

Redistribution and the Persistence
of Income Inequality

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Abstract

This paper examines empirically the role of redistribution of human capital expenditure in the persistence of income inequality across generations. Intergenerational income persistence is found to depend on community characteristics. Families from very poor communities and very wealthy communities exhibit higher intergenerational income persistence than families living in middle-income communities. The role of redistribution of human capital (education) expenditure is assessed within this context. In particular, redistribution is hypothesized to affect families in poor communities differently than families in non-poor communities. Redistribution is found to have a significant effect in reducing persistence of economic status for families in poor neighborhoods, but not in non-poor neighborhoods. These results suggest that redistributive educational funding has its greatest impact where community-level constraints on human capital investment due to low incomes are greatest.

1 Introduction

The motivation for many redistributive school funding programs is that they will benefit poor children in poorly funded schools. Casual observation suggests that such programs would improve the quality of education in poor areas, thus improving the skill levels and ultimately adult economic status of the children educated in these schools. Based on such observations, there has been a substantial theoretical literature aimed at understanding the role of community effects in the determination of human capital accumulation, adult earnings, and intergenerational income persistence (as for example in Becker and Tomes (1979), Loury (1981), Durlauf (1996), Glomm and Ravikumar (1992), Fernandez and Rogerson (1995, 1996), and Bénabou (1994)). Further theoretical work has analyzed the role of redistribution in affecting this persistence (Cooper (1998)). In addition there has been a large empirical literature aimed at assessing the impact of school quality on future earnings. The goal of this paper is to assess empirically the role of redistributive school financing on the persistence of income inequality across generations.

State and federal funding of public schools in the United States existed well before the arrival of court mandates for redistribution in the early 1970's.¹ In 1968 over 50% of education revenue in the United States was from non-local (i.e., State and Federal) sources.² To the extent that such external funding can be considered as augmenting locally available funding and therefore redistributing educational funding, the question of the impact of redistribution on intergenerational income inequality is broader than assessing the impact of the specific programs instituted under court mandate. Since intergenerational data are not available over a sufficient time period to evaluate specific finance reforms, this paper analyzes the impact of redistributive educational funding more generally, looking at differences across neighborhoods in the degree to which schools are

¹A notable early example is *Serrano vs. Priest*. While earlier court cases challenged inequities in the provision of public education, these were focused more on racial inequities than specifically on funding inequities, although the two are related.

²National Center for Education Statistics, 1992.

funded by redistribution.

The effect of redistribution on educational outcomes has been analyzed in previous work. In particular, Downes (1992) assesses the impact of finance reform in California. This study finds little improvement in test scores in California, following the court mandated equalization of school funding across school districts in the state. The finding of little effect on test scores is not entirely surprising. There exists an empirical literature on the effects of school quality on test scores (for example, Hanushek (1989)) which finds that improvements in school quality as measured by expenditures per pupil, pupil-teacher ratios, etc., do not improve student test scores. There are several possible explanations for this result. Test scores could be a poor measure of student ability, if some students take tests better than others or if tests do not measure skills taught to all students to whom the test is administered. Alternatively, test scores could measure student ability well, but be a poor measure of future economic status. A primary motivation for improving schools in poor areas is to improve the chances of children when they become adults and participate in the labor market. Therefore, it might be more appropriate to use earnings or other measures of economic status as the effect being evaluated when looking at redistribution or school funding more generally.

If better education affects students' long-run economic status, but test scores are a noisy measure of this economic status, then little effect on test scores could be found, while a substantive effect on economic status could be found. A substantial empirical literature assesses the impact of the quality of education on future earnings. The results of these studies are mixed, but overall suggest the possibility that expenditures and other measures of school quality can have an impact on future economic status. A positive relationship between expenditure per pupil and a child's future earnings as an adult has been found by Morgan and Sirageldin (1968) and Johnson and Stafford (1973). Further work by Card and Krueger (1992) has found a positive relationship between various school quality measures and the return to education. However, more recent work by Betts (1995a, 1995b,

and 1996) and Heckman, Layne-Farrar, and Todd (1996) questions this result. These authors conclude that the relationship is at best weaker than Card and Krueger suggested. More recently, Murray, Evans, and Schwab (1995) and Hoxby (1996) find that improved school quality can improve student outcomes.³

The goal of this paper is *not* to assess the impact of school quality on earnings, although this issue is clearly related to the issue of focus in this paper. Rather, this paper assesses the impact of redistributive school funding on intergenerational income inequality. Clearly, if educational expenditure has no impact on a child's future earnings, then it will be difficult to find that redistributive school funding in particular has any impact on the persistence of earnings across generations. However, a finding that redistribution does reduce persistence for families in poor communities is consistent with the interpretation that *a*) redistributive funding has loosened the constraint on investment in human capital in poor communities and *b*) the resulting improved funding reduces the likelihood that a child growing up in a poor community would be poor as an adult.

A theoretical framework implies that children of poor families who live in communities which do not receive redistribution will tend to grow up with low human capital levels and will be poor as adults.⁴ Within this context, children of poor families who live in communities that receive redistribution of human capital expenditure will accumulate more human capital, and therefore will tend to have a lower probability of remaining poor. Existing empirical studies of intergenerational income inequality, distinct from the empirical analysis of school quality and earnings, have not addressed the issue of human capital expenditure redistribution. Preliminary evidence of the importance of redistribution is presented in Cooper (1998). The work presented in this paper undertakes a more complete analysis of this question.

³For the data sample used in this paper, a simple regression of son's economic status on father's economic status and revenue per pupil does indicate a positive impact ($p=.09$) of educational expenditure per pupil on a son's earnings. However, no causal interpretation of such a regression is made in this paper.

⁴Models of persistent income inequality are presented in Durlauf (1996), Bénabou (1994), and Cooper (1998).

This work differs from earlier work analyzing the dynamics of income inequality across generations in several ways. First, this paper is empirical. The analysis of redistribution to this point has been largely theoretical (as, for example in Cooper (1998) and Hoff and Lyon (1995)). Second, the impact of redistribution on intergenerational persistence of economic status is being analyzed, rather than the impact of school quality or redistribution on test scores or the level of earnings as an adult. Third, this paper extends the existing analysis of intergenerational persistence to look more closely at community impacts on this persistence. In particular, the methodology permits persistence to be different across neighborhoods with different characteristics. Finally, this paper extends the existing literature on persistence to look at human capital expenditure explicitly.

The findings are as follows. First intergenerational income persistence is found to be U-shaped, rather than constant across communities. Consistent with earlier findings in Cooper, Durlauf and Johnson (1994) but with a different methodology, persistence is found to be higher in both very poor and very wealthy communities, but much lower in middle-income communities. Second, within this framework, redistribution is found to be a significant determinant of intergenerational income persistence, but the effect differs across poor and non-poor communities. Specifically, poor communities receiving redistribution exhibit lower intergenerational persistence of economic status than without redistribution, indicating a reduced probability of staying poor into the next generation. Redistribution does not reduce persistence similarly in non-poor neighborhoods.

The remainder of this paper is as follows: Section 2 presents a summary of theoretical work illustrating the impact of redistribution on intergenerational persistence of income inequality. In addition, this section presents the empirical implications of the theory that will be evaluated in this paper. Section 3 discusses the data used in the analysis. Section 4 presents the empirical results on the impact of redistributive school funding on the persistence of income inequality across generations. Section 5 concludes.

2 Theory and Empirical Implications

Theoretical work on the dynamics of income inequality across generations has concluded that community effects are important in determining the degree of persistence in economic status across generations. Further work has analyzed the impact of redistribution on persistence, as well. This section presents a summary of the theoretical results and their empirical implications, in order to provide a context for the empirical results of Section 4.

Consider a set of communities, with groups of families living within each community.⁵ Parents within communities choose how much to spend on human capital investment (education), but are constrained by the level of parental income in the community. Human capital is produced at the community level, with all children in a community receiving the same level of human capital. This feature of the model captures the notion of public education, with all children in a particular area attending the same public school.⁶

In a simple model with no redistribution, substantial intergenerational persistence for families in poor communities results due to the impossibility of borrowing against children's future earnings to finance current human capital accumulation. Children in poor communities attend poorly funded schools and accumulate low levels of human capital as a consequence. With low human capital, productivity and earnings as an adult are correspondingly low, making the children of families in poor communities likely to be poor. If poor families tend to live in poor communities (which will result from zoning restrictions or housing price differentials), then the children of poor parents are likely to be poor, yielding substantial intergenerational persistence for low income families.

We can think of human capital for an individual i (with the assumption of one individual per

⁵A more complete version of the model discussed briefly here is presented in Cooper (1998).

⁶The option of private education is not considered here. As is well known in the public choice literature, when a discrete option of private education is allowed, preferences are no longer single peaked and the existence of voting equilibria is not guaranteed. Work by Glomm and Ravikumar (1992) and Gradstein and Justman (1996) attempts to analyze voting equilibria in the presence of a private education alternative.

family, i indexes equivalently individuals and families) born at time t , living in a community n which does not receive redistribution, as being dependent on the neighborhood income distribution:

$$h_{i,t} = h_n(F_{y_{n,t}}), \quad (1)$$

where $F_{y_{n,t}}$ is the distribution of parental incomes in neighborhood n at time t . In this simple formulation a person's human capital level is determined entirely by the education that person receives, and this education is funded entirely by the local community. In this case, the human capital level of any child in a particular community is determined only by the income distribution of that community, which in turn determines how much is spent on education.⁷ This formulation of the determination of human capital levels in a community is a human capital or education quality production function. The greater is spending in a particular community, the higher is human capital for all children in that community.

If adult income is determined by childhood human capital accumulation, then adult income can be expressed as

$$Y_{i,t+1} = Y(h_{i,t}, h_{j,t}, \xi_{i,t+1}) \quad (2)$$

$\forall j \neq i$, where $\xi_{i,t+1}$ is a productivity shock received by individual i born at t when an adult in period $t + 1$. The inclusion of human capital levels of other individuals reflects a spillover of other individuals in production, whereby the productivity of one individual depends not only on her own human capital level, but on the human capital levels of coworkers.⁸ The productivity shock represents the notion that while all children in a community attend the same school and receive the same education, they will not all be equally productive when adults.

Once redistribution is permitted, the human capital for children in a particular neighborhood

⁷Of course in practice there will be individual variation in economic status of adults due to individual or family-specific characteristics. Therefore, common childhood human capital levels do not preclude the possibility of individual and family effects on the level of economic status.

⁸This is relevant for voluntary redistribution, but is not essential for derivation of the effect of redistribution on intergenerational income persistence.

becomes a function both of the neighborhood income distribution (determining local expenditure on education) and the redistributive human capital expenditure received from other communities. With sufficient spillovers across communities, redistribution of human capital spending will take place voluntarily, as shown in Cooper (1998).⁹ Defining $\gamma_{n,t}$ as the rate at which educational funds in neighborhood n at time t are matched by external funds, we can rewrite human capital determination for an individual i born at time t and living in neighborhood n as

$$h_{i,t} = h_n(F_{y_{n,t}}, \gamma_{n,t}). \quad (3)$$

Within this framework, redistribution can be shown to reduce the probability of staying in poverty from one generation to the next. Specifically, it can be shown that

$$\frac{\partial(\Pr(Y_{i,t+1} \leq Y^{pov} | Y_{i,t} \leq Y^{pov}))}{\partial \gamma_{n,t}} < 0 \quad (4)$$

where Y^{pov} is the poverty line.¹⁰ The empirical implications of this model are quite clear. Redistribution to poor communities should reduce the intergenerational persistence for families in those communities.

The analysis of Section 4 evaluates the empirical implication presented in equation 4. In a regression of son's income on father's income

$$Y_i^s = \alpha + \rho Y_i^f + \epsilon_i \quad (5)$$

⁹For voluntary redistribution to make sense, it must be the case that children remain in the same area as adults as they grew up in. In order for a child to benefit from working with those to whom redistribution was made when they were children, it must be the case that those children who received redistribution work in the same area as those children of families giving redistribution, when adults. In the sample of families in this paper, approximately 75% of children lived in the same state as adults as they grew up in as children. To the extent that a state captures a labor market (which makes sense for some states more than others, clearly), this sample exhibits relatively little mobility across labor markets from generation to generation. County-level mobility cannot be assessed since county information for children when they become adults is not available.

¹⁰More formal derivations of these results are presented in Cooper (1998). The result that the probability of remaining in poverty across generations is reduced with redistributive human capital expenditure relies mainly on assumptions of boundedness of productivity shocks, as well as assumptions on the first derivatives of the human capital production function and the individual income determination function. Depending on how far below the poverty line a particular family is, it might take redistribution across several periods in order to achieve a positive probability of leaving poverty. In the simplified version presented here, it is assumed that a sample family could see some benefit from redistribution in any period. To the extent that more than one period of redistribution is required, the empirical results will show a smaller effect of redistribution than the theory would imply. To the extent that the empirical results do show an effect of redistribution, we can infer that for at least some families, the distance below the poverty line was small enough for redistribution to have an effect in the time frame observed.

where Y_i^s is the son's income and Y_i^f is the father's income, an estimate of intergenerational persistence is the coefficient on father's income. Solon (1992) and Zimmerman (1992) estimate an intergenerational persistence parameter of about 0.4 from such a regression. The probability of being in poverty, conditional on having parents who were poor, is clearly closely related to this more general estimate of persistence. More generally, the theoretical literature with and without analysis of redistribution suggests that the intergenerational persistence parameter ρ , depends on community characteristics. This empirical framework can be written generally as

$$Y_i^s = \alpha + \rho Y_i^f(F_{Y_{n,t}}) + \epsilon_i \quad (6)$$

where $F_{Y_{n,t}}$ is the income distribution in neighborhood n at time t .¹¹ If the probability of being in poverty conditional on having parents who lived in poverty is high, then the coefficient on father's income will be high (and positive) for families in poor communities, indicating a strong tendency toward the same economic status for children as their parents. If, on the other hand, the probability of being in poverty as an adult is low, conditional on having parents who were in poverty, then there will be little correlation between parental and child economic status, and the estimate of ρ will be close to zero. Therefore, it is straightforward to interpret the commonly used intergenerational regressions in terms of the implications of the model for conditional probabilities of being in particular ranges of income.

Earlier work by Cooper, *et al.* (1993) using regression tree analysis, finds that the community income distribution does affect the estimate of ρ . Specifically, ρ is estimated to be higher than 0.4 for families in very low or very high income communities, but lower than 0.4 for families in middle-income communities. Community factors therefore appear to be important in intergenerational persistence, inducing substantial nonlinearity in the relationship between children's and parents' incomes. The empirical results presented in Section 4 look at the role of community in-

¹¹Empirical strategies for estimating this relationship will be discussed below.

come in intergenerational persistence, but focus primarily on the impact of redistribution within this context.

The empirical strategy used in the analysis is to parameterize the intergenerational persistence parameter, ρ , as a function of community characteristics such as income and redistribution. Assessing whether persistence is constant across communities with different characteristics, and in particular whether it depends on redistribution, can be examined within this context. The general framework involves specifying the functional form for ρ as a function of community characteristics, and then running the regression as follows

$$Y_i^s = \alpha + \rho(F_{Y_{n,t}}, \gamma_n)Y_i^f + \epsilon_i \quad (7)$$

where several alternative functional forms for $\rho(F_{Y_{n,t}}, \gamma_n)$ are investigated.¹² The Appendix contains results from these alternative specifications. Existing theory (and the earlier work by Cooper, et al (1993)) suggests that ρ is higher for families in low and high income communities, and lower for families in middle income communities, suggesting a U-shape to the measure of intergenerational income persistence. Therefore, one possible specification is

$$\rho(F_{Y_{n,t}}, \gamma_n) = a + b \text{inc}_n + c \text{inc}_n^2 \quad (8)$$

where inc_n is median income in community n . The null hypothesis of constant ρ across communities can be tested against the alternative of U-shaped persistence with respect to community income by testing the joint significance of b and c .

The role of redistribution can be incorporated by expanding this function. Theory suggests that redistribution should affect families in poor communities differently than wealthy communities, suggesting an interaction between the community income distribution and the degree of redistribution.

¹²In addition, the possibility that α differs across individuals, as a function of both community and individual characteristics, is also investigated.

With interactions, as for example in

$$\begin{aligned} \rho(F_{y_{n,t}}, \gamma_{n,t}) = \\ a + b \text{ inc}_n + c \text{ inc}_n^2 + d \text{ redistrib}_n + e \text{ redistrib}_n^2 + f \text{ inc}_n \times \text{ redistrib}_n, \end{aligned} \quad (9)$$

the effect of redistribution on persistence is

$$\frac{\partial \rho}{\partial \text{redistrib}} = d + 2e \text{ redistrib} + f \text{ inc} \quad (10)$$

which clearly depends on the level of redistribution as well as the level of community income. When $d < 0$, $e < 0$, and $f > 0$, an increase in redistribution reduces persistence, holding community income constant, but the reduction in persistence is mitigated as income rises. Therefore at low levels of income, a given level of redistribution reduces persistence, as $d < 0$ and $e < 0$ dominate, while at higher levels of income persistence is reduced less or perhaps even rises if f is sufficiently positive.

The empirical work uses data on the level of education revenue from non-local sources to capture the effect of redistribution. This variable is closely related to the theoretical parameter γ_n in the following sense. γ_n is defined as a matching fund rate, so γ_n times the level of internal funding determines the external funding received in addition to the level of investment internal to the community. Total human capital expenditure is therefore $(1 + \gamma_n) \times Q_n$, where Q_n is revenue raised locally. Theoretical work makes predictions regarding the impact of changes in γ_n , as in equation 4. Since

$$\frac{\partial \gamma_n Q_n}{\partial \gamma_n} > 0, \quad (11)$$

the predicted signs of effects with respect to the level of revenue from non-local sources are the same as the predicted effects with respect to γ_n .

3 Data

To address the question of the role of redistributive human capital investment in the intergenerational persistence of economic status empirically, data from the Panel Study of Income Dynamics (PSID) are used. The advantage of this data set over alternatives such as the SIPP, NLSY (often used in addressing the impact of school quality on outcomes) or the Census, is that the PSID has surveyed the same families over a period of over 25 years. In particular, those family members who were children at the beginning of the sample period but who are now adults and heads of households themselves are still surveyed. This means that data on the incomes of parents and children can be obtained without relying on the children to estimate their parents' incomes (which is known to be a very noisy measure since children do not remember their parents' incomes, even if they ever knew them). In addition, the survey is conducted each year, so unusual years of earnings can be identified as such.

Furthermore, because data are collected on children in each household, the PSID contains the geographic information of where the current heads of household lived when they were children in earlier years of the survey.¹³ This is particularly important in an analysis of the effects of school finance on adult income. While adult geographic information can be important in measuring adult earnings, it is information on school finance where a person went to primary and secondary school that is essential in evaluating its effects.

Male heads of household are used in this analysis to abstract from earnings differentials due to gender, which are largely correlated with occupational choice and years of work experience. Therefore, the analysis uses father-son pairs.¹⁴ Income of the head of household is a noisy measure of economic status since differences in family size may make two families with comparable earnings

¹³Only county and state information are provided in the PSID, rather than more narrow definitions of communities.

¹⁴Only the oldest son from each family is used, as in Solon (1992). In addition, three outlier observations have been deleted.

have very different economic status. For this reason, the log of the ratio of income to needs is used as the measure of parental and child economic status, rather than income or earnings alone.¹⁵ The needs standard can be thought of as a subsistence income for a family, adjusted for family size. The income/needs ratio is therefore a measure of economic status since it accounts for how much income the household has, relative to a subsistence level. The income/needs ratio is also averaged over three years, for both fathers and sons, to account for measurement error in individual years of data.¹⁶ In addition, since fathers' incomes are measured later in life than sons' incomes, incomes are adjusted for age by fitting the log income/needs ratio to a quadratic age-earnings profile. These profiles are fit separately for fathers and for sons. Residuals from these age-earnings profiles are used as age-adjusted incomes relative to needs, and are referred to as "income" throughout the analysis.¹⁷

To assess the impact of school finance characteristics, data on the funding of schools in the area in which the people surveyed in the PSID lived as children are required. The measure of school quality used in this analysis is revenue per pupil. In particular, a high level of total school revenue from state or non-local sources indicates that redistribution is relatively high in that area.¹⁸ Data on sources of educational revenue for counties (the narrowest geographic information about families provided in the PSID), comes from the *Census of Governments, 1967*, which provides information by school district within counties. Data were aggregated to the county level to be consistent with PSID geographic definitions. Excluded from this sample are non-independent school districts and

¹⁵The results using the head of household's labor income for both fathers and sons shows no statistically significant impact of any community factors on intergenerational persistence. Due to the likelihood of substantial measurement error in labor income, it is not surprising that coefficients on variables interacted with labor income are near zero. For this reason a more comprehensive measure of economic status is used throughout this paper.

¹⁶See Solon (1992) and Zimmerman (1992) for an econometric analysis of the impact of averaging to reduce measurement error.

¹⁷Alternatively, one can fit separate age-earnings profiles by race. Results using this specification are presented in Table 4. The results are qualitatively similar to those of Table 2 at all but low redistribution levels. At very low redistribution levels the results indicate perverse effects of redistribution, perhaps capturing the fact that very low redistribution observations are unusual in a number of dimensions.

¹⁸The issue that some states may tax heavily and spend substantial amounts at the state level but not redistribute the tax revenue across communities will be addressed later in the paper.

school districts with fewer than 3,000 students.¹⁹

The PSID is well-known to oversample poor families, and therefore probability weights are used throughout the analysis of this paper to account for the fact that not all families have equal probability of being in the sample. Table 1 shows means and standard deviations for the key variables used in the analysis, in both weighted and unweighted form. Sons' and fathers' log income-to-needs ratio, age, and race are summarized, as are community level variables such as the median county income, the level of educational revenue per pupil from non-local sources, and the local revenue per pupil. The mean level of revenue from non-local sources (weighted) is approximately \$320, but ranges from \$50 to \$900 per pupil (in 1967\$), providing substantial variation with which to estimate the effect of redistribution.

4 Empirical Results

This section presents results on the nonlinearity of the relationship between children's and parents' economic status, and then moves on to evaluate the impact of education expenditure redistribution. The methodology here is different from previous work such as Cooper, *et al.* (1994). Based on earlier evidence of a roughly U-shaped profile for intergenerational persistence with respect to community income, this section starts by examining functional forms consistent with this evidence, as well as alternatives, to assess the nonlinearity of the relationship between children's and parents' incomes. Once this nonlinearity has been established, redistribution is incorporated.

A variety of functional forms for nonlinear intergenerational persistence are evaluated. Results are presented in the Appendix to this paper. Based on the results of a variety of functional

¹⁹Non-independent school districts are those which are agencies of the local government. Unless we think that these districts or the small districts that are also excluded react differently in response to redistribution, then we need not worry that the results presented in Section 4 are biased. If, however, we think omitting these districts leaves us with an unrepresentative sample of school districts, then we must limit our interpretation of the results to the type of districts covered in the analysis.

forms, the remainder of the paper uses the functional form presented in the previous section, with intergenerational persistence a quadratic function of community income, and with redistribution also a quadratic and interacted with community income, as in equation 9. This specification not only appears to fit the data better than alternatives, but also fits well with previous theoretical work on redistribution and empirical work analyzing intergenerational income persistence.

Table 2 presents the results of assessing the impact of community characteristics on intergenerational persistence of economic status. The coefficient on father's income in column 1, 0.552, is the estimate of intergenerational persistence which assumes this persistence to be the same across all communities (*i.e.*, not a function of community characteristics). This result is consistent with the findings of Solon (1992) and Zimmerman (1992).²⁰ The remainder of the columns of this table investigate the role of community income and redistribution in intergenerational persistence of economic status.

Column 2 indicates that intergenerational persistence of economic status is not constant, and in particular, appears to be a quadratic function of community income.²¹ The negative coefficient on county income and the positive coefficient on the square of county income indicate higher intergenerational persistence for individuals growing up in both low and high income communities, relative to families in middle income communities. These coefficients are individually significant at the 5% level. To see that these differences in persistence across communities are economically significant, note that the estimate of ρ for a family living in a community of median income \$6000 would be 0.635. For a family in a community with median income of \$10000 the estimate would be 0.463, and in a community with median income of \$13000 the estimate would be 0.628.

The impact of redistributive school funding is incorporated as described in section 2. In particular, redistribution is allowed to either increase or decrease intergenerational persistence (or have

²⁰While there are slight variations in the data used, relative to Solon, the finding of about 0.4 is confirmed here.

²¹The independent variables in this section of the table are all interacted with father's income, and therefore can be interpreted as coefficients in the equation for intergenerational persistence, ρ , as in equation 9.

no effect), and can either affect communities of different median incomes equivalently, or differently. The estimates suggest which of these effects is observed in actuality. Columns 3 and 4 show two slightly different versions incorporating redistribution. The negative and significant coefficient on redistribution, and the positive and significant coefficient on the interaction between community income and redistribution are consistent with the predicted signs of the parameters in equation 9. These results indicate a reduction of persistence as redistribution is increased for those children growing up in low-income communities, with this effect mitigated and even reversed at higher income levels.²² Conditional on the quadratic impact of community income on persistence that has already been documented, the incremental impact of considering redistribution is quantitatively important. The coefficients on redistribution and the interaction between community income and redistribution are jointly significant at the 11% level (using column 4).

To see the qualitative consequence of redistribution on persistence, note that for a family living in a community with median income of \$6000, the intergenerational persistence parameter would be 0.813 when external funding is \$200 per pupil (in 1967\$).²³ When external funding accounts for \$600 per pupil, intergenerational persistence is reduced to 0.215. For a family in a community with median income of \$10,000 persistence would be 0.422 with \$200 in external funding, and 0.249 with \$600 in external funding. Figure 1 shows the fitted values for the persistence parameter over a range of community income levels and redistribution levels.²⁴ The Solon or Zimmerman estimates would be seen in this context as a horizontal line at approximately $\rho=0.4$. The linear persistence estimate from these data would appear as a horizontal line at 0.55. Each line in Figure 1 represents the

²²The squared redistribution term is retained in column 4 and for the remainder of the paper despite the fact that it is insignificant at the 5% level. This term is retained since without it the community income-redistribution interaction is substantially more restrictive in the sense that the fitted value lines as presented in Figure 1 would all intersect at a single point without this term, due entirely to the algebra of the functional form. Since this appears a particularly restrictive functional form, the additional term which does not force this single intersection is included. Substantial collinearity of the independent variables results, and therefore the joint significance of all redistribution variables is reported and referred to for the remainder of the paper.

²³These calculations use the results in column 4, Table 2.

²⁴At the extremes of the community income distribution these estimates are not very precise since there are very few families in communities with these characteristics (in this data set).

fitted value for ρ across community income levels for a particular level of redistribution. Different lines represent different levels of redistribution. The three values presented correspond to the 10th, 50th, and 90th percentiles of the (unweighted) distribution of redistribution levels. Note that in low-income communities redistribution is associated with lower values of ρ .

The next step is to account explicitly for the fact that redistribution would be expected to matter when school expenditures are low (which to this point has been captured in the community income effect). Column 5 of Table 2 includes local revenue per pupil in the function for intergenerational persistence (i.e., interacted with father's income). This variable is not statistically significant at the 5% level, and more importantly, does not qualitatively affect the role of redistribution in persistence (i.e., the coefficients on redistribution, redistribution², and income \times redistribution). A dummy variable for African-American sons is also included in column 6, and is also found to be insignificant in determining intergenerational persistence, suggesting that intergenerational persistence is not greater for African Americans than for white families, once community income and redistribution factors are taken into account. Column 7 includes regional dummies in the persistence function, which reduces the p-value on the joint significance of the redistribution values from .11 to .07 without any substantial effect on the parameters of the persistence function itself.

One concern is the extent to which measured effects of redistribution on intergenerational persistence are in fact capturing other community or family effects on persistence which are mistakenly attributed to redistribution. In considering other community factors, they can be classified into two categories. The first includes those community characteristics that can be summarized by community income. Since community income is already incorporated into the analysis, these characteristics are controlled for. An example of such a community characteristic is the existence of role models, which can also be captured by variables measuring educational attainment in the community.

In addition there are other community characteristics possibly correlated with redistribution which are not easily summarized in community income. For example, there could exist other forms of redistribution (other than school funding) that matter for intergenerational persistence, such as welfare spending. More generally, one would want to control for the general degree of “generosity” of the state or county government to isolate the educational spending redistribution effect. The level of welfare payments per participant and government spending per capita may provide information on general generosity of the local government.

Column 8 of Table 2 includes both government spending per capita and welfare spending per participant as measures of general “generosity” of the county government. Neither of these variables is individually significant, nor are they jointly significant, nor does inclusion of these variables appear to affect the community income or redistribution variables substantially. Therefore the measure of redistribution used in the analysis does not appear to be capturing variation in more general government support, wrongly attributing it to educational expenditure redistribution.

In addition, it might also be of concern that states spend on both primary/secondary school education as well as higher education. To the extent that higher education spending is correlated with primary/secondary education spending and with intergenerational persistence and is omitted, one might wrongly attribute an effect to the primary/secondary redistribution. In addition, states may collect substantial taxes and return the revenue in various forms to communities without substantially redistributing it across communities. These might be considered “interventionist” governments which appear to be redistributing since the level of school funding from non-local sources is high, but are not in fact redistributing since funds are not substantially reallocated across communities. To account for the possibility of state-level differences in higher education funding policies or in degree of “intervention,” state dummy variables are incorporated into the

analysis.²⁵

Results incorporating state dummy variables into the persistence function (i.e., interacting them with the father's income to determine whether state variation in persistence is present and furthermore whether it affects the results on the importance of redistribution) are presented in column 9 of Table 2. The signs of the income and redistribution variables are unchanged, and many of the magnitudes are qualitatively similar, however now several coefficients are now individually not significant. The joint significance of the redistribution variables is now $p=.13$. The inclusion of an additional 37 interactive terms may account for the increase in the standard errors, which change much more than the coefficients in several cases. Overall, however, persistence appears to fit the same general shape as without the state effects.

A key consideration in this analysis is the extent to which redistributive school funding can be isolated as a contributing factor to the degree of persistence of income inequality across generations. If characteristics of school finance in an area reveal the choice of families to live in that area, then one cannot conclude that redistribution was exogenous in determining outcomes for children. Similarly, if parents select school characteristics in order to provide the best possible (expected) outcome for their children, then school funding characteristics would in fact be endogenous in the determination of son's earnings. In the data set that is used here, school characteristics are measured at the county level. In many parts of the U.S. a county is not equivalent to a school district. In fact, many counties include multiple school districts. Therefore, while parents might choose a particular school district in which to live, county-level school funding data is sufficiently aggregated so as to be considered exogenous with respect to a child's outcome or intergenerational income persistence.

In particular, county selection by families is likely exogenous to the determination of children's economic status since parents choose a county based on job location, but choose a residence within

²⁵Of course, state dummy variables also capture additional unobserved variation across states.

a county based on quality of schools and other local characteristics. In addition, as long as county-level school finance characteristics are correlated with individual school finance characteristics, then the estimation as presented in this paper is essentially the reduced form where county-level characteristics instrument for individual school funding characteristics in the determination of children's incomes.²⁶ Given the existing evidence, the geographic level at which redistribution is measured, and the fact that redistribution is determined in childhood but outcomes are measured in adulthood, it seems plausible that county characteristics are exogenous with respect to son's economic status.

Table 3 presents results analogous to those in Table 2, but excluding counties with only one district. In counties with more than one district, endogeneity is less likely to be a problem. The results in Table 3 indicate qualitatively similar findings to those results in Table 2. While some coefficients are no longer individually significant, the joint significance of the redistribution variables is now quite strong ($p < .05$ in most specifications) despite the reduction in sample size. These findings refute the likelihood of endogeneity as an explanation for the redistribution results.

While the focus so far has been on characterizing persistence, it is also important to note that the factors that affect persistence might also be considered as factors in determining the level of son's earnings. In terms of the regression specification, those variables which are interacted with father's earnings to form the persistence function, might also arguably appear in their uninteracted form, as determinants of son's economic status. In other words, α in equation 7 could also be a function of both community income and redistribution, as well as other community and individual characteristics. Column 10 of Table 2 includes the community income and redistribution variables in uninteracted form, including both the race dummy variable and local education revenue per

²⁶As a further indication that endogeneity is likely not a problem in this analysis, Heckman *et al.* (1996) note that analysis of school quality effects with less aggregated data actually yield weaker results, which is inconsistent with the hypothesis that school quality is endogenous in determining children's outcomes. This conclusion is consistent, however, with measurement error in school quality at the local level.

pupil, since even though they were not significant determinants of persistence, economic intuition suggests that they belong in a regression determining son's economic status as a function of the father's economic status.²⁷

The conclusions regarding the role of redistribution in intergenerational persistence are not affected by including these uninteracted components. The coefficient on redistribution is still negative, and the coefficient on the interaction between community income and redistribution is still positive. In addition, the interacted redistribution variables are jointly significant ($p=.02$). Note that redistribution does not appear to affect the level of a son's income, but rather only the persistence of incomes across generations. This result is consistent with the human capital investment constraint model, where the constraint is relaxed by redistribution.

Overall the empirical results suggest that the relationship between parents' and children's economic status is indeed nonlinear, and in particular intergenerational persistence is higher for children growing up in low and high income communities than in middle income communities. Furthermore, redistribution is a significant determinant of intergenerational income inequality, reducing persistence for children growing up in low income communities, making them more likely to grow out of poverty across generations.

5 Conclusion

This paper has shown empirically that redistribution of school funding can have significant effects in reducing intergenerational income inequality. Motivated by theoretical work on the importance of community factors, intergenerational persistence is shown to depend on community income. In

²⁷The goal of this paper is *not* to present a specification of sons' earnings, but rather a specification of persistence. An equation determining sons' earnings would include, among other variables, the sons' education levels. When that exercise is performed here, redistribution is no longer statistically significant. However, redistribution *is* significant in determining the sons' education levels. Therefore, the results presented here can be seen as the reduced form of a two-stage estimation where sons' education depends nonlinearly on redistribution, and sons' earnings are a linear function of sons' education levels.

particular, persistence is found to be higher for families in very low income and very high income communities than in middle income communities.

The role of redistribution is analyzed explicitly in this context. External funding of schools is found to affect low income communities differently from high income communities, as theory would predict. Specifically, intergenerational persistence for families in low income communities is reduced as the constraint of funding schools from the local tax base is lifted. This reduction of persistence through relaxation of the constraint of using local incomes to finance human capital expenditure is not apparent in middle-income or high-income communities.

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