LOCAL RESPONSES TO SCHOOL FINANCE EQUALIZATION: WEALTH OR PLACE?

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ABSTRACT

Over the past 50 years, a combination of court cases and legislative actions has greatly reduced the variance in revenues across school districts within states by removing local property tax as the major revenue source for schools. This paper examines a single state, Kentucky, over a long period of time to examine the extent to which localities can offset state efforts to remove property wealth as the basis of revenue disparities. The empirical results suggest that even in a state with a strong state education reform and constraints on revenues, the property wealth of localities continues to enter as a significant determinant of local contributions to education that exceeds to some degree the state efforts to offset inequality among districts. Indeed, wealth exhibits a stronger effect on revenues now than when the reform was introduced. Moreover, in Kentucky, the districts located in the Appalachian region of the state continue to contribute less own-source revenues not because of the property wealth differences but because of other "place-based" factors that cannot be captured in the data.

Keywords: local revenues, school districts, finance equalization

1. INTRODUCTION

One of the most salient current policy issues is the growing income and wealth gap within countries. While world wealth has grown and inequality across countries has diminished over the past three decades, the increased within-country inequality continues to create political and social challenges in the U.S. and other countries. Some of the gap in the U.S. is place-based and relates to long-standing deficiencies in human capital accumulation in those places.1 Urban areas with highly educated populations have disproportionately

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1. See Chetty, et. al. (2014). This paper is one of a series dealing with wealth inequality and geography. Also, see Islam, Minier and Ziliak (2015) for a discussion of the 5 regions of the U.S., including Appalachia, that experience persistent poverty.
attracted the industries that have experienced large wealth gains in recent decades. Rural areas, and especially rural areas with less educated populations, have stagnated or lost employment and wealth. For education policy, it is of great interest to note that the rising inequality within the U.S. has almost perfectly corresponded to the period in which states attempted to equalize education opportunities by diminishing local property wealth as the base for education revenues. Both scholars and policymakers have assumed that court cases and legislation that resulted in greater centralization of finance for schools at the state level would diminish the variance in expenditures across school districts within states. Greater equality would then reduce the human capital gap in the long-run.

Empirical evidence generally supports the idea that revenue variance within states has been reduced by school finance equalization reforms (SFEs) (Murray et al., 1998; Card and Payne, 2002, LaFortune et. al., 2016). There is less agreement regarding the effects of SFEs on economic or educational outcomes (Hanushek, 1986; 2006; Hanushek and Lindseth, 2009; Card and Payne, 2002; Jackson, Johnson, and Persico, 2016). Particularly relevant to this paper is work by Cascio, Gordon, and Reber (2013) that found localities reduced their own source revenues following the introduction of Title I federal spending. In so doing, the local jurisdictions partially offset increases in federal spending.

This paper looks at the revenue responses of local governments to a SFE in a single state, Kentucky. In 1989, the Kentucky Supreme Court found that the state constitution required that “[e]ach child, every child, . . . must be provided with an equal opportunity to have an adequate education” (Rose v. Council for Better Education, emphasis in original). Kentucky was the first state to implement a reform that emphasized “adequacy” of funding and not merely equal resources across districts (Lafortune et. al., 2018, p. 5). There were initially substantial increases in resources to districts in addition to a change in the formula for state aid (Clark (2003), Hoyt (1999) and Flanagan and Murray (2004). While the reform initially eliminated the gap in revenues between districts, after a period of almost 30 years, gaps in per pupil spending have re-emerged.

We examine evidence to determine whether the return of the gap is based on property wealth, whether it is based on “place”, or whether both enter the

2. Attention to the relationship between the educational reforms and outcomes has increased recently for several reasons and not least of which is the passage of time that enables researchers to focus on long term consequences of the changes.

3. A later study will examine outcomes associated with financed-induced reforms.


5. See Figures 1 and 2.
explanation. In the case of Kentucky, evidence suggests the response difference is explained by both initial property wealth and place. Increases in revenues from their own tax bases among the wealthiest districts now largely drive the disparities between districts. And, controlling for property wealth, income, and several other factors, districts located outside of Appalachia continue to generate more local revenues for their schools than those districts located in Appalachia. The findings suggest that progressive state formulae may not be sufficient to change long-standing patterns of spending. Like Jackson et al. (2018), this paper raises questions about the importance of the source of revenues for schools.

2. SCHOOL FINANCE BACKGROUND

In the 1970s and 80s, economists devoted a great deal of attention to education finance issues. The academic interest was driven, in part, by the onset of court and legislative actions surrounding the equity of states’ finance mechanisms. Because schools historically relied largely on local sources of revenues (typically property taxes), wide disparities in revenues between districts often resulted. Some of this reliance on local revenues stemmed from the history of public schools in the U.S. and the heavy role of towns and localities in providing subsidies to the schools. As late as 1930, schools still received over 80% of their revenues from the locality in which they resided (Toma, 2014).

Critics of local funding and the property tax argued that reliance on local tax bases was inherently unfair to the children of lower property wealth districts. The California Supreme Court in 1971 agreed with the critics in its Serrano v. Priest decision. The California legislature responded with a plan that shifted more responsibility to the state and limited the extent to which localities could increase taxes on property. The California decision led to a wave of challenges to state funding systems across the United States. Over the next 25 years, courts in 43 states would hear cases regarding the constitutionality of the funding system for public schooling, and these court challenges continue today. Many states have followed the California lead and overturned their funding systems while others have not overturned their systems but have modified existing sources of revenues for schools. But even in states without a court challenge, states generally have been proactive in moving toward funding formulae that shift more responsibility to the state and away from local tax bases. The result

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6. This paper will focus on place by separating school districts located in Appalachia and those not located in Appalachia. Differences in educational choices and outcomes between the two locales have been emphasized in previous works. See Cowen et al. (2012), Fowles et al. (2014), Streams et al. (2011) and Barrett et al. (2012).

7. Jackson et al. (2016) distinguish between “exogenous” income changes in spending via court-ordered spending and “endogenous” local spending changes. They argue that the exogenous changes in spending are the ones that generated school achievement improvements.
of these changes in funding sources has been to reduce the average variance in funding across local districts within a state.\(^8\)

Implicit in the motivation to centralize funding at the state level and equalize revenues across districts is the notion that school expenditures and student achievement are directly linked. While there is a long history of research that casts doubt on this assumption (Hanushek, 1986, 1997, 2006), recent research regarding the link between funding and student achievement, and the role of educational expenditures more generally has been renewed (Hoxby, 2001; Murray et. al., 2004; Baicker and Gordon, 2006; Jackson et. al., 2016; Lafortune et.al., 2018). Lafortune et al. (2018) suggests that low-income and high-income districts have been roughly at revenue parity since 2001 because of the way in which funding has been allocated to schools over the past twenty-five years. They find that court reforms have reduced between-district inequities but because of the distribution of poor and minority students across rich and poor districts, the reforms have not reduced the gap between high and low-income students or the minority-white gap. Jackson et. al. (2016) found positive long run improvements with relatively large coefficients on court-ordered spending variables over a host of measures of outcomes.

But not all studies have found such large or positive improvements associated with finance reforms. Baicker and Gordon (2006) found that court orders requiring more state financing of schools and more progressivity have been followed by little evidence of more resources available for low-income districts, and this is especially true when examining the effect on other public services available to those districts. The reason for the overall static outcome in resources available in low income districts is the fact that state revenues are substituting for local revenues either directly to the schools or indirectly in the form of resources for other public services.

Recent studies at the state level have begun to try to provide insights into why particular patterns of effects may be observed in the national studies (Conlin and Thompson, 2014; Hyman, 2016). Hyman, for example, finds evidence that there have been long-term gains in Michigan student outcomes beyond high school following state finance reform. Both college enrollment and degree receipt increased following Michigan’s school finance reforms but he found that resources were directed toward schools serving wealthier families within districts.

This paper looks at a single state, Kentucky, which adopted strong centralized finance reforms. Kentucky is interesting because it is generally considered to have been an influential case that inspired others “to go well beyond equality in spending and focus on ensuring that all students in the state have equitable

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8. See Toma (2014) for a fuller discussion.
access to adequate educational opportunities” (Flanagan and Murray, 2004, p. 195). Kentucky also offers the advantage of looking at the effects of centralization over the long run because the Court-ordered financial reform has been in place since 1990. In the spirit of Baicker and Gordon (2006), Cascio et al. (2013), and Hyman (2017), we look at the reaction of local school district funding decisions to a court-ordered formula for funding.

3. THE KENTUCKY SETTING

Historically, Kentucky relied heavily on the property tax to fund its schools. There was early recognition that this reliance resulted in inequalities in school funding related to tax capacity and there was an attempt in 1952 to remedy the problem by introducing minimum funding from the state (Day, 2011). To participate in the state program, localities were required to tax the assessed value of property at a uniform rate. By 1976, enforcement of local effort had vanished and the program had become a flat grant to all districts funded by a state property tax. Legislation known as a Power Equalization Program (PEP) was passed in 1976 that provided state funds “to districts to supplement revenues raised through a local property tax at a state-set rate” (Flanagan and Murray, 2004, p. 197). State funds accounted for 63% of total school funding by 1989. But the PEP did not reduce the spending inequalities across districts. Failure stemmed from multiple causes including (1) the unwillingness of local boards to tax at the rate that took full advantage of the PEP; (2) the state did not enforce uniform fair-market valuations on property throughout the state; and, (3) the state rarely fully funded the PEPs (Flanagan and Murray, 2004, pp. 197-8).

Starting with efforts from school superintendents “whose districts were among the bottom third of the state as measured in assessed value per pupil” (Day, 2011, p. 18), the Council for Better Education ultimately filed a lawsuit against the Kentucky legislature alleging that the General Assembly and Governor had not lived up to the constitutional requirement to provide an adequate education for the Commonwealth’s children.9 In 1989, the Kentucky Supreme Court in Rose v. Council for Better Education, held that the state had failed in its duty to “provide for an efficient system of common schools.”10

Of interest to this paper, many of the property-poor districts were and continue to be in the Appalachian region of the state. In the decade prior to the Supreme Court decision, for example, all districts in the bottom decile of property wealth were in Appalachia and only two districts in Appalachia belonged in the top decile of wealth. These wealth differences and other factors resulted

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9. For a full history of the forces leading to the lawsuit, see Day (2003; 2011).
in gaps in the revenues coming from and to school districts located in the Appalachian region relative to other school districts. Along with these revenue differences, the population of Appalachia was then and remains less-educated, lower income, and experiences higher rates of unemployment and poverty than the non-Appalachian portions of the state thus earning the area the title of a “persistent poverty” region of the U.S. (Islam, Minier, and Ziliak, 2015).

In response to the Supreme Court’s decision, the legislative body passed the Kentucky Education Reform Act (KERA) which consisted of several components, including accountability, governance, and finance. The finance legislation required districts to follow a minimum rate of taxation on local property wealth. Each school district was required to assess property at 100% of its market value. These changes were instituted as a means of encouraging the districts to raise own-source revenues higher than what existed under the prior formula. As a further incentive, the assessed property value had to be taxed at a minimum rate of 30 cents per $100 of assessed value as a condition of receiving funds from the state funding system, known as Support Education Excellence in Kentucky (SEEK).

As described by law, the state funds to districts consisted of two fundamental components: a per pupil adjusted base guarantee (ABG) and funds known as Tier 1 funding. A district’s local required revenue would be applied to the ABG, and the state would fund the remaining balance. School districts could go beyond their local required tax effort up to 15% of the revenue generated through the ABG. As with the ABG, the additional Tier 1 amount is comprised of a local and state portion that depends on the district per pupil property assessment divided by the equalization level of 150% of the statewide per-pupil assessment average, providing the percentage for which the district must pay. The remaining amount is paid by the state if a district levies the maximum Tier 1 tax rate. Local effort for all districts is capped at 30% beyond the revenue generated by the ABG plus Tier 1 max and is not equalized by the state (LRC, 2007).

From an economic perspective, this formula was designed to encourage local districts to raise additional revenues to qualify for a state match of funds. Technically, a floor was established in terms of the rates at which districts must tax the fully valued property of the district to be eligible for state funds as well as a ceiling on additional revenues that could be raised. The variation in district

11. The accountability component was among the first in the country to require that schools be held accountable in the form of annual testing. Governance addressed issues such as local site-based school councils and nepotism in hiring practices (Flanagan and Murray, 2004).

12. The guaranteed base per pupil is adjusted for higher-cost students, such as exceptional or at-risk students and for transportation (LRC, 2007).
revenue between this floor and ceiling is the focus of this study. The state provided incentives for local effort beyond the floor by matching Tier 1 revenue. Over the years, the proportion of districts qualifying for maximum Tier 1 matching has increased from 70% in 1993 to 93% as of 2007 (LRC, 2007, p. 49). This trend is due to both an increase in local effort among some districts as well as a decline in the effort required to qualify.

By design, the SFE formula initially equalized revenues per pupil across districts. At the initial implementation of the SEEK formula, legislation also authorized relatively large increases in state appropriations via the base to districts. The legislation, consequently, changed not only the funding formula but also the level of revenues (and expenditures) per pupil to the districts (Hoyt, 1999; Clarke, 2003). Funding was equalized by the state’s redistribution of state funds from the higher property wealth districts to the lower property wealth districts.

This funding formula was designed to remove property wealth as the basis of revenue disparities between districts. But legislation also allowed for “permissive taxation” in the form of utility taxes for school districts and occupational taxes by cities, counties, and school districts. Prior to KERA, 93 districts levied a utility tax and 6 districts levied an occupational tax. In FY 1991, 57 districts adopted a utility tax and 2 districts adopted an occupational tax, for a total of 150 districts levying a utility tax and 8 districts levying an occupational tax. By adding these taxes, districts could increase their local tax effort without raising, or significantly raising, their property taxes in to qualify for Tier I equalization. By FY 2007, 157 districts had levied a utility tax, and 8 districts continued to levy an occupational tax. (No district has levied an excise tax.)” (LRC, 2007).

4. CONCEPTUAL FRAMEWORK

As described above, Kentucky placed a floor on local property tax revenues mandating that localities contribute to the cost of the production of schooling. State revenues to the districts were based on this required local contribution as an effort to prohibit the substitution of state revenues for own source revenues. The KERA legislation also placed a ceiling on local property revenues but the

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ceiling was less binding than the floor in that it could be adjusted with the permission of taxpayers’ votes. And, there were at least some adjustments to local revenues that could occur by taxing other sources of revenues than property. After almost three decades, the remainder of this paper examines two questions: (1) did the SEEK formula remove the influence of property wealth on K-12 education resources? And, (2) controlling for wealth, did the equalization formula remove “place” as a factor in own source revenue generation?

To further explore the research question, suppose that the centralized funding formula succeeds in reducing or neutralizing wealth as a source of revenues. And, for a moment, suppose that the reduced variance in revenues leads to smaller school outcome differences. Over the long run, the reduced variance in school outcomes presumably would imply that taxpayers across districts be more similar in their latent demands for public education, controlling for shocks to the economy and other similar factors. In this idealized world, successful school finance reform would mean that localities’ willingness to pay for their own schools would not only be independent of property wealth (because it was neutralized by the state formula) but the resulting reduced variance in education of the population would change the underlying differences in the population and the subsequent demand for education. This implies that in this idealized framework, the location of a district and its property wealth should play little role in the revenues generated for education, ceteris paribus.

If, on the other hand, school formulae that attempt to equalize revenues are effective neither at neutralizing wealth as a source of variance in school districts’ revenues nor at reducing the variance in educational outcomes, factors such as wealth and place will continue to influence demand and influence localities’ willingness to generate revenues. One way in which this could happen is that the funding improves outcomes for certain segments of the population but those who benefit move out of the district to wealthier districts with more opportunities. Our empirical model is not intended to examine the effects of KERA and the SEEK funding formula on school or population outcomes directly. Rather, we more modestly ask whether, after almost three decades of SFE, we continue to observe differences in local revenues the districts contribute to schools and to what extent those can be explained by property wealth, and secondarily, by place, that should no longer enter funding outcomes.

Figure 1 illustrates basic trends in school district finance since the 1970s with an emphasis on the patterns of funding by (5th and 95th) wealth vigintiles. As Figure 1 illustrates, steep increases in funding immediately following KERA

14. Even with a referendum, there is the tier II cap of 30% beyond ABG + Tier I. There are a few districts exceeding this cap due to their pre-KERA revenue being grandfathered.

15. In another paper, we look at long-term changes in the education of the adult population of the districts.
have been followed by smaller growth over time. It also illustrates that differences by wealth in total state and local revenues per pupil across district locales were erased in the early years following the passage of the SFE. From about 2000 onward, however, the wealth gap in district revenues has re-emerged and resembles that which existed prior to 1990.

**Figure 1. State and Local Revenues Per Pupil by Property Wealth, 1977-2013**

![Image of Figure 1 showing trends in state and local revenues per pupil by property wealth from 1977 to 2013.](image-url)

Figure 2 provides a look at the trends of local revenues only. As can be seen, there has always been a gap in revenues generated by local districts based both on wealth and on place (controlling for no other factors). The gray solid and dashed lines indicate the trends and the gap for (20th and 80th percentile) wealth among non-Appalachian districts and the black lines demonstrate trends and gaps by the same wealth percentiles among located in Appalachia. As the gray lines indicate, although revenues have increased over time, the gap between local revenues for low and high wealth districts has grown rather than diminished. And, while the gap between Appalachian and non-Appalachian districts in the bottom quintile of wealth disappeared for a few years following KERA, it has reappeared. A larger gap has developed over time between the

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16. Federal revenues are not reported in the tables but our results throughout the paper do not change when these revenues are included in the analyses.

17. Note that post-the reform, the graph looks at “voluntary” contributions – i.e., beyond those required to qualify for the state matching aid.

18. Quintiles are used so Appalachian districts can be included as a separate comparison.
wealthiest districts in Appalachian and those outside of Appalachia. The remainder of this paper seeks to understand whether these trends and their differences are significant controlling for observable characteristics and whether factors such as wealth and place are significant in explaining these differences.

Figure 2. Local Revenues Per Pupil By Region and Property Wealth, 1977-2013

5. DATA AND EMPIRICAL MODEL

5.1. DATA

The data for this model span from 1977 to 2013 and come from multiple sources. Basic data on district revenues from all sources and levels of government were collected from the Elementary and Secondary General Information System (ELSEGIS) surveys for 1976-1977 and 1979-1980 and the annual F-33 Survey of Local Government Finances. Both surveys were sponsored by the National Center for Education Statistics (NCES) in conjunction with the U.S. Census Bureau. In addition, the Kentucky Department of Education maintains a publicly available historical series of data on the SEEK funding that provides information on tax rates, local revenue required for the state equalization fund-
ing, the total amount of funding provided to the districts, and the per pupil assessed value of property in each district on which the funding decision is based.\textsuperscript{19}

The publicly available data are from 2001 to the present. Data from 1990 – 2000 are available only in paper form and must be requested from the Kentucky Department of Education. From these data, we constructed variables such as “voluntary or additional” local revenues collected by districts and whether a district is above or below the average district in assessed value. Data on district-level aggregate home values and demographic variables, including median household income, population of the districts, percent elderly and percent black are from the National Center for Education Statistics (NCES), Common Core Data, the U.S. Census school district tabulations for 1970, 1980, 1990, and 2000, and the pooled district-level samples from the American Community Surveys (ACS) from 2009 to 2013.\textsuperscript{20} To build a complete panel of the economic and demographic variables from the Census and ACS tabulations, we used linear interpolation to impute values for the years between the Census and ACS years.\textsuperscript{21} We measure the importance of coal in each county’s economy (i.e. coal dependency) with the ratio between coal revenue and county personal income net of government transfers. County-level data on coal production in short tons is from the Kentucky Department for Energy Development and Independence. We estimate coal revenue by multiplying production by the average price per ton of bituminous coal. We obtained the price data from the U.S. Energy Information Administration. Descriptive statistics are presented in Table 1.

5.2. EMPIRICAL MODELS AND RESULTS

We begin by examining the effects of property wealth on per pupil revenues by revenue source to assess whether the relationship has changed over time. The basic model to be estimated is as follows:

\[
R_{it} = \mu_i + T_t + \beta_1 V_{it} + \beta_2 V_{it} \ast T_t + \beta_3 X_{it} + u_{it}
\]  

\textsuperscript{19} http://education.ky.gov/districts/SEEK/Pages/Historical-SEEK.aspx; accessed 2/21/2017. Data prior to 2001 were provided in paper PDFs to Toma and these data were transferred manually to the data set.

\textsuperscript{20} A limitation of the Census/ACS home value data is that they do not include commercial property value. We have data on assessed property value from 1991 to 2013. We estimated the models for this period and observe patterns that are only slightly different than the results presented here. Specifically, the gap between the property wealth effects of Appalachian and non-Appalachian districts is slightly larger when we use the assessed value data, with the larger effect observed among non-Appalachian districts. These results are not presented here but are available upon request.

\textsuperscript{21} To match the ACS data with our finance data, we assumed that each district’s demographic and economic characteristics did not change from 2009 to 2013.
Where the dependent variables, $R_{it}$, alternatively will be total state plus local revenues per pupil, state revenues per pupil, total local revenues per pupil, and the amount of revenues raised by localities (Voluntary Local Revenue) above that which is required to receive SEEK funding. Each district $i$ will be observed in years, $t$, ($t = 1977-2013$). $V$ represents real aggregate home value per pupil. Relevant socioeconomic characteristics are denoted by the vector $X$. $T$ represents the year effects and $\mu$ is the district fixed effect.

### Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
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</thead>
<tbody>
<tr>
<td>State and Local Revenues</td>
<td>$7,367</td>
<td>$1,374</td>
<td>$4,297</td>
<td>$28,355</td>
</tr>
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<td>State Revenues</td>
<td>$5,379</td>
<td>$1,009</td>
<td>$2,622</td>
<td>$11,288</td>
</tr>
<tr>
<td>Local Revenues</td>
<td>$1,988</td>
<td>$1,161</td>
<td>$302</td>
<td>$20,907</td>
</tr>
<tr>
<td>Voluntary Local Revenues</td>
<td>$1,163</td>
<td>$855</td>
<td>$60</td>
<td>$20,265</td>
</tr>
<tr>
<td>Home Value</td>
<td>$94,886</td>
<td>$74,678</td>
<td>$7,770</td>
<td>$919,859</td>
</tr>
<tr>
<td>Median Household Income</td>
<td>$35,482</td>
<td>$13,084</td>
<td>$13,570</td>
<td>$160,000</td>
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<td>Coal Dependency</td>
<td>0.29</td>
<td>0.89</td>
<td>0</td>
<td>9.95</td>
</tr>
<tr>
<td>District Population</td>
<td>23,301</td>
<td>57,850</td>
<td>1,000</td>
<td>744,000</td>
</tr>
<tr>
<td>% African American</td>
<td>4.07</td>
<td>5.25</td>
<td>0</td>
<td>32.09</td>
</tr>
<tr>
<td>% Poverty</td>
<td>20.54</td>
<td>8.34</td>
<td>1.67</td>
<td>49.73</td>
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<tr>
<td>% Unemployed</td>
<td>6.71</td>
<td>3.59</td>
<td>0.96</td>
<td>24.77</td>
</tr>
<tr>
<td>% Pop. Age 65 or Older</td>
<td>10.4</td>
<td>4.08</td>
<td>-3.81</td>
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<tr>
<td>% Homeownership</td>
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<td>10.55</td>
<td>36.39</td>
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<td>Appalachian County</td>
<td>0.42</td>
<td>0.49</td>
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<td>1</td>
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</table>

*Notes: All dollar amounts are in 2009 dollars. Revenues and property value are per pupil.*

To estimate the above, we include interactions between home value per pupil and the year indicators to allow the property wealth effect to vary over the course of the panel. The vector of socioeconomic variables, $X$, include median household income, district population, the percentage of the population that is black, the district poverty and unemployment rates, the percent of the population above 65 years of age, the percentage of homes that are owner-occupied and, finally, coal dependency. The latter is included because of the long-standing economic and cultural role of coal in certain parts of the state and especially in the Appalachian region of the state. We assume all variables included will affect the demand for education in a district and will subsequently be reflected in the revenues raised by localities. While other independent variables above are included in standard models of the demand for education and the direction of influence follow normal demand functions, the role of coal dependency is less clear. High levels of coal production should be positively influencing the economy of a district and, thus, be positively related to a district’s willingness to raise own source revenues. On the other hand, coal may be associated with
negative influences on the environment and long-standing cultural factors that negatively influence demand for schooling. Finally, the error term, $u$, is clustered at the district level, $i$.

5.3. PROPERTY WEALTH EFFECTS

Equation (1) estimates allow us to determine the effect of property wealth on a given revenue type for a year by computing the sum of the coefficient on home value per pupil and the interaction term between home value per pupil and the indicator for the year of interest. Based on the estimated coefficients from the above equations, Figure 3 plots the effect of a $1,000 increase in home value per pupil on each revenue type for each year in our panel from 1977 onward. In the Figure, we can see that the effect of property wealth on state aid was regressive pre-KERA in that higher property tax wealth was associated with more state aid. In 1977, an increase in home value per pupil of $1,000 would have led to an additional $4.00 per pupil in state aid. This regressive effect spikes in 1989 at $5.11 per pupil. The adoption of KERA in 1990 almost immediately made state aid roughly neutral with respect to district property wealth. This neutrality continued until the early 2000s. However, the property wealth effect reversed direction and became increasingly progressive starting in the mid-2000’s. Now increased local property wealth implies less state aid.

Figure 3. Property Wealth Effects on School District Revenues by Source, 1977-2013

The progressivity of the state aid formula has increasingly been offset, however, by a growing positive response in the local revenue base to property wealth. This pattern is apparent in the two darker lines of Figure 3. Throughout
the pre-KERA period and through the first several years following KERA adoption, local revenue was not very responsive to local property wealth. Starting in the late 1990’s, the property wealth effect on local revenues started to slope upwards. During this period, a $1,000 increase in home values per pupil was associated with an increase in total revenues of about $3 per pupil. We can see that the effect on voluntary local revenue (revenues beyond that required for SEEK funding) was about $1.50 per pupil. The effect continued to grow throughout the 2000’s and is quite sizable by the end of our panel. For 2013, the property wealth effects on local revenue are $16.34 and $9.82 per pupil for total and voluntary local revenue, respectively.

In Figure 4, we can see the extent to which these positive property wealth effects on local revenue outstripped the progressivity of the state aid formula. The trajectory of state plus local revenue per pupil is scarcely distinguishable from that of local revenue at first glance. By the end of the panel, the effect of a $1,000 increase in home value per pupil is associated with an increase in combined state-local resources per pupil of $13.46. Thus, it appears that variation in educational opportunities created by revenue differences among districts that differ significantly in terms of property wealth not only has widened many years after the adoption of KERA but is greater than it was prior to the education finance reform. Property wealth has returned as a factor in revenue variance across districts.

**Figure 4. Property Wealth Effects on State and Local Revenues, 1977-2013**

![Graph showing property wealth effects on state and local revenues from 1977 to 2013.](image)

**5.4. DIFFERENCES IN THE PROPERTY WEALTH EFFECTS BY PERCENTILE WEALTH**
Due to the progressivity of the state funding formula and variation in the socioeconomic characteristics of districts with different levels of initial property wealth, it is conceivable that the property wealth effects vary among different district types. We modify equation (1) which estimates average wealth effects to allow the property wealth effect to vary both over time and among districts in different percentiles of initial property wealth (i.e. the 1977 distribution of home value per pupil):

\[
R_{it} = \mu_i + T_t + \beta_1 V_{it} + \beta_2 V_{it} * T_t + \beta_3 V_{it} * P_i + \beta_2 V_{it} * T_t * P_i + \beta_5 X_{it} + \beta_6 T_t * P_i + u_{it}
\]  

Where \( P \) denotes the district’s percentile in the state distribution of home value per pupil in 1977, which is the first year in the data panel. We interact \( P \) with the primary home value variable, \( V \), and with the interactions between \( V \) and the year indicators to allow the property wealth effects to vary among districts with respect to their initial property wealth. We also interact \( P \) with the year indicators to control for differences in the year effects.

The estimated equations enable us to map the trajectories of the property wealth effect for specific percentiles of initial property wealth. Figure 5 displays lines for the districts in the 5th, 50th, and 95th percentiles of the 1977 distribution of home values per pupil. These percentiles represent the low, middle, and high initial wealth districts. As can be seen, it was not revenues given to the highest wealth districts but to the low and middle wealth districts in the pre-KERA years that were largely driving the regressive nature of state funding.

For roughly the first decade in the post-KERA period, the state aid formula became increasingly progressive and, as intended by the reform, the property wealth effects did not differ significantly between low and high wealth districts. This is also indicated in Table 2, column 2, which shows the Wald test results for the differences in the property wealth effects between the districts that were in the 5th and 95th percentiles of 1977 home value per pupil. The table illustrates the differences in the effects for these districts for different time intervals before and after KERA adoption. We can see that differences in the property wealth effect on state aid for the low and high wealth districts are not statistically significant during the post-KERA period.

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22. We also estimated equations with the differences between 25th and 75th percentile districts and another one with the differences between the 33rd and 75th percentile districts. The direction of the differences and the statistical significance in the differences resemble those reported here. The magnitudes are smaller in both the alternative cases as would be expected. Tables are available upon request from the authors.
Figure 5. Effect of a $1,000 Increase in Home Value Per Pupil on State Funding Per Pupil, Different Levels of Initial Property Wealth, 1977-2013

Table 2. Estimated Differences in Property Wealth Effects Between Low and High Initial Wealth District.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>State Revenue</th>
<th>Local Revenue</th>
<th>Voluntary Local Revenue</th>
<th>State-Local Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 10 Years Prior</td>
<td>$10.07**</td>
<td>-$16.89***</td>
<td>-$11.45***</td>
<td>-$6.81</td>
</tr>
<tr>
<td>1 to 5 Years After</td>
<td>$6.39</td>
<td>-$9.92**</td>
<td>-$5.46*</td>
<td>-$3.53</td>
</tr>
<tr>
<td>6 to 10 Years After</td>
<td>$1.45</td>
<td>-$6.40</td>
<td>-$3.53</td>
<td>-$4.96</td>
</tr>
<tr>
<td>11 to 15 Years After</td>
<td>$0.65</td>
<td>-$4.64</td>
<td>-$3.53</td>
<td>-$3.98</td>
</tr>
<tr>
<td>16 to 20 Years After</td>
<td>-$3.38</td>
<td>-$6.93</td>
<td>-$6.55**</td>
<td>-$10.30*</td>
</tr>
<tr>
<td>More than 20 Year After</td>
<td>-$5.58</td>
<td>-$10.65</td>
<td>-$8.77*</td>
<td>-$16.23**</td>
</tr>
</tbody>
</table>

Note: *p<0.10, **p<0.05, ***p<0.01

Figure 6 and columns 3 and 4 of Table 2 show the pre- and post-KERA trends in the property wealth gradients on total local revenue for the low, median, and high initial wealth districts. During the pre-KERA years, there is an inverse relationship between property wealth and local revenue for the median and low wealth districts. For most of the 1990’s, the decade immediately following reform, the property wealth effect on local revenue hovers around zero.

23. Note: The district with home value per pupil at the 5th percentile of the 1977 distribution of per-pupil home value is the “low” initial wealth district while the district that had home value per pupil at the 95th percentile is the “high” initial wealth district.
for the median and low wealth districts. However, the positive effect of property wealth on local revenue starts to grow steadily from about 2000 onward. Toward the end of the panel, an increase in home value per capita of $1,000 leads to an increase in local revenue of around $13 per pupil for the median wealth district and $9 per pupil for the low wealth district. The property wealth gradient for the high wealth district fluctuates between zero and small, positive levels but starts to increase steadily from about 1999 onward, reaching a plateau considerably higher than the gradients for the median and low wealth districts. During this time frame, an increase in home value per capita of $1,000 leads to an increase in local revenue of around $17 per pupil.

**Figure 6. Effect of a $1,000 Increase in Home Value Per Pupil on Total Local Revenue Per Pupil, Different Levels of Initial Property Wealth, 1977-2013**

In short, it appears that KERA narrowed the gaps in the property wealth gradients for districts with vastly different levels of initial wealth but did not completely close them. Growth of the property wealth gradients was constrained over the decade following reform. However, after the first decade, the magnitude of the property wealth effects on local revenue increased for districts across the distribution of initial levels of wealth, with the gap between the low and high wealth districts widening.

We see similar patterns for the effects of property wealth on voluntary local revenue in Figure 7. The extent to which state aid has offset the differences in the property wealth effects on local resources among districts has diminished over time. Figure 8, (and the last column of Table 2), indicate that gaps in the property wealth effects on combined state and local revenues per pupil were
greatly narrowed over the decade following KERA. The responsiveness of state-local resources to property wealth for the high wealth district starts to outpace the property wealth effects for the lower wealth districts around the mid-2000’s. By the end of the panel, the effect of an $1,000 increase in home value per pupil on per pupil state-local revenues is about $16 higher for the high wealth district than it is for the low wealth district. Thus, the gap in wealth effects on combined state-local resources is larger in magnitude at the end of the panel than it was prior to KERA.

**Figure 7. Effect of a $1,000 Increase in Home Value Per Pupil on Voluntary Local Revenue Per Pupil, Different Levels of Initial Property Wealth, 1977-2013**
5.5. DIFFERENCES IN PROPERTY WEALTH EFFECTS BY APPALACHIAN STATUS

Due to differences between the Appalachian and non-Appalachian regions of the state in culture and other unobserved factors, it is conceivable that the property wealth effects vary between the two regions. As stated earlier, we are interested not only in whether property wealth enters the equation in determining revenues for schools but also whether these differences are tied to the Appalachian identity. For these reasons, we finally estimated a model in which the property wealth effect can vary both over time and between the Appalachian and non-Appalachian regions of the state:

\[
R_{it} = \mu_i + T_t + \beta_1 V_{it} + \beta_2 V_{it} \ast T_t + \beta_3 V_{it} \ast A_i + \beta_2 V_{it} \ast T_t \ast A_i + \beta_5 X_{it} + \beta_6 T_t \ast A_i + u_{it}
\]  

(3)

Where \( A \) denotes an indicator that is equal to 1 for districts in the Appalachian region of the state and zero otherwise. We interact \( A \) with the primary home value variable, \( V \), and with the interactions between \( V \) and the year indicators to allow the property wealth effects to vary between the two regions. We also interact \( A \) with the year indicators to control for differences in the year effects.

The estimated equations enable us to map the trajectories of the property wealth effect for the two regions of the state. To economize on presentation length, we summarize these results in a table instead of graphs. Table 3 shows the Wald test results for the differences in the property wealth effects between
the two regions for different time intervals before and after KERA adoption. In column 1 of Table 3, we see that state aid responded positively to property wealth among Appalachian districts and that the effect exceeded that for the average non-Appalachian district. Specifically, the effect of $1,000 increase in home value per pupil on state aid for the average Appalachian district was about $11 greater per pupil than it was for the average non-Appalachian district.

This result resembles what we observed for low-wealth districts vis-a-vis the high-wealth districts prior to KERA. In the post-KERA period, the state aid formula became increasingly progressive but the property wealth effects did not differ significantly between the two regions. The second and third columns of Table 3 indicate that the trajectories of the property wealth effects on local revenue did not differ significantly between Appalachian and non-Appalachian districts after the implementation of the reform. These results differ significantly from those that we obtained when we used initial wealth as the moderating variable. With that specification, we found divergence in the property wealth gradients from about 2000 onward that favored the higher-wealth districts. These results suggest that the Appalachian-non-Appalachian dichotomy perhaps obscures important within-region differences in initial property wealth that significantly impact local tax effort.

Table 3. Estimated Differences in Property Wealth Effects Between Appalachian and non-Appalachian Districts

<table>
<thead>
<tr>
<th>Time Period</th>
<th>State Revenue</th>
<th>Local Revenue</th>
<th>Voluntary Local Revenue</th>
<th>State-Local Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 10 Years</td>
<td>$10.80***</td>
<td>$1.20</td>
<td>$1.64</td>
<td>$11.99***</td>
</tr>
<tr>
<td>1 to 5 Years</td>
<td>$3.30</td>
<td>$2.01</td>
<td>$1.11</td>
<td>$5.32**</td>
</tr>
<tr>
<td>6 to 10 Years</td>
<td>$1.47</td>
<td>$1.60</td>
<td>$0.37</td>
<td>$3.07</td>
</tr>
<tr>
<td>11 to 15 Years</td>
<td>$1.88</td>
<td>$1.63</td>
<td>-$0.23</td>
<td>$3.51</td>
</tr>
<tr>
<td>16 to 20 Years</td>
<td>$1.09</td>
<td>$0.77</td>
<td>-$1.38</td>
<td>$1.85</td>
</tr>
<tr>
<td>More than 20</td>
<td>$0.13</td>
<td>$3.22</td>
<td>$0.50</td>
<td>$3.35</td>
</tr>
</tbody>
</table>

Note: **p< 0.05, ***p<0.01

5.6. PLACE-BASED DIFFERENCES

Though shifts in the local property tax base are obviously important, a large fraction of the variation in school district revenue is driven by time-invariant district characteristics. Among our equations, the fixed effects explain 60-90% of the variation in school district resources. The importance of place in demand for education is a primary motivation of this study, yet the unbiasedness of fixed-effect estimation limits our ability to examine this relationship due to the time-invariant nature of place-based indicators, such as Appalachia.
To estimate the effect of Appalachia on school district revenues, we employed a hybrid model which estimates both within- and between-effects for panel or multilevel data (Allison, 2009). Specifically, we used the following equation:

\[
R_{it} = \beta_1 (X_{it} - \bar{X}_i) + \beta_2 \bar{X}_i + \beta_3 A_i + \beta_4 A_i * T_t + e_t + u_{it} \tag{4}
\]

where \( X \) is a vector of the same controls and interactions between property wealth, Appalachian indicator \( A \), and time-period \( T \) as were included in equation (3). To simplify reporting, years were collapsed into three-time period indicators using 1990—the year of reform—as the base comparison: 1) pre-KERA (1977,1986-1989), 2) post-KERA (1991-2000), and current (2001-2013).

Lastly, \( \bar{X}_i \) equals the unit (i.e. school district) mean for each time-variant variable and represents the key departure from a standard random- or fixed-effects model. The coefficient for the first term, \( \beta_1 \), equals the same within-effects that would be obtained from a fixed-effects model. The inclusion of each mean provides the between-effects, represented by \( \beta_2 \). Coefficients for time-invariant factors, such as \( \beta_3 \) for the Appalachian indicator, are estimated as random-effects. An important advantage of the hybrid model is that time-invariant factors can be estimated as they would be in a standard random-effects model while accounting for differences between units (i.e. school districts) that would bias results. Of course, the unbiasedness of the random-effects estimates still requires time-invariant variables to be uncorrelated with the time-invariant error term \( e_t \) conditional on covariates.24

Figure 9 illustrates the results when estimating the effect of a district’s location in Appalachia on the four revenue variables previously used. The estimates equal the linear combination of the Appalachian and Appalachian-time period coefficients, or \( \beta_3 + \beta_4 T_t \), where \( T = 1 \) for each time-period and 0 for year 1990. Other than state revenue in the current period, the figure illustrates that location in Appalachia is associated with less per-pupil revenue controlling for within- and between-district variation in observable characteristics, most notable of which are property wealth and median household income.25

24. We prefer using fixed-effects over the hybrid model throughout the study because the former incorporates interaction terms much more easily and estimates the same within-district coefficients. Moreover, we are unwilling to claim the Appalachian indicator is uncorrelated with other unobserved district characteristics conditional on our control variables, which is supported by the rejection of the Hausman test comparing random- and fixed-effects models.

25. Values in Figure 7 are the sum of the base-year Appalachian coefficient and interaction between time-period and Appalachian indicator. All estimates other than state plus local revenue in the current period and state revenue in the post-KERA period, are jointly significant at the 5% level or lower. Estimates are available by request.
The inclusion of state plus local, state, and local revenues demonstrates how the two primary sources of revenue compare between Appalachia and non-Appalachia regions and whether the two sources approximately offset each other as KERA was intended to do. There is substantial disparity in state plus local revenues in the pre-KERA period, which is reduced in the ten years following reform. Though negative, state plus local revenue in Appalachia is statistically insignificant from zero in the current period, suggesting that KERA has achieved parity with respect to place as it pertains to these two regions. This result is primarily driven by the substantial increase in state revenues over time compared to only a modest decline in local revenues over time. It is important to note that districts do not receive less (or more) state revenue because they are located in Appalachia, but rather due to the average local revenue raised in the Appalachian region.

Figure 9. Effect of Appalachia on Revenues

Most relevant to the importance of place in demand for education is voluntary local revenue. Whereas total local revenue is comprised of required revenue that partially determines state revenue, voluntary local revenue is largely separate from the mechanics of the equalization formula. According to the results, Appalachian districts raise approximately $400 less in per-pupil voluntary local revenue than non-Appalachian districts, all else equal. This disparity has declined approximately $100 since the pre-KERA period but has persisted between the two periods after reform. Controlling for numerous factors, Appala-

26. A portion of voluntary local revenue is still influenced by state matching.
chian districts receive about the same amount of total revenue as non-Appala-
chian districts due to SFE, but after more than two decades, Appalachian dis-
tricts still levy less per-pupil revenue locally.

6. CONCLUDING COMMENTS

This paper addresses whether a state with a path-forming Court-ordered
school finance reform succeeded in closing revenue inequality between dis-
tricts. Looking at revenues raised to support K-12 schools at the state plus local
level, the mandated local level plus voluntary, and voluntary alone, we find sim-
ilar results. Property wealth vanished as a determinant of variance in school
district revenues immediately following the Kentucky school finance reform
and continued to be a non-factor for about a decade after its enactment. But for
almost two decades hence, property wealth has re-entered the picture as a deter-
minant of school district revenues. Indeed, the magnitude of the effect of wealth
on total state and local revenues has increased in size in recent years. Higher
property wealth translates into higher revenues and the relationship is largely
driven by “voluntary” contributions from local school districts. Furthermore,
controlling for wealth, as well as income and education attainment, location of
the school district matters for education revenues in the state of Kentucky. There
remains a difference in the level of revenues in Appalachian districts and those
outside of Appalachia that is not explained by wealth. Other than the geographic
existence of mountains, why do the districts located in Appalachia differ in con-
tributions to education both at the total and local voluntary levels? More re-
search is necessary to identify the reason why.

Understanding local responses and local gains from finance reforms is an
essential part of evaluating the effectiveness of school finance reforms nation-
ally. The study of Kentucky reveals that it is difficult to enact legislation that
closes all the ways in which local districts can offset state attempts to neutralize
wealth as a source of school revenue inequality. In the long run, both wealth
and place again play a role in the revenue disparities of school districts in the
state.
REFERENCES


