The impact of education expenditures on income inequality: Evidence from US states

The Honors Program

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ABSTRACT

While the effect of various types of government expenditures on income inequality has been studied extensively, whether education expenditures impacts income inequality is less clear. The purpose of this paper is to examine the relationship between education expenditures and income inequality. Specifically, I explore the impact of tertiary versus primary and secondary education spending on income inequality using panel data for 50 US states over the period 1987-2015. Using an ordinary least squares model with time and state fixed effects, I find that total and disaggregated education expenditures have a significant inequality-reducing effect on the income distribution. The findings support continued spending policies at all levels of education as a way to reduce income inequality.

Keywords: Education expenditures; Income inequality; Panel data

JEL Classification: H75, D31, C23, I24

INTRODUCTION

Over the past few decades, income inequality in the US has grown substantially, largely as a result of aggressive growth in the incomes of the top 1 percent (Hayes and Vidal, 2015). As evident in Appendix A, since 1987, the share of income owned by those at the top of the income distribution has grown considerably, with the top 10% owning over half of the income in 2015. At the same time, the vast majority of incomes have increased little, while others struggle economically or live in poverty. This is noteworthy because those with a dearth of financial resources face consequences that are detrimental to an individual's health, living conditions, social connections, development, and opportunities later in life (Newman and O'Brien, 2011). Moreover, the negative effects of income inequality are not solely confined to those who directly experience it. Studies have found strong associations between inequality and a variety of social problems such as mental illness, mortality, homicide, hostility, racism, violent crime, imprisonment, and drug abuse (Hsieh and Pugh, 1993; Kaplan et al., 1996; Wilkinson and Pickett, 2007). As Wilkinson and Pickett (2009) explain, the effects of income inequality "extend to almost all sections of society … [because] material inequality serves as a determinant and measure of the scale of social status differentiation in society" (p. 509). When societies are more unequal, the struggles of those at the bottom are relatively greater and begin to permeate into society as a whole, increasing social instability.

In order to address this issue, it has become the responsibility of the government to implement policies of redistribution and provide equal opportunities. Fiscal policy – in the form of taxes and transfers – has become one of the most effective tools at the disposal of the government to eliminate income inequality. In particular, government revenues and expenditures have been found to reduce overall income inequality by diminishing the gap between the economic top and

the rest (Beramendi and Cusack, 2009; OECD, 2012; Hayes and Vidal, 2015; Higgens et al., 2015). While the redistributive effectiveness of various types of government expenditures have been studied extensively, the focus of this paper is to investigate the effect of education expenditures on income inequality.

One crucial way of transforming initial socioeconomic disparities is through policies focused on increasing education equity (Heckman, 2011). In today's society, human capital accumulation is a crucial determinant of one's future social and economic success, particularly since most high-paying jobs require well-educated individuals. Therefore, it should follow that investments in education that focus on expanding the number of educated people in society will reduce income inequality. Although there have been numerous studies that consider the link between income inequality and education expenditures, the findings are contradictory: some find that education expenditures lead to a reduction in income inequality, e.g. Sylwester (2002) and Higgens et al. (2015); while others report that public spending on education contributes to an increase in income inequality, e.g. Jimenz (1986) and Bishop et al. (1992). It is possible that the mixed findings in the extant literature are obscured by the variability in the redistributive effectiveness of different types of education spending.

Examining education expenditures as a whole assumes that spending will have a uniform effect on outcomes. However, it is more probable that there are varied effects associated with allocations at different stages of schooling. In the US, everyone is required to attend primary and secondary school until the age of sixteen[1], so it is made free and accessible to all students. Nevertheless, among the various public schools there are discrepancies in the quality of

[1] In some states the minimum age requirement is seventeen or eighteen.

education that arise as a result of financial differences between communities, since these schools rely heavily on local taxes as a source of funding. For the same reason, there are also divergences in the quality of education between public and private schools. Therefore, expenditures on primary and secondary education that focus on reducing disparities in educational quality should decrease income inequality, since doing so would equalize learning opportunities (Heckman, 2011). Conversely, higher education is not a requirement, so those who choose to go to college must pay tuition to attend. The financial burden of obtaining a post-secondary degree inherently means that it will be more difficult for individuals from lower socioeconomic groups to enroll (Brand and Xie, 2010). Since the spending on tertiary education is primarily benefiting those who attend, expenditures on higher education will increase income inequality because a relatively smaller proportion of individuals from disadvantaged backgrounds go to college.

Additionally, the discrepancy in the findings of much of the literature on education expenditures and income inequality is likely because most studies focus on national-level data. However, in the US, the educational system is decentralized, with direct power and oversight of educational institutions at all levels given to the state and local governments. By only looking at spending at the national level, studies could potentially miss important nuances that arise due to the structure of the various state educational systems. This paper adds to the literature by examining the effects of state-level education spending on income inequality using panel data for the 50 US states over the period 1987 to 2015. In particular, I analyze the impact of primary and secondary versus tertiary education expenditures on income inequality. Using an ordinary least squares model with time and state fixed effects, the results suggest that total and disaggregated education expenditures have a significant inequality-reducing impact. These findings are robust to alternate income inequality measures and with the inclusion of control variables.

The rest of the paper is organized as follows: Section 2 discusses the relationship between education expenditures and income inequality. Section 3 presents the model and data. The empirical results are reported in Section 4, while the final section concludes.

LITERATURE REVIEW AND HYPOTHESIS

While numerous studies have confirmed a link between income inequality and education, the findings suggest a complicated relationship. One prominent economic theory, the human capital model, posits that the association between education expansion and income inequality can be explained by the level and distribution of education, with income inequality increasing unequivocally with education inequality (Gregorio and Lee, 2002). However, the effect of increasing the average level of schooling is more ambiguous, and depends upon the returns to education at different stages of learning. With education expansion, constant or increasing returns to education result in more income inequality, whereas declining returns lead to a more equal income distribution (Coady and Dizioli, 2017).

Another theory, promoted by Knight and Sabot (1983), asserts that a rise in the average years of education affects the earnings distribution through two factors: the composition effect and the compression effect. The composition effect refers to the impact of a change in the educational composition of the labor force on inequality. Initially, when there is more education inequality, the wage distribution expands with education expansion as more people gradually begin to acquire higher income. However, income inequality eventually falls as fewer uneducated people remain. Here, the returns to education also play a role: when the overall premium on education is relatively small, a reduction in income inequality occurs later in the expansion process. Likewise, when the returns to education are greater for less educated individuals, income inequality is

reduced sooner. Meanwhile, the compression effect of human capital accumulation denotes the narrowing of the distribution of wages due to the increase in the supply of educated workers. When the growth in the supply for educated workers outpaces that of the demand for educated workers, the earnings premium on education is reduced, thus diminishing income inequality. Knight and Sabot (1983) found that, though the composition effect can raise income inequality, countries with higher educational attainment have more equal income distributions because the compression effect ultimately outweighs it. Galor and Moav (2004) support this, and argue that the accumulation of human capital, and therefore the extent of economic equality and growth, is greater "if it is shared by a larger segment of society" (p. 1021).

One of the main ways to reduce education inequality and increase the average level of schooling is through public expenditures on education. However, given these theories, when just looking at education as a whole, it can be quite difficult to ascertain whether a given education spending policy will lower income inequality. In particular, if the returns to education vary across different levels of learning, the overall redistributive effectiveness of education expenditures may be obscured. Therefore, when examining the effects of education expenditures on income inequality, it is important to distinguish between the effects of expenditures geared towards different stages of learning. In the US, education can be broken into two categories: compulsory education (primary and secondary), and non-compulsory education (tertiary). At every level, there are public and private institutions available, but the main distinction between the two categories is accessibility. Primary (elementary) school, middle school, and secondary school (high school) are accessible and offered free to all students. At the postsecondary level, both public and private institutions require tuition, limiting the number of people who participate in higher education. Ultimately, in order to identify where redistribution efforts are most useful, it

is important to understand how the structure of the US educational system can affect the relationship between public spending on education and income inequality.

In the US, formal education begins at the age of five with elementary school. Yet, evidence suggests that it is inequality in the development of human capabilities – which occurs prior to formal schooling – that initially produces disparities in social and economic outcomes (Heckman, 2011). The cognitive and social abilities that are cultivated during early childhood through familial environment and resources are crucial determinants of future potential, achievements, and success. Studies show that children exposed to poor parenting tend to experience a dearth of stimulation and investment at an early age, leading to a gap in cognitive and emotional skills, that when not addressed early, will accelerate over time (Heckman, 2011). However, achieving high-quality parenting has become increasingly difficult: "the high cost of living often requires dual careers and income. Work hours and commutes are long, wages are stagnant, and relatively few jobs offer generous parental leave benefit" (Heckman, 2011, p. 33). In the end, it has become nearly impossible for poor families to provide the necessary resources towards early investment in their children. Therefore, differences in initial economic and social circumstances, which are passed on from parent to child, ultimately create challenges for those born in lower socioeconomic groups. However, as Heckman (2011) explains, though individuals cannot alter the capabilities and economic resources they inherit at birth, inequality of familial resources can be supplemented through access to high-quality early-childhood education programs. These programs serve as a way to diminish the cognitive and character skills imbalances that form between children of different socioeconomic backgrounds, and can ultimately reduce income inequality.

In order to improve the disparities inherent across socioeconomic groups, early intervention is a more effective and cost-efficient way to prevent the formation of skills gaps, rather than attempting to address the problems that persist as a result of them. Still, while early investment is crucial in eliminating skills inequality, high-quality primary and secondary schools are necessary to sustain that equity (Heckman, 2011). Moreover, increasing education equality through reforms that aim to encourage completion of secondary education will also lead to a reduction in income inequality (Fournier and Johansson, 2016). Therefore, government cash transfers and tuition assistance towards primary and secondary education are vital, particularly for disadvantaged children who will benefit in the form of better education, health, and economic outcomes later on in life (Heckman, 2011). Public spending on non-tertiary schooling is an important form of redistribution in the US because all components – which include public childcare, Head Start, and primary and secondary education – are progressive in absolute terms, indicating that the benefits are reaching the poorest families (Higgens et al., 2015). However, this is not necessarily positive, particularly if the reason for the progressivity is the result of rich families choosing private schools because of low-quality public schools. Nevertheless, for public education spending, a focus on creating an equitable foundation that is continued through high-quality schooling at all levels will lead to gains for society as a whole due to skills increases that lead to greater productivity.

With regard to post-secondary education spending, its effects on income inequality are due to the non-compulsory nature of tertiary education in the US. Unlike primary and secondary education, tertiary education is not obligatory, so individuals who wish to attend must pay tuition. Therefore, the decision to pursue a post-secondary degree is to a large extent influenced by cost-benefit analyses; individuals invest in higher education so long as the economic benefits in the

long run outweigh the costs today. However, the decision to attend university is also greatly determined by sociological factors, and "as such, mechanisms influencing college attainment may differ by social background" (Brand and Xie, 2010, p. 274). For people from higher income families, going to college is a cultural expectation and less of a financial burden, so economic justifications play a moderately small role. As a result, these individuals are in a better position to attain a college degree, thus expanding their potential job opportunities and improving their ability to earn income in the future. Comparatively, individuals from lower socioeconomic backgrounds are less likely to go to college, since it is harder to forgo income now to attend school with only the possibility of economic gains in the future (Brand and Xie, 2010; Sylwester, 2002). This subsequently leads to limited participation of lower income individuals in institutions of higher education.

Due to the rising costs of tuition, many people in the US rely on government redistribution in the form of tertiary education transfers as a means to pay for college. These benefits are primarily disbursed to the persons receiving the education in the form of higher-income jobs that are otherwise unattainable without a degree. This trend has been re-enforced by technological progress, which has increased the demand for skilled workers (Sachs and Sanders, 2017). Those who cannot afford the higher education necessary for these new jobs miss out on the benefit, so that college-educated workers experience greater income growth compared to those with only a high school education. Furthermore, since many do not attend college due to the high cost, the demand for educated workers is rising faster than the supply of educated workers (Atkinson, 2015), which widens the wage differential due to an increase in the premium on education. Consequently, expenditures for higher education have given rise to a transfer of income from the lower to the middle and upper classes due to the under-representation of members of poorer

families in higher education institutions (Alchian, 1977). As opposed to early childhood education, where spending decreases income inequality due to a reduction in skills inequalities, tertiary education expenditures increase the skills disparity and thus broaden the income distribution because of the bias towards higher income individuals. Bishop et al. (1992) corroborate this, and suggest that all else being equal, increased spending on higher education is associated with states with greater income inequality.

The outcome of education expenditures on income inequality is ultimately shaped by the structure of the US educational system which decides the returns to education, since skills drive future earnings ability. Investment in early childhood education lowers skills imbalances between children, while spending on equitable, high-quality primary and secondary learning extends this foundation. Furthermore, since these levels of education are accessible to everyone, these expenditures are more likely to benefit those at the bottom of the socioeconomic ladder. Conversely, spending on tertiary education widens the skills disparity between different socioeconomic groups due to the under-representation of lower income individuals at institutions of higher education.

These discussions lead me to my main hypothesis: all else being equal, primary and secondary education expenditures lower income inequality, while post-secondary education expenditures increase income inequality.

DATA AND EMPIRICAL MODEL

I use annual data for 50 US states over the period 1987 to 2015. Given the extensive focus on this subject, a variety of metrics have been created to measure income inequality. Throughout the literature, measures of income inequality tend to be either "one-number summary statistics, such

as the Gini [coefficient, or] information about the income distribution at various points, such as shares of income or percentile ratios" (OECD, 2012, p. 4). I employ four different income inequality measurements in my empirical analysis: the Gini index, the Atkinson index, the Theil index, and the shares of income of the top 10% of the income distribution. The inequality data are given by Frank (2009) who aggregates annual IRS income data from 1917 to 2015. Developed in the early twentieth century by sociologist Corrado Gini and derived from the Lorenz curve, the Gini index is a statistical measure of the dispersion of income where a value of 1 represents perfect inequality and a value of 0 represents perfect equality (Ciment, 2013). The Atkinson index, similar to the Gini index, is based on the concept of "the equally distributed equivalent level of income" (Dincer and Gunalp, 2012, p. 285). This index also has values ranging from 0 to 1, where inequality increases as the index approaches 1. The Theil entropy index is also common among the literature, and measures the overall "disorder" in the income distribution, with larger values representing greater income inequality. As opposed to the Gini, Atkinson, and Theil indices, which look at the entire income distribution when measuring inequality, income shares expose the scope of inequality at certain points along the income distribution.

Appendix B reports summary statistics for various measures of inequality. As of 2015, New York has the highest income inequality across all measurements except for the shares of income of the top 10% of the income distribution, in which Florida has the most inequality. Similarly, in 2015, West Virginia has the lowest income inequality across all measurements excluding the shares of income of the top 10%, where Alaska has the lowest inequality. In terms of averaging across the 29 years, Connecticut, Florida, and New York have the highest inequality, whereas Alaska, Iowa, and West Virginia have the lowest.

Data on education expenditures are provided by the Census Bureau, broken down at the state level into tertiary, secondary and primary, and other. The dollar amounts of these different levels of education expenditure are each scaled as a percentage of gross state product (GSP). Data are not provided at the state-level for 2001 and 2003, so these years are excluded. I analyze the effects of total education expenditures, primary and secondary education expenditures, and tertiary education expenditures on the various inequality measures. On the basis of averages, Vermont, Utah, and West Virginia spend the most as a percentage of GSP on total education, primary and secondary education, and tertiary education, respectively. Meanwhile, Nevada, Hawaii, and Connecticut spend the least as a percentage of GSP on those respective spending categories. These summary statistics can also be found in Appendix B.

As a preliminary estimation of the relationship between education expenditures and income inequality, Appendix C shows average income inequality of each state against average education expenditures as a percentage of GSP. Using the Theil index as the income inequality measure, a general trend of decreasing inequality with increasing total education spending is evident. This negative relationship also appears, though to a lesser extent, when looking at primary and secondary education spending (Appendix D) and tertiary education spending (Appendix E). Though this cannot imply causation, these graphs provide preliminary evidence of the potential relationship between the various measures of educational expenditures and income inequality.

To examine the impact of education expenditures on income inequality, I estimate the following equation:

$$I_{i,t} = \alpha + \beta Expend_{i,t}^{k} + \gamma X_{i,t} + \delta_i + \varphi_t + \varepsilon_{i,t} \quad (1)$$

Where *i* denotes state, *t* denotes time, *I* represents income inequality, *Expend* represents expenditures, *k* signifies total, secondary/primary, and tertiary education expenditures, *X* is the vector of controls, δ_i represents the state effects, φ_t denotes the time effects, and $\varepsilon_{i,t}$ is the error term. Equation 1 is estimated using an OLS model with time and state fixed effects.

In keeping with the literature, I include a vector of control variables. First, following the model promoted by Simon Kuznets, I include the log of real income per capita and its square to capture the Kuznets Curve. Kuznets (1955) states that as economies develop, inequality first begins to rise. Upon achievement of a certain level of economic growth, inequality eventually levels off, and then falls with more advanced stages of development. This model is typically captured using GDP as a measure of growth, but since education expenditures are scaled using GSP, I use real income per capita given by the Bureau of Economic Analysis as a proxy for economic development. In addition, following studies such as Frank (2009), Dincer and Gunalp (2012), and Sylwester (2002), I include measures of educational attainment. Educational attainment is captured by two variables: the percentage of high school graduates and the percentage of college graduates. The data are obtained from Frank (2009). Following Dincer and Gunlap (2012), the final control variables are the unemployment rate and the employment shares in manufacturing and farming. The data for the unemployment rate come from the Bureau of Labor Statistics, while the data for the employment shares come from the Bureau of Economic Analysis. A brief description and summary statistics for the inequality measures, education expenditures, and control variables are presented in Appendix F and Appendix G respectively.

RESULTS AND DISCUSSION

The empirical results are displayed in Appendix H. My baseline model uses the Theil index as a measure of income inequality. According to Frank (2014), the Theil index is more analytically favorable, since it is "both decomposable and, unlike the other inequality measures, satisfies the strong principle of transfers, … [which] implies that changes in inequality from reallocations of income depend only on the relative distances between individuals, not their locations within the overall distribution" (p. 258). I first regress total education expenditures as a percentage of GSP on the Theil index and find the relationship to be negative and statistically significant, suggesting that education expenditures as a whole decrease income inequality (column 1). I then regress primary and secondary education expenditures as a percentage of GSP (column 2) and tertiary expenditures as a percentage of GSP (column 3) on the Theil index. Similarly, the coefficients on the expenditure variable in these two regressions are negative and statistically significant, indicating that the different types of education expenditures decrease income inequality. In particular, the results suggest that tertiary education expenditures have a greater inequality-reducing impact than spending on primary and secondary education.

The findings support my first hypothesis that government expenditures on primary and secondary education decrease income inequality. When state and local governments distribute more to early education, this equalizes educational prospects. Just as Knight and Sabot (1983) explain, the compression effect that occurs due to increased investment on primary and secondary education translates into lower income inequality. Contrary to my second hypothesis, the results advocate for increased spending on tertiary education as a way to narrow the income distribution. One possible explanation is that the state grants given to colleges and universities are mainly used for scholarships focused on providing opportunities for individuals from lower

socioeconomic groups to participate. Therefore, allocating more expenditures towards institutions of higher education reduces income inequality.

Once control variables are added to the model (columns 4-9), the significance of the various education expenditures remains, however the relationship is slightly attenuated. The results of the control variables are somewhat consistent with the literature. The inverted U-shape relationship promoted by Kuznets between economic growth and income inequality is not upheld. The coefficient on the log of real income per capita is negative and statistically significant, while the coefficient on the log of real income per capita squared is positive and statistically significant. This suggests a relationship that is the reverse of the Kuznets Curve, where income inequality decreases with economic growth up to a certain point, after which it begins to increase again. Though the results do not support the inverted U-shaped hypothesis, they are consistent with similar findings by Dincer and Gunalp (2012). In addition, according to the results, increasing the unemployment rate results in less income inequality. The coefficients on both education attainment variables and both employment shares variables are insignificant.

As a robustness check, I employ three other income inequality measures: the shares of income of the 10%, the Atkinson index, and the Gini index. The results of the models using the income shares and Atkinson index are presented in Appendices I and J, respectively[2]. As with the first set of regressions, when regressed alone, the various education expenditures have a significant inequality-reducing effect, though this effect is insignificant for primary and secondary education spending when using the Atkinson Index (Appendix J). Once again, when control variables are

[2] The results of the Gini regressions were abnormal and opposite of those observed using other inequality measures. Additionally, the results for the control variables were inconsistent with the literature. For more information, please contact the author.

added to the models, the coefficients of the education expenditure variables remain statistically significant, though this effect is insignificant for tertiary education spending when using the shares of income of the top 10% (Appendix I). The regressions from both inequality measures also suggest a similar reverse Kuznets curve. For the shares of income of the top 10%, the coefficient on the college attainment variable is negative and statistically significant, suggesting that increasing college attainment reduces income inequality. The remaining control variables have a limited statistical impact on income inequality, for both the shares of income of the top 10% and the Atkinson index.

As an additional robustness check, Appendix K presents the results of the same models using the Theil index, this time applying five-year averages due to the missing expenditure data in 2001 and 2003[3]. As before, when the different education expenditures are regressed alone against the Theil index the findings reveal a significant negative association between the two variables. Once again, this relationship persists with the addition of control variables. The main difference in these regressions is that unemployment is no longer significant, while the college attainment variable is found to be significant in reducing income inequality. This is consistent with the literature which finds that increasing the supply of educated workers (here increasing the number of individuals with a college degree) narrows the income distribution. Following the same procedure using the other income inequality measures, the results remain similar, and uphold the inverse relationship between the various types of education spending and income inequality. In summary, I find that spending on education at every level has a significant inequality-reducing

[3] Using five-year averages creates 6 time periods. The first five have five years, and the last time period has four years.

effect that is robust across various measures of income inequality, in the presence of additional control variables, and using five-year averages of the data.

CONCLUSION

In this study, I analyze the relationship between educational expenditures and income inequality using panel data from the 50 US states from 1987 to 2015. While previous studies focused on educational spending in its aggregate, my analyses examine the effects of different types of educational expenditures derived from the structure of the US educational system. Using OLS regression techniques with state and time fixed effects, I find that increases in educational expenditures, both in total and disaggregated into the two main stages of schooling, decrease income inequality as measured by the Theil index. These results also occur when using the share of income of the top 10% and the Atkinson index as measures of inequality. All educational expenditure variables are statistically significant in these regressions, apart from primary and secondary education spending when using the Atkinson index. With the addition of control variables, these relationships are upheld.

The findings suggest there is a significant inverse relationship between educational expenditures and income inequality, indicating that continued expenditures at all levels of education will be crucial to combat income inequality. More specifically, contrary to my original hypothesis, spending on higher education has the greatest inequality-reducing effect, signifying that spending efforts should focus on tertiary education, particularly as it pertains to improving the quality and accessibility of post-secondary institutions. When it comes to fiscal policy decisions, the results reinforce the need for more emphasis on education and public expenditures on education as important tools for improving income equality. The continued rise of income inequality over the

past few decades is not just an individual issue, but a national problem that should concern policymakers. As Heckman (2011) argues, "we need a capable and productive workforce that will compete successfully in the global economy. Underdeveloped human potential burdens our economy and leaves us with a workforce that is less than it could be" (p. 31). Education is the principal way in which people can develop the necessary skills requisite to enter the labor force. However, those that are strained economically face hardships that inhibit their ability to further their education. As a result, the struggles of those at the bottom ultimately diminish the capability of a nation to sustain growth, and promote political and social instability (Ganguly and Thompson, 2017). A more unequal society will only exacerbate the problem further. Policymakers have an obligation to address this issue, and these findings demonstrate that one effective way of doing so is through public expenditures on education.

In the future, studies on education expenditures should separate early-childhood, primary, and secondary education spending as a way to capture the distinctive impacts of early development intervention. Furthermore, additional control variables should be added to the model, particularly demographic variables and an education inequality variable. Also, alternative empirical methods would also be advantageous, such as models that include time lags on the expenditure variables specific to the type of education. For example, it is reasonable to assume that spending on primary education will not have a meaningful impact on the income distribution until those individuals that are currently in elementary school enter the workforce later in life. Consequently, for allocations towards primary education, it is likely that the effects will not be seen for another ten to fifteen years. Conversely, spending on tertiary education will have a more immediate impact since the benefits of this expenditure are going towards people who will enter the labor force sooner. Incorporating education-specific time lag variables will improve the

model by providing a more realistic depiction of the real-world effects of education expenditures on income inequality.

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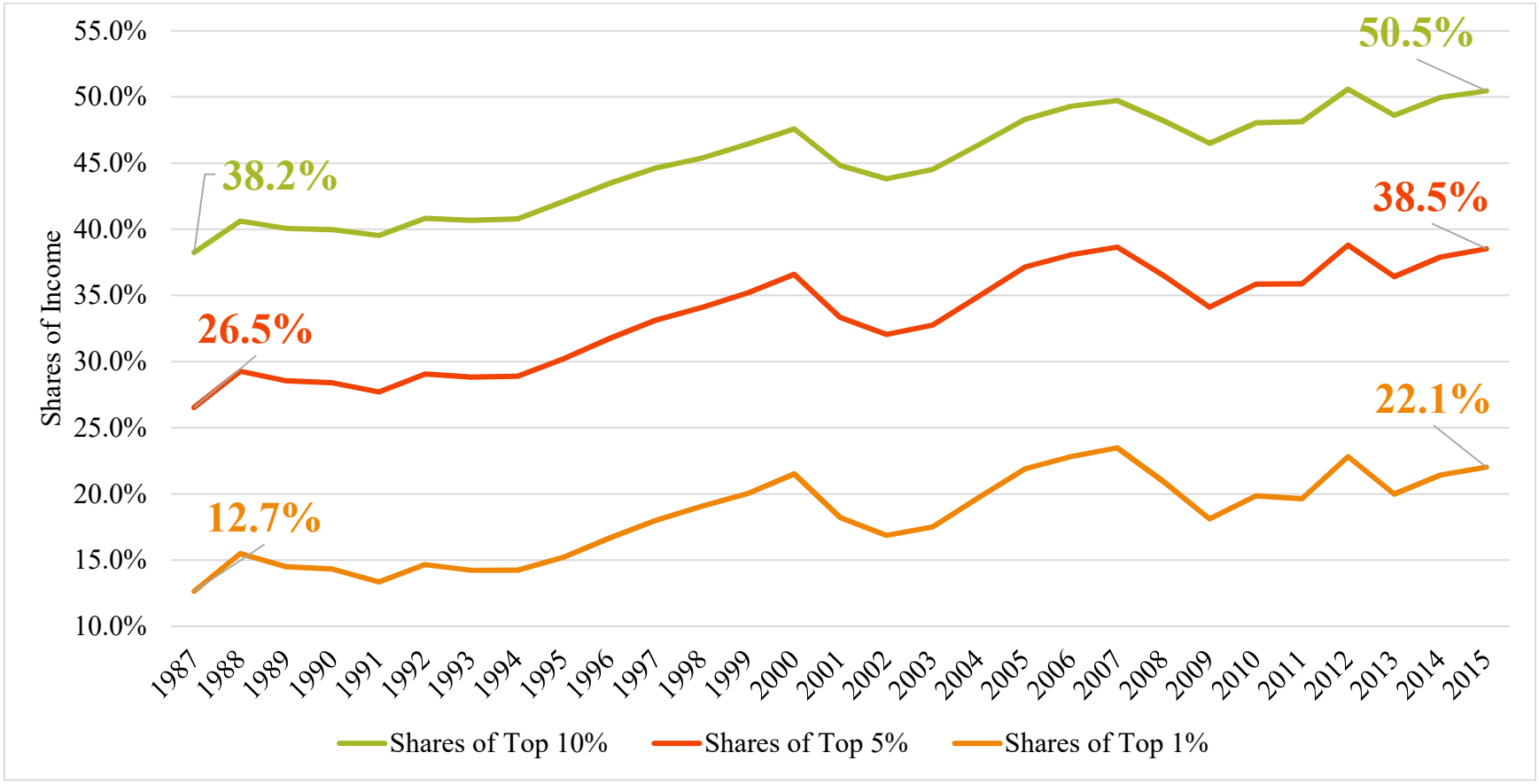
APPENDICES

Appendix A – Growth in Income Inequality



Appendix B – Inequality and Education Expenditure Averages by State

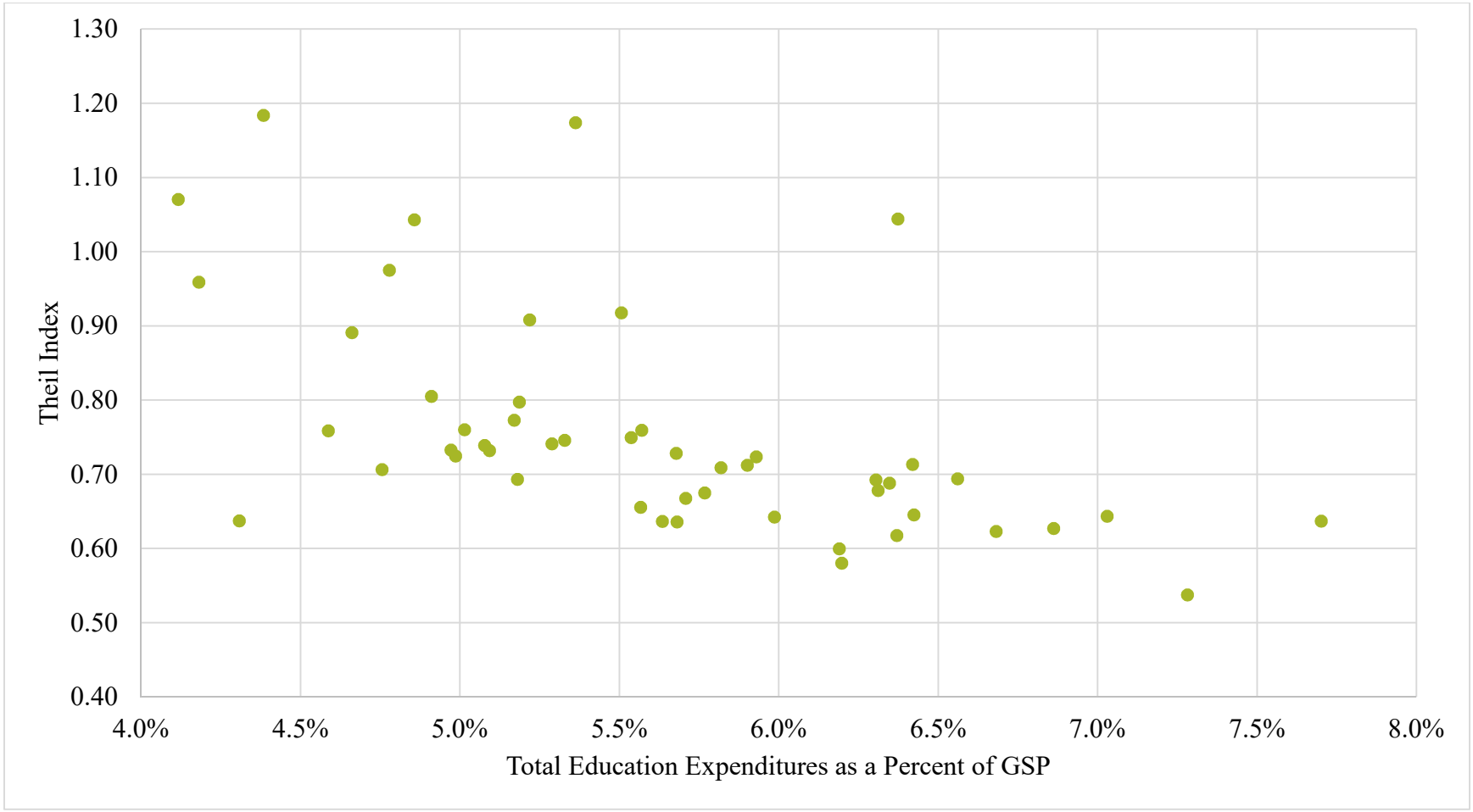
State	*Atkin*	*Gini*	*Theil*	*Top10%*	*Education (Total)*	*Education (Primary/Secondary)*	*Education (Tertiary)*
Alabama	0.253	0.579	0.693	43.06%	6.30%	3.70%	2.16%
Alaska	0.260	0.607	0.643	33.79%	5.99%	4.42%	1.33%
Arizona	0.261	0.584	0.746	44.67%	5.33%	3.39%	1.67%
Arkansas	0.248	0.588	0.688	42.08%	6.35%	4.04%	1.85%
California	0.307	0.625	0.975	46.88%	4.78%	3.20%	1.38%
Colorado	0.275	0.586	0.805	41.87%	4.91%	3.21%	1.55%
Connecticut	0.344	0.624	1.184	52.34%	4.38%	3.32%	0.85%
Delaware	0.256	0.550	0.707	40.74%	4.76%	2.75%	1.61%
Florida	0.313	0.640	1.043	51.39%	4.86%	3.53%	1.07%
Georgia	0.271	0.594	0.773	43.75%	5.17%	3.69%	1.16%
Hawaii	0.241	0.559	0.637	35.67%	4.31%	2.67%	1.56%
Idaho	0.245	0.595	0.668	38.80%	5.71%	3.68%	1.77%
Illinois	0.291	0.595	0.891	45.28%	4.66%	3.27%	1.15%
Indiana	0.243	0.558	0.637	39.58%	5.63%	3.59%	1.75%

Iowa	0.230	0.549	0.581	35.94%	6.20%	3.75%	2.17%
Kansas	0.256	0.574	0.712	39.19%	5.90%	3.77%	1.95%
Kentucky	0.242	0.571	0.636	41.72%	5.68%	3.45%	1.77%
Louisiana	0.263	0.605	0.733	42.47%	4.97%	3.31%	1.32%
Maine	0.233	0.551	0.600	39.64%	6.19%	4.47%	1.41%
Maryland	0.265	0.555	0.741	39.83%	5.29%	3.56%	1.50%
Massachusetts	0.303	0.593	0.959	47.48%	4.18%	3.07%	0.87%
Michigan	0.257	0.572	0.694	43.12%	6.56%	4.29%	2.07%
Minnesota	0.263	0.564	0.750	40.95%	5.54%	3.79%	1.46%
Mississippi	0.239	0.594	0.627	41.50%	6.86%	4.20%	2.29%
Missouri	0.258	0.578	0.725	41.51%	4.99%	3.51%	1.26%
Montana	0.244	0.610	0.644	40.19%	7.03%	4.65%	1.90%
Nebraska	0.253	0.577	0.709	36.74%	5.82%	3.76%	1.84%
Nevada	0.307	0.620	1.071	49.56%	4.12%	3.02%	0.96%
New Hampshire	0.264	0.561	0.760	41.30%	5.01%	3.71%	1.13%
New Jersey	0.301	0.592	0.918	46.30%	5.51%	4.30%	1.01%

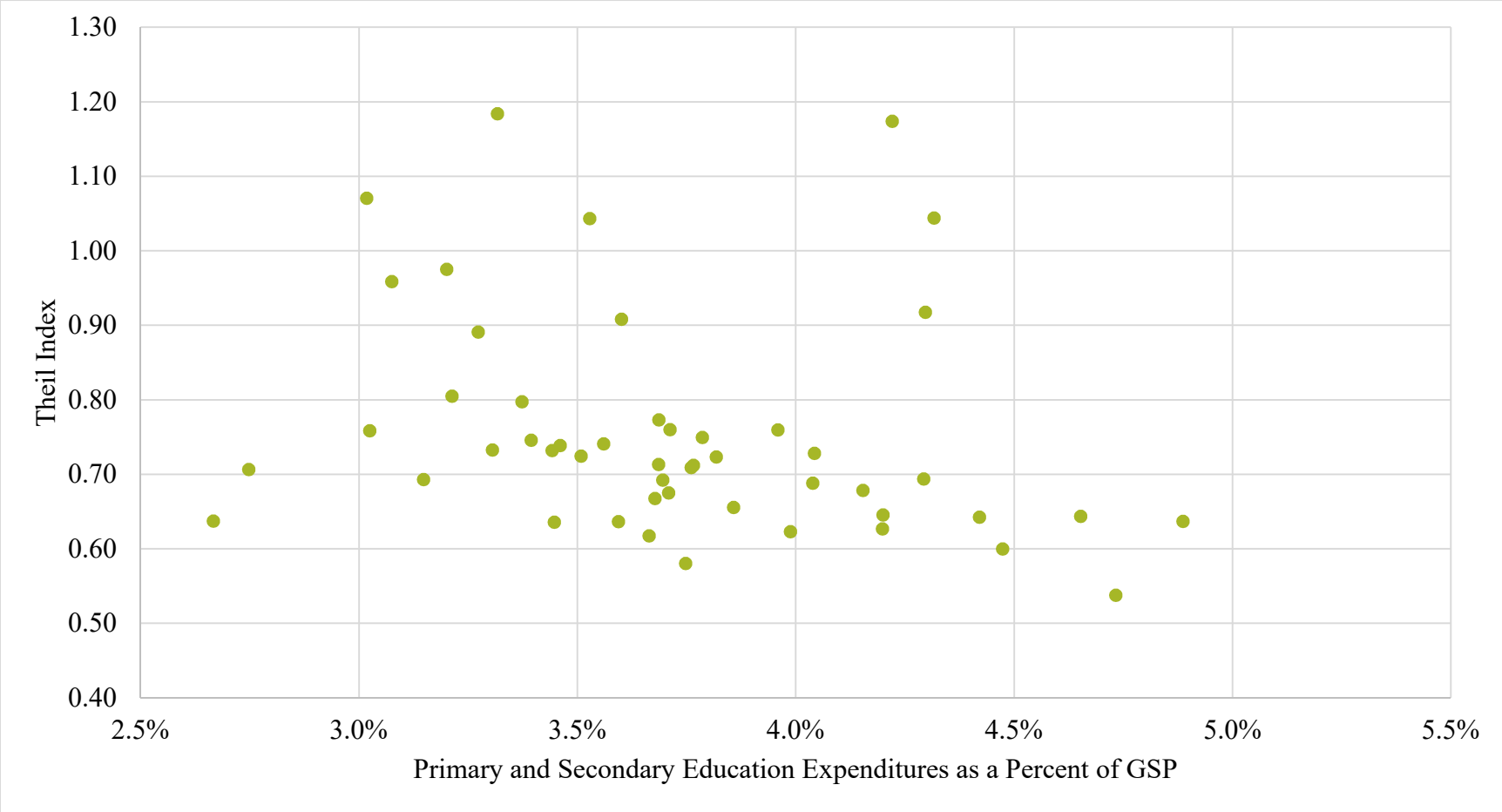
New Mexico	0.243	0.592	0.623	40.93%	6.68%	3.99%	2.38%
New York	0.339	0.639	1.174	52.23%	5.36%	4.22%	0.95%
North Carolina	0.254	0.568	0.693	41.40%	5.18%	3.15%	1.83%
North Dakota	0.238	0.574	0.618	36.52%	6.37%	3.66%	2.44%
Ohio	0.243	0.550	0.656	39.99%	5.57%	3.86%	1.43%
Oklahoma	0.256	0.592	0.724	39.91%	5.93%	3.82%	1.86%
Oregon	0.250	0.570	0.675	41.96%	5.77%	3.71%	1.86%
Pennsylvania	0.267	0.576	0.760	42.97%	5.57%	3.96%	1.22%
Rhode Island	0.260	0.564	0.728	42.61%	5.68%	4.04%	1.21%
South Carolina	0.245	0.571	0.646	42.04%	6.42%	4.20%	1.77%
South Dakota	0.257	0.601	0.739	37.68%	5.08%	3.46%	1.37%
Tennessee	0.263	0.587	0.759	43.12%	4.59%	3.02%	1.30%
Texas	0.295	0.622	0.908	44.64%	5.22%	3.60%	1.49%
Utah	0.254	0.575	0.714	39.37%	6.42%	3.69%	2.47%
Vermont	0.243	0.564	0.637	40.24%	7.70%	4.89%	2.32%
Virginia	0.264	0.561	0.732	40.00%	5.09%	3.44%	1.44%

Washington	0.269	0.569	0.798	43.10%	5.19%	3.37%	1.51%
West Virginia	0.223	0.549	0.538	42.59%	7.28%	4.73%	1.97%
Wisconsin	0.248	0.554	0.678	39.75%	6.31%	4.15%	1.93%
Wyoming	0.306	0.620	1.044	44.08%	6.37%	4.32%	1.79%

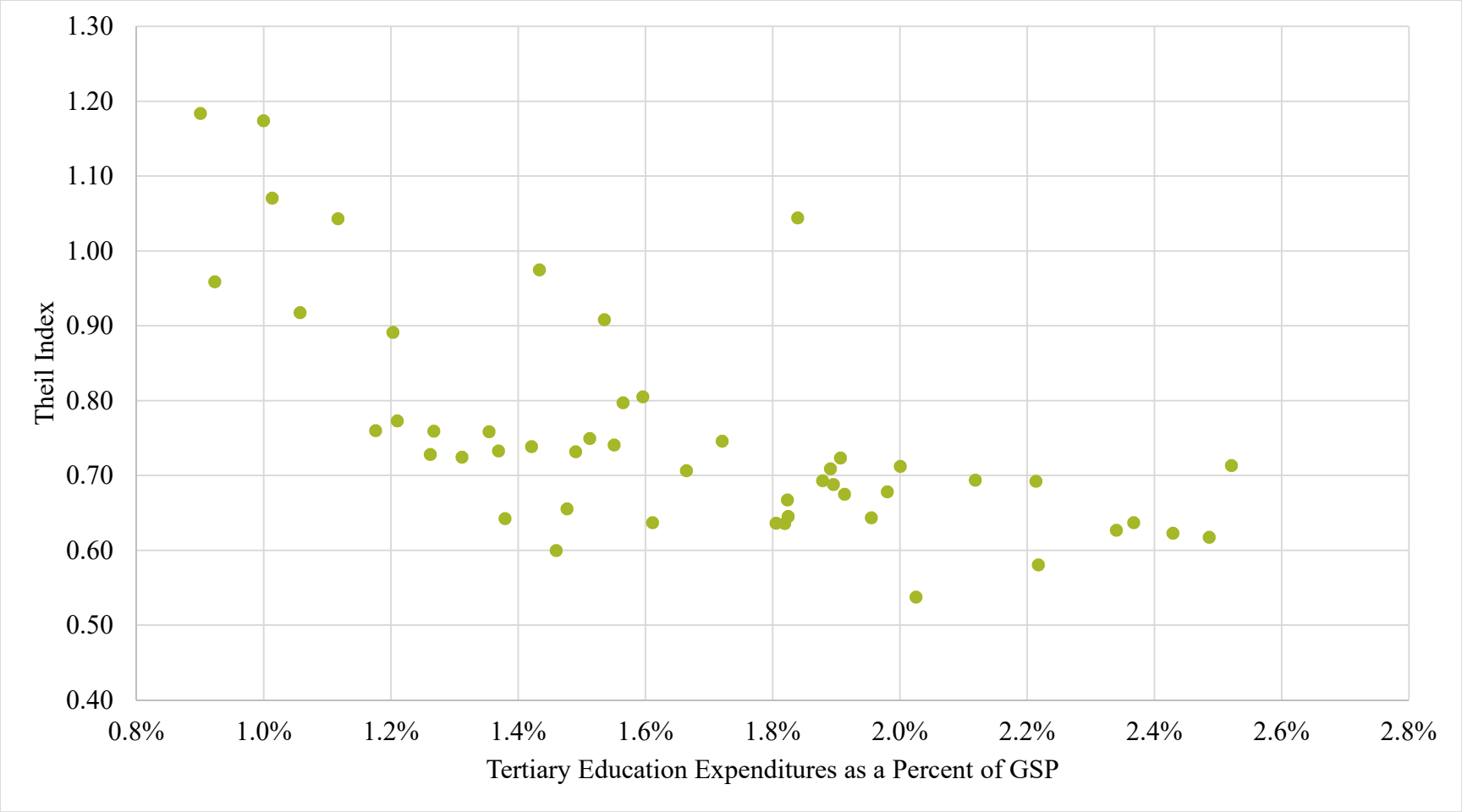
Appendix C – Theil Index by Total Education Expenditures



Appendix D – Theil Index by Primary and Secondary Education Expenditures



Appendix E – Theil Index by Tertiary Education Expenditures



Appendix F – Variable Descriptions

Variable Name	*Description*	*Source*
Atkinson Index	Atkinson Index	Frank (2009)
Gini Index	Gini Index	Frank (2009)
Theil Index	Theil Index	Frank (2009)
Shares of Top 10%	share of income owned by the top 10% of the income distribution	Frank (2009)
Education Expenditures (total)	total education expenditures as a percent of GSP	Census Bureau
Education Expenditures (primary/secondary)	primary and secondary education expenditures as a percent of GSP	Census Bureau
Education Expenditures (tertiary)	tertiary education expenditures as a percent of GSP	Census Bureau
(Log) Real Income Per Capita	log of real income per capita	Bureau of Economic Analysis
(Log) Real Income Per Capita Squared	log of real income per capita squared	Bureau of Economic Analysis
High School Attainment	percent of high school graduates	Frank (2009)
College Attainment	percent of college graduates	Frank (2009)
Unemployment	percent of the labor force unemployed	Bureau of Labor Statistics
Manufacturing Employment Shares	percent of jobs in manufacturing	Bureau of Economic Analysis
Farm Employment Shares	percent of jobs in farming	Bureau of Economic Analysis

Appendix G – Summary Statistics

Variable	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Observations*
Atkinson Index	0.264	0.038	0.196	0.411	1,450
Gini Index	0.583	0.037	0.489	0.711	1,450
Theil Index	0.756	0.187	0.316	1.498	1,450
Shares of Top 10%	42.05%	0.053	28.50%	62.17%	1,450
Education Expenditures (total)	5.62%	0.009	3.29%	8.91%	1,350
Education Expenditures (primary/secondary)	3.73%	0.006	2.06%	5.59%	1,350
Education Expenditures (tertiary)	1.61%	0.005	0.61%	2.92%	1,350
(Log) Real Income Per Capita	4.494	0.133	4.148	4.797	1,450
(Log) Real Income Per Capita Squared	20.214	1.192	17.202	23.013	1,450
High School Attainment	61.53%	0.049	45.11%	74.84%	1,450
College Attainment	16.85%	0.043	7.40%	30.56%	1,450
Unemployment	5.66%	0.018	2.30%	13.78%	1,450
Manufacturing Employment Shares	10.22%	0.047	2.00%	24.01%	1,449
Farm Employment Shares	2.48%	0.020	0.17%	11.72%	1,450

Appendix H – Regression Estimates (Dependent Variable – Theil Index)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education Expenditures (total)	-3.660***			-2.283***			-2.398**		
	(1.093)			(0.850)			(0.919)		
Education Expenditures		-3.365**			-2.627**			-2.594**	
(primary/secondary)		(1.461)			(1.023)			(1.124)	
Education Expenditures			-10.690***			-5.318*			-5.456*
(tertiary)			(2.732)			(2.757)			(2.771)
(Log) Real Income Per Capita				-12.137***	-12.619***	-11.028***	-12.017***	-12.743***	-11.175***
				(3.389)	(3.355)	(3.569)	(3.362)	(3.266)	(3.681)
(Log) Real Income Per Capita				1.499***	1.556***	1.382***	1.474***	1.556***	1.383***
Squared				(0.383)	(0.379)	(0.403)	(0.374)	(0.364)	(0.408)
High School Attainment				0.095	0.069	0.048	0.079	0.057	0.052
				(0.223)	(0.225)	(0.223)	(0.252)	(0.256)	(0.251)
College Attainment				-0.552	-0.532	-0.576	-0.519	-0.500	-0.537
				(0.422)	(0.429)	(0.415)	(0.413)	(0.422)	(0.407)
Unemployment							-0.908*	-0.923*	-0.961*
							(0.524)	(0.526)	(0.488)
Percent Manufacturing							-0.180	-0.148	-0.094
							(0.458)	(0.465)	(0.444)
Percent Farm							0.611	0.411	0.495
							(1.124)	(1.109)	(1.131)
State Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square (Overall)	0.4048	0.3111	0.4868	0.6015	0.5820	0.6124	0.5719	0.5506	0.5905
Number of Observations	1,350	1,350	1,350	1,350	1,350	1,350	1,349	1,349	1,349

Notes: Robust standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix I – Regression Estimates (Dependent Variable – Shares of Top 10%)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education Expenditures (total)	-0.584**			-0.641**			-0.888***		
	(0.232)			(0.850)			(0.224)		
Education Expenditures		-0.751**			-0.971***			-1.235***	
(primary/secondary)		(0.292)			(0.313)			(0.293)	
Education Expenditures (tertiary)			-1.107**			-0.730			-1.097
			(0.637)			(0.677)			(0.693)
(Log) Real Income Per Capita				-2.451**	-2.680**	-2.217**	-1.964*	-2.283**	-1.838
				(1.060)	(1.062)	(1.088)	(1.027)	(1.016)	(1.108)
(Log) Real Income Per Capita				0.274**	0.299**	0.250**	0.221*	0.257**	0.209*
Squared				(0.119)	(0.119)	(0.122)	(0.113)	(0.112)	(0.122)
High School Attainment				0.115*	0.118*	0.089	0.084	0.083	0.064
				(0.067)	(0.067)	(0.068)	(0.071)	(0.072)	(0.072)
College Attainment				-0.185**	-0.179*	-0.187**	-0.186**	-0.179**	-0.186**
				(0.091)	(0.091)	(0.092)	(0.087)	(0.089)	(0.088)
Unemployment							-0.145	-0.142	-0.170
							(0.148)	(0.151)	(0.142)
Percent Manufacturing							-0.178	-0.182	-0.129
							(0.138)	(0.138)	(0.138)
Percent Farm							0.346	0.298	0.249
							(0.332)	(0.327)	(0.344)
State Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square (Overall)	0.4047	0.3711	0.4260	0.3826	0.3488	0.3902	0.2835	0.2547	0.3188
Number of Observations	1,350	1,350	1,350	1,350	1,350	1,350	1,349	1,349	1,349

Notes: Robust standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix J – Regression Estimates (Dependent Variable – Atkinson Index)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education Expenditures (total)	-0.552***			-0.330**			-0.424***		
	(0.205)			(0.143)			(0.152)		
Education Expenditures		-0.415			-0.383**			-0.469**	
(primary/secondary)		(0.277)			(0.170)			(0.186)	
Education Expenditures (tertiary)			-1.931***			-0.768			-0.930*
			(0.478)			(0.494)			(0.510)
(Log) Real Income Per Capita				-3.026***	-3.097***	-2.866***	-2.894***	-3.25***	-2.753***
				(0.619)	(0.619)	(0.649)	(0.612)	(0.597)	(0.673)
(Log) Real Income Per Capita				0.363***	0.371***	0.346***	0.348***	0.363***	0.333***
Squared				(0.069)	(0.069)	(0.072)	(0.067)	(0.065)	(0.073)
High School Attainment				0.031	0.027	0.024	0.017	0.013	0.012
				(0.039)	(0.039)	(0.040)	(0.041)	(0.042)	(0.041)
College Attainment				-0.050	-0.047	-0.053	-0.051	-0.047	-0.054
				(0.078)	(0.079)	(0.076)	(0.073)	(0.075)	(0.072)
Unemployment							-0.126	-0.129	-0.136
							(0.092)	(0.093)	(0.086)
Percent Manufacturing							-0.082	-0.087	-0.076
							(0.084)	(0.084)	(0.082)
Percent Farm							0.113	0.079	0.090
							(0.189)	(0.187)	(0.189)
State Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square (Overall)	0.5241	0.4587	0.6064	0.7119	0.6991	0.7219	0.6967	0.6836	0.7135
Number of Observations	1,350	1,350	1,350	1,350	1,350	1,350	1,349	1,349	1,349

Notes: Robust standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix K – Regression Estimate Using 5-Year Averages (Dependent Variable – Theil Index)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education Expenditures (total)	-3.651***			-1.669**			-2.019**		
	(0.896)			(0.798)			(0.859)		
Education Expenditures		-3.118***			-1.797*			-2.053*	
(primary/secondary)		(1.186)			(1.032)			(1.088)	
Education Expenditures			-11.848***			-4.360*			-5.041**
(tertiary)			(2.607)			(2.304)			(2.417)
(Log) Real Income Per Capita				-13.501***	-13.755***	-12.605***	-12.657***	-13.197***	-11.821***
				(2.014)	(2.061)	(1.998)	(2.202)	(2.230)	(2.243)
(Log) Real Income Per Capita				1.654***	1.686***	1.559***	1.565***	1.626***	1.474***
Squared				(0.223)	(0.228)	(0.223)	(0.240)	(0.243)	(0.245)
High School Attainment				0.207	0.168	0.154	0.173	0.133	0.124
				(0.280)	(0.279)	(0.275)	(0.289)	(0.289)	(0.287)
College Attainment				-1.268***	-1.252***	-1.302***	-1.240***	-1.221***	-1.270***
				(0.386)	(0.387)	(0.387)	(0.392)	(0.394)	(0.394)
Unemployment							-0.216	-0.233	-0.260
							(0.474)	(0.476)	(0.475)
Percent Manufacturing							-0.144	-0.118	-0.099
							(0.257)	(0.257)	(0.255)
Percent Farm							0.719	0.525	0.623
							(0.768)	(0.760)	(0.765)
State Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square (Overall)	0.3614	0.2530	0.4723	0.5684	0.5504	0.5857	0.5534	0.5351	0.5770
Number of Observations	300	300	300	300	300	300	300	300	300

Notes: Robust standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$