lower public goods provision (Alesina and Ferrara 2005 for a survey of the evidence). Given this, a natural question is whether the positive effects of oil discoveries on education spending were muted by a greater share of black people. In the appendix, I show that this was not the case.

pation of oil counties in the program could simply reflect a wealthier black community. In table 5, I therefore analyze the sources of the non-Rosenwald contribution. For every Rosenwald construction project, I know how much of the original cost was paid for by local public funds, the local black community or the local white community. This allows me to calculate how much each of these groups spent on the construction of new Rosenwald schools and how this changed with oil discoveries. The contribution of local blacks does indeed increase by more than 493$ (1940 value). However, the lion's share of the increased local contribution comes from local public funds, which increase by 3,890$ in the wake of oil discoveries. This is more than the overall average cumulative public contribution for the whole sample. Also interestingly, there is only a small and negative change in the amount paid by the local white community, whose contribution generally was not very large to begin with. While historians have pointed out that many oilmen also became philantropists (Rister 1949, p. 405), they do not seem to have played a large role in acquiring Rosenwald schools.

In these regressions, I have always used the cumulative 1940 $ amount spend by county c up until year t. This closely resembles the definition of the school and teacher variables and reflects the permanent investments that the counties made. In the appendix, I additionally show specifications that use the natural logarithm of the cumulative contributions or the value of the annual per capita contributions. Both specifications confirm the finding that public funds are the key driver of the increased Rosewald contributions of oil rich counties. Moreover, for brevity, I have here only showed the Rosenwald results for my basic difference-in-differences strategy. Results when excluding neighboring counties without oil or when including state x year fixed effects are also provided in the appendix.

I have shown that oil discoveries led to increased county tax revenue, to increased education spending, and that at least part of this spending went to the local black community. However, increased *spending* need not necessarily translate to improved *outcomes*. In the following, I examine whether there is a discernible positive effect of oil discoveries on educational outcomes.

I begin by looking at the quality of education provided. A standard measure for the quality of schooling inputs in the age of segregation are student-teacher ratios in black and white schools (Card and Krueger 1992, Donohue et al 2002, Ashenfelter et al 2006). Unfortunately, I do not have county-level data that details the number of students in white and black schools, respectively. However, using the census, I can count the number of students and teachers of either race in each county and use these counts to produce average student-teacher ratios per race and county. I do this for the years 1900-1940. In table 6, I use my standard county-level difference-in-differences strategy to estimate the effect of oil discoveries on student-teacher ratios, weighting the regression by the respective number of school children per race. Columns 1-3 show the results for whites, where there is no apparent effect. As before, Columns 2 and 3 drop non-oil counties adjacent to oil counties, and include state x year fixed effects, respectively. The absence of an effect for whites is robust across these specifications. Turning to columns 4-6 though, oil discoveries are associated with a drop of around 14 students per black teacher. Thus, it seems that there is a relative increase of the quality of black schooling. The changes in black student-teacher ratios happen in a time when student-teacher ratios are generally declining: In 1910, the average number of children per white teacher was 36.6, but by 1940 this number had declined to 19.4. For blacks, the decline started at 78.5 students per black teacher in 1910 and ended at 38. One potential explanation for the different effects of oil discoveries for the two races thus could be that there was little room for white student-teacher ratios to decline over and above their general trend.

As an additional measure of the quality of education provided,table 7 looks at measures of teacher quality. For this, I use the 1940 full count census, which has data on educational attainment and wages. I focus on the sampled people that give their occupation as "teacher". I look at 3 measures of teacher quality in a county: average education, measured by the share of teachers that completed at least 12th grade (and thus graduated from high school) or at least 4 years of college, and their average log annual wage income. Columns 1-3 show the effect of oil discoveries for white teachers (regression weighted by the number of white teachers with non-missing information), columns 4-6 for blacks (weighted by the number of black teachers with non-missing information). As can be seen, oil-rich counties seem to attract better-educated white teachers. While the effect is marginally insignificant, the point estimate indicates an increase in the probability of having had 4 or more years of college by 2.5 percentage points (column 1). Given that overall only 43% of white teachers in the sample went to college for 4 or more years, this would be a sizable increase. There is no effect for high school graduation, which however was very high to begin with, with an overall mean of more than 80%. Black teachers, on the other hand, do not display any increased education levels (columns 4 and 5). The evolutions of wage incomes display a similar picture: White wages increased considerably, whereas the coefficient for blacks is not significant and considerably smaller than for their white counterparts (in spite of starting from a substantially lower base). The wage results of course have to be interpreted with a bit of caution, since they are in nominal terms. Oil rich counties experienced general wage increases, and so local prices could also have appreciated. Hence, the 11% wage increase for white teachers does not necessarily mean that real wages of teachers grew. However, it is still noteworthy that nominal teacher salaries grew more for white than for black teachers, in line with the education results. Thus, while the quality of black teachers seems to remain relatively unchanged, both the wage and education differences to their white counterparts increased, indicating that the relative (and from the education results, also the absolute) quality of white teachers increased.

So far the analysis has shown that oil discoveries led to increased public spending on education. White students benefitted from relatively better teachers, whereas black students benefitted from better access to school thanks to counties' increased participation in the Rosenwald program, and from lower student-teacher ratios. Did these changes also translate into increased school attendance? In table 8, I use census data from 1900-1940 to estimate the effect of oil discoveries on school enrollment rates of children aged 5-16. I do not find that oil wealth counties display increased school attendance, neither for white children, nor for blacks. For the latter, the point estimates are positive, but very imprecisely estimated and also not very sizable. This is surprising, given the previous result that oil counties were more likely to participate in the Rosenwald program and thus build schools for rural black children.

Could the absence of a school attendance effect be due to better labor market conditions in oil-rich counties? The oil discoveries I study have been found to lead to substantial wage gains, especially for men (Maurer and Potlogea 2017). These wage gains are likely to have been biased towards lower-skilled occupations. Thus, adolescents might have been tempted to leave school and seek employment in the booming oil and manufacturing sectors. Evidence for this has been provided for several different settings by Black et al (2005), Emery et al (2012), Kumar (2014), Cascio and Narayan (2015), and Rickman et al (2017). Averaging over the whole age distribution thus might mask heterogeneous impacts of oil discoveries. In Figures 6 and 7, I therefore show coefficients that repeat my baseline differences-in-differences specification for school enrollment in one-year age bins. As can be seen, the absence of an enrollment effect is visible along the whole age distribution. Neither seem the increased funds for education to have fostered younger children's attendance, nor were older students more likely to leave school and seek employment. If anything, there might be a small positive effect for blacks at the ages of 6-11 and a small negative effect for blacks aged 15 and 16, but all of these effects are relatively limited and amount to at most 2.5 percentage points.

5 Robustness

In this section, I probe the robustness of my findings to alternative specifications. The key identifying assumption of my difference-in-differences strategy is that in the absence of oil discoveries, counties with and without major oil deposits would have evolved in the same way over time. This assumption can of course not be proven rigorously, but a standard test is a leads-and-lags analysis to ascertain whether the two groups of counties evolved similarly before the discoveries, and whether the effect of the discoveries only appears after the actual discoveries (Angrist and Pischke 2009). For this purpose, I use a regression of the form

$$y_{ct} = \alpha_c + \tau_t + \sum_{j \in \{-29,-19,-9,0,10,20\}} \beta_j DiscoveredOilField_{c,t+j} + X_c' \gamma_t + u_{ct} \tag{3}$$

where the set of dummies $DiscoveredOilField_{c,t+j}$ code for whether an oil field is to be discovered $20-29$ years from period t, $10-19$ years from period t, $9-1$ years from period t or was discovered $0-9$ years prior to period t, $10-19$ years prior to period t or more than 20 years prior to period t. Oil discoveries that occur more than 30 years after the reference period are the omitted reference category. I use this specification for student-teacher ratios and school attendance. For the Rosenwald program, where I have annual data, but for only 11 years, decadal leads and lags are too coarse, so there I use 5-year time periods that go from 15-19 years before an oil discovery to more than 20 years after an oil discovery. The results of this exercise are presented in tables 9 and 10. The results mostly show the expected pattern: The leading variables that code oil discoveries that have not yet taken place are usually small in absolute values, not significantly different from zero, and without any apparent trend. In the case of black student-teacher ratios, oil-rich counties if anything were on a trend towards more students per teacher, which then seems to have been reverted by oil discoveries. Turning to the lags that indicate discoveries that have already taken place, an interesting result is that black school attendance did increase considerably in the long run, i.e. more than 10 years after oil discoveries.

For revenue and education spending, I only have data for 3 years that are very much apart. Using decadal leads and lags therefore is not very appropriate in this case. Instead, I use a different specification to check whether the effects of oil discoveries only happen after the oil actually has been discovered. I have data for 1890, 1932, and 1957. In 1890, none of the oil fields in my sample had been discovered. The oil fields can thus be grouped into three categories: Those discovered before 1932, those discovered after 1932, but before 1957, and those discovered after 1957. For oil fields discovered before 1932, I would expect to find spending and revenue effects in both 1932 and 1957. For oil fields discovered between 1932 and 1957, on the other hand, I would expect to find differential behavior only in 1957, whereas oil wealth discovered after 1957 should never have any effect. According to this reasoning, I divide oil discoveries into the three groups mentioned above and interact them with year dummies (omitting 1890 as the base year for all groups). The results of this exercise are presented in table 11. While further dividing the sample naturally impairs precision, the pattern of the point estimates is still very reassuring: Counties whose oil fields were discovered by 1932 display sizable point estimates already in 1932, and even larger ones in 1957. Counties whose oil fields were discovered by 1957, on the other hand, do not display any revenue effect and at best a very muted education spending effect in 1932, and larger coefficients in 1957. Finally, oil wealth that was discovered only after 1957 has no effect in either 1932 or 1957.

The leads and lags specifications can also not be employed for the cross-sectional regressions that examine teacher quality in 1940. Instead, in table 12, I present the results from a different robustness check, in which I drop all counties with already discovered oil fields and only compare non-oil counties to oil counties whose oil field has not yet been discovered. Oil that is not yet discovered should not have any effects, so I would not expect to find sizable coefficients for the "not yet discovered" dummy. If oil wealth that has not yet been discovered already has an effect on teacher quality in 1940, then this would suggest that oil and non-oil counties are inherently different, and that the comparison upon which my cross-sectional regressions are based is not a valid one. However, as the results in table 12 show, this does not seem to be the case: In 1940, the quality of teachers in counties with oil that has not yet been discovered is statistically not different than in counties without any oil, lending further credibility to my cross-sectional results.

In the Appendix, I additionally show that my results are also robust to dropping all non-oil counties and deriving identification only from the timing of oil discoveries within the set of oil-rich counties (the one exception being education spending, which displays a lower point estimate and loses significance), and that my student-teacher ratio results are not driven by the potentially imprecise data for 1900.

6 Conclusion

In this paper, I estimate the effect of oil discoveries on education provision in the early 20th century Southwestern United States. I find that oil wealth increased local education spending per capita by 9-15%. Much of this additional funding seems to have gone towards improving the quality of schooling: I find that the quality of white teachers increased, both in terms of their nominal wages and their education level. For black school children, the quality of teachers does not appear to have changed substantively, but oil-rich counties were more likely to participate in the Rosenwald school building program, and student-teacher ratios for black children declined substantially. However, in spite of these beneficial changes, black school enrollment did not change differentially in counties with or without oil wealth. Oil discoveries and the associated local revenue increases thus seem to have predominantly improved the quality of local education provision, rather than the quantity.

My results of a positive effect of oil on education spending stand in contrast to several other papers on resource wealth that often do not find positive effects of oil wealth on living standards in Brazil and Colombia due to corruption and elite capture (Caselli and Michaels 2013, Martinez 2016), but they fall in line with positive effects on infrastructure in my area of observation (Michaels 2011).

What can explain that oil revenues seem to have such different implications in the Southwestern United States, a region that was marked by the Democratic party's quasi-monopoly to power (Besley et al 2010) and thus seems to be a prime candidate for elite capture? One potential explanation is the channel through which funds were made available for the county. Education in the particular was to a large extent financed by an ad valorem tax on property, and oil discoveries increased (sometimes tremendously) the value of local proerty. Oil revenue thus did not simply come as a windfall, but in the form of internally-"earned" taxes, for which the literature would predict larger positive effects on living standards (Martinez 2016). It could be this design of the Southern tax system that made oil discoveries ultimately beneficial for the local population.

Generally, my study adds to an increasing body of literature that finds positive effects of resource wealth in the United States, contrasting the experience of many other countries. Further research should try to understand what drives this American exceptionalism in the exploitation of petroleum wealth.

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Tables and Figures

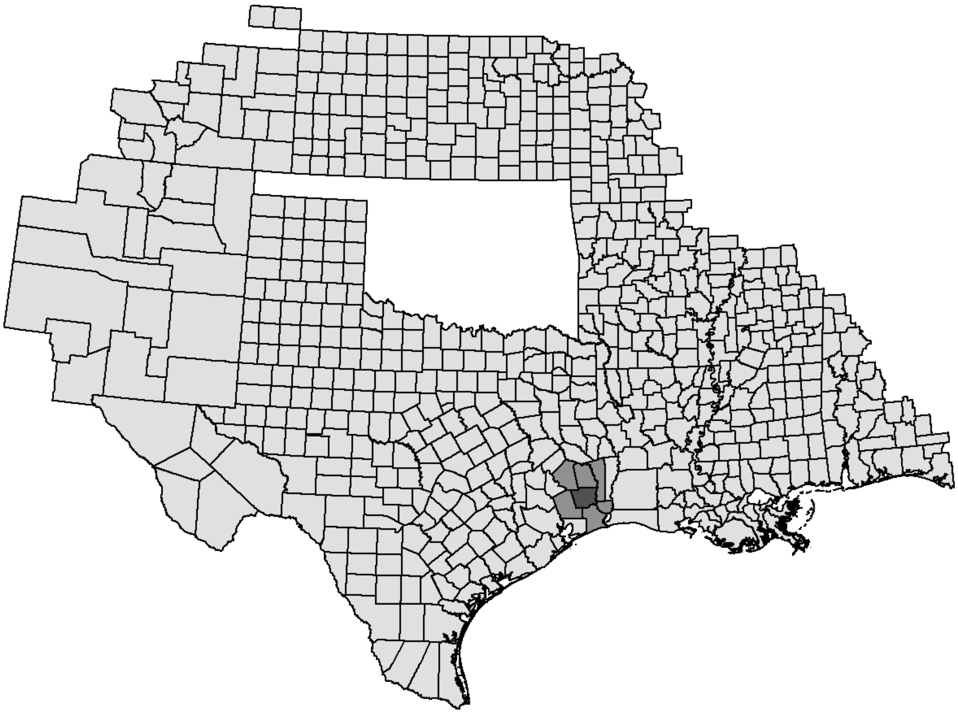

Figure 1: Map of Oil Discoveries 1900

Note: Oil abundant counties (dark grey), Neighbors of oil abundant counties (grey), Other counties (light grey)

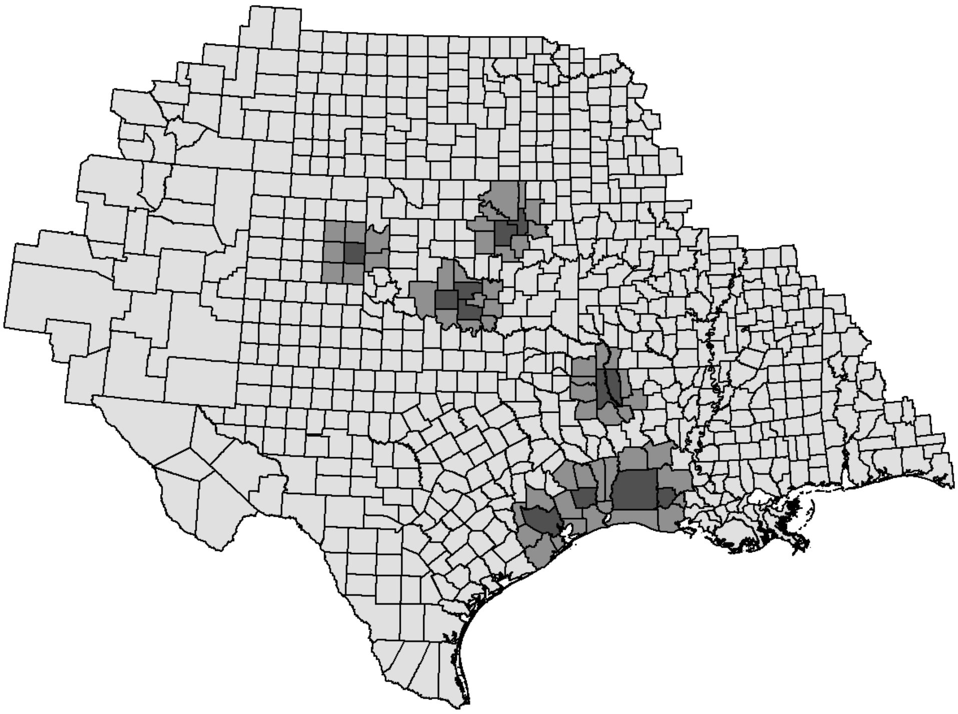

Figure 2: Map of Oil Discoveries 1910

Note: Oil abundant counties (dark grey), Neighbors of oil abundant counties (grey), Other counties (light grey)

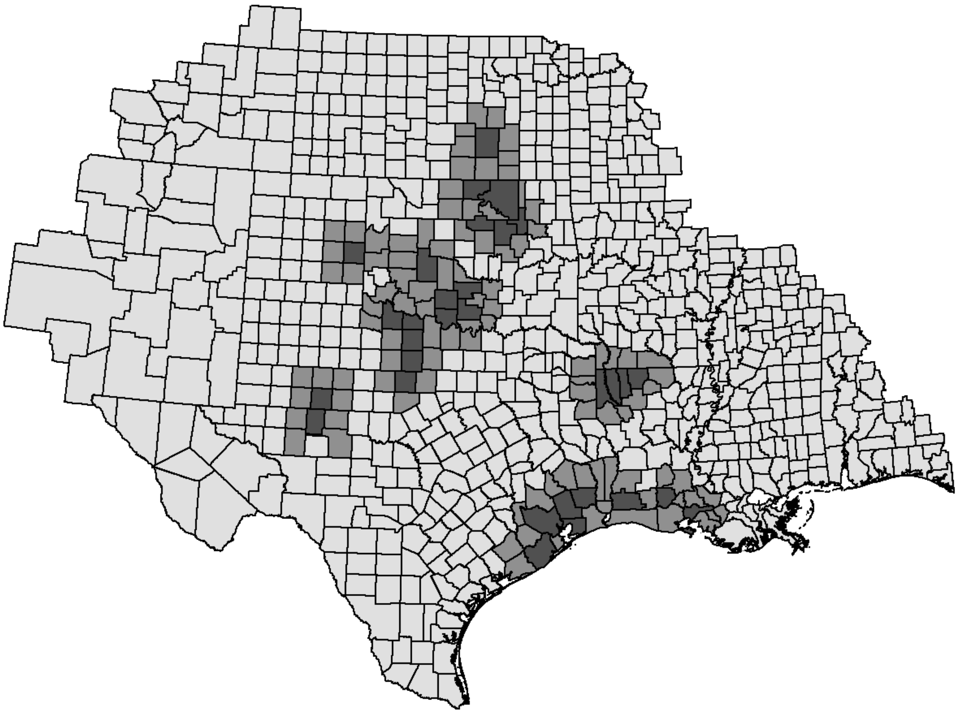

Figure 3: Map of Oil Discoveries 1920

Note: Oil abundant counties (dark grey), Neighbors of oil abundant counties (grey), Other counties (light grey)

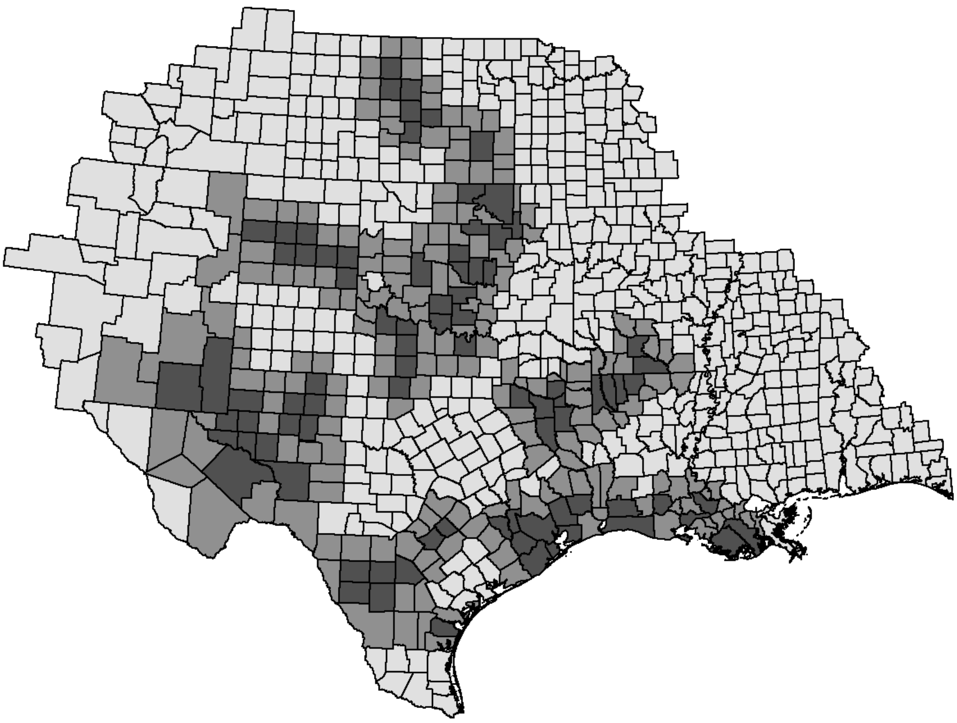

Figure 4: Map of Oil Discoveries 1930

Note: Oil abundant counties (dark grey), Neighbors of oil abundant counties (grey), Other counties (light grey)

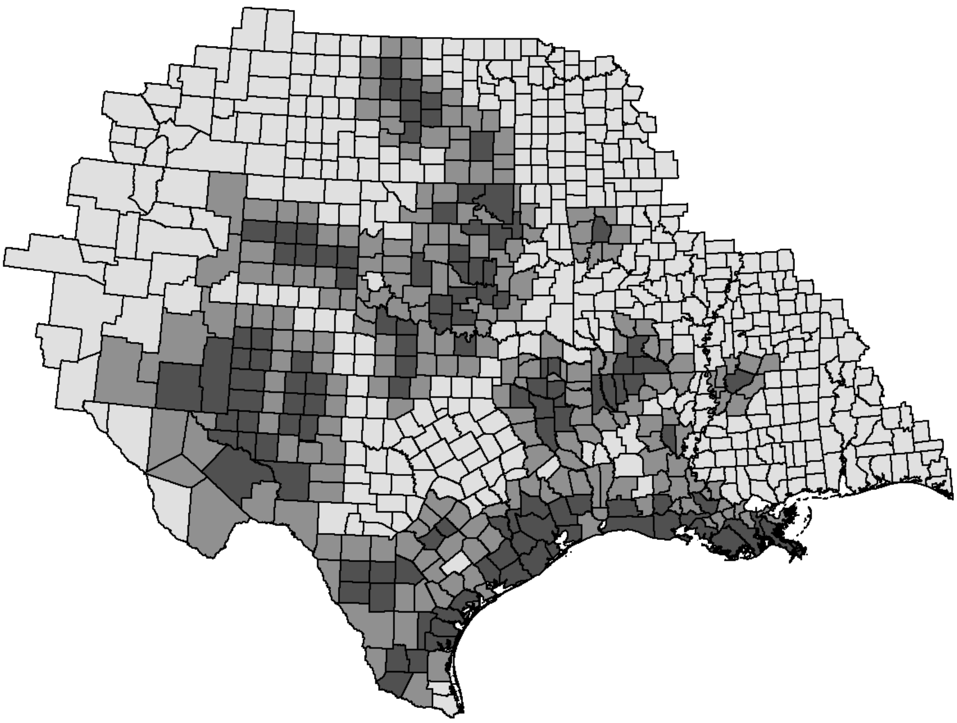

Figure 5: Map of Oil Discoveries 1940

Note: Oil abundant counties (dark grey), Neighbors of oil abundant counties (grey), Other counties (light grey)

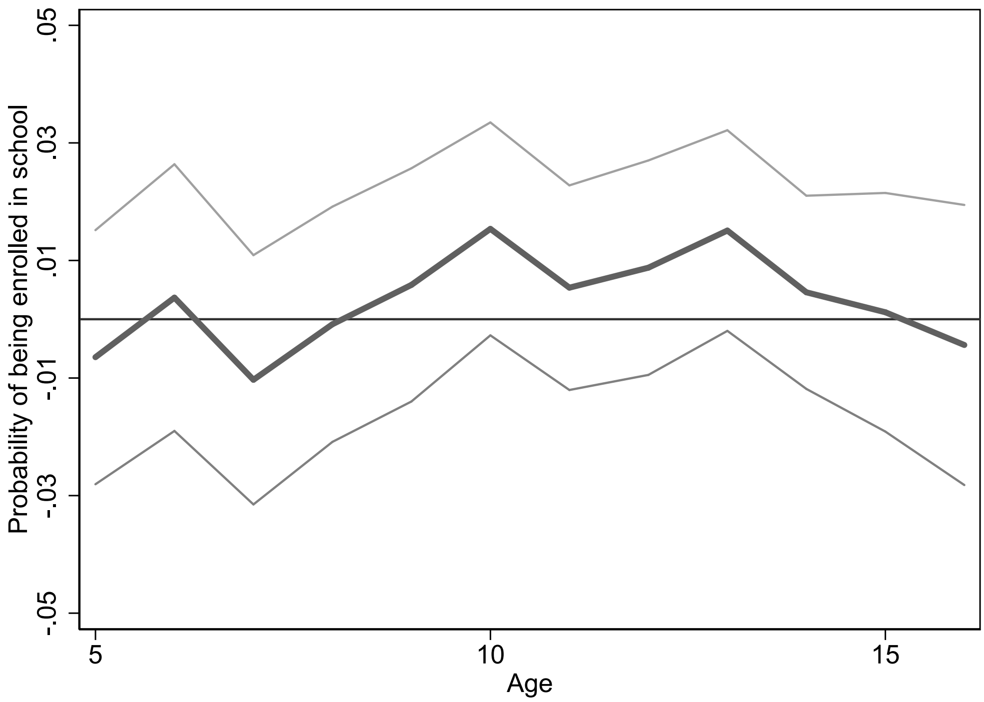

Figure 6: Effect of oil discoveries on school enrollment by age, white students

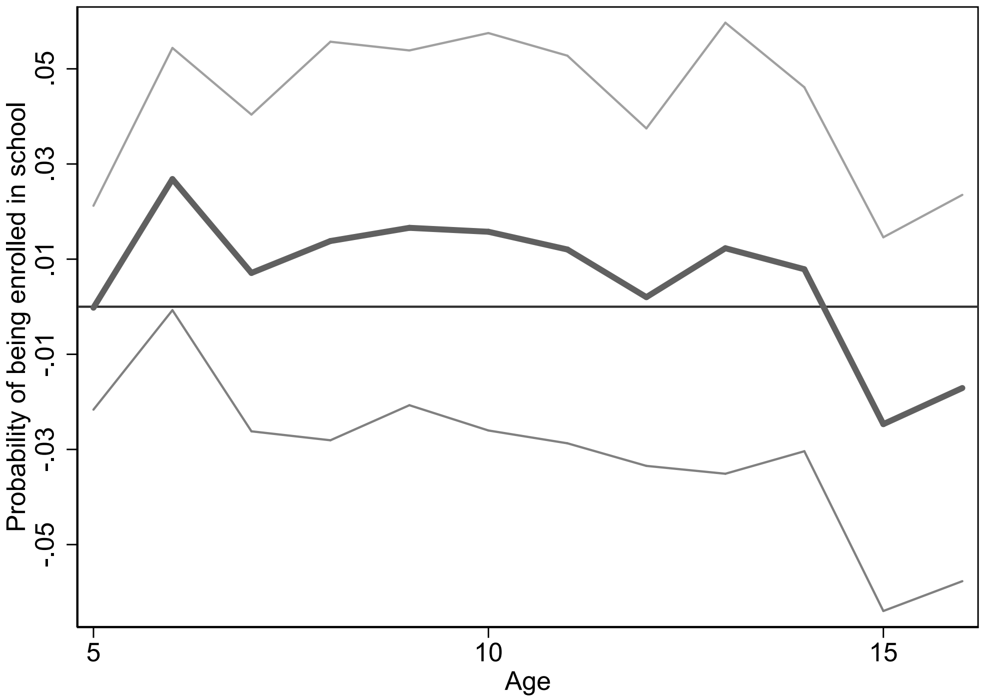

Figure 7: Effect of oil discoveries on school enrollment by age, black students

	Mean	Standard deviation	No. of counties.
Black school attendance 1900	0.410	0.231	401
Black school attendance 1920	0.603	0.234	659
Black school attendance 1940	0.748	0.187	670
White school attendance 1900	0.558	0.163	588
White school attendance 1920	0.735	0.095	758
White school attendance 1940	0.799	0.066	774
Student-teacher rations for white children, 1900	35.162	29.436	463
Student-teacher rations for black children, 1900	37.237	27.571	151
Student-teacher rations for white children, 1920	31.164	11.391	757
Student-teacher rations for black children, 1920	65.830	55.668	471
Student-teacher rations for white children, 1940	19.388	13.606	755
Student-teacher rations for black children, 1940	38.003	69.267	504
County revenue per capita 1890 (1940 $)	14.508	40.589	222
County revenue per capita 1932 (1940 $)	10.898	8.068	771
County revenue per capita 1957 (1940 $)	63.212	29.514	774
Education spending per capita 1890 (1940 $)	3.092	3.350	542
Education spending per capita 1932 (1940 $)	12.143	7.413	772
Education spending per capita 1957 (1940 $)	33.897	15.682	774

Table 1: Summary statistics at the county level

VARIABLES	(1)	(2)	(3)
	Ln(Revenue per capita)		
Discovered Oil Field	0.187*	0.243*	0.160*
	(0.096)	(0.140)	(0.089)
Mean Dep Var	2.956	2.869	2.956
Observations	1,767	1,331	1,767
Clusters	774	659	774
Excludes neighbors		X	
State x year FE			X

Data from 1890, 1932, and 1957, dollar values deflated to 1940. All regressions control for county fixed effects, year fixed effects, and time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 2: The effect of oil discoveries on county revenue

VARIABLES	(1)	(2)	(3)
	Ln(Education spending per capita)		
Discovered Oil Field	0.145**	0.166**	0.092*
	(0.062)	(0.077)	(0.053)
Mean Dep Var	2.335	2.156	2.335
Observations	2,086	1,649	2,086
Clusters	774	720	774
Excludes neighbors		X	
State x year FE			X

Data from 1890, 1932, and 1957, dollar values deflated to 1940. All regressions control for county fixed effects, year fixed effects, and time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 3: The effect of oil discoveries on county education spending

VARIABLES	(1) Share students potentially covered	(2) Has RW school	(3) # RW teachers	(4) # RW schools
Discovered Oil Field	0.068	0.063	2.426**	0.787**
	(0.044)	(0.042)	(0.982)	(0.376)
Observations	9,114	9,124	9,124	9,124
Mean Dep Var	0.104	0.347	4.805	1.859

Annual data from 1920-1931, 772 counties. All regressions control for county fixed effects, year fixed effects, and time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: The effect of oil discoveries on participation in the Rosenwald program

VARIABLES	(1)	(2) Cumulative original cost (in dollars) paid by	(3)
	Local public funds	Local white community	Local black community
Discovered Oil Field	3,889.177**	-16.094	493.505*
	(1,591.252)	(43.239)	(254.245)
Mean Dep Var	3,392.523	324.935	1,322.524

Annual data from 1920-1931, 9,124 observations, 772 counties. All regressions control for time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 5: The effect of oil discoveries on financing participation in the Rosenwald program

VARIABLES	(1)	(2)	(3) Ratio of children attending school to teachers	(4)	(5)	(6)
		Whites			Blacks	
Discovered Oil Field	-0.041	1.402	0.161	-13.380**	-14.136*	-16.440**
	(1.637)	(1.998)	(1.739)	(6.534)	(7.762)	(7.046)
Mean Dep Var	28.172	28.989	28.172	62.025	63.740	62.025
Observations	12,067,944	10,094,395	12,067,944	2,989,214	2,525,423	2,989,214
Clusters	774	738	774	577	518	577

Regressions use decadal data from 1900 - 1940. Control variables: Year fixed effects, county fixed effects, time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall. Columns 1-3 weight by the number of white students per year and county, columns 4-6 by the number of black students. The number of observations takes the frequency weights into account.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6: The effect of oil discoveries on student-teacher ratios, 1900-1940

VARIABLES	(1) Completed education: whites College	(2) whites Highschool	(3) Ln (Salary income) whites	(4) Completed education: blacks College	(5) blacks Highschool	(6) Ln (Salary income) blacks
Discovered Oil Field	0.025	0.007	0.112***	-0.002	-0.007	0.063
	(0.018)	(0.012)	(0.026)	(0.028)	(0.035)	(0.052)
Mean Dep Var	0.428	0.811	6.584	0.278	0.699	5.890
Observations	162,744	162,744	136,583	25,628	25,628	21,898
Clusters	755	755	755	503	503	500

All regressions control for longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall, state fixed effects. The number of observations takes the frequency weights into account.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 7: The effect of oil discoveries on teacher quality measures, 1940

VARIABLES	(1)	(2)	(3) School attendance rates	(4)	(5)	(6)
Discovered Oil Field	0.001	0.006	-0.002	0.005	0.002	0.007
	(0.006)	(0.013)	(0.008)	(0.015)	(0.006)	(0.011)
Mean Dep Var	0.750	0.612	0.746	0.601	0.750	0.612
Observations	16,255,432	5,096,499	13,670,942	4,407,595	16,255,432	5,096,499
Clusters	774	737	741	694	774	737
Sample	White	Black	White	Black	White	Black
Excludes Neighbors			X	X		
State x year FE					X	X

Regressions use decadal data from 1900 - 1940. Control variables: Year fixed effects, county fixed effects, time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall. The regressions are weighted by the number of school-aged children of the respective race. The number of observations reflects these frequency weights.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 8: The effect of oil discoveries on school enrollment

VARIABLES	(1) Student-teacher ratios white	(2) black	(3) School attendance rates white	(4) black
-29 to -20	0.124	-0.669	0.005	0.008
	(1.724)	(4.648)	(0.009)	(0.017)
-19 to -10	-2.004	7.715	0.008	0.035*
	(2.156)	(8.838)	(0.011)	(0.021)
-9 to -1	-3.459	14.648	-0.010	0.023
	(2.352)	(11.592)	(0.012)	(0.027)
0 to 9	-2.689	-4.938	-0.005	0.007
	(2.898)	(9.546)	(0.014)	(0.023)
10 to 19	-2.131	-2.640	0.008	0.055*
	(3.016)	(10.922)	(0.013)	(0.028)
20+	-1.422	0.037	0.018	0.090**
	(3.761)	(15.952)	(0.016)	(0.038)
Observations	12,067,944	2,989,214	16,255,432	5,096,499
Years	1900-1940		1900-1940	
Counties	774	577	774	737

Control variables:Control variables: Year fixed effects, county fixed effects, time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall. Column 1 weighted by the number of white students, column 2 by the number of black students., column 3 and 4 by the number of school-aged children of the respective race. The number of observations reflects these frequency weights. Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Leads and lags analysis, part 1

VARIABLES	(1) Cumulative original cost paid by: Public funds	(2) Cumulative original cost paid by: White community	(3) Cumulative original cost paid by: Black community	(4) Share students potentially covered	(5) Has RW school	(6) # RW teachers	(7) # RW schools
-19 to -15	-1,108.901*	-94.259	229.345	0.028	0.014	-0.756	-0.254
	(615.149)	(78.335)	(460.620)	(0.031)	(0.066)	(0.644)	(0.234)
-14 to -10	-1,028.945	-138.078	240.132	0.031	-0.040	-1.108	-0.402
	(1,377.371)	(113.258)	(538.682)	(0.039)	(0.072)	(0.937)	(0.362)
-9 to-5	-794.160	-187.169	14.426	0.053	-0.020	-1.402	-0.502
	(1,665.817)	(227.354)	(572.787)	(0.049)	(0.083)	(1.288)	(0.477)
-4 to -1	41.387	-265.392	602.662	0.070	0.021	0.361	0.214
	(2,067.802)	(235.614)	(712.333)	(0.057)	(0.099)	(2.090)	(0.812)
0 to 4	3,251.152	-274.954	836.097	0.129*	0.073	1.883	0.630
	(2,717.305)	(253.189)	(788.062)	(0.072)	(0.106)	(2.438)	(0.934)
5 to 9	6,379.498*	-220.343	1,573.862*	0.178**	0.063	4.567	1.815
	(3,520.669)	(271.721)	(953.091)	(0.082)	(0.115)	(2.890)	(1.166)
10 to 14	6,567.090*	-73.314	2,112.592	0.213**	0.083	5.167	2.177
	(3,483.900)	(301.946)	(1,341.230)	(0.093)	(0.135)	(3.417)	(1.520)
15 to 19	4,828.001	-156.898	1,662.657	0.192	0.052	3.018	1.141
	(3,868.808)	(304.670)	(1,292.289)	(0.121)	(0.171)	(3.565)	(1.512)
20+	9,645.757*	-286.161	2,442.858	0.221*	0.120	8.041	3.733*
	(5,024.032)	(331.359)	(1,577.156)	(0.134)	(0.209)	(5.435)	(2.204)
Observations	9,124	9,124	9,124	9,114	9,124	9,124	9,124
Years	1920-1931						

Annual data from 1920-1931, 772 counties. All regressions control for county fixed effects, year fixed effects, and time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall. Dollar values are deflated to 1940.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Leads and lags analysis, part 2

VARIABLES	(1) Ln(Revenue per capita)	(2) Ln(Education spending per capita)
Discovery Before 1932 x I1932	0.144	0.152
	(0.190)	(0.098)
Discovery Before 1932 x I1957	0.204	0.233**
	(0.202)	(0.103)
Discovery Before 1957 x I1932	-0.064	0.073
	(0.245)	(0.126)
Discovery Before 1957 x I1957	0.142	0.167
	(0.253)	(0.131)
Discovery After 1957 x I1932	0.038	-0.242
	(0.193)	(0.301)
Discovery After 1957 x I1957	-0.021	-0.025
	(0.159)	(0.114)
Observations	1,767	2,086

Data from 1890, 1932, and 1957, 774 counties. All regresions control for county fixed effects, year fixed effects, and time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall. Dollar values are deflated to 1940.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Leads and lags analysis, part 3

VARIABLES	(1) Completed College White	(2) Completed Highschol White	(3) ln(Salary income) White	(4) Completed College Black	(5) Completed Highschool Black	(6) ln(Salary income) Black
Not yet discovered	-0.018	-0.024	-0.060	0.004	0.039	-0.012
	(0.026)	(0.028)	(0.045)	(0.036)	(0.052)	(0.095)
Observations	131,952	131,952	110,527	21,036	21,036	17,831
Clusters	640	640	640	418	418	417

All regressions control for longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall, state fixed effects. Regressions are weighted by the number of teachers of either race with nonmissing education or wage information, respectively. The number of observations reflects these frequency weights.

Robust standard errors, clustered at the county level, in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 12: Robustness checks, cross-sectional regressions

Appendix

In this appendix, I present several additional findings and robustness checks.

A large literature in Economics has found that racial heterogeneity is detrimental to public goods provision.[9] In my setting, it might be that white voters were less willing to spend oil windfalls on education and public goods if the black population share was larger. To examine this, table A1 shows the results from my baseline difference-in-differences specification with log county revenue and education spending per capita as outcomes, but additionally including the black population share and the interaction of oil discoveries with the black population share. As before, population data are interpolated from decadal data provided by Haines and ICPSR (2010) This specification allows me to analyze whether counties with more black residents had generally lower revenue and education expenditures, and whether their response to oil discoveries was more muted. As can be seen, there is little evidence for both scenarios: Both the coefficients on black population and its interaction with oil discoveries are small and not significantly different from 0, and the point estimates also do not display a clear pattern. The racial heterogeneity of a county seems not to influence whether the county experienced revenue and education spending increases after oil discoveries.

As discussed in section 3, the student-teacher ratio data for 1900 is based on a 5 % sample only. Since such samples usually contain only few teachers and even fewer black teachers, the student-teacher-ratio for that year is often undefined and generally appears very noisy. In table A2, I therefore redo table 6, but omitting 1900 and focussing only on the 4 census years where I have full count data. The qualitative conclusions remain unchanged: While the ratio of white schoolchildren to white teachers stayed constant, the number of black students per black teacher decreased substantially. If anything, the point estimates are even larger in absolute value for blacks.

[9] A survey of this literature is provided by Alesina and La Ferrara (2005). Of particular relevance for this study are those that look at the effect of ethnic heterogeneity on public education provision in the US such as Poterba (1997), Goldin and Katz (1999) and Alesina et al (1999).

In a final robustness check for my difference-in-in-differences strategy, I drop all counties that do not have any major oil deposits and only compare the outcomes in counties with such fields before and after their respective discoveries. This is a very demanding robustness check, as it drops more than 75% of my sample. The results are shown in table A3 andA4. As can be seen, most of my results survive unqualified: Oil discoveries led to greater revenue per capita, lower student-teacher ratios for black students, and greater participation in the Rosenwald program. An exception to this is the coefficient for education spending, which remains positive, but is greatly reduced in size and not significantly different from zero anymore. Another change concerns black school attendance, where in this specification (and contrary to leads and lags analysis in section 5), I find a negative coefficient for black school. Overall, however, the results from this robustness check provide further validation for my key results, as they indicate clear increases in school quality for blacks, but with no increased school enrollment.

Throughout the paper, I have shown results always for my basic difference-in-differences specification and for alternative specifications where I included state x year fixed effects or excluded counties without oil wealth but bordering oil rich ones. For the Rosenwald regressions with their several outcome variables, I have only shown the basic specification. For completeness, tables A5 and A6 report results when excluding counties adjacent to oil rich ones and when including state x year fixed effects, respectively. As can be seen, the results are similar to those of the main specification.

Many counties never participated in the Rosenwald fund, so that the cumulative contribution of public funds, local whites, or local blacks is very often 0. Because of this, I have so far used the contributions in levels as my measure of Rosenwald participation. In table A7, I show results based on a log specification. This leaves me with only 2,000-3,000 observations, which impairs precision and renders some coefficients marginally insignificant. In addition, focussing on counties with a positive cumulative contribution, I only examine the intensive margin response here, and not the decision to participate at all. In spite of these caveats, however, the point estimates still indicate a sizable response of public funds, black funds, and in this specification also white funds to oil discoveries.

Finally, in table A8, I look at the per-capita spending increases in terms of public funds and the funds of the white and black community, respectively. Looking at a county's total cumulative spending on Rosenwald participation most closely resembles the regressions with the number of schools and teachers and is therefore my preferred specification. However, total spending might just have been driven by population increases. I use decadal population data from the ICPSR county dataset (Haines and ICPSR, 2010) to interpolate annual populations and then divide current-year Rosenwald spending by the interpolated population. I use the current-year expenditures here since with growing populations, it makes less sense to add up past per capita expenditures. In column 1, I look at public funds (divided by total population) and find that there is indeed a statistically significant effect: Oil discoveries increased the amount of public funds spent on Rosenwald participation by around 3.5 cents per person and year. The effects of whites and blacks were much more muted and not significantly different from zero, indicating that the increased contribution of black citizens to the Rosenwald program was merely driven by their increased numbers.

VARIABLES	(1) Ln(Revenue per capita)	(2) Ln(Education spending per capita)
Discovered Oil Field	0.202*	0.142*
	(0.120)	(0.078)
Discovered Oil Field x black pop. share	-0.094	0.005
	(0.581)	(0.377)
Black population share	0.158	-0.091
	(0.537)	(0.303)
Observations	1,767	2,086

Data from 1899, 1932, and 1957, dollar values deflated to 1940, 774 counties. All regressions control for county fixed effects, year fixed effects, and time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A1: Racial heterogeneity and public spending

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Ratio of children attending school to teachers					
	Whites			Blacks		
Discovered Oil Field	-0.295	0.465	-0.007	-17.230**	-21.485**	-20.005**
	(1.618)	(2.013)	(1.704)	(7.854)	(9.960)	(8.128)
Observations	10,905,388	8,937,087	10,905,388	2,783,672	2,321,637	2,783,672
Clusters	774	728	774	577	515	577

Regressions use decadal data from 1910 - 1940. Control variables: Year fixed effects, county fixed effects, time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall. Columns 1-3 weight by the number of white students per year and county, columns 4-6 by the number of black students. The number of observations reflects these frequency weights.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A2: Student-teacher ratio results without data for 1900

VARIABLES	(1) ln(Revenue per capita)	(2) ln(Educ.spending per capita)	(3) Student-teacher ratios white	(4) Student-teacher ratios black	(5) School attendance white	(6) School attendance black
Discovered Oil Field	0.174*	0.026	1.237	-15.939*	-0.004	-0.039***
	(0.097)	(0.072)	(1.623)	(8.939)	(0.006)	(0.013)
Observations	386	439	2,479,262	577,266	3,614,590	1,020,848
Counties	171	171	171	138	171	167
Years	1890, 1932, 1957		1900-1940		1900-1940	

Control variables: Year fixed effects, county fixed effects, time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall. Column 3 weighted by the number of white students, column 4 by the number of black students. Columns 5 and 6 are weighted by the number of school-aged children of the respective race.The number of observations reflects these frequency weights.

Standard errors, clustered at the county level, in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table A3: Dropping counties without major oil fields

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Cumulative original cost paid by			Share students	Has RW school	# RW teachers	# RW schools
	Public funds	White community	Black community	potentially covered			
Discovered Oil Field	3,302.020**	-6.505	391.803	0.061	0.069	2.064**	0.645
	(1,579.225)	(53.213)	(291.848)	(0.047)	(0.047)	(1.027)	(0.405)
Years				1920-1931			

Annual data from 1920-1931, 171 counties, 2,002 observations. All regressions control for time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall.
Standard errors, clustered at the county level, in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A4: Dropping counties without major oil fields, part2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Cumulative original cost paid by			Share students	Has RW school	# RW teachers	# RW schools
	Public funds	White community	Black community	potentally covered			
Discovered Oil Field	5,166.017**	-17.355	657.490**	0.104*	0.071	3.539***	1.325***
	(2,107.243)	(49.195)	(296.960)	(0.055)	(0.046)	(1.263)	(0.486)
Years				1920-1931			

Annual data from 1920-1931, 682 counties, 7,347 observations. All regressions control for time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A5: Rosenwald results, dropping that are next to a county with a discovered oil field

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Cumulative original cost paid by			Share students	Has RW school	# RW teachers	# RW schools
	Public funds	White community	Black community	potentally covered			
Discovered Oil Field	3,946.063**	24.533	621.160**	0.071*	0.065*	2.675***	0.879**
	(1,537.462)	(44.514)	(257.737)	(0.042)	(0.039)	(0.985)	(0.367)
Observations	9,124	9,124	9,124	9,114	9,124	9,124	9,124
Years				1920-1931			

Annual data from 1920-1931, 772 counties. All regressions control for time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall, as well as state x year fixed effects.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A6: Rosenwald results, including state by year fixed effects

	(1)	(2)	(3)
VARIABLES	Log of the cumulative original cost paid by		
	Public funds	White community	Black community
Discovered Oil Field	0.616	0.294	0.329*
	(0.379)	(0.226)	(0.187)
Observations	3,097	1,998	3,034
Clusters	329	210	313

Annual data from 1920-1931, 772 counties. All regressions control for time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall, as well as state x year fixed effects.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A7: Rosenwald spending results, log specification

	(1)	(2)	(3)
VARIABLES	Curent-year contribution		
	Public funds per inhabitant	White community per white inhabitant	Black community per black inhabitant
Discovered Oil Field	0.034*	0.004	0.005
	(0.018)	(0.002)	(0.009)
Observations	9,124	9,124	8,868
Clusters	772	772	756

Annual data from 1920-1931. All regressions control for time-varying effects of longitude, latitude, aridity, semi-aridity, distance to the closest river, distance to the ocean, annual rainfall, as well as state x year fixed effects.
Standard errors, clustered at the county level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A8: Rosenwald spending results, current-year contribution per capita

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