The Concentration of investment in education in the US (1970-2018)

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Abstract

This study aims to analyse the concentration of investment in education in the US from 1970 to 2017. I study both the distribution of spending for K-12 and Higher Education and then present different scenarios to combine both inequalities. Even if the distribution of education spending is less unequal than the one of income or even wages, these spending are still very unequally distributed and, as for income and wages, inequalities have significantly increased over the past four decades, due to spending in higher education. Indeed, the top 10% of students for whom the most is spent used to have 28% of the overall amount of instructional expenditure in 1970 and now have more than 36%. Inequalities in educational investments are coming from two sources: unequal length of studies and unequal spending per grade, the latter being the main driver of the concentration observed. As a matter of fact, if everyone were to have the same educational attainment, the level of inequalities would almost be the same. The only way to reduce significantly the concentration in educational spending would be to equalize spending within each grade across districts and universities.

JEL Classification: I22, I24, H52, N32

Keywords: School Finance, investment in education, History of Education, Government Expenditure on Education

Contents

"While courts and legislatures have significantly changed the fiscal responsibilities for schools since the early 1970s, surprisingly little is known about the effects of these alteration. Some efforts have been made to track the spending patters of these changes, but less attention has gone to consideration of the overall level." (Hanushek [2002])

"Although there remains widespread disagreement about the relative importance of difference explanations for the recent increase in inequality and the stubborn persistence of poverty, the role of labor market skills and workers' education figures high on the list." (Heckman et al. [2005])

"Only if our country faces the consequences of growing income inequality will it be able to maintain its rich heritage of upward social mobility through educational opportunity." (Duncan and Murnane [2011])

1 Introduction

All over the world, education has long been considered as a means of guaranteeing equality of opportunities by allowing fair and equitable access to prestigious schooling and professions to those successful in their educational career. Education is regarded as one of the most powerful instrument for reducing income inequality. This vision is particularly important in the US, considered as a "land of opportunities" where everyone could achieve their dream through hard work and determination (Dhatt [2002]). Nowadays this myth is highly debated and controversial. Many studies have shown inequalities in educational access depending on social origins, gender, race or place of residence (Heckman et al. [2005]; Bailey and Dynarski [2011]; Duncan and Murnane [2011]; Rothstein [2019], etc.). The most prestigious colleges and universities have mostly students coming from very favoured social backgrounds. For example, on average, Harvard students have parents in the top 2% of the US wage distribution (Piketty [2013]). Children having parents in the top 1% of the income distribution are 77 times more likely to attend an Ivy League college than those in the bottom income quintile (Chetty et al. [2017]). There is thus a gap between the meritocratic ideal and the reality of the educational system.

Many people thought that making high school and higher education accessible to the masses would reduce inequalities, the idea being that the different "school movement(s)" (Goldin and Katz [1997]) would allow any individuals with the same aptitudes to have access to the same education and thus to the same social position. Nevertheless, differences in educational attainment depending on social origins persist and even among people having the same level of education, there is a huge variety in the quality of the education received. Moreover, this variance in quality seems to have increased over time, at least for higher education (Hoxby [2009]).

The rationale behind public investment in education is centered around externalities created by education (with returns for the entire community in terms of growth, diminution of criminality for instance). Some part of education is considered as a quasi-public good – especially for low level of education –. Another part is considered as a private good: in higher education, private returns are high, justifying that a substantial part of educational investments are made privately through tuition or the opportunity cost of forgone wages. Regarding education as an investment dates back to the 17th century with writings of Petty [1769] and Smith [1776] (*"The acquisition of [...] talents during [...] education, study, or apprenticeship, costs a real expense, which is capital in [a] person. Those talents [are] part of his fortune [and] likewise that of society"*). It was brought into mainstream economics by Schultz [1961], Becker [1962] and Mincer [1970].

In this paper, I focus on educational inequalities, not through the lens of social origins but through economic inequalities: not the same amount of money is invested in everyone's education. Investments in education represent a fair amount of public spending – in the US, expenditure of educational institutions represented 71,575 million dollars in 1970, *i.e.* 6.7% of GDP and 1,293 billions dollars in 2015, *i.e.* 7.1% of GDP (McFarland et al. [2017]) –. Its distribution among individuals is a high stake as it is likely to condition future inequalities within a cohort. Following the study of Piketty (Piketty [2013]) on the evolution of the concentration of income during the twentieth century, I study the concentration of educational expenditure, examining the percentage of the expenditure going to the most favored 1%, 5% and 10% of individuals. Moreover, focusing on costs of schooling is interesting as being an impartial measure, it is a good method of making comparisons, over time, over different areas and between several levels of education.

Over the past decades, a big increase in income inequality is observed, particularly in the US (Piketty and Saez [2003]). Some authors (Goldin and Katz [2009]) argue that rising inequalities in the US can be explained

by a "skill biased technical change" with the increase in demand for educated workers rising return to education since the 1980's. Indeed, between 1977 and 2007, the inflation-adjusted wage of college graduates grew by 25 percent, whereas that of high school graduates increased by only 1 percent, and that of high school dropouts fell by 13 percent (Levy and Murnane [2004]). Why then hasn't the supply of educated people adjusted to this technological bias on the labor market? Can inequalities in education spending account for this non-adjustment? On a descriptive perspective, we can wonder if education produces inequalities of the same "order of magnitude" as wage inequalities for instance. What are the economic inequalities produced by the institution that includes equality in its principles?

Moreover, it can be considered that "Money does matter" in education and that the quality of the education received won't be the same if someone received $50,000 in the 1970's (in 2017 dollars) or $100,000 in the 2010's (in 2017 dollars) – corresponding to spending for individuals at the 10th percentile of spending – or $197,000 in the 1970's (in 2017 dollars) or $482,000 in the 2010's (in 2017 dollars) – corresponding to spending for 99th percentile of spending – all along their educational career. There is a longstanding debate in the economics of education literature regarding the impact of more resources on educational outcomes. The Coleman report *Equality of Educational Opportunity* (Coleman [1966]) published by the US Government in 1966 conveyed the idea that money in education doesn't matter. This idea, often the only one remembered from the report, is going a little bit too far in its conclusion: indeed, it concluded that money need to be invested wisely and that more money by itself doesn't make better schooling outcomes (*«There appears to be no strong or systematic relationship between school expenditure and student performance»*, Hanushek [1986]). Nowadays, it's usually considered that money does matter and even so in deprived or segregated areas, especially when used to impact class size, which is, with teacher quality, the main driver of per pupil expenditure. Jackson et al. [2015] showed that increased per pupil spending were associated with improved schooling outcomes using school finance reforms as exogeneous shifter of per pupil spending.

Inequalities in educational spending are coming from two sources:

- Length of studies: it costs more if someone stay longer in school;

- Within the same grade, equal amounts of money are not invested into each person: it costs more if someone is in a more expensive school district or college.

The first inequality can to some extend be considered as "fairer" as on a global perspective, it makes more sense to allow individuals with higher abilities to pursue their studies longer. However, the access to higher levels of studies and most selective curriculum is also very socially determined.

In this paper, I try to evaluate these two inequalities in spending on education and their evolution over time from the 1970's to the 2010's, a period characterized by a big increase in income and wages inequalities. Whereas many studies focus on one particular level of the educational system (Hoxby [2009] on spending per selectivity of colleges, Jackson et al. [2015] on spending in K-12 education, etc.), I will try to compare these inequalities at different levels of education (elementary and secondary, higher education) and to combine them. It's also interesting to distinguish a cross-sectional approach while viewing inequalities in a given grade and a longitudinal approach taking into account all the educational career. If the districts or universities with the highest spending are always the same, the longitudinal inequalities are reinforcing; if there is mean reversion in spending, longitudinal inequalities are attenuated. Previous research (Zuber [2003]), evaluated these inequalities

in the French context of public investment in education at the end of the 19th and 20th centuries, the idea is to extend the analysis to the American context in the last decades (1970-2017). Whereas Zuber [2003] focused only on public investment in education, I decided to focus on public investment for elementary and secondary education and on both public and private institutions for higher education.

For K-12 education, I observe that if, over the period, per pupil spending have more than doubled in real term, the level of inequalities has stayed almost the same with the top 1% having 3% of the spending, the top 10, a bit less than 20% and the bottom 50 around 40%. Higher education spending for instruction are far more unequally distributed than K-12 spending and inequalities at this level of education have increased over time. Indeed, for one year of higher education, the top 1% of students for whom the most is spent have 11% (compared to 7% in 1980) of the overall instructional spending, the top 10% has 36% (compared to 28% in 1980) and the bottom 50% has 20% of the spending (compared to 26% in 1980). Mean student spending have increased by 85% in real terms but this figure conceals huge disparities: spending for the top 1% have increased by 175% and spending for the median student have only increased by 50%. These figures concern only the sub-population of college goers and one year of education; results taking into account all individuals and the length of studies are even more unequal.

The paper is structured as follows. Section 2 contains a short literature review of inequalities in educational spending in the U.S; section 3 presents the data and sources used; section 4 focuses on K-12 education; section 5 on higher education; section 6 presents scenarios of combination of inequalities for the entire educational career, section 7 shows some elements of comparison with France and with income inequalities, section 8 explores different mechanisms of explanation of these evolutions and the last section concludes.

2 Educational investment in the US

2.1 Massification of Different Levels of Education

2.1.1 The High School "Movement"

During the first half of the XXth century, the US appeared as an exception in terms of secondary schooling. The proportion of pupils continuing their studies beyond primary school was way higher compared to European countries. The rate of obtention of High School diplomas grew a lot between 1930 and 1960 (Figure 2.1). According to Goldin and Katz [1997], this movement was made possible due to local control, local public funding, separation of the Church and of the State, openness and gender neutrality. At the time, the fact that school funding relied on school district (as opposed to the centralized European education system) was seen as a virtue as it allowed local control of the school system and flexibility in terms of rules and curricula. *"Areas with greater homogeneity of economic condition, higher levels of wealth, and more community stability were the earliest to extend education to the secondary level and experienced the greatest expansion during the initial years of the high school movement."* (Goldin and Katz [1997]).

2.1.2 Higher Education

In 1900, the number of students going to college was approximately 160,000, in less than 1,000 institutions (Dhatt [2002]). The number of colleges grew very rapidly at the beginning of the XXth century. Federal funding

Figure 2.1: Percent of high school graduates and bachelor graduates per cohorts from 1910 to 2017
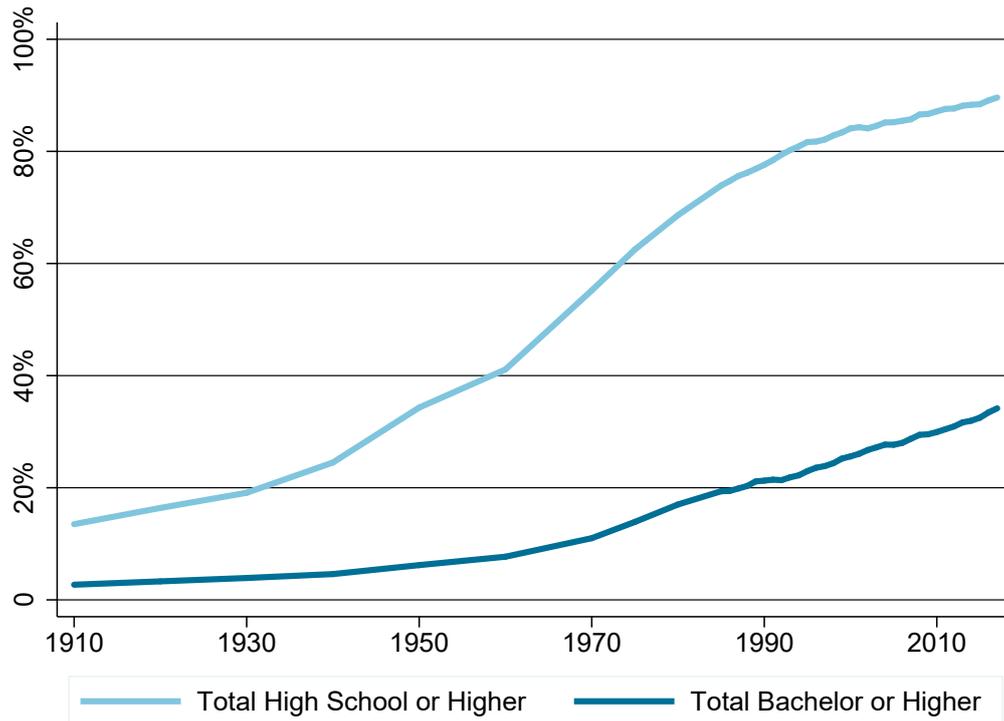
from the Morrill Land-Grant Colleges Acts of 1862 and 1890 helped to fund new colleges, many of them being public state universities.

After WWII, the GI Bill made college possible for veterans paying for tuitions and living expenses. Far from being anecdotal, the GI Bill developed a widespread belief of the necessity to go to college (Dhatt [2002]). U.S. higher education was open and forgiving, just as it was the case for lower grades (Goldin [2014]). Students who did not do well enough in high school could go to a community college and then transfer to a four year college. The institutions of higher education were spread out over the country, enabling rural families to send their children to university.

Starting in the late 1960's, early 1970's, a big increase in the proportion of individuals obtaining a bachelor degree is observed (Figure 2.1).

2.2   Inequalities in Investment in Education

Educational expenditures in real term have increased tremendously during the second half of the XXth century in the US. As a percent of GDP, global educational expenditures have gone from 3% of GDP in the 1950's to 7% of GDP today, around 4% being dedicated to K-12 education and around 3% to higher education (Figure 2.2).

Figure 2.2: Educational expenditure as a percent of GDP

(a) Global

(b) K-12 and Higher Education
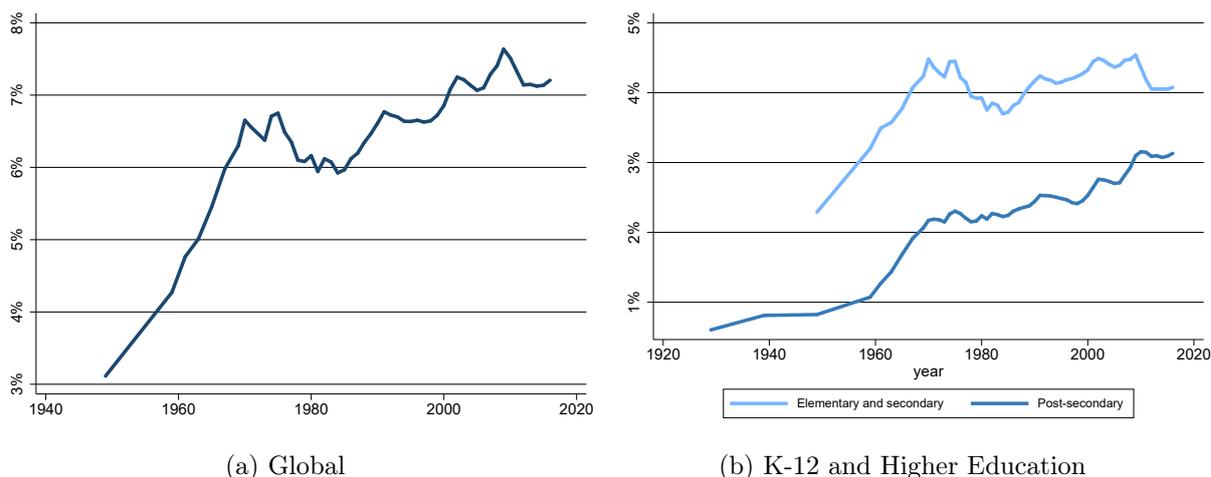
2.2.1   K-12 Education

In the United States, schools are funded by local property taxes[1]. Because of this, the more affluent a neighborhood, the higher the funding for that school district. Duncan and Murnane [2011] showed that when the K-12 educational system was implemented, Americans accepted inequalities in funding as incomes of families at the bottom of the distribution were growing quite rapidly, inequalities remained relatively stable and the country was characterized by a high rate of inter-generational economic mobility. They also state that *"Between 1977 and 2007, America's GDP per capita nearly doubled again. This time, however, the fruits of economic growth were confined to a smaller proportion of the population"*. As C.Goldin (Goldin [2001]) argues, the virtues of the past could have transformed themselves in flaws of the present as with school systems receiving funding based on property taxes, there are wider disparities in funding between wealthy and poor districts. Residential segregation is the driving force of this unequal system. In the late 1960s, the case of *Serrano v. Priest* was entered into California state court and changed the stability of financing. This case alleged that the state funding of schools violated the 14th amendment of the US constitution which requires equal treatment of individuals under the law. The *Serrano* suit argued that because local property tax bases differ, this funding arrangement discriminated against students in poor districts by making the fundings dependent upon the wealth of the community. The Supreme Court ruled in 1973 that the state funding formula didn't violated the individual state constitution but the *Serrano* case lead to many schools finance reforms. In response to large within-state differences in per pupil spending across wealthy and poor districts, state supreme courts overturned school finance systems in 28 states between 1971 and 2010 (Fulton and Long [1993], Corcoran and Evans [2015]). Murray et al. [1998] found that court-ordered finance reforms reduced within-state inequality in spending by 19 to 34 percent. Nevertheless, as between state spending inequalities represent around two third of total inequalities in education spending, the ability to equalize the resources available to students at the country level seems more limited. This paper only focuses on inequalities created by unequal investment in schools whereas investment at home also represents a big amount of inequalities in investment in education. Duncan and Murnane [2011] showed that in the 1970's

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[1]The proportion of local taxes among school fundings varies a lot between states, as is seen in the case of New Hampshire and New Mexico: 85% of school resources come from local taxes in New Hampshire and 12.3% in New Mexico (Fischel [2006])

high-income families spent about $2,700 more per year than low-income families on child enrichment such as books, computers, high-quality childcare, summer camps, private schooling, music lessons, etc. By 2005, this gap had nearly tripled, to $7,500.

2.2.2 Higher Education

In terms of higher education, some authors (Ellwood et al. [2000], Belley and Lochner [2007]) observe a dramatic increase in the role of family income in explaining college attendance, college quality and amount of hours worked while studying from 1980s to 2000s. According to them, this is explained by the fact that more people are credit constrained today than in the early 1980's. Orfield and Lee [2005] showed that only 11% of children from the bottom fifth of earnings earn a college degree while 80% of the top fifth do so. Rates of college completion increased by only four percentage points for low-income cohorts born around 1980 relative to cohorts born in the early 1960s but by 18 percentage points for individuals born in high income families. *"Even among those who had the same measured cognitive skills as teenagers, inequality in college entry and completion across income groups is greater than it was two decades ago"* (Bailey and Dynarski [2011]). There also seems to be a decrease in the fraction of students from low-families at the institution with the highest upper mobility rates which let forecast lower mobility rate for most recent cohorts (Chetty et al. [2017]).

2.2.3 Link between Inequalities in Educational Investment and Wages Inequalities

The period studied is also caracterized by an increase in income and wages inequalities. Goldin and Katz [2009] estimate that between the early 1980s and 2005, demand for college graduates increased by 3.5% per year while relative supply of college graduates increased by 2% per year only, creating a growth in the college rate premium at the rate of 0.9%. But why hasn't the supply of educated workers kept up pace with demand? Some authors (Kane [2007]) suggest that the recent rise in tuition costs, decline in Pell Grant offerings, and gradual erosion of real student loan borrowing limits in the U.S. may be responsible for the modest response in aggregate college attendance rates despite the sharp rise in its economic returns. Carneiro and Heckman [2003] argue that the current tax system favor human capital on the job (with tax deduction) rather than full time schooling (as there is no deduction for college tuitions). Katz (in Heckman et al. [2005]) argues that the change in family structure, with more single-parent families can help explain the slower growth of educational attainment.

Conversely, the effect of income inequality on education spending has been studied. Hoxby [1998] examines the evolution of inequalities in per pupil spending in Massachusetts, Illinois, and California. Overall, she finds that decades in which spending inequality rose the most (the 1930's and the 1970's) were also decades of rising income inequality and the decade in which spending inequality fell the most (the 1940's) was a decade of falling income inequality.

Even if this paper doesn't provide causal evidence, section 7 presents some elements of comparison with wages inequalities.

2.3 Are per Pupil spending Important?

"Contrary to the narrative of administrative bloat, spending cuts affect core instruction and academic support, generating large downstream impacts on educational attainment." (Deming and Walters [2017])

In 1966, an especially controversial report was released by a sociology professor at the University of Chicago, titled *the Coleman report* (Coleman [1966]). It was one of the first report based on detailed statistical data and argued that school fundings have little incidence on student achievement. It was actually mostly arguing that socioeconomic origins and family background matter more in terms of achievement than per pupil spending. Between 1960 and 2000, real per pupil spending more than doubled and student/teacher ratio felt by one third without a similar increase in student performance (Hanushek [1986]). This is the main rationale toward arguing that "schools doesn't matter" or that "increasing spending is inefficient to increase educational performance".

First, it should be remembered that the period studied is a decently long period and that the education production function is likely to have changed over the period, especially as more opportunities for women were available on the job market: teacher salaries had to adjust to these outside opportunities. Secondly, for feasibility and convenience, student performance are almost always measured in terms of test scores and these test scores might not be a good indicator of improvements in educational performances and non cognitive outcomes created by higher spending. Some literature has shown that raising school expenditure improves labor- market outcome (Card and Krueger [1992]). It might be that schools with more funding are able to invest more in extracurricular activities like daycare, after school programs, summer schools which are not effective at raising test scores but do have an influence on student cognitive development and behavior. Lastly, when it comes to schools, outcomes are not obvious since the objective can be multi-dimensional (increase educational attainment of pupils, make good citizens, raise their consciousness, attenuate inequalities created by different household environment, etc.) and the measure of these outcomes can be subject to a lot of biases. In this sense, focusing on costs of schooling – even if it's not a perfect predictor of the benefits students get out of it – is interesting as it is an impartial way of measure and a good element of comparison, over time, over different areas and between several levels of education.

3   Data Sources and Construction of Databases

3.1   Elementary and Secondary Data: Annual Survey of School System Finances

The Census of Government has been conducted every five years since 1967 and records administrative data on school spending for every school district in the US. This is the data source used in all existing national studies of school finance reforms. INDFIN contains school district finance data annually for a sub-sample of large school districts from 1967 to 1991. It means than from 1970 to 1987, in years ending in '2' and '7' the entire universe is canvassed and in intervening years, a sample of the population of interest is surveyed (Figure 3.1). The survey coverage includes all state and local governments in the United States. After 1987, the CCD School District Finance Survey consists of data submitted annually to the National Center for Education Statistics and includes data on school spending for every school district in the US. Data on per pupil spending are directly available from 1987 to 2016 (*Public Elementary-Secondary Education Finance Data*, US Census Bureau) but I have to recompute them for previous years (*Data on Historical Finances of Individual Governments* (IndFin), US Census Bureau). The way I compute it is by keeping only administrative entities having "SCH", "EDUC", "VOCATIONAL", "ATTENDANCE AREA", "REAA", "COLLEGE", "ELEM", "S.A.U." or "RESA" in the name and then dropping the ones for whom "SCH" was in the name of the city or the congressional district for instance. I intend to keep only school districts this way as the original data includes local government entities

such as counties, municipalities, townships, special districts, and school districts. I then divide total educational expenditure by the student population of the school district to obtain per pupil spending for 1967 and every year from 1970 to 2012. For the year where I have the two sources of data (1987-2012), I check that enrollment data and per pupil expenditure data are of the same order of magnitude for each district.

Figure 3.1: Number of school districts covered by the data
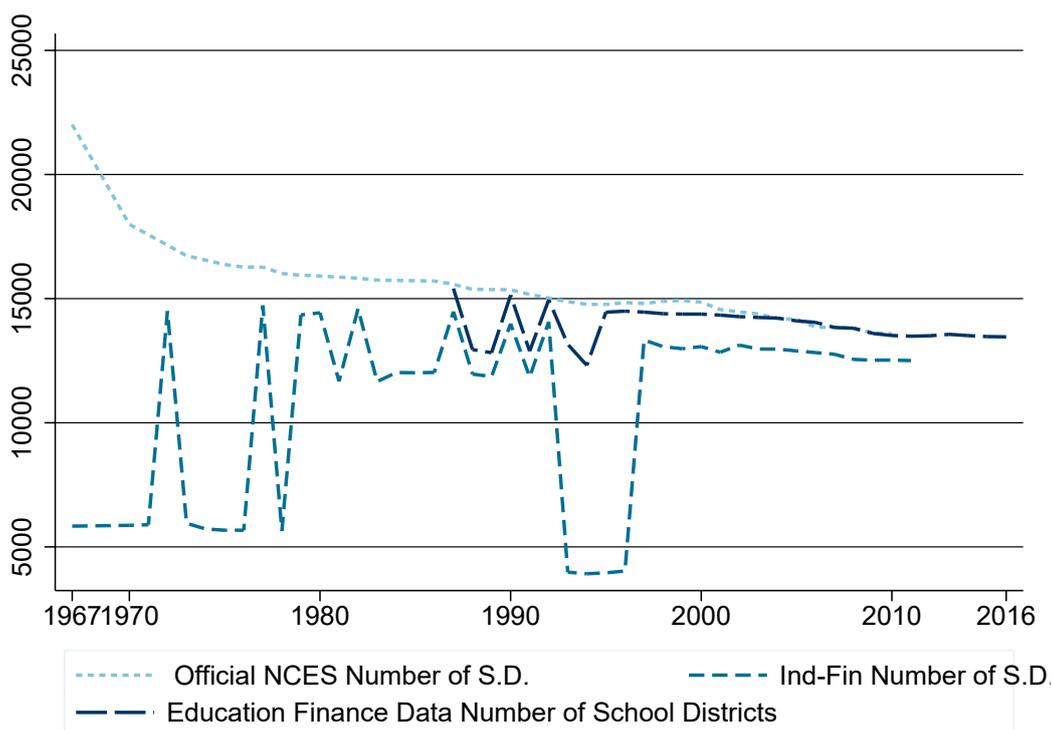
In order to conduct longitudinal analysis of per pupil spending, I merge data over time with the district identifier. Due to changes in school districts boundaries and incomplete data in the 1970's, not all school districts are present for 12 years in a row. I drop districts for which more than 4 years of data are missing and I infer missing values for districts with less than 4 years out of the 12 computing the average between adjacent years for which I have the data. I present robustness check with a constant coverage of districts (3,633 districts in the 1970's and 15,981 districts in the 1990's-2000's) in Appendix B. Not having data on movers, my analysis assumes that districts and their residents are fixed. I also assume that there are no repeaters. The effect of repeaters is ambiguous: primary and secondary repeaters are more likely to have a shorter educational career, reducing inequalities in spending while repeaters in higher education are people having nonlinear curricula, more likely to increase inequalities in spending.

3.2 College Data: IPEDS Data

IPEDS (Integrated PostSecondary Education Data System) is a collection of surveys spanning from 1980 to 2017 regarding college finance, enrollment, admissions, completions, graduation, outcome, institutional characteristics, libraries, etc. I compute per student spending for instructional expenditure, per student total spending without grants and with grants, average total expenditure (excluding half of research spending, hospital expenditure and independent operations), etc. from 1980 to 2017 based on total expenditure and fall total enrollment. From 1980 to 2017, there are 7,046 colleges in the database, distributed as followed in 2017 [2]:

Table 3.1: Sector of colleges in 2017

Sector of institution	Frequence	Percentage
Public, 4-year or above	775	11%
Private not-for-profit, 4-year or above	1,701	24.14%
Private for-profit, 4-year or above	661	9.38%
Public, 2-year	981	13.92%
Private not-for-profit, 2-year	169	2.40%
Private for-profit, 2-year	864	12.26%
Public, less-than 2-year	248	3.52%
Private not-for-profit, less-than 2-year	85	1.21%
Private for-profit, less-than 2-year	1,562	22.17%
Total	7,046	100.00

Reading: In 2017, 11% of colleges are public, 4-year or above colleges.
Sample: 2017's colleges and universities.
Sources: IPEDS 2017.

3.2.1 Education spending

Unlike for elementary and secondary education, higher education institutions have other purposes than instruction: most are also research institutions. As such, the separation of educational expenditure and research expenditure is a matter of convention. For instance, IPEDS includes "departmental research funding" in "instructional expenditure" whereas other research funding belongs to "research expenditure". To minimize the bias coming from convention, I construct several variables of educational spending. My main specification is based on "Instructional expenditure" as this is a type of expenditure that focuses the most on educational purpose and that is comparable over the entire period (many categories of expenditure have changed their coverage over the period in IPEDS survey). My second main specification is based on "Average Total Expenditure" which also includes part of research spending (half of them) and spending for infrastructure (as well as spending for student service, academic support, institutional support, etc.) but excludes hospital expenditure, independent operations and half of research expenditure. I present this as an element of comparison as students benefit, at least partly from having higher research spending: they have better faculty members, better facilities, etc. Keeping only half of research spending is a convention but in the absence of evidence about how much of research spending actually

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[2]As for K-12 education, I present in Appendix B results using a constant coverage of institutions with institutions that are in the database from 1980 to 2017 (3,453 institutions out of the 7,121 that existed at some point between 1980 and 2017).

benefit to students, this can be considered as a reasonable assumption. Average Total Expenditure is also one of the category that is the most stable over time in IPEDS survey.

It is important to take into account other definitions than spending for instruction as some authors (Webber and Ehrenberg [2010]) showed that instructional spending per student in both public and private 4-year colleges grew at a slower rate than median expenditure per student in other categories (research, public service, academic support, student services, scholarships and fellowships) and that these other categories of expenditure are more important towards influencing graduation in less selective colleges. As for every empirical work, but maybe even more for descriptive work, it is important to present several hypotheses so that results do not rely on a particular specification. That is why I present results with 6 different definitions of spending in the Appendix A[3]:

- **Instruction per Student**: based on IPEDS spending for instruction divided by total enrollment

- **Average Total Expenditure per Student**: total expenditure (excluding hospital expenditure, independent operation and half of research expenses) divided by total enrollment.

- **spending per Student**: spending for instruction, student service, public service, academic support and institutional support divided by total enrollment.

- **spending per Student with Grants**: same variable as "spending per student" with grants and scholarships expenditures divided by total enrollment.

- **Average Tuition**: total tuition revenue divided by total enrollment.

- **Average Total Public Expenditure per Student**: share of public (federal, state or local) among total expenditure divided by total enrollment. As for average total expenditure, this category also includes research expenditure. Ideally, this would be my second main specification, to see if the distribution of public spending has evolved in a particular way. Unfortunately, the definition of the categories of "public spending" in IPEDS have changed a lot over time (especially when it goes to federal and state grants). This is why I focus on Average Total Expenditure as a second specification, it being more reliable over time.

3.2.2 Length of Studies

For the global longitudinal analysis, I take into account the length of studies. From 2005 and onward, I have information on graduation and completion rate per institution. I compute the average length of associate degree studies and bachelor studies per institution the following way:

$$Associate\_Length = Dropout * 1 + Graduation\_2\_Year * 2 + Graduation\_3\_Year * 3 + Graduation\_4\_Year * 4$$

$$Bachelor\_Length = Dropout * 2 + Graduation\_4\_Year * 4 + Graduation\_6\_Year * 6 + Graduation\_8\_Year * 8$$

With $Associate\_Length$ the average length of studies for an associate degree, $Bachelor\_Length$ for a bachelor degree, $Dropout$ the proportion of dropout (as detailed information on dropout is not available, I assumed that dropouts of associate degree have 1 year of studies and dropouts of bachelor degree have 2 years) and $Graduation\_n\_Year$ the proportion of students that take n years to graduate. In 2017, the mean dropout rate is 0.51 for bachelor studies (similar to 2005) and 0.41 for associate degrees. The average length of associate

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[3]See Appendix A for more detail on the definition of spending

degree studies is 1.83 and bachelor studies is 3.35 years (it was 3.20 in 2005). Most students that do graduate take longer than 2 or 4 years to graduate but as many students dropout, the average length of studies is smaller than the length required to complete the degree. Indeed, in 2017 for bachelor studies, on average 24% of students graduate within 4 years (they were 32% if 2005), 45% within 6 years (as in 2005) and 49% within 8 years (as in 2005). For associate degree, 37% graduate within 2 years, 57% within 3 years and 59% within 4 years. For the length of master, as I do not have data on time to graduate for master students, I add two years to the average length of bachelor studies.

For institutions with missing values for the length of studies, I impute the average of institutions belonging to the same decile of expenditure and to the same sector (Public, Private, 2 years and 4 years institutions, etc.). For institutions that only report enrollment for undergraduate student globally but not specifying the proportion of associate degree and bachelor degree students, I infer values based on the proportion of these two types of students for the same kind of institutions (institutions belonging to the same decile of expenditure and to the same sector). As I do not have data on length of studies per institution prior to 2005, I use the 2005 coefficient for previous years weighting by the average completion rate – ratio of bachelor recipients to people receiving some college education – over time based on Bound et al. [2010]. Using the average length to complete a degree within an institution reduces the variance in spending as it doesn't take into account the fact that within an institution, for a particular degree, different people stay different time in college and thus have unequal spending. Nevertheless, it allows me to take into account the variation in length of studies between institutions and for three different level of attainment : associate degrees, bachelor degrees and master degrees.

3.3 Public and Private Education

3.3.1 K-12 Education

For elementary and secondary education, I only focus on public schools as they are the only one recorded in annual survey of school system finances and as I want to focus on public spending invested in children. In this section, I provide some aggregate data regarding private schooling to have an idea of where they are in the distribution of educational spending.

Across the entire period, approximately 10% of pupils are enrolled in private schools (Figure 3.2). This proportion is very stable over time. Average per pupil spending for pupils enrolled in private schools are lower than average per pupil spending for pupils enrolled in public schools (Figure 3.3). In real term, average per pupil spending have increased by 113% in the private sector and 62% in the public sector from 1970 to 2016.

3.3.2 Higher Education

For higher education, I focus both on public and private institutions because the share of individuals studying in private institutions is significantly higher and less stable than for K-12 education; both public and private institutions receive public fundings – at least through federal grants received by students –, have tuitions and fees, and have grant systems which can be considered as a way to pay for education by the community, even if it doesn't go through taxes.

In terms of institutions, a big increase in the number of for-profit institutions is observed – both among 2-year and 4-year colleges – whereas the number of public and private non-profit institutions is relatively constant. The majority of colleges are private non-profit 4-year institutions. Among public colleges, there are more 2-year

Figure 3.2: Percentage of pupils and students enrolled in private schools and private colleges (1970-2017)
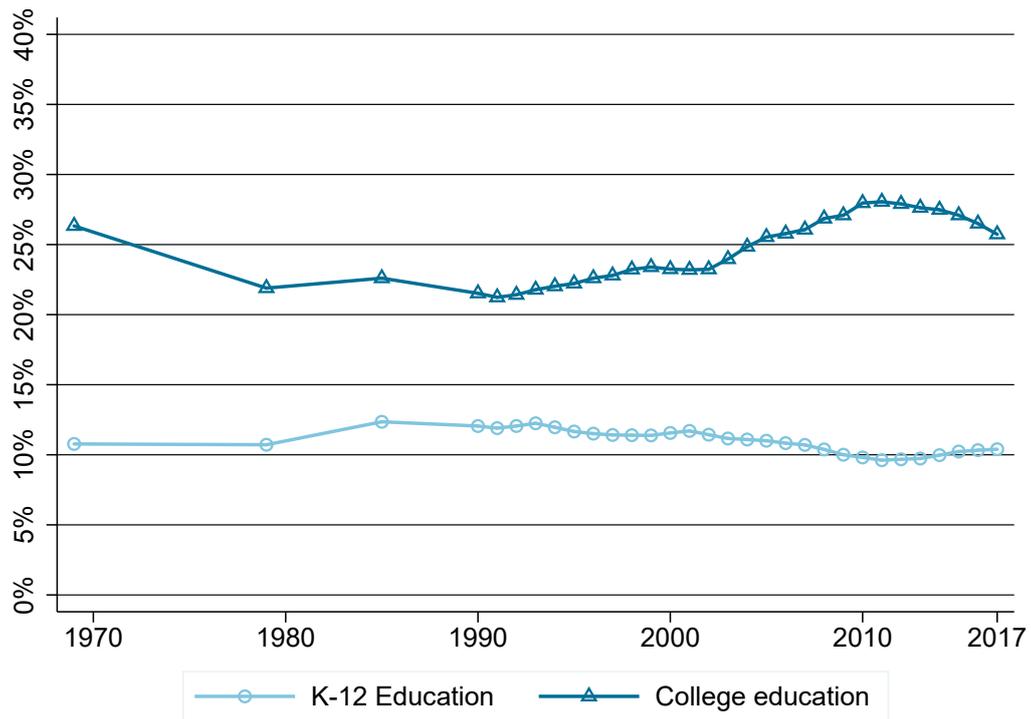
Reading: In 2017, approximately 10% of pupils are enrolled in private schools and 25% of students are enrolled in private colleges.
Sources: National Center for Education Statistics, 2017.

Figure 3.3: Average per pupil spending (in 2017 dollars) per year in public and private elementary and secondary schools (1969-2016)
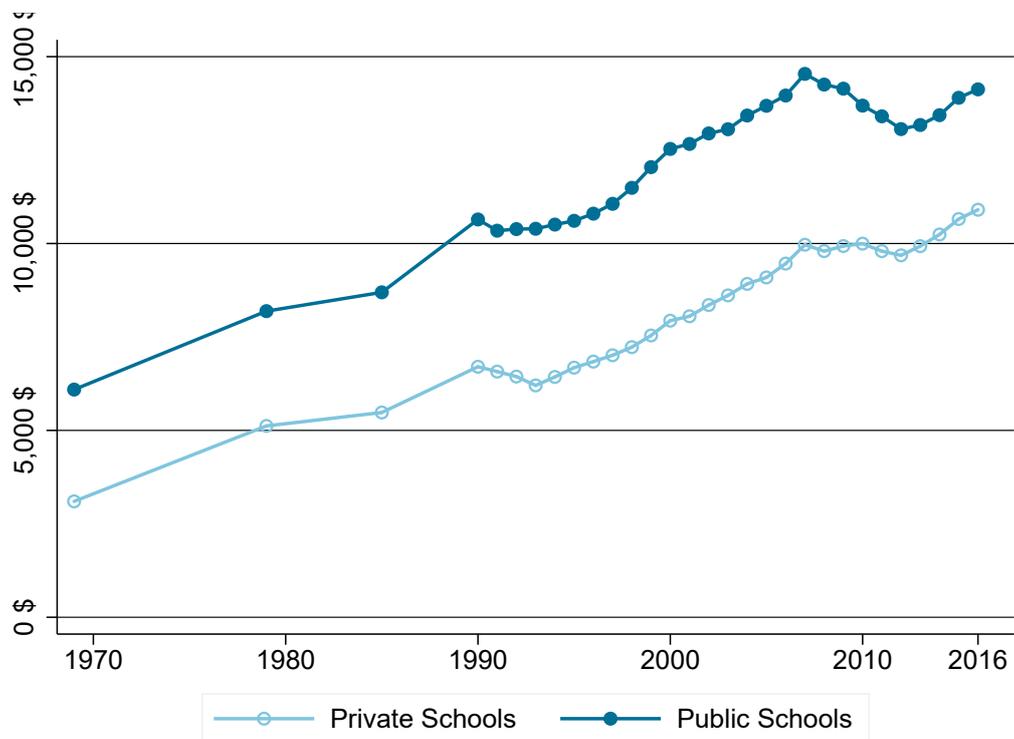
Reading: In 2016, average per pupil spending are approximately $14,000 in the public sector and $11,000 in the private sector.
Sources: National Center for Education Statistics, 2017.

institutions than 4-year ones (Figure 3.4).

Figure 3.4: Number of public, private non-profit and private for-profit 2-year and 4-year colleges (1980-2015)

Unlike for K-12 education, on average, per student spending for higher education are higher in private institutions than in public ones (Figure 3.5).

Figure 3.5: Average per student spending (in 2017 dollars) in public and private colleges (1969-2016)
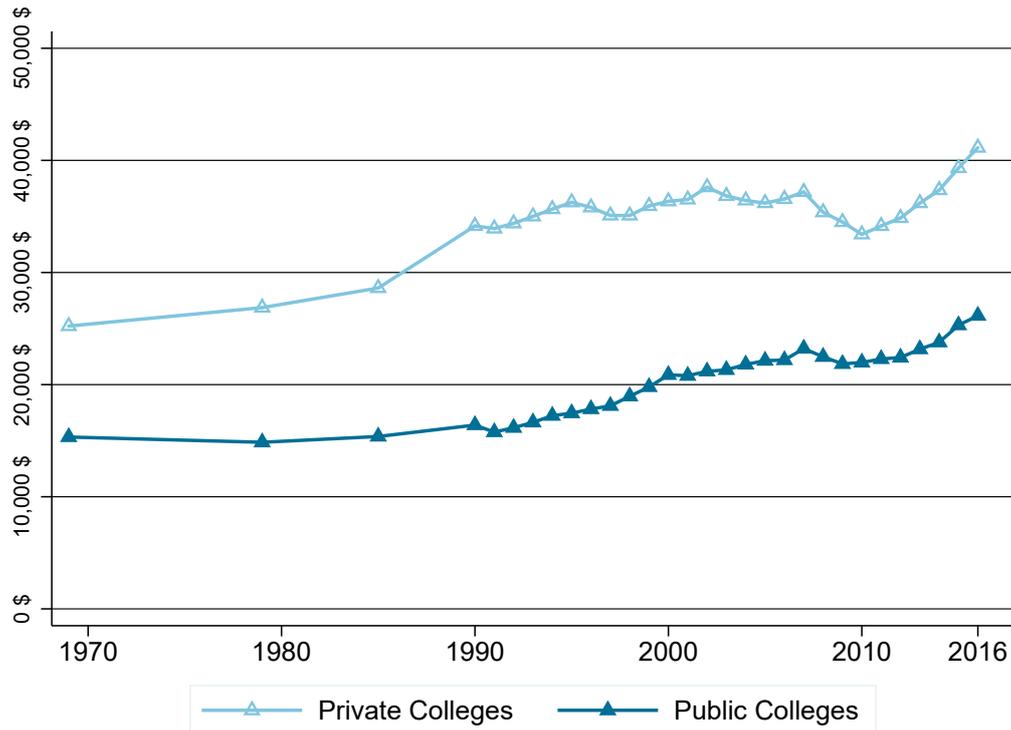
Reading: In 2016, average per student spending are approximately $25,000 in the public sector and $40,000 in the private sector.
Sources: National Center for Education Statistics, 2017.

4 K-12 Education

In this section, I study the distribution of elementary and secondary spending, from 1967 to 2016. Not having data at the school but at the district level, I only study between districts inequalities, which is a lower bound for inequalities in education spending as not all schools have the exact same per pupil spending within a district[4].

4.1 Cross-Sectional Analysis

Overall, the distribution of spending for one year of elementary or secondary education is pretty stable. Around 3% of the overall spending are dedicated to the top 1% of pupils for whom the most is spent, between 14% and 19% for the top 10% of pupils and around 40% for the bottom 50% of pupils. A small decline in the concentration of educational investments from 1967 to 2000 is observed, date when this concentration starts to increase again so that over the entire period, the level of inequalities in these spending doesn't change much. Everyone gets a significant amount of investment even if a concentration of investments in education is observed at the top of the distribution with the top 1% of pupils for whom the most is spent for one year of K-12 education having a bit more than twice the average amounts (Figure 4.1). The share of spending dedicated to the bottom 50% of pupils fluctuated from 37% in 1970 to 41.3% in 2000 and almost returned to 1970 level with 38% in 2016. Conversely, the share of the top 10% of pupils has gone from 18.5% in 1970 to 14.4% in 1995 and has returned to 18.7% in 2016 (Figure 4.2).

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[4]Studying Texas school districts, Lane et al. [2018] showed that large gaps in teacher experience and facility quality remain even among students in the same school district and that state-level equalization schemes may not be sufficient to narrow socioeconomic gaps if large within-district disparities continue to exist.

Table 4.1: Evolution of cost and distribution of per pupil expenditure from 1967 to 2016 in constant 2017 dollars (cross-sectional analysis)

	1967	1970	1975	1980	1985	1990
Total number of students in the data	28,604,772	28,548,784	30,438,324	35,653,084	32,669,830	40,432,080
Total number of districts in the data	5,837	5,869	5,673	14,430	12,016	15,138
Mean of per student spending	$4,841	$5,708	$6,198	$6,782	$7,483	$8,492
Top 0.1% of students	$19,187	$21,766	$19,043	$18,788	$20,715	$25,652
Percentage of the overall spending	0.95%	1.07%	0.70%	0.46%	0.41%	0.40%
Top 0.5% of students	$12,144	$15,975	$15,531	$14,622	$16,800	$20,135
Percentage of the overall spending	2.16%	2.31%	1.75%	1.38%	1.37%	1.42%
Top 1% of students	$10,327	$13,842	$12,989	$13,103	$15,187	$18,081
Percentage of the overall spending	3.28%	3.65%	2.90%	2.43%	2.45%	2.53%
Top 10% of students	$6,584	$7,954	$8,418	$8,913	$9,971	$12,165
Percentage of the overall spending	16.5%	18.5%	17.0%	15.8%	16.1%	16.6%
Bottom 50% of students	$4,540	$5,367	$5,864	$6,556	$7,187	$7,926
Percentage of the overall spending	38.7%	37.0%	39.5%	40.0%	39.7%	39.0%
Bottom 10% of students	$3,242	$3,586	$4,249	$4,744	$5,217	$5,794
Percentage of the overall spending	5.86%	5.44%	6.03%	6.19%	5.78%	6.19%
	1995	2000	2005	2010	2016	Evolution
Total number of students	43,807,624	46,432,784	48,055,256	48,266,208	48,514,348	+ 69%
Total number of institutions in the data	14,454	14,378	14,105	13,515	13,471	+131%
Mean of per student spending	$8,761	$9,723	$10,863	$11,636	$11,833	+144%
Top 0.1% of students	$24,641	$45,439	$48,908	$44,358	$38,616	+101%
Percentage of the overall spending	0.33%	0.58%	0.65%	0.58%	0.57%	
Top 0.5% of students	$19,815	$20,650	$24,982	$26,713	$28,041	+131%
Percentage of the overall spending	1.33%	1.62%	1.67%	1.65%	1.63%	
Top 1% of students	$17,950	$18,773	$21,942	$24,225	$25,563	+148%
Percentage of the overall spending	2.40%	2.63%	2.75%	2.72%	2.76%	
Top 10% of students	$12,307	$13,043	$14,968	$16,426	$17,196	+161%
Percentage of the overall spending	14.4%	16.2%	17.1%	18%	18.7%	
Bottom 50% of students	$8,108	$8,964	$9,819	$10,326	$10,481	+131%
Percentage of the overall spending	40.1%	41.3%	40.4%	39.5%	38.3%	
Bottom 10% of students	$6,435	$7,561	$8,243	$8,613	$8,488	+162%
Percentage of the overall spending	6.86%	7.17%	7.01%	6.82%	6.48%	

Reading: In 2016, the top 10% of student for whom the most is spent have spending above $17,196 per year, they have 18.7% of the overall spending.
Sample: 1967-2016 School Districts.
Sources: Historical Finances of Individual Governments (IndFin) for 1967-1985 and Public Elementary-Secondary Education Finance Data for 1990-2016, US Census Bureau.

Figure 4.1: Distribution of spending for one year of K-12 education in 1970 and 2016 in 2017 dollars
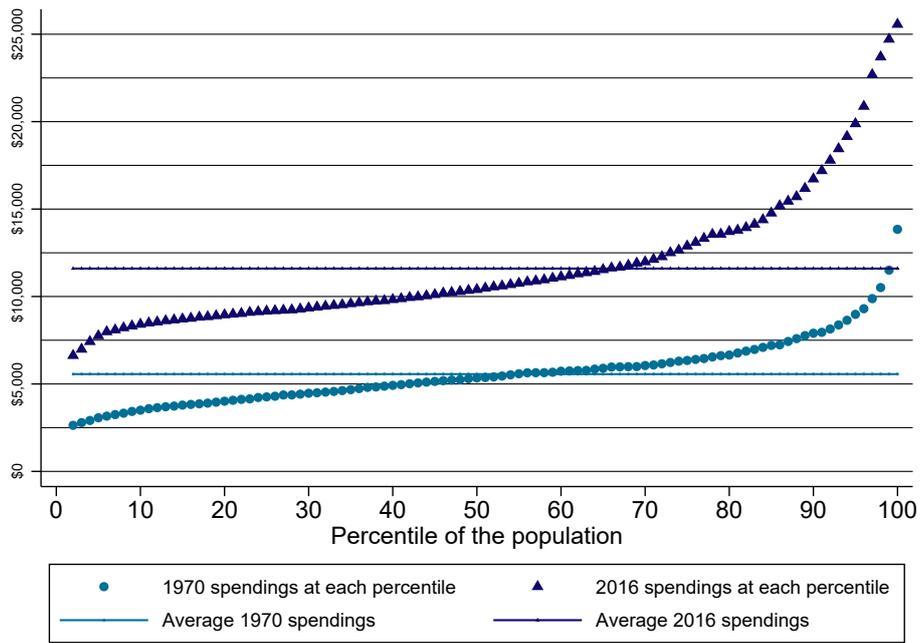
Reading: In 2016, average per pupil expenditure per district where around $12,000.
Sample: 1970 and 2016 School Districts.

Sources: Historical Finances of Individual Governments (IndFin) for 1970 and Public Elementary-Secondary Education Finance Data for 2016, US Census Bureau.

Figure 4.2: Shares of spending dedicated top 1%, top 10% and bottom 50 % of pupils for one year of K-12 education from 1970 to 2016
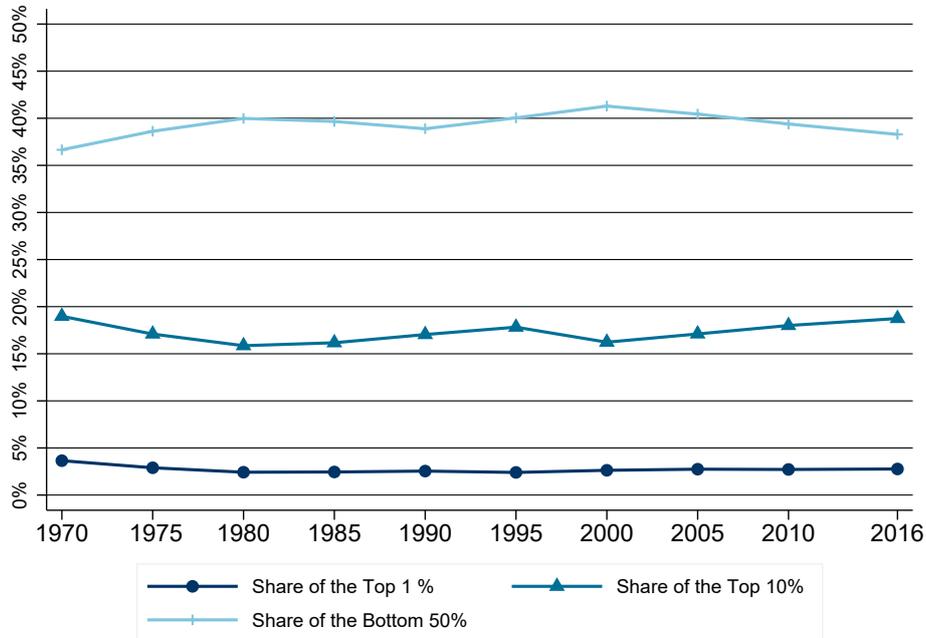
Reading: In 2016,the top 10% of pupils for whom the most is spent for one year of K-12 education have around 20% of the overall spending.
Sample: 1970 to 2016 School Districts.

Sources: Historical Finances of Individual Governments (IndFin) for 1967-1985 and Public Elementary-Secondary Education Finance Data for 1990-2016, US Census Bureau.

4.1.1 Growth Incidence Curve

To see how have evolved spending all along the distribution, growth incidence curves of per pupil spending show the growth occurred at each percentile of the distribution of K-12 education spending for one year of education. From 1972 to 2016, a U-shaped pattern is observed with most of the growth in spending occuring at the bottom and at the top of the distribution of spending (Figure 4.3). Percentiles below the 30th percentile and above the 75th percentile have increased per pupil spending by more than 100%. This evolution in fact reflects two very different evolutions over time with a decrease in the concentration of spending from 1972 to 2000 as the least spending percentiles have known the biggest increase over this period – presumably under the influence of school finance reforms – and an increase in the concentration of spending from 2000 to 2016 as the pattern is totally inverted: the most spending percentiles have known the biggest increase in per pupil spending (Figure 4.4).

Figure 4.3: Growth incidence curve of per pupil spending between 1972-2016
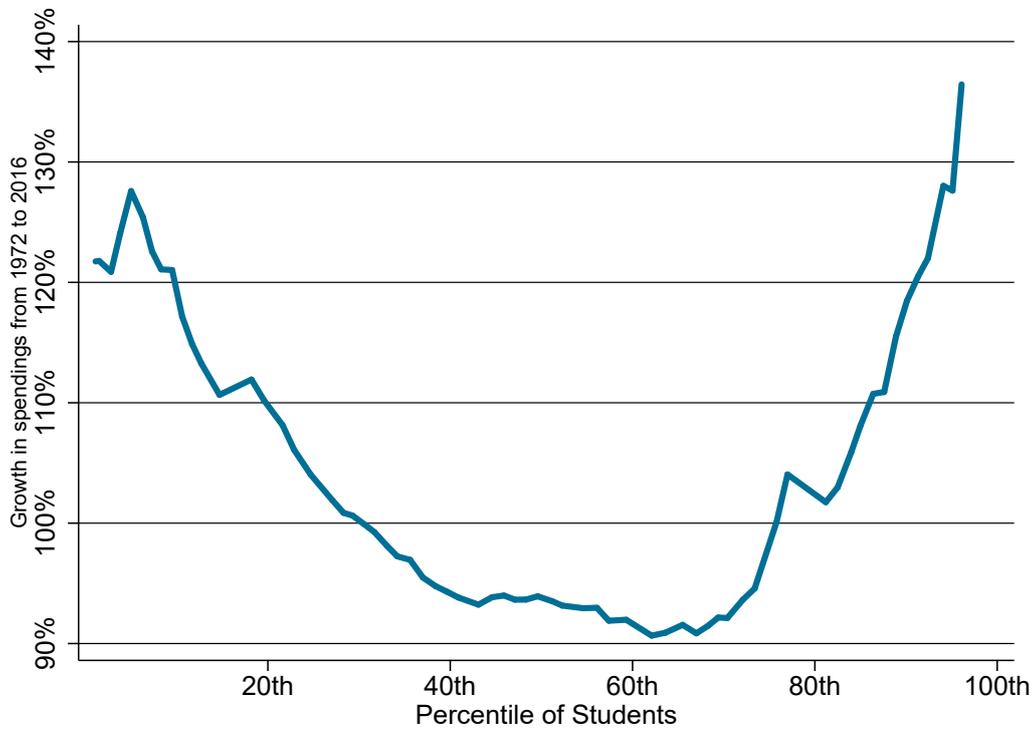
Reading: Between 1972 and 2016, per pupil spending for those at the 80th percentile of the distribution of spending increased by slightly more than 100% in real terms.
Sample: 1972 and 2016 School Districts.

Sources: Historical Finances of Individual Governments (IndFin) for 1972 and Public Elementary-Secondary Education Finance Data for 2016, US Census Bureau.

Figure 4.4: Growth incidence curve of per pupil spending between 1972-2000 and 2000-2016

(a) 1972-2000

(b) 2000-2016
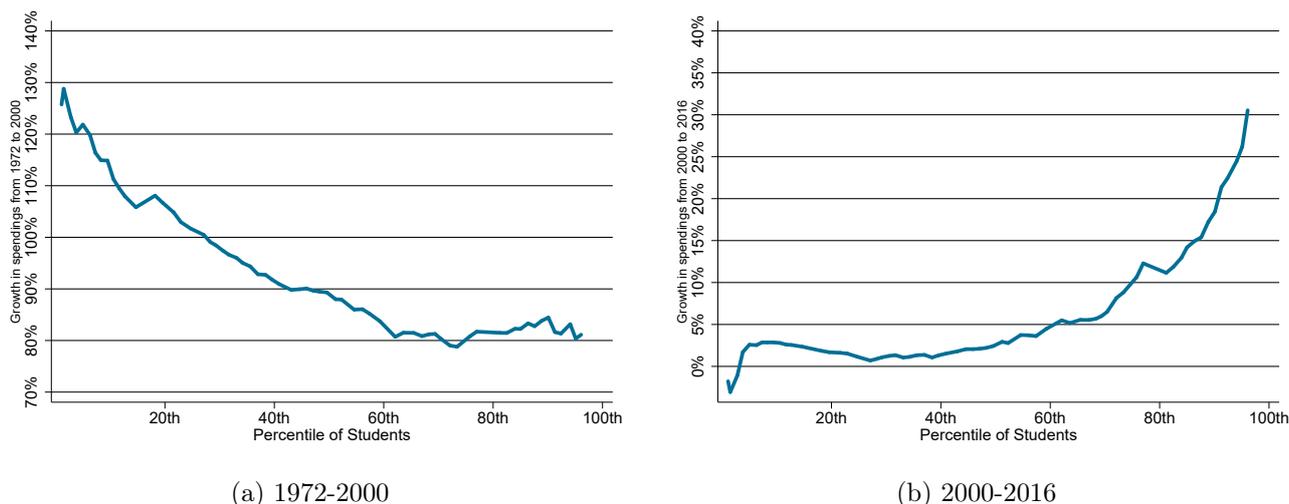
Reading: Between 1972 and 2000, per pupil spending for those at the 80th percentile of the distribution of spending increased by around 80% in real terms.
Sample: 1972, 2000 and 2016 School Districts.

Sources: Historical Finances of Individual Governments (IndFin) for 1972 and Public Elementary-Secondary Education Finance Data for 2000 and 2016, US Census Bureau.

4.2 Longitudinal Analysis

As the "career" of a pupil doesn't stop after one year, inequality in spending must be studied all over the educational trajectory. The purpose of this section is to study inequalities in K-12 education, from first grade to the end of high school. I do not take into account pre-school, because school finance data doesn't include it and because it's more diverse and less often publicly funded (appart from some special programs like Head Start or Perry preschool). This is to me remembered that Kindergarden already account for a big part of inequalities in education at the youngest age.

I study K-12 education for 12 consecutives years (from 1970 to 1982; 1975 to 1987 and so on). As I do not have data on which specific grade pupils are enrolled to, I compute mean spending for each district. This is very likely that a senior High School year costs more than a First grade year but this is the same approximation made for all districts so that the year cost overestimated for first graders is underestimated for high school students.

In this first part, I make the assumption that everyone is going to elementary and secondary school and have (at least) 12 years of education. The inequality in spending is not coming throught the unequal length of studies. In section 6, I will release this assumption and study the inequality coming through different lengths of studies taking into account high school dropouts.

Over the period, the concentration of educational investment are similar for the cross-sectional and the longitudinal analysis showing that there seems to be persistence in spending on education: the first-order auto-correlation coefficient of per-pupil spending is 0.71. Districts that are big spenders tend to stay big spenders, districts that are small spenders tend to stay small spenders so that over 12 years, inequalities are similar to over 1 year.

Table 4.2: Distribution of per pupil spending for 12 years of elementary or secondary education in the 1970's and in the 1990's-2000's

	1970-1981		1998-2009	
	Percentage of the Overall spending	Amount (in 2017 dollar)	Percentage of the Overall spending	Amount (in 2017 dollar)
Mean spending		$79,678		$130,265
Top 0.1%	0.93%	$231,022	0.56%	$642,335
Top 0.5%	1.90%	$164,551	1.64%	$285,318
Top 1%	2.86%	$168,665	2.68%	$257,530
Top 10%	15.82%	$102,330	16.78%	$178,449
Bottom 50%	40.51%	$76,708	40.91%	$118,281
Bottom 10%	6.49%	$56,591	7.19%	$100,935

Reading: In the 1970's, the top 10% of students for whom the most is spent have spending above $102,330 (in 2017 dollars) for 12 years of K-12 education, they have 15.8% of the overall spending.
Sample: 1970-1981 and 1998-2009 School Districts.
Sources: Historical Finances of Individual Governments (IndFin) for 1967-1985 and Public Elementary-Secondary Education Finance Data for 1990-2016, US Census Bureau.

Between the 1970's and the 2000's, the distribution of spending for education has changed very little (Figure 4.5). This is striking to observe that over the period, per pupil spending in real term have more than doubled (Figure 4.7) whereas the level of inequalities has stayed almost the same with the top 1% having 3% of the spending, the top 10, 20%, the bottom 50, 40% and the bottom 10, 7% approximately.

4.3   Role of School Finance Reforms

This is striking to observe that, despite several school finance reforms aiming at equalizing spending across districts, the concentration of investment in education has stayed fairly stable over the period. Decomposing the total variance in per pupil spending across districts in a between states and between counties component, the variance between state has increased over time from around 50% of the total variance in 1970 to around 70% (Figure 4.6). The between-district variance has decreased, from around 30% of the total variance to 20%, presumably under the influence of school finance reforms.

The variance of per pupil spending seems to have stayed relatively stable until 2000 and then started increasing (Figure 4.7).

Some event studies (Jackson et al. [2015] Lafortune et al. [2018]) have found a reduction in inequalities in spending following school finance reforms in the 1970's and early 1980's. Several explanations can reconcile my findings with them: first, they study a constant pool of districts (poor *vs* rich districts) whereas I have a pool of districts in each decile changing a little bit over time: poor districts of yesterday are not the exact same one as those of today. Secondly, they study reforms in the 1970's and 1980's, whereas I observe a small increase in inequalities starting from 2000. Thirdly, they showed that even if a reform is effective at reducing per pupil spending, after 5 years of increase in per pupil spending in the poor districts when induced to do so, there is

Figure 4.5: Distribution of longitudinal and cross-sectional per pupil spending in the 1970's and in the 2000's

(a) Cross sectional analysis

(b) Longitudinal analysis
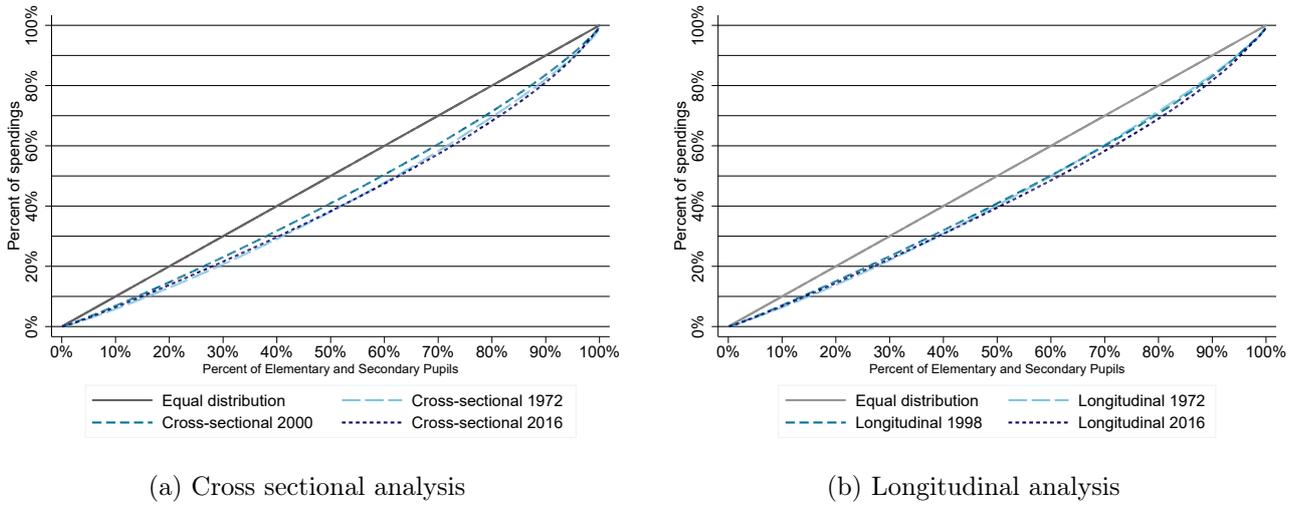
Sample: 1970's and 2000's School Districts
Sources: Historical Finances of Individual Governments (IndFin) for 1970-1981 and Public Elementary-Secondary Education Finance Data for 1998-2009 and 2005-2016, US Census Bureau.

N.B.: For the longitudinal analysis, I made the assumption that everyone is getting 12 years of elementary-secondary education.

Figure 4.6: Decomposition of the variance in per pupil spending between district into a between-state part, a between-county part and a between-district part from 1970 to 2016
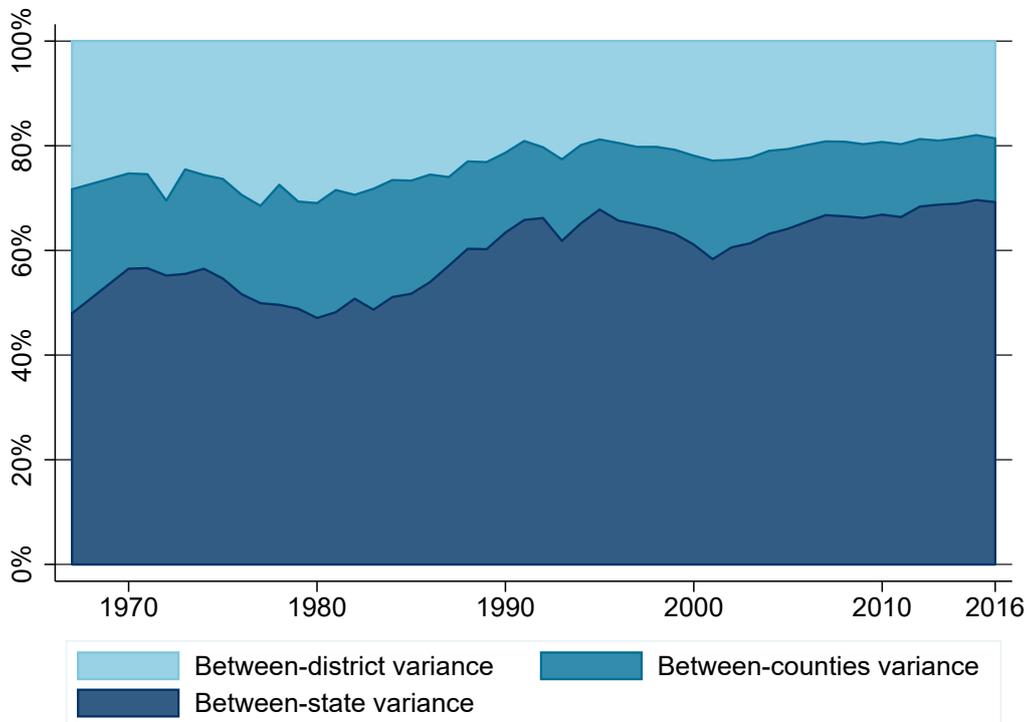
Reading: In 1970, around 50% of the total variance was between-state variance and 30% was between district variance.
Sample: 1970 to 2016 School Districts.

Sources: Historical Finances of Individual Governments (IndFin) for 1967-1985 and Public Elementary-Secondary Education Finance Data for 1990-2016, US Census Bureau.

Figure 4.7: Evolution of average spending in 2017 dollars and standard deviation between district, between counties and between states
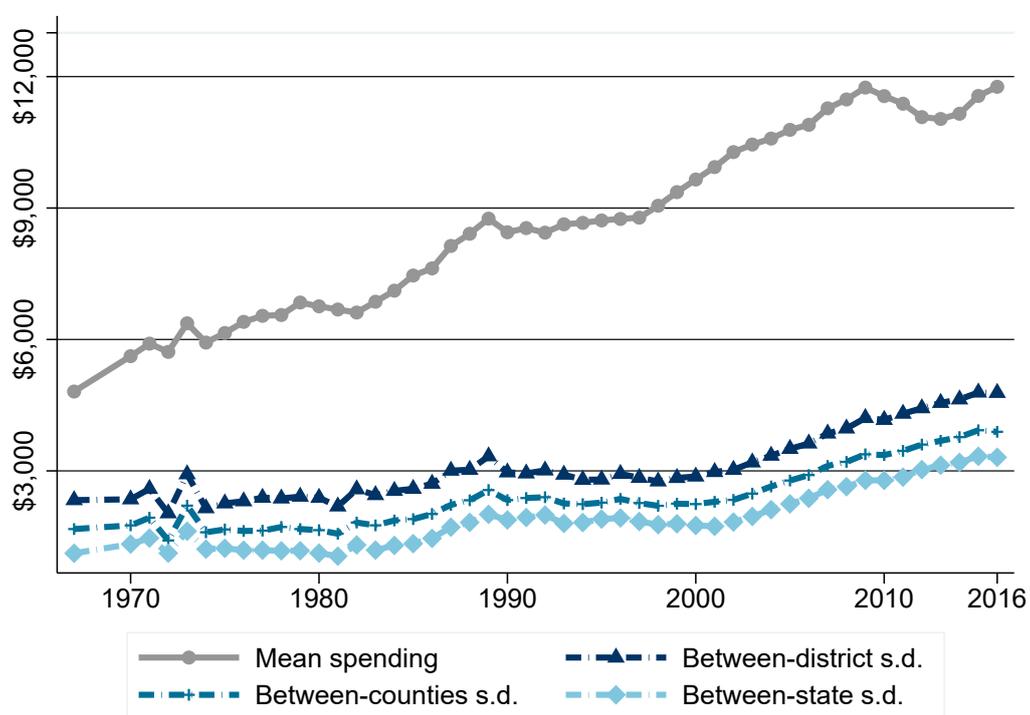
Reading: In 1970, average per pupil expenditure per district where around $6,000 and between counties standard deviation was around $3,000.

Sample: 1970 to 2016 School Districts.

Sources: Historical Finances of Individual Governments (IndFin) for 1967-1985 and Public

Elementary-Secondary Education Finance Data for 1990-2016, US Census Bureau.

a reversal to the pre-existing trend of reduction. Lastly, even if school finance reforms are effective in reducing inequalities in per pupil spending at the state level, it seems to have been counterbalanced by an increase in between-state per pupil variance, such that, at the global level, the level of inequalities in K-12 spending has changed very little since the 1970's. The last footnote of Jackson et al. [2015] goes in this direction: *"Today, most of the variance in per pupil spending is across states, rather than within state. Thus, the effect of school finance reforms can be limited, as far as equalisation of spending across the U.S. is concerned"*.

In the same direction, Card and Payne [2002] found that the gap in state aid between poor districts and rich districts widened by $300 per student more in states where the financing system was found unconstitutional than in other states but that the decrease in inequalities in spending between districts was partially offset by fiscal substitution effects through changes in local revenue collections (districts where state aid increase the least tended to increase more local revenue) and was partially or fully offset by widening inequalities in local revenues between richer and poorer districts. Lastly, Biasi [2019] shows that households respond to the change in the tax price introduced by each reform by "voting with their feet" and moving across districts. This sorting affects house prices and the property tax base, which in turn affect school districts' revenues, a mechanism that can mitigate the ability of school finance reforms to decrease inequalities in spending.

5 Higher Education

In this section, I study the concentration of investments in higher education. With the data of the Integrated Postsecondary Education Data System (IPEDS), I have information on instructional expenditure and I compute per student instructional expenditure dividing by fall enrollments. This "instructional expenditure" variable is computed in IPEDS separating which part of a university fund goes to research and which part goes to instruction and as so, relies on convention but it is the best proxy for the cost of a college education – part of it being paid by students and their family through tuition fees and part of it being paid by the community through taxes and donations (McPherson and Schapiro [2006]) –. Tuitions by themselves are a bad proxy for per student spending as their level depends on the level of subsidy which varies a lot between private and public institutions and even within institutions of the same type. Moreover, many public colleges have a big difference between in-state and out-of-state tuitions. As a second specicification, I present the evolution of spending for average total expenditure[5]. This type of expenditure also takes into account student service, academic support, institutional support, research fundings (I only keep half of them), maintenance of buildings and plants. It can be consider that students benefit at least indirectly from having more research fundings in their institution as they have access to better faculty, more resources, better facilities, etc. [6]

5.1 Students only

This section focus on the distribution of spending for instruction and average total expenditure for the sub-population of college goers. Results concerning the entire population are presented in the next section. Contrary to K-12 education, the length of studies in higher education varies tremendously, that is why I only present results for one year of college education (cross-sectional results) and results taking into account the length of studies are presented in the next section about the entire educational career.

In 1980, the mean per student instructional spending for one year of higher education is $4,825 in 2017 dollars and $8,919 in 2017 (Table 5.1). In 1980, the top 1% of students for whom the most is spent have 7.0% of the overall spending (compared to around 3% for K-12 education), the top 10% has 27.7% of the overall spending (compared to 20%), the bottom 50% have 25.5% of the spending (compared to 40%) and the bottom 10% has 3% of the overall spending (compared to 7%).

spending are thus far more unequaly distributed at the higher education level than at the elementary and secondary levels. Contrary to the distribution of elementary and secondary per pupil spending where little evolution is seen over the period, the distribution of per student instructional expenditure have known a significant increase in inequalities from 1980 to 2017. Indeed, average per student spending have increased by 85% in real terms whereas spending for the top 1% have increased by 175% and spending for the median student have only increased by around 50%.

Focusing on the distribution computed with average total expenditure (Table 5.2), the level of inequalities are similar, sometimes a bit smaller than with instructional spending only. This shows that spending not included in instructional spending such as spending for research (only half of it is included in my average total expenditure variable), student and public services, academic support, maintenance and operation of buildings are a bit less

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[5]The computation of this category and alternative specification is explained in details in section 3.

[6]I present results based on alternative definitions of spending (total students oriented resources with or without grants, average public expenditure and average tuition revenue in Appendix A.)

concentrated than spending for instruction. As for instructional spending, over the period, higher deciles have known the biggest increase in total average spending (+104% for the top 1%) whereas the median has known the smallest increase over the past four decades (+47%).

Table 5.1: Evolution of cost and distribution of instructional expenditure per student from 1980 to 2017 in 2017 dollars

	1980	1985	1990	1995	2000
Total number of students in the data	11,409,336	11,677,120	13,145,883	13,474,887	14,542,413
Total number of institutions in the data	2,619	2,765	2,866	3,034	4,565
Mean of per student spending	$4,825	$5,442	$5,894	$6,376	$7,171
Top 0.1 % of students	$59,310	$76,390	$87,237	$76,869	$101,513
Percentage of the overall spending	1.62%	1.84%	2.00%	2.05%	2.41%
Top 0.5 % of students	$27,790	$32,516	$43,417	$50,469	$52,675
Percentage of the overall spending	4.61%	4.50%	5.51%	6.03%	6.44%
Top 1 % of students	$19,392	$22,113	$27,946	$33,275	$39,711
Percentage of the overall spending	6.94%	7.32%	8.29%	8.73%	9.30%
Top 10 % of students	$8,113	$9,150	$10,306	$11,265	$12,608
Percentage of the overall spending	27.69%	29.04%	30.93%	32.45%	34.20%
Bottom 50 % of students	$3,938	$4,334	$4,463	$4,777	$5,108
Percentage of the overall spending	25.54%	25.01%	24.09%	23.54%	22.54%
Bottom 10 % of students	$1,716	$1,902	$1,975	$2,107	$2,287
Percentage of the overall spending	2.97%	2.88%	2.81%	2.84%	2.65%

	2005	2010	2015	2017	Evolution
Total number of students	17,102,282	20,401,724	20,394,492	20,183,886	+76.9%
Total number of institutions in the data	5,042	5,756	6,539	6,411	+145%
Mean of per student spending	$7,285	$7,695	$8,723	$8,919	84.8%
Top 0.1 % of students	$91,595	$108,654	$128,743	$130,375	+119%
Percentage of the overall spending	2.11%	1.12%	1.80%	1.13%	
Top 0.5 % of students	$61,907	$69,909	$81,734	$85,767	+208%
Percentage of the overall spending	6.13%	5.84%	6.23%	6.45%	
Top 1 % of students	$51,760	$51,895	$55,015	$53,346	+175%
Percentage of the overall spending	9.93%	9.86%	10.48%	10.55%	
Top 10 % of students	$12,542	$14,415	$15,723	$16,172	+99.3%
Percentage of the overall spending	36.43%	36.2%	36.09%	36.25%	
Bottom 50 % of students	$4,983	$5,230	$5,935	$5,882	+49.3%
Percentage of the overall spending	21.10%	20.52%	20.72%	20.28%	
Bottom 10 % of students	$2,271	$2,369	$2,571	$2,561	+49.2%
Percentage of the overall spending	2.48%	2.29%	2.23%	2.15%	

Reading: In 2017, the top 10% of student for whom the most is spent in instructional expenditure for one year of higher education have spending above $16,172, they have 36.25% of the overall spending.
Sample: 1980's - 2010's colleges and universities.
Sources: IPEDS (Integrated Postsecondary Education Data System), Finance and Enrollment Data.

Table 5.2: Evolution of cost and distribution of average total expenditure per student from 1980 to 2017 in constant 2017 dollars

	1980	1985	1990	1995	2000
Total number of students in the data	11,409,336	11,677,120	13,145,883	13,474,887	14,542,413
Total number of institutions in the data	2,619	2,765	2,866	3,034	4,565
Mean of per student spending	$13,080	$15,358	$16,540	$18,307	$19,977
Top 0.1 % of students	$149,637	$181,658	$211,158	$229,153	$298,723
Percentage of the overall spending	1.41%	1.57%	1.90%	1.75%	3.25%
Top 0.5 % of students	$75,845	$95,213	$106,930	$108,438	$140,285
Percentage of the overall spending	3.94%	4.51%	4.92%	4.86%	6.42%
Top 1 % of students	$68,245	$71,332	$82,499	$93,353	$111,245
Percentage of the overall spending	6.69%	7.30%	7.63%	7.61%	9.22%
Top 10 % of students	$23,756	$27,492	$31,006	$34,011	$35,565
Percentage of the overall spending	29.72%	30.42%	31.87%	32.40%	34.36%
Bottom 50 % of students	$103,14	$11,683	$11,932	$13,080	$14,091
Percentage of the overall spending	22.54%	22.35%	21.52%	21.35%	21.04%
Bottom 10 % of students	$3,772	$4,410	$4,805	$5,373	$5,783
Percentage of the overall spending	2.46%	2.34%	2.39%	2.49%	2.33%
	2005	2010	2015	2017	Evolution
Total number of students	17,102,282	20,401,724	20,394,492	20,183,886	+76.9%
Total number of institutions in the data	5,042	5,756	6,539	6,411	+145%
Mean of per student spending	$19,996	$19,684	$22,117	$23,181	+77.2%
Top 0.1 % of students	$237,455	$223,777	$248,432	$267,058	+78.4%
Percentage of the overall spending	2.16%	1.92%	1.64%	1.71%	
Top 0.5 % of students	$142,488	$149,477	$158,242	$165,751	+118%
Percentage of the overall spending	5.40%	5.63%	5.73%	5.78%	
Top 1 % of students	$122,594	$127,522	$137,484	$139,443	+104%
Percentage of the overall spending	8.93%	8.77%	8.90%	9.09%	
Top 10 % of students	$37,125	$37,885	$41,600	$45,118	+89.9%
Percentage of the overall spending	34.84%	35.47%	35.16%	35.44%	
Bottom 50 % of students	$13,427	$13,053	$14,413	$15,209	+47.4%
Percentage of the overall spending	20.45%	20.22%	20.5%	20.23%	
Bottom 10 % of students	$5,938	$5,723	$6,703	$6,582	+74.4%
Percentage of the overall spending	2.43%	2.45%	2.50%	2.44%	

Reading: In 2017, the top 10% of student for whom the most is spent in average total expenditure for one year of higher education have spending above $45,118, they have 35.44% of the overall spending.
Sample: 1980's - 2010's colleges and universities.
N.B.: Average total spending also include spending for research (half of them) and as such, do not only represent educational expenditure.
Sources: IPEDS (Integrated Postsecondary Education Data System), Finance and Enrollment Data.

5.2 Entire population

To know which percentage of a cohort is going to higher education, I multiply the proportion of High school graduates by the proportion of high school graduates enrolling in college based on NCES data (Table 5.3).

Taking into account people excluded from higher education (Table 5.4 and Table 5.5), inequalities in in-

vestments int higher education are higher as there is a mass point at zero for people never accessing higher education. At the beginning of the period, the bottom 50% of individuals used to have zero spending, they have around 3% of the spending at the end of the period both for instructional spending (Table 5.4) and average total expenditure (Table 5.5). Conversely, the top 10% of students for whom the most is spent have around 50% of the overall spending all over the period (against 28% for the subpopulation of college goers). The increase in the concentration of investment in higher education is a bit more tenuous for the entire population as the higher level of concentration is partly compensated by the fact that more people have access to university (Figure 5.1).

Table 5.3: Distribution of college goers for the cohorts studied

Year Of First Grade	High School Graduate As a percent of 17 years old	Percent of High School graduates Going to College	Percent of the cohort Going to college
1970	72.4%	50.6%	36.7%
1973	72.4%	57.7%	41.8%
1978	73.4%	60.1%	44.2%
1980	73.0%	61.8%	45.2%
1983	69.3%	61.9%	42.9%
1988	69.8%	63.3%	44.2%
1990	72.2%	65.2%	47.1%
1993	75.4%	68.6%	51.7%
1998	79.8%	68.1%	54.3%
2000	80.5%	66.2%	53.3%
2003	84.6%	69.2%	58.6%
2005	85.3%	66.7%	56.9%

Reading: For the cohort entering in first grade in 1970, 36.7% of individuals went to higher education.
Sources: NCES based on U.S. Department of Commerce, Census Bureau, Historical Statistics of the United States, Colonial Times to 1970; Current Population Reports, Series P-20, various years; CPS Historical Time Series Tables on School Enrollment, 2017.

Figure 5.1: Percentage of a high school graduates going to college
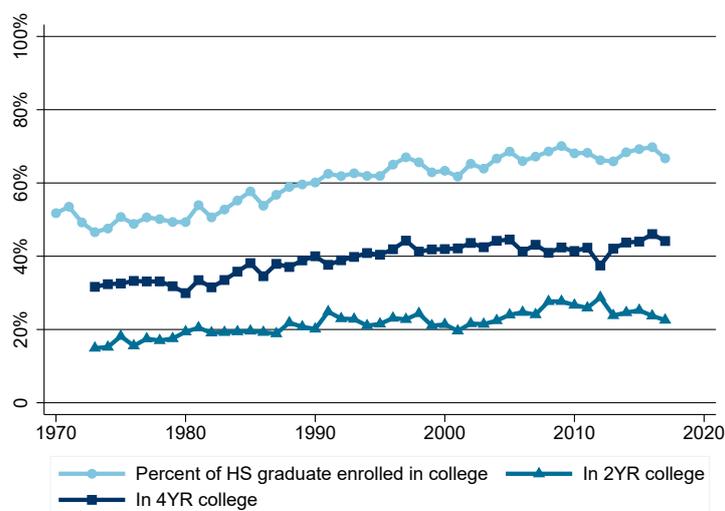
Reading: In 2016, around 70% of High School graduates go to college.
Sources: National Center for Education Statistics, 2017.

Table 5.4: Evolution of cost and distribution of instructional expenditure per individual from 1980 to 2017 in 2017 dollars

	1980	1985	1990	1995	2000
Mean of per student spending	$1,771	$2,277	$2,605	$2,735	$3,169
Top 0.1 % of students	$33,040	$43,052	$51,076	$59,657	$79,818
Percentage of the overall spending	3.29%	3.21%	3.48%	3.56%	4.16%
Top 0.5 % of students	$17,195	$20,681	$26,651	$31,698	$37,553
Percentage of the overall spending	8.05%	8.20%	8.97%	9.65%	10.26%
Top 1 % of students	$14,276	$16,898	$20,079	$23,634	$26,747
Percentage of the overall spending	12.92%	12.13%	13.48%	14.77%	15.39%
Top 10 % of students	$5,508	$6,597	$7,143	$7,607	$8,415
Percentage of the overall spending	47.77%	49.15%	49.81%	48.36%	47.50%
Bottom 50 % of students	–	–	–	–	–
Percentage of the overall spending	–	–	–	–	–
Mean of per student spending	$3,766	$4,178	$5,111	$5,075	+186%
Top 0.1 % of students	$86,357	$88,380	$108,781	$118,428	+258%
Percentage of the overall spending	2.799%	2.579%	2.599%	2.529%	
Top 0.5 % of students	$51,760	$54,518	$64,325	$66,670	+287%
Percentage of the overall spending	9.939%	9.159%	9.449%	9.659%	
Top 1 % of students	$30,517	$35,181	$41,874	$41,989	+194%
Percentage of the overall spending	15.39%	13.94%	13.5%	14.68%	
Top 10 % of students	$9,498	$10,498	$12,444	$12,674	+130%
Percentage of the overall spending	49.34%	49.25%	47.40%	48.34%	
Bottom 50 % of students	$1,776	$2,175	$2,880	$2,694	+∞
Percentage of the overall spending	0.57%	1.65%	3.71%	2.75%	

Reading: In 2017, the top 10% of individuals for whom the most is spent in higher education spending for instruction have spending above $12,674, they have 48.34% of the overall spending.
Sample: 1980's - 2010's colleges and universities.
Sources: IPEDS (Integrated Postsecondary Education Data System), Finance and Enrollment Data.

Table 5.5: Evolution of cost and distribution of average total expenditure per individual from 1980 to 2017 in 2017 dollars

	1980	1985	1990	1995	2000
Mean of per student spending	$4,644	$6,225	$7,311	$7,854	$8,830
Top 0.1 % of students	$93,665	$114,866	$135,369	$133,933	$172,684
Percentage of the overall spending	2.80%	2.77%	3.13%	3.12%	4.5%
Top 0.5 % of students	$50,235	$64,898	$78,834	$87,670	$106,395
Percentage of the overall spending	8.52%	7.86%	8.43%	8.42%	10.19%
Top 1 % of students	$39,278	$48,373	$60,142	$66,394	$76,185
Percentage of the overall spending	12.71%	12.10%	12.71%	12.93%	15.56%
Top 10 % of students	$15,718	$19,499	$21,501	$23,972	$24,819
Percentage of the overall spending	45.29%	49.25%	48.16%	46.86%	46.56%
Bottom 50 % of students	–	–	–	–	–
Percentage of the overall spending	–	–	–	–	–
Mean of per student spending	$10,338	$10,689	$12,960	$13,190	+184%
Top 0.1 % of students	$194,222	$191,703	$246,697	$248,785	+165%
Percentage of the overall spending	3.07%	2.85%	2.59%	3.03%	
Top 0.5 % of students	$123,083	$130,473	$141,050	$139,647	+177%
Percentage of the overall spending	8.69%	8.09%	7.44%	8.16%	
Top 1 % of students	$79,982	$81,215	$101,053	$105,003	+167%
Percentage of the overall spending	13.73%	13.30%	12.75%	12.93%	
Top 10 % of students	$27,604	$28,090	$33,002	$34,560	+119%
Percentage of the overall spending	49.86%	49.49%	47.13%	48.40%	
Bottom 50 % of students	$4,658	$5,455	$7,340	$7,002	+∞
Percentage of the overall spending	0.66%	1.87%	4.04%	3.04%	

Reading: In 2017, the top 10% of individuals for whom the most is spent in higher education spending have spending above $34,560, they have 48.40% of the overall spending.

Sample: 1980's - 2010's colleges and universities.

Sources: IPEDS (Integrated Postsecondary Education Data System), Finance and Enrollment Data.

5.3 Comparison over Time

Between 1980 and 2017, a significant increase in inequalities in instructional spending is observed (Figure 5.2 (a)). Taking into account all individuals, inequalities in instructional expenditure have decreased (Figure 5.2 (b)) due to the higher proportion of college goers in the more recent cohorts. Lorenz curves computed with average total expenditure are very similar to those with instructional expenditure. As Lorenz curves do not allow to decompose inequalities into different subgroups, it is interesting to focus on shares of spending dedicated to different groups of students (Figure 5.3).

Figure 5.2: Lorenz curve of higher education spending for instruction between 1980 and 2017

(a) Students only

(b) All individuals
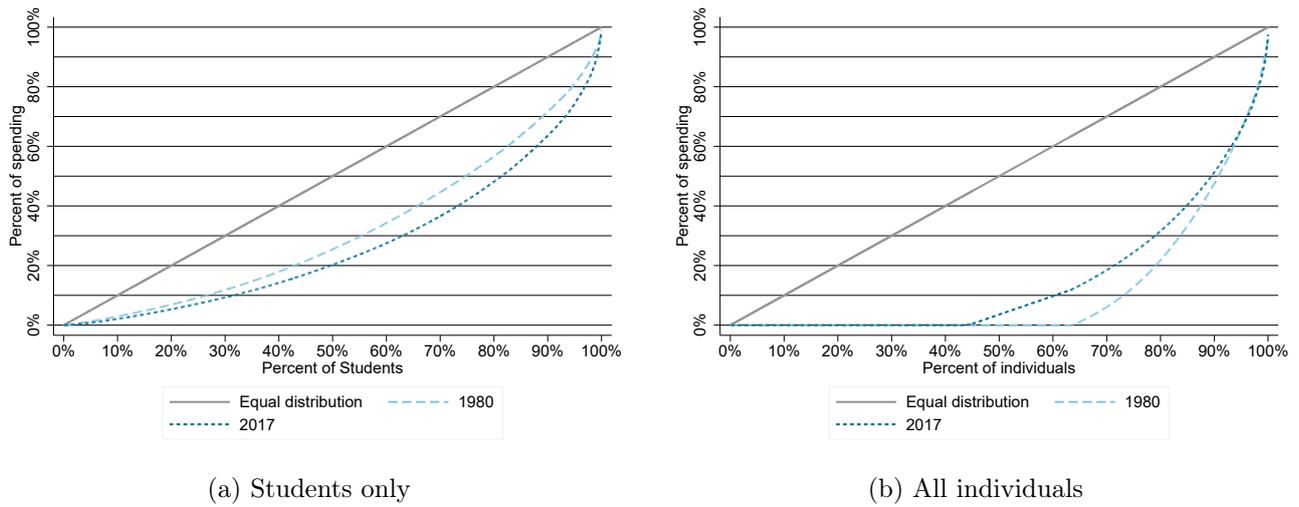
Reading: In 2017, the bottom 50% of students for whom the least is spent for higher education had around 20% of the overall spending .
Sample: 1980 and 2017 Colleges and Universities.
Sources: IPEDS Enrollement and Finance Data in 1980 and 2017.

Shares dedicated to the top 1% and top 10% of students on the subpopulation of college goers have increased significantly (Figure 5.3 (a) and Figure 5.3 (c)) while these proportion are stable for the entire population of individuals. When considering the entire population (Figure 5.3 (b) and Figure 5.3 (d)), almost half of the total amount of spending (both for instruction or for average total expenditure) are dedicated to only 10% of the students while half of the population has almost no investment – either because they do not go to higher education or because they have access to curriculums with very low level of investment –. This is striking to observe that if among students, the concentration of invesmtent in higher education has increased, among the entire population, shares dedicated to the top 1%, top 5% and bottom 50% of individuals are remarkably constant over the period with around 50% of the spending going to the top 10% of individuals for whom the most is spent and 15% going to the top 1%.

The distribution of spending reveals that investment are extremely concentrated at the top of the distribution (Figure 5.4) compared, for instance, to what was observed in K-12 education. In 2017, the top 1% of students having the highest investment receive between 6 times (for instruction) and 8 times (with average total expenditure) the average amounts of spending.

The growth incidence curve for students with instructional expenditure is increasing all along the distribution of spending: the highest percentiles of spending have known the biggest increase over the period (Figure 5.5 (a)).

The subpopulation of college goers has known a divergence in instructional spending and a higher stratification of spending between institutions. Hoxby [2009], showed that between 1966 and 2006, most of the increase in student-oriented resources and average subsidy per student occurred in the most selective institutions increasing the stratification of institutions in higher education. The pattern is slightly different with average total expenditure as those at the bottom of the distribution have known bigger increase in expenditure than those in the middle even if the main increase in expenditure occurred at the top with more than 100% of increase for those above the 90th percentile of spending (Figure 5.5 (c)). This is consistent with the finding (Jacob et al. [2018]) that less selective institutions have increased more extra-curricular spending (student service, academic support etc.) than core spending for instruction. For the entire population, the biggest increase occured at the middle of the distribution as they used to have zero spending (not going to higher education) and now have access to higher education (Figure 5.5 (b) and Figure 5.5 (d)).

Figure 5.3: Shares of spending dedicated top 1%, top 10% and bottom 50% of students for one year of higher education from 1980 to 2017

(a) Instructional Expenditure - Students Only

(b) Instructional Expenditure - All Individuals

(c) Average Total Expenditure - Students Only

(d) Average Total Expenditure - All Individuals

Share of the Top 1 %   Share of the Top 10%
Share of the Bottom 50%
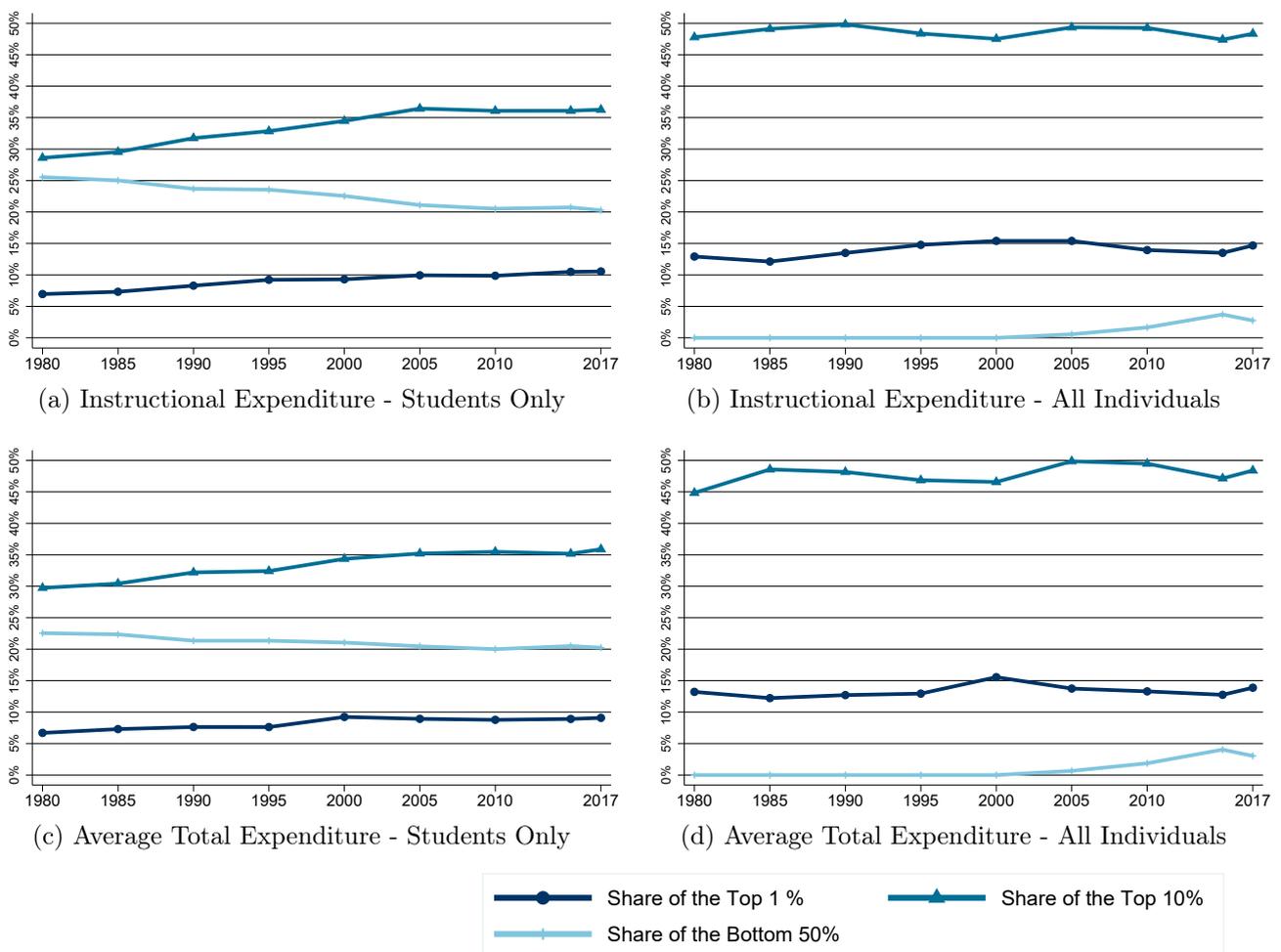
Reading: In 2017, for college goers, the top 1% of students have more than 35% of total instructional expenditure.
Sample: 1980 to 2017 Colleges and Universities.
Sources: IPEDS Data, Finance and Enrollment surveys.

Figure 5.4: Distribution of spending for one year of higher education education in 1980 and 2017 in 2017 dollars
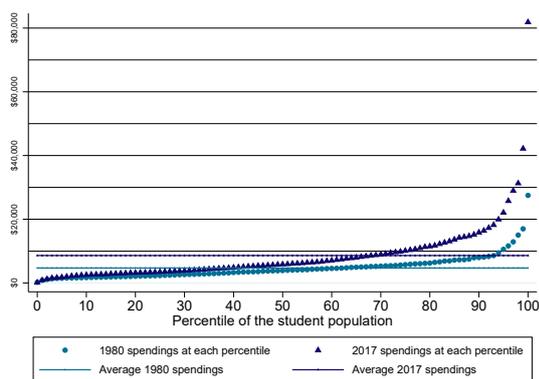
(a) Instructional Expenditure
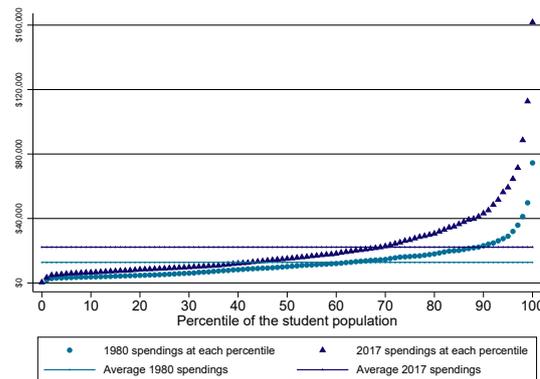
(b) Average Total Expenditure

Reading: In 2017, average instructional expenditure for one year of education where a bit less than $10,000. spending for the top 1% of students for whom the most is spent in instructional expenditure where higher than $60,000.
Sample: 1980 and 2017 Colleges and Universities.

Sources: IPEDS Data, Finance and Enrollment surveys.

Figure 5.5: Growth incidence curve of per student spending from 1980 to 2017
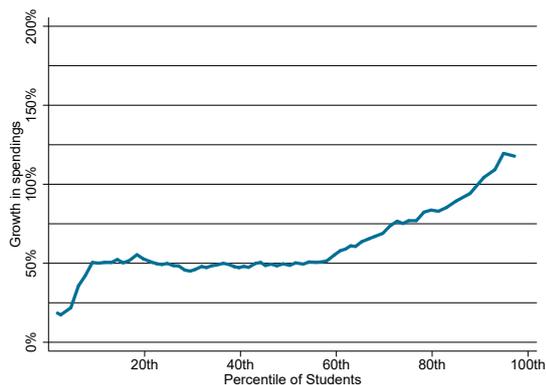
(a) Instructional Expenditure - Students Only
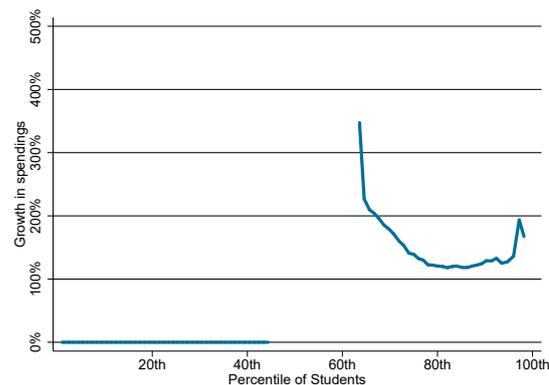
(b) Instructional Expenditure - All Individuals
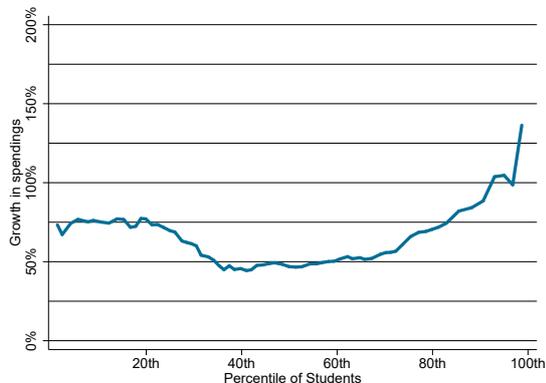
(c) Average Total Expenditure - Students Only
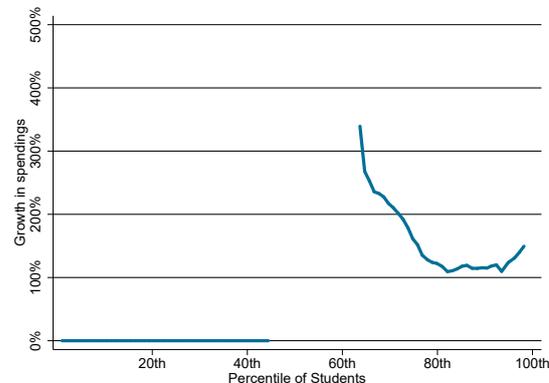
(d) Average Total Expenditure - All Individuals

Reading: Between 1980 and 2017, for college goers, per student instructional spending increased by around 100% for those at the 90th percentile of the distribution of spending.
Sample: 1980 and 2017 Colleges and Universities.

Sources: IPEDS Data, Finance and Enrollment surveys.

6 Scenarios of Global Inequalities in Educational Spending

Not having individual data, I do not know where have studied the ones having longer studies. In this section, I compute global inequalities in spending based on two hypotheses: the first one assumes that dropouts are uniformly distributed among all the deciles of spending – it can be considered as a lower bound for inequalities in spending – and the second one assumes that dropouts are concentrated among the lowest spending districts – it can be considered as an upper bound for inequalities in spending –.

6.1 Presentation of the Computation of the Length of Studies

6.1.1 K-12 Education

My first cohort studied is the 1964 cohort as individuals born this year are entering elementary education in 1970, when my data on spending per district starts continuously. My last cohort is the one entering first grade in 2005 as they reach higher eduction in 2017, the last year of my data. I do not take into account repeaters.

As data on dropout per district (Common Core Data, NCES) only exist starting in 2009 and is only present for around 13% of the districts, I use average dropout data from NCES statistics making two assumptions on the distribution of dropouts along the distribution of spending (Figure 6.1) [7].

Figure 6.1: Percent of high school dropout from 1970 to 2016
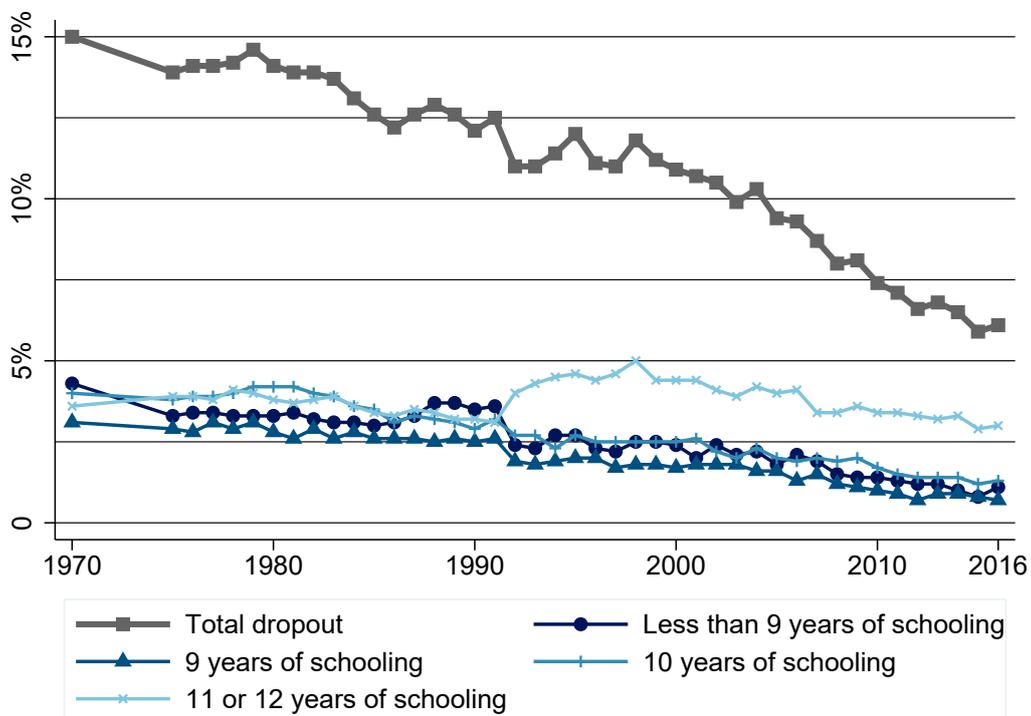
Reading: In 2016, there are around 6% of high school dropouts.
Sources: National Center for Education Statistics, 2017.

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[7]See next section for more details on the hypotheses

6.1.2 Higher Education

I only focus on associate degrees, bachelor degrees and master degrees as spending for Ph.D. students respond to a different logic than the ones for lower level of education. For higher education, starting from 2005, I have completion data in IPEDS: I compute an average length of studies for associate degree, bachelor degree and master degree per institution as explained in section 3.

6.2 Presentation of the Hypotheses

6.2.1 First Scenario: Lower bound for Inequalities

In the first scenario, I make the assumption that the variance of spending for a given year is equally distributed among the different lengths of studies: alternatively said, it means than among those who drop after 10th grade, 1% have been in the 1th percentile of spending, 1% in the 99th percentile of spending and so on. It is very likely that inequality levels computed this way are lower bounds for inequalities in spending as the one getting the most expensive primary and secondary education are more likely to stay enroll longer. Indeed, many studies showed the positive impact of student aids on completion and retainment (Bettinger [2004]; Kane [2006]; Deming and Dynarski [2010], Fack and Grenet [2015]) or the impact of public spending on retainment and graduation (Card and Krueger [1996], Deming and Walters [2017])

6.2.2 Second Scenario: Upper bound for Inequalities

In a second scenario, I assume that all the dropouts are concentrated among the least spending deciles: it means that the 3.4% of students dropping after 8th grade in the 1970's are located in the 3.4 lowest deciles of spending, the 2.9% of students dropping after 9th grade in the 1970's are the 2.9 following lowest deciles of spending and so on. Then I match the college distribution to the highest spending decile corresponding to the proportion of college goers (Table 5.3). For instance, in the 1970's, 36.7% of individuals went to college, I assume that they had elementary and secondary education in the highest spending districts. This hypothesis changes the distribution of spending through elementary and secondary schooling and through who are the one going to college as I still use the length of studies computed separately for associate degrees, bachelor degrees and master degrees with completion and graduation data from IPEDS for college education.

6.3 Results

6.3.1 With Instructional expenditure

The main specification focuses on instructional expenditure for the cohorts entering first grade in 1970, 1998 and 2005. Overall, expected given the fact that education spending inequalities for K-12 education have stayed fairly stable and those for higher education have increased, shares dedicated to the top 10%, top 1% and top 0.5% seem to have increased over time whereas the one of the bottom 50 has slightly decrease (Table 6.1). The top 10 used to have between 18.6 % (hypothesis 1) and 20.0% (hypothesis 2) in the 1970's and has between 22.2% and 23.5% in the 2000's. The bottom 50 used to have between 36% (hypothesis 2) and 37.3% (hypothesis 1) in the 1970's and has between 34.2% and 35.3% in the 2000's. Nevertheless, the one of the bottom 10 has slightly increased: they used to have between 4.53% (hypothesis 2) and 5.69% (hypothesis 1) in the 1970's and

have between 5.39% and 5.87 % in the 2000's. This is consistent with the fact that higher education spending have increased the least for students located in the middle of the distribution of spending.

This is striking to observe than besides the big differences in the two hypotheses I made (dropouts distributed uniformly among the different level of spending or among the least spending deciles), the distribution are quite similar. As expected, when dropouts are concentrated in the least spending decile, the distribution is more unequal as the same individuals have both less spending per year and less years of education. Nevertheless, the order of magnitude stay the same as there is an enormous variance in spending within each grade, and dropouts only concern a small fraction of the population (around 14% in the 1970's and around 10% in the 2000's). This matters certainly more through who are the one going to college but college education only represents between 1 and 6 years of schooling among a far longer educational career.

Figure 6.2: Shares of spending for the entire educational career with instructional spending for higher education

(a) 1970 - Hypothesis 1

(b) 1970 - Hypothesis 2

(c) 2005 - Hypothesis 1

(d) 2005 - Hypothesis 2
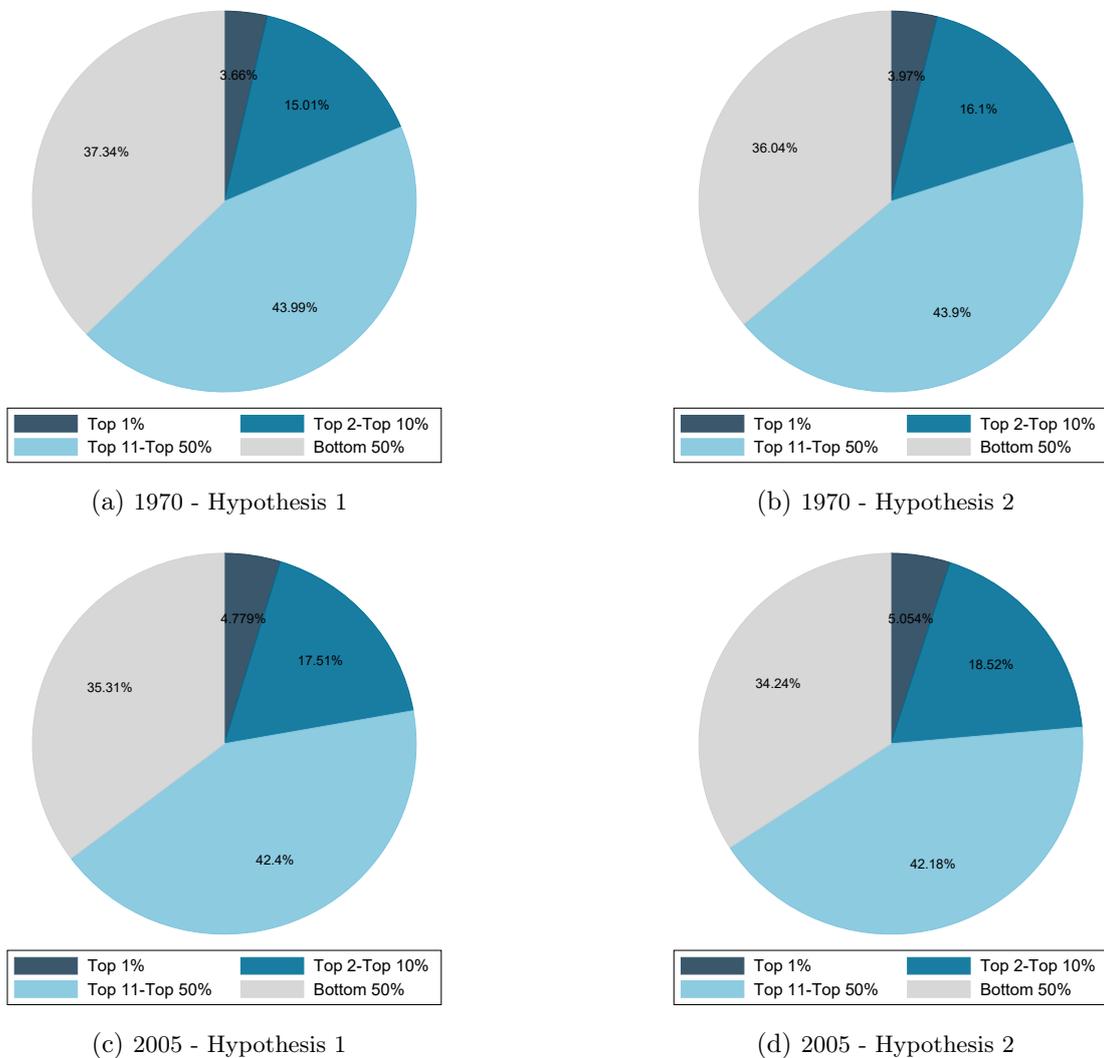
Reading: The bottom 50% of individuals for whom the least is invested in education in the 2005 cohort have between 33.8% and 35.1% of the overall spending.

Sample: Cohorts entering first grade in 1970 and 2005.

N.B.: Spending for K-12 education are educational spending whereas spending for higher education are instructional spending only.

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education.

Table 6.1: Distribution of spending with instructional spending for higher education

| | 1970 cohort - Instructional expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$83,584		$83,584
Top 0.1 %	0.99%	$370,264	1.09%	$396,463
Top 0.5 %	2.35%	$242,658	2.55%	$259,807
Top 1 %	3.66%	$197,081	3.97%	$220,148
Top 10 %	18.6%	$114,778	20.0%	$122,897
Bottom 50 %	37.3%	$75,952	36.0%	$75,045
Bottom 10 %	5.69%	$52,871	4.53%	$46,306

| | 1998 cohort - Instructional expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$145,294		$145,294
Top 0.1 %	0.82%	$829,954	0.99%	$1,040,319
Top 0.5 %	2.70%	$523,762	2.93%	$539,865
Top 1 %	4.35%	$407,069	4.60%	$416,777
Top 10 %	20.8%	$203,104	22.0%	$217,043
Bottom 50 %	36.8%	$118,312	35.7%	$117,583
Bottom 10 %	6.08%	$96,098	5.41%	$98,070

| | 2005 cohort - Instructional expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$157,726		$157,726
Top 0.1 %	0.95%	$1,093,674	1.13%	$1,214,180
Top 0.5 %	3.03%	$619,547	3.27%	$639,052
Top 1 %	4.77%	$482,163	5.05%	$487,009
Top 10 %	22.2%	$237,344	23.5%	$249,557
Bottom 50 %	35.3%	$126,777	34.2%	$125,446
Bottom 10 %	5.87%	$101,762	5.39%	$101,878

Reading: Among individuals entering first grade in 1970, the bottom 50 percent of individuals having the lowest spending had spending between $75,045 (hypothesis 2) and $75,952 (hypothesis 1) all over their educational career. They had between 36% and 37.3% of the overall spending.

Sample: 1970- 1981 school districts and 1980 colleges for the 1970 cohort; 1998-2005 school districts and 2005 colleges for the 1998 cohort, 2005-2017 school districts and 2017 colleges for the 2005 cohort.

N.B.: Expenditure for K-12 education are total educational expenditures whereas expenditure for higher education are instructional expenditure only.

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for higher education.

6.3.2   With Average Total expenditure

As a second specification, I focus on average total expenditure for the cohorts entering first grade in 1970, 1998 and 2005. As highlighted in the higher education case, total expenditure also include fundings for research (I included half of research expenditure) but it can be considered that students benefit partly from these spending. Moreover, this is more consistent with the definition of spending considered for elementary and secondary education where I included total education spending and not only instructional spending. Focusing on average total expenditure, the picture is a little different as the distribution of expenditure is more unequal and has increased more over time (Table 6.2): the share of the top 10% was between 23.3% (hypothesis 1) and 25.2% (hypothesis 2) – compared to between 18.6% and 20% for instructional expenditure – for the cohort entering first grade in 1970 and between 28.0% and 29.5% for the cohort entering first grade in 2005 – compared to between 22.3% and 23.5% –. The share of top 1% is also a bit higher, at the expense of the one of the bottom 50% and bottom 10%. This is not explained by the fact that average total expenditure are more unequally distributed – section 5 showed that they are even slightly more equally distributed – but by the fact that average total expenditure represent bigger amount than instructional expenditure and as higher education spending are far more unequally distributed than elementary and secondary ones, when they represent a bigger proportion of the total spending, inequalities are higher. Similarly, as inequalities in higher education have increased and inequalities in K-12 education are stable, when the former represent a bigger amount of the total of spending than the latter, the global level of inequalities increases more.

Table 6.2: Distribution of spending with average total expenditure for higher education

| | 1970 cohort - Average total expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$95,623		$95,623
Top 0.1 %	1.21%	$656,346	1.40%	$666,588
Top 0.5 %	3.30%	$395,491	3.55%	$419,200
Top 1 %	5.15%	$306,529	5.51%	$330,161
Top 10 %	23.3%	$147,150	25.2%	$160,089
Bottom 50 %	33.4%	$77,487	31.8%	$75,045
Bottom 10 %	5.08%	$53,672	4.01%	$46,306

| | 1998 cohort - Average total expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$169,502		$169,502
Top 0.1 %	1.30%	$1,403,783	1.50%	$1,635,348
Top 0.5 %	3.97%	$911,752	4.26%	$936,856
Top 1 %	6.30%	$676,406	6.63%	$677,952
Top 10 %	26.5%	$266,254	27.9%	$292,117
Bottom 50 %	32.0%	$123,217	30.4%	$121,404
Bottom 10 %	5.23%	$97,664	4.60%	$98,070

| | 2005 cohort - Average total expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$192,740		$192,740
Top 0.1 %	1.53%	$1,692,718	1.70%	$1,847,243
Top 0.5 %	4.29%	$1,099,818	4.55%	$1,136,695
Top 1 %	6.73%	$805,170	7.04%	$822,221
Top 10 %	28.0%	$311,467	29.5%	$340,366
Bottom 50 %	30.2%	$134,714	28.5%	$131,522
Bottom 10 %	4.96%	$103,578	4.47%	$101,878

Reading: Among those that entered first grade in 2005, the bottom 50 percent of spending had spending between $131,522 (hypothesis 2) and $134,714 (hypothesis 1). They had between 28.5% and 30.2% of the overall spending.

Sample: 1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 1998-2005 School Districts and 2005 colleges for the 1998 cohort, 2005-2017 School Districts and 2017 colleges for the 2005 cohort.

N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are total expenditure (also include half of research expenditure).

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education.

Figure 6.3: Shares of spending for the entire educational career with average total expenditure

(a) 1970 - Hypothesis 1

(b) 1970 - Hypothesis 2

(c) 2005 - Hypothesis 1

(d) 2005 - Hypothesis 2
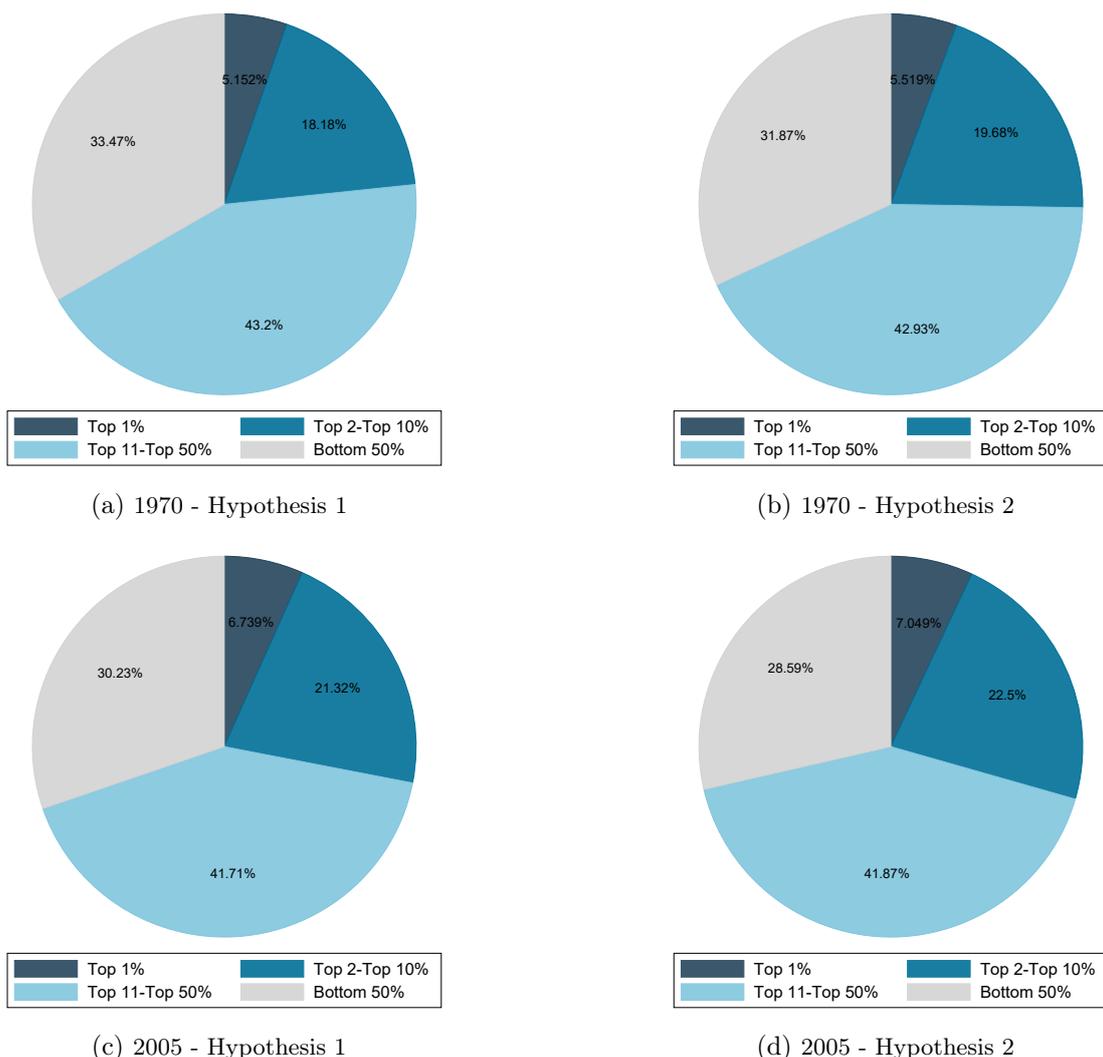
Reading: In 1970, the bottom 50% of individuals for whom the least is invested in education have around 30% of the overall spending.
Sample: Cohorts entering first grade in 1970 and 2005.
N.B.: spending for K-12 education are educational spending whereas spending for higher education are average total expenditure (include half of research expenditure).
Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education.

6.3.3 Some comparisons over time

From 1980 to 2015, the share of education spending dedicated to the bottom 50 percent of individuals for whom the least is spent has decreased a bit from 37% to 35% of the spending for results computed with instructional expenditure and from 34% to 30% for results computed with average total expenditure, while the ones of the top 10 and top 1 percent have slightly increased (Figure 6.4).

As for K-12 and higher education, I compute growth incidence curves of spending. The curve has a U-shaped pattern with most of the increase in expenditure ocurring at the bottom and at the top of the distribution. This pattern leads to something very similar to the "elephant curve" found by Milanovic [2016] for the growth of income from 1988 to 2008. Only people above the 90th percentile of spending have known an increase in

Figure 6.4: Evolution of the shares of the top 1, top 10 and bottom 50 of education spending for the cohorts entering first grade between 1970 and 2005

(a) Instructional expenditure

(b) Averate Total Expenditure
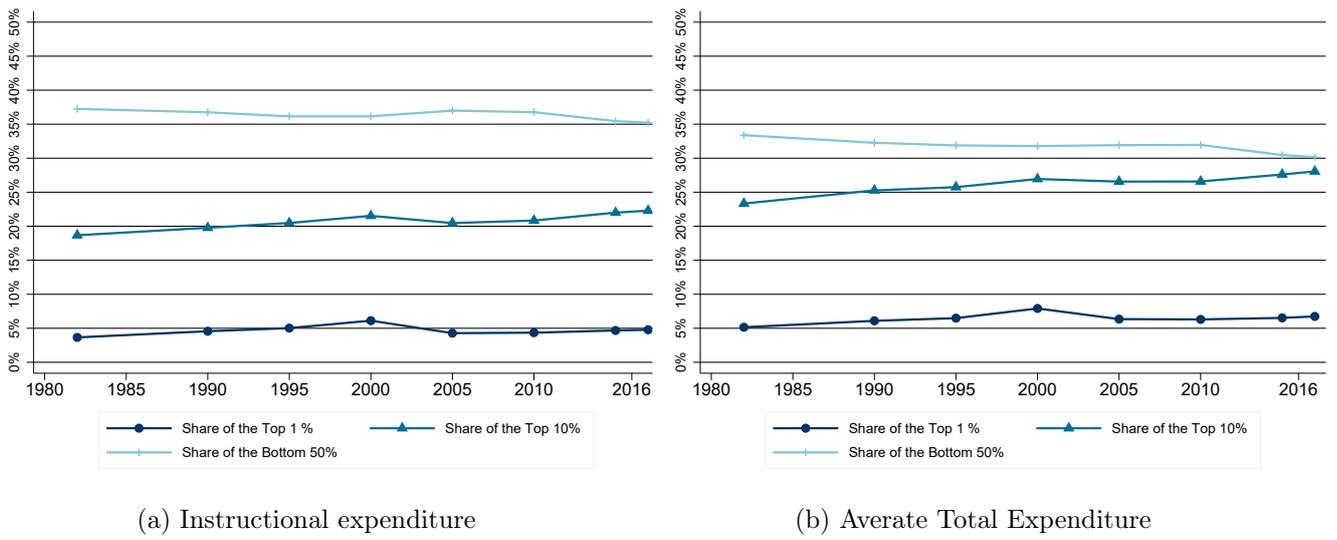
Reading: The top 1 percent of people having the highest spending on education in the cohort entering first grade in 1970 have between 4% (instructional expenditure) and 5% (average total expenditure) of the overall spending.

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education.

expenditure higher than 100% over the past four decades.

Figure 6.5: Growth incidence curve of education spending from the 1970's to the 2000's
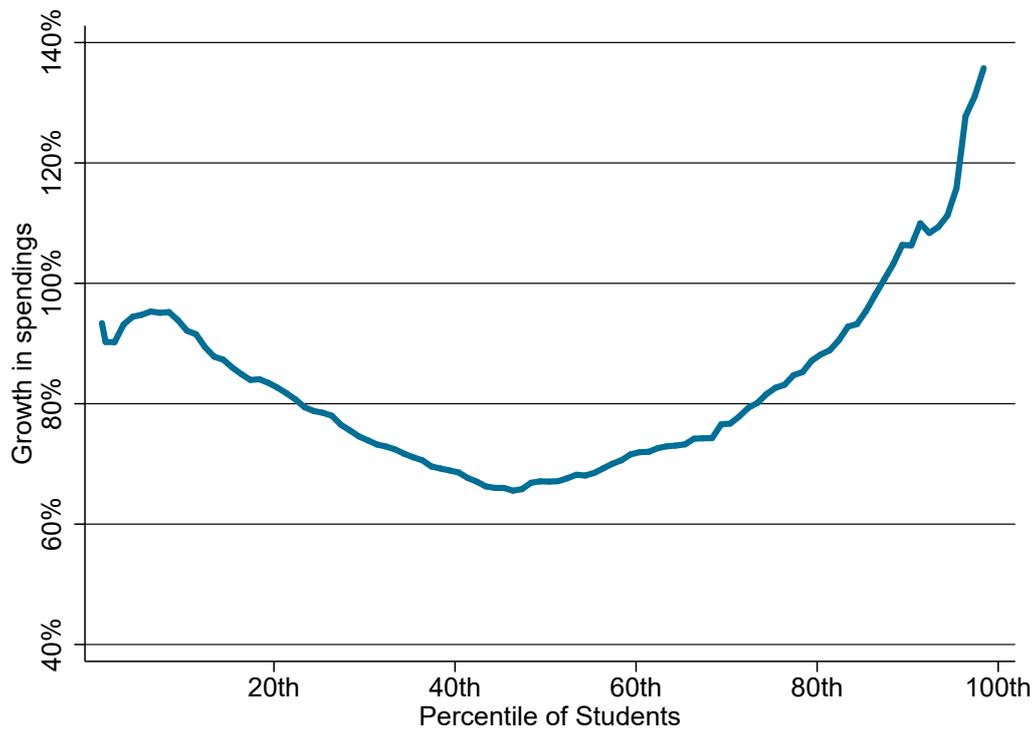
Reading: Between the 1970's and 2000's, per pupil spending for education increased by around 100% for those at the 90th percentile of expenditure.
Sample: 1970-1981 and 2005-2017 School Districts, 1980 and 2017 Colleges and Universities.
N.B.: Computations are made based on instruction per student for higher education and hypothesis 1 of combination of inequalities in K-12 and Higher Education, results with average total expenditure follow the same pattern.

Sources: Historical Finances of Individual Governments (IndFin) for 1970-1981, Public Elementary-Secondary Education Finance Data for 2005-2016, US Census Bureau and IPEDS Data, Finance, Completion and Enrollment surveys.

7 Some Elements of Comparison with Wages Inequalities

7.1 Comparison over Time

Comparing the evolution of pre-tax income over time with the distribution of educational spending for cohorts entering first grade between 1970 and 2003, the concentration of pre-tax income is much higher than the one of educational spending but evolutions goes in the same direction (Figure 7.1). The top 1% of people having the highest pre-tax income used to have 25 times more than the bottom 50% of people having the lowest pre-tax income in 1980 and has 80 times more in 2015 [8]. The top 1% of people having the highest educational expenditure used to have 4 – with instructional expenditure for higher education – or 7 – with average total expenditure – times more than the bottom 50% of people having the lowest education spending in 1980 and has 6 – with instructional expenditure for higher education – or 10 – with average total expenditure – times more in 2015.

7.1.1 Specific Role of Higher Education

Focusing on higher education, there is a big increase in educational spending inequalities as seen in section 5. There are far more similarities between distributions of pre-tax income and of instructional expenditure. The ratios of higher education spending of the top 1 over the bottom 50 almost completely follows the one of pre-tax income (Figure 7.2) and for the one of the top 10 percent over the bottom 50, higher education spending are even more unequally distributed than pre-tax income. These figures concern only the subpopulation of college goers, results taking into account the fact that a substantial proportion of the population receive no funding for higher education shows that there are far more inequalities in the distribution of investment in higher education than in the distribution of income.

This evolution is consistent with a model where what matters the most for the evolution of the top 10% share is the higher education that has been invested in them whereas for the top 1%, "human capital is not totally enough" in a sense and must be coupled with other forms of endowment (economic capital, social capital embeded in social connection for instance, etc.). This paper doesn't provide causal evidence and the causality between income inequalities and educational investment inequalities could go both way. Indeed, the increase in educational investment inequalities could have reinforced the increase in income inequalities ; conversely the increase in income inequalities could have increased the demand for expensive higher education thus causing the divergence in investment in higher education observed. The magnitude of both of these effects, explaining the stylized facts observed, remain an open question.

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[8]Data is from the World Inequality Database.

Figure 7.1: Evolution of the distribution of education spending for the cohorts entering first grade between 1970 and 2003 and pre-tax Income in the US
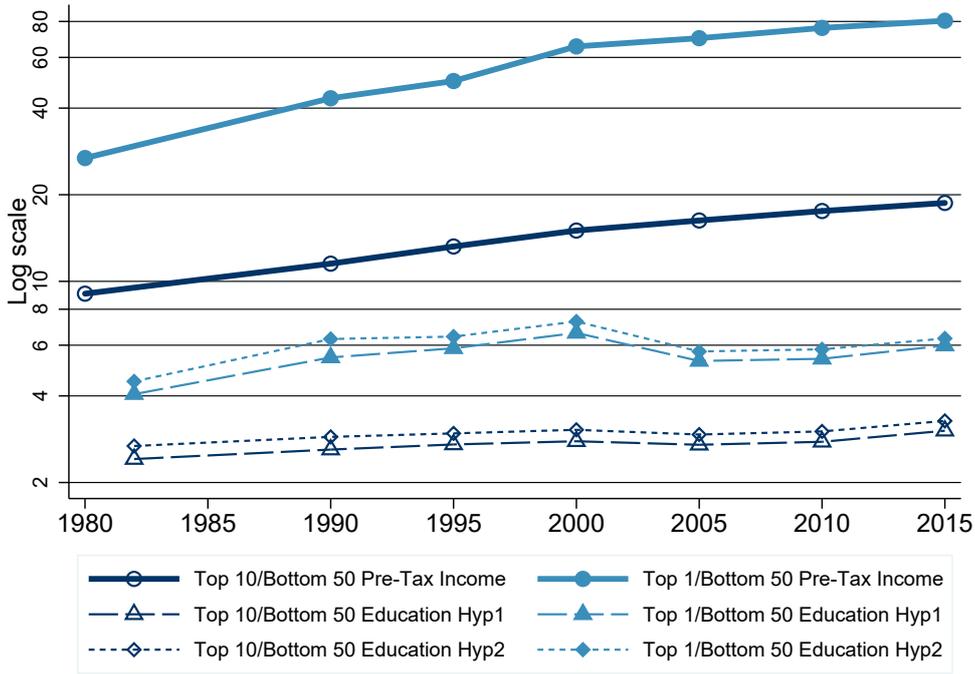
(a) Instructional expenditure
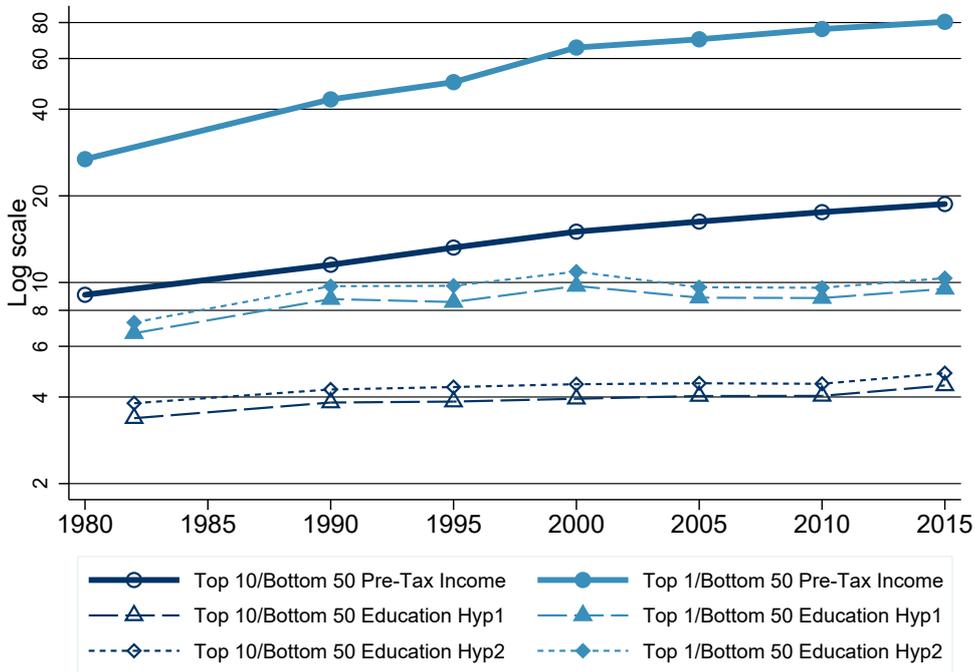
(b) Averate Total Expenditure

**Reading**: In 1980, the top 1 percent of people having higher pre-tax income in the US have 27 times more than the bottom 50; in comparison the top 1 percent of people having the highest education spending in the cohort entering first grade in 1970 have between 5 times (instructional expenditure) and 9 times (average total expenditure) more than the bottom 50.
NB: Hypothesis 1: dropouts are uniformly distributed among deciles of spending
Hypothesis 2: dropouts are concentrated in the lowest spending deciles.

Sources: Author's computations based on WID data for pre-tax income, this master thesis data for educational spending.

Figure 7.2: Evolution of the distribution of higher education spending and pre-tax income in the US from 1980 to 2015
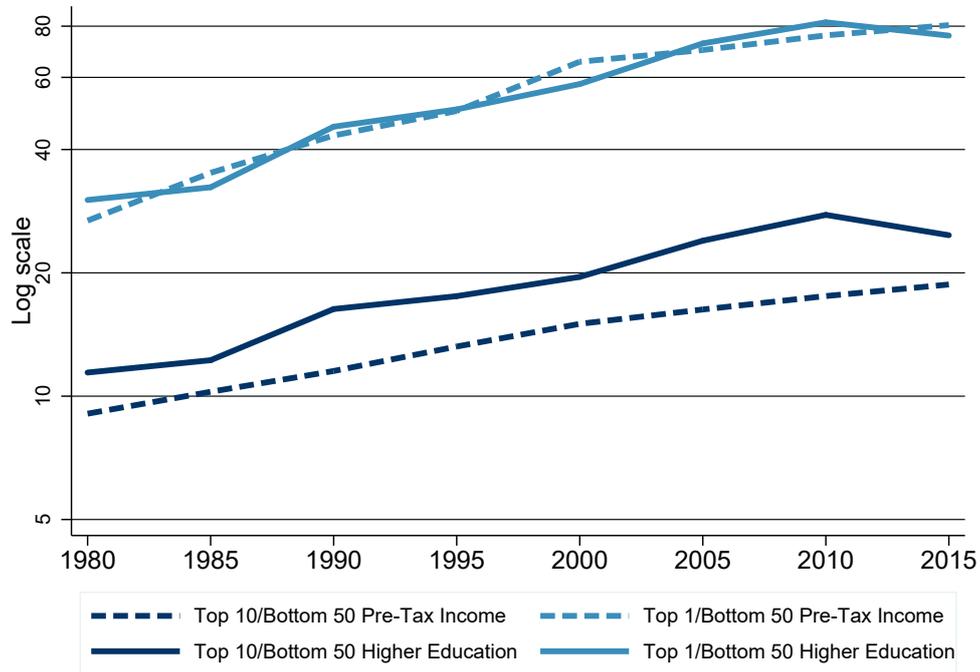
(a) Instructional expenditure
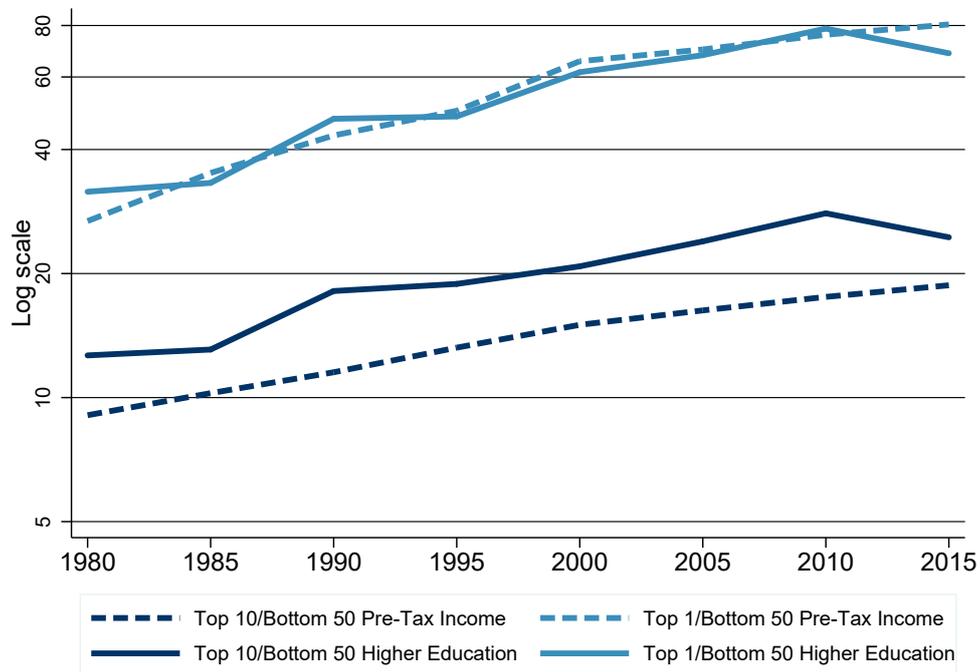
(b) Averate Total Expenditure

Reading: In 1980, the top 1 percent of people having higher pre-tax income in the US have 27 times more than the bottom 50.
NB: There is a lag between educational spending and income: people currently in college are not in the labor market so that the distribution of higher education expenditure should be compared to the one of pre-tax income, 10 years after or latter for instance.

Sources: Author's computations based on WID data for pre-tax income, this master thesis data for higher education spending (IPEDS survey).

7.2 Comparison with French data

This is impossible to compare directly with results from France because spending data in France are presented aggregated, often at the country level. There is no equivalent of the Public Elementary-Secondary Education Finance Data for K-12 education (that would present spending at the city level for elementary school, department level for middle school and region level for high-school) or of IPEDS survey for Higher Education. I thus present some elements of comparison based on a previous master thesis by Zuber [2003] with French data that evaluated these inequalities based on different curriculums and different fields of study.

Average spending are higher in the US for every level of education (Figure 7.3), this is particularly notable for private higher education institutions.

Figure 7.3: Average spending per level of education in France and in the US (in 2017 dollars)
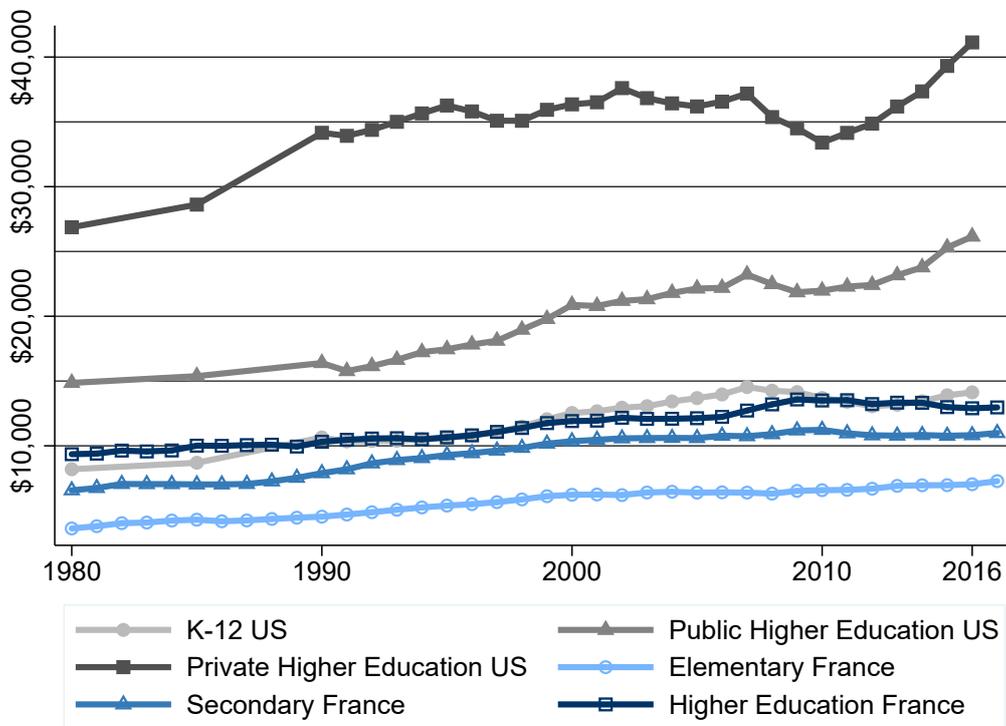
Reading: In 1980, average per student spending in US public universities were 15,000 dollars.
N.B.: I converted French spending in dollars using the average exchange rate over the period so that evolutions are invariant to variations in the exchange rate.
Sources: NCES for the US and DEPP for France.

As pre-tax labor income, the distribution of education spending is more unequal in the US than in France (Figure 7.4) but the order of magnitude are still totally different. In the US, pre-tax labor income are far more unequally distributed than education spending as the top 10 percent has more than 10 times more pre-tax labor income than the bottom 50 and has 3 times more education spending with instructional expenditure and 4 times more with average total expenditure. The top 1 percent has more than 40 times more pre-tax labor income than the bottom 50 and has between 5 and 9 times more educational spending.

Figure 7.4: Distribution of education spending and pre-tax labor income in France and in the US in 2001
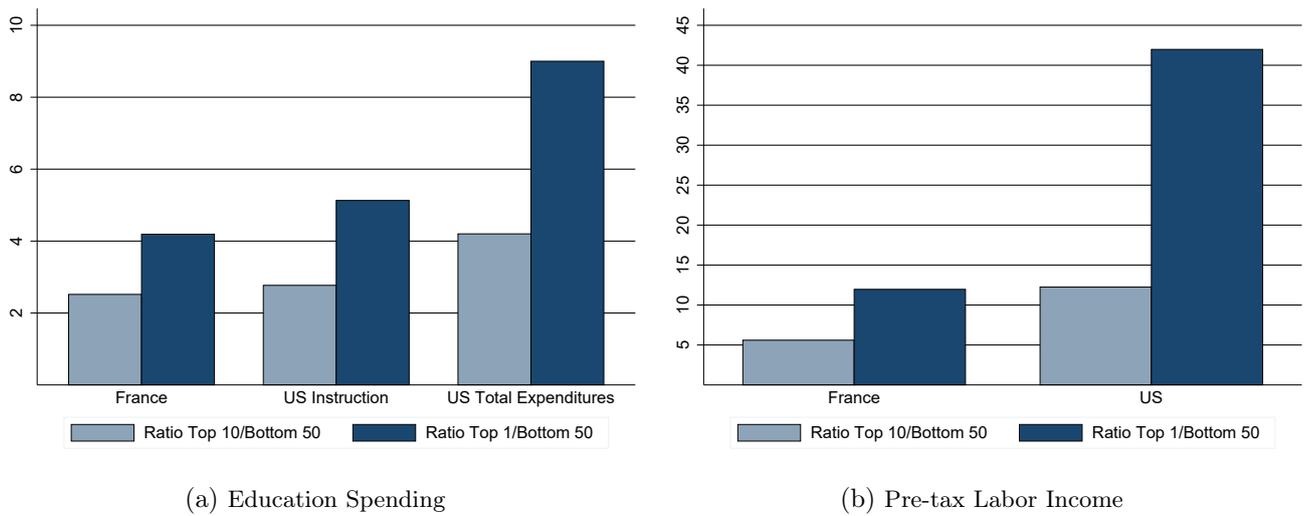
(a) Education Spending

(b) Pre-tax Labor Income

Reading: In 2001, the top 1 percent of people having higher pre-tax labor income in the US have more than 40 times more than the bottom 50; in comparison the top 1 percent of people having the highest educational spending have around 5 times more than the bottom 50 in education spending with instructional expenditure for Higher Education and 10 times more with average total expenditure.
NB: Distribution for education spending are an average of results with hypothesis 1 and hypothesis 2 (lower and higher bounds for inequalities.)
Sources: Author's computations based on WID data for pre-tax income, this master thesis data for education in the US and Zuber (2003) for education in France.

7.2.1 Higher Education

Focusing on higher education only, spending are far more unequally distributed and closer to pre-tax income. Order of magnitude of the distribution of higher education spending and wages are very similar (Figure 7.5), with higher education spending being even slightly more unequally distributed than pre-tax labor income. This is consistent with a model where what matters the most in terms of returns to education is higher education and where K-12 education is a way to provide some common ground to all citizens, distributed relatively equally (compared to wages).

Computing the ratios of wages inequalities over education spending inequalities (Figure 7.6), wages inequalities are almost always higher than educational ones. With the entire educational career, wages inequalities are between 3 and 6 times bigger than educational ones. With higher education spending, they are between 0.9 and 3 times bigger. For the top 1 percent compared to the bottom 50, the level of wages inequalities in France compared to educational ones is higher than in the US. For the top 10 percent compared to the bottom 50, levels of wages inequalities over educational ones are similar in France and in the US.

Figure 7.5: Distribution of higher education spending (for those going to higher education) and pre-tax labor income in France and in the US in 2001
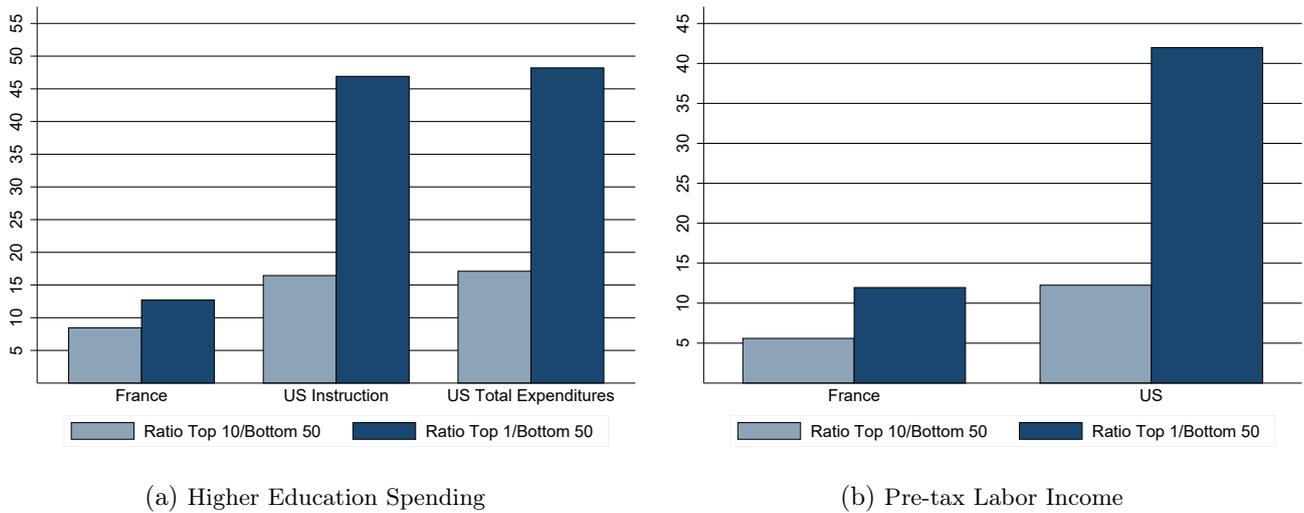
(a) Higher Education Spending


(b) Pre-tax Labor Income

Reading: In 2001, the top 1 percent of people having higher pre-tax labor income in the US have more than 40 times more than the bottom 50; in comparison the top 1 percent of people having the highest higher education spending have almost 50 times more than the bottom 50.

Sources: Author's computations based on WID data for pre-tax income, this master thesis data for the US and Zuber (2003) for France

Figure 7.6: Ratio of wages inequalities over educational inequalities in 2001
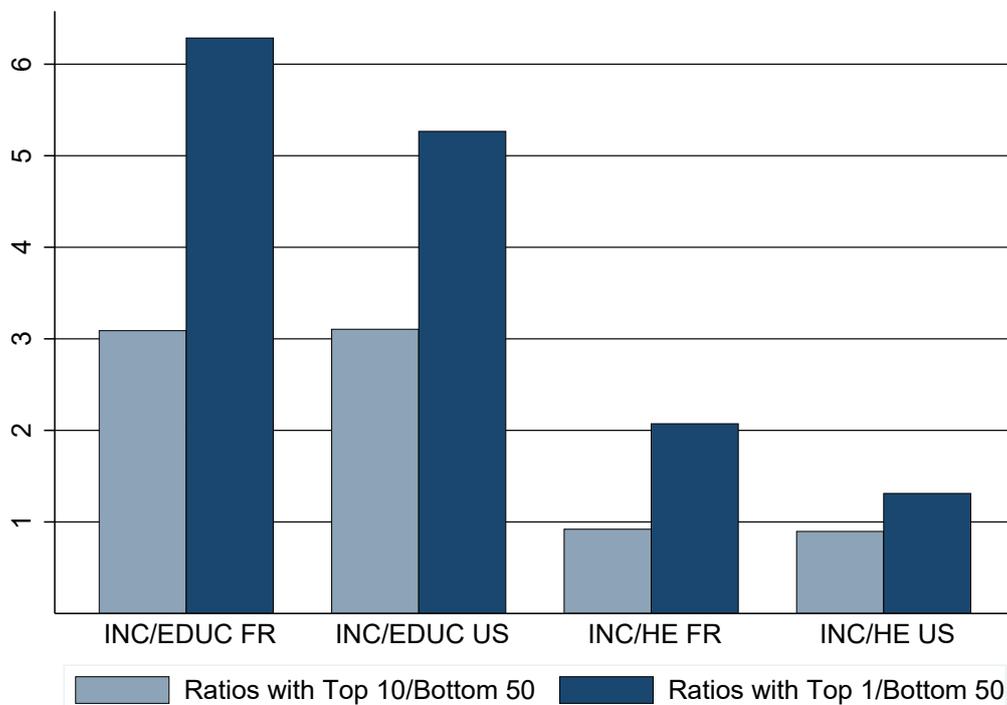
Reading: In 2001 in France, for the top 1 percent, there are 6 times more pre-tax labor income inequalities than education spending inequalities.

Sources: Author's computations based on WID data for pre-tax income, this master thesis data for the US and Zuber (2003) for France.

8   Some Elements of Explanation

8.1   Decomposition of Inequalities

As I mentioned in the introduction, inequalities are coming from two sources: not everyone has the same level of education and not everyone has the same spending per grade. The first inequality can, to some extend, be considered as "fairer" as it makes more sense to have higher ability students pursuing their studies longer – some authors showed that contrary to many other spending, optimal educational spending can be anti-redistributive – (Arrow [1971]). To know what is the main source of inequality, it is interesting to decompose them: what would have been the level of inequalities in the 1970 if the educational attainment was the one of 2005? And, what would have been the level of inequalities in the 2005 if the educational attainment was the one of 1970?

For this decomposition, I infer the proportion of secondary dropouts of 1970 to the 2005 cohort and the one of 2005 to the 1970 cohort. For college, I compute counterfactual spending for 1980 with 1980 spending and 2017 length of studies and for 2017 with 2017 spending and 1980 length of studies per institution. I then use the same method as in section 6 to combine inequalities in K-12 and higher education : hypothesis 1 assumes that dropouts are uniformly distributed in each percentile and hypothesis 2 assumes that dropout are concentrated at the bottom of the distribution of spending. I use the proportion of college goers of 2017 for 1980 and of 1980 for 2017.

Overall, with this decomposition, levels of inequalities are really similar to those found in the main specification: having the level of educational attainment of 2005 in 1970 or of 1970 in 2005 would not change much in the distribution of spending (Table 8.1 and Table 10.11).

Moreover, this is striking to find opposite results that what I would expect. Indeed, I would expect that the level of inequalities in the 1970 with 2005 educational attainment would be lower than the one in the main specification – as there are less dropouts and more people have access to higher education – and the level of inequalities in 2005 with 1970 educational attainment to be higher than the one in the main specification – as there are more dropouts and less people have access to higher education –. Even if the change is teneous, I find opposite effects: the level of inequalities in 1970 with 2005 educational attainment slightly increases and the level of inequalities in 2005 with 1970 educational attainment slightly decreases.

- With instructional expenditure (Table 8.1)[9], in 1970 with 2005 educational attainment the top 10% would have between 19.3% and 20.2% of spending (contrary to between 18.6% and 20%) and the bottom 50% would have 34.9% and 36.3 % (contrary to between 36% and 37.3%).

- In 2005 with 1970 educational attainment the top 10% would have 21.1% and 22.9% of spending (contrary to between 22.2% and 23.5%) and the bottom 50% would have 35.2% and 36.5% (contrary to between 34.2% and 35.3%).

This can be explained as the level of inequalities in higher education is way higher than the one in elementary and secondary education: when more people have access to it, the overall level of inequalities is higher. There is so much variance in spending per grade, that the overall level of educational attainment doesn't seem to play a big role. This is to be confirmed in the next section.

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[9]Results with Average Total Expenditure for Higher Education are presented in the Appendix A - Table 10.11

Table 8.1: Hypothetical distribution of spending with instructional spending for higher education

| | 1970 cohort - 2005 Educational Attainment | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$89,612		$89,612
Top 0.1 %	1.02%	$453,240	1.10%	$485,637
Top 0.5 %	2.48%	$273,809	2.61%	$282,372
Top 1 %	3.87%	$224,017	4.06%	$237,041
Top 10 %	19.3%	$126,791	20.2%	$131,630
Bottom 50 %	36.3%	$80,629	34.9%	$77,790
Bottom 10 %	5.60%	$55,518	5.04%	$55,567
	2005 cohort - 1970 Educational Attainment			
	Hypothesis 1		Hypothesis 2	
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$147,092		$147,092
Top 0.1 %	0.90%	$867,164	1.14%	$1,036,911
Top 0.5 %	2.78%	$525,808	3.14%	$555,339
Top 1 %	4.36%	$413,070	4.77%	$437,774
Top 10 %	21.1%	$216,440	22.9%	$229,341
Bottom 50 %	36.5%	$122,247	35.2%	$121,388
Bottom 10 %	5.83%	$96,392	4.86%	$84,899

Reading: If those that entered first grade in 2005 had the educational attainment of the 1970's, the bottom 50 percent of individuals would have spending between $121,388 (hypothesis 2) and $122,247 (hypothesis 1). They would have between 35.2 % and 36.5% of the overall spending.
Sample:1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 2005-2017 School Districts and 2017 colleges for the 2005 cohort.
N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are instructional expenditure only.
Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education.

8.2 Role of Length of Studies

Applying the level of educational attainment of 2005 to 1970 and reversly doesn't change much in terms of the distribution of inequalities. To explore further what is the role of global educational attainment on the distribution of spending, I study the distribution of spending if everyone were to attain the bachelor level. The only inequality that remains is through variance of spending per grade. As expected the two hypotheses give the same results as they change through the distribution of dropouts and here I assume everyone to have the same level of education.

Once again, this is striking to observe that the distribution of spending doesn't change much. If everyone where to go until bachelor studies with the same distribution of spending as currently (Table 8.2 and Table 10.12):

- With instructional expenditure (Table 8.2)[10], in 1970 the top 10% would have 18.5% of spending (contrary to between 18.6% and 20%) and the bottom 50% would have 37.3 % (contrary to between 36% and 37.3%).

- In 2005 the top 10% would have 21.8% of spending (contrary to between 22.2% and 23.5%) and the bottom 50% would have 35.5 % (contrary to between 34.2% and 35.3%).

The decrease in the concentration of spending is slightly more visible at the top of the distribution but still teneous. Leveraging educational attainment with everyone having access to an undergraduate degree would not decrease a lot inequalities in spending as long as the variance per grade stays the same.

In order to reduce inequalities in educational spending, giving more people access to higher education until the bachelor level would not change much of the picture, contrary to what is expected with regard to the experience of European countries for instance. Indeed, in Europe, many policies aiming at reducing educational inequalities try to expand the public of higher education. It doesn't mean that more people having access to the bachelor level is not a good think, it probably have many benefits: raising human capital of the population, increasing broadeness of mind, reducing criminality, etc. It just means that this would not be an efficient way of reducing inequalities in educational investment, as long as the variance within grades stays the same.

The next section will explore what would be the result of reducing the variance within each grade.

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[10]Results with Average Total Expenditure for Higher Education are presented in the Appendix A - Table 10.12

Table 8.2: Hypothetical distribution of spending with instructional spending for higher education

| | 1970 cohort - Everyone Bachelor | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$98,255		$98,255
Top 0.1 %	0.92%	$467,598	0.92%	$467,598
Top 0.5 %	2.29%	$283,204	2.29%	$283,204
Top 1 %	3.59%	$232,730	3.59%	$232,730
Top 10 %	18.5%	$134,475	18.5%	$134,475
Bottom 50 %	37.3%	$91,509	37.3%	$91,509
Bottom 10 %	5.69%	$62,668	5.69%	$62,668

| | 2005 cohort - Everyone Bachelor | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$172,488		$172,488
Top 0.1 %	0.88%	$1,076,570	0.88%	$1,076,570
Top 0.5 %	2.69%	$668,817	2.69%	$668,817
Top 1 %	4.40%	$489,401	4.40%	$489,401
Top 10 %	21.8%	$259,710	21.8%	$259,710
Bottom 50 %	35.5%	$144,898	35.5%	$144,898
Bottom 10 %	5.86%	$112,119	5.86%	$112,119

Reading: If those that entered first grade in 2005 would all go until bachelor studies, the bottom 50 percent of individuals would have $144,898 in spending. They would have 35.5% of the overall spending.
Sample: 1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 2005-2017 School Districts and 2017 colleges for the 2005 cohort.
N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are instructional expenditure only.
Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education.

8.3   Role of Variance in spending per Grade

As removing the inequality coming from the length of studies would not change a lot the distribution of spending, we can wonder what would be this level of inequality if everyone were given the same spending.

In this section, I study what would be the level of inequalities if the only inequality to remain would be the one of the length of study but if everyone were given the average spending in each of their curriculum (everyone in first grade has the average spending for one year of K-12 education, everyone in bachelor has the average spending for one year of bachelor, etc.)

Here the levels of inequalities are a much smaller renforcing the idea that the main inequality comes through variance of spending per grade (Table 8.3 and Table 10.13):

- With instructional expenditure (Table 8.3)[11], in 1970 the top 10% would have 11.2% of spending (contrary to between 18.6% and 20%) and the bottom 50 % would have 46.4 % (contrary to between 35.9% and 37.3%)

- With instructional expenditure, in 2005 the top 10% would have 12.1% of spending (contrary to between 22.3% and 23.6%) and the bottom 50% would have between 46.3% and 46.5% (contrary to between 33.8% and 35%)

Reducing the variance in spending within each grade – between districts for elementary and secondary education and between institutions for higher education – would be much more efficient to decrease the concentration of investments in education than having everyone completing the same level of education (not taking into account the fact that having everyone completing the same level of education would probably not be efficient on a social planner perspective).

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[11]Results with Average Total Expenditure for Higher Education are presented in the Appendix A - Table 10.13

Table 8.3: Hypothetical distribution of spending with instructional spending for higher education

| | 1970 cohort - Everyone mean spending | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$180,511		$180,511
Top 0.1 %	0.11%	$206,283	0.11%	$206,283
Top 0.5 %	0.56%	$205,799	0.57%	$205,799
Top 1 %	1.13%	$205,460	1.14%	$205,460
Top 10 %	11.2%	$196,014	11.2%	$196,014
Bottom 50 %	46.4%	$176,927	46.4%	$183,419
Bottom 10 %	7.51%	$153,785	7.37%	$147,440
	2005 cohort - Everyone mean spending			
	Hypothesis 1		Hypothesis 2	
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$164,327		$164,327
Top 0.1 %	0.13%	$211,676	0.13%	$211,676
Top 0.5 %	0.64%	$208,290	0.64%	$208,290
Top 1 %	1.27%	$207,443	1.27%	$207,443
Top 10 %	12.1%	$189,497	12.1%	$189,497
Bottom 50 %	46.6%	$155,806	46.5%	$155,806
Bottom 10 %	8.58%	$155,806	8.45%	$155,806

Reading: If those that entered first grade in 2005 would all have the same spending per grade (the only inequalities coming from different length of studies), the bottom 50 percent of individuals would have $155,806 in spending. They would have 46.5% of the overall spending.
Sample: 1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 2005-2017 School Districts and 2017 colleges for the 2005 cohort.
N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are instructional expenditure only.

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education.

9 Conclusion

This study aimed at analysing the distribution of education spending in the US from 1970 to 2017. For K-12 education, despite several school finance reforms that occurred since the 1970's, the level of inequalities in per pupil spending between districts at a national level has stayed remarkably constant with the top 1% of pupils having between 2.5% and 3% of the spending, the top 10 between 15% and 19% and the bottom 50 around 40% of the spending. The concentration of these spending had decreased a little in the 1970's and 1980's (presumably under the influence of school finance reforms) but has increased back in the late 1990's-early 2000's to reach the same level of 1970 nowadays.

In Higher education, the picture is totally different as instructional spending and several definitions of expen-

diture are far more concentrated with the top 1% of students having between 7% and 11% of expenditure, the top 10% having between 28% and 36% and the bottom 50 between 20 and 25%. Contrary to what is observed for K-12 education, the concentration of spending for higher education has increased a lot over the past four decades, as the most spending deciles have known the biggest increase in expenditure.

At a global level, as expected, the level of inequalities has increased a little, but far less than for higher education alone as higher education only represents between 1 and 6 years of study whereas K-12 education last 12 years for people graduating from High-School. Overall, the top 1% of individuals for whom the most is spent for education have around 5% of spending, the top 10% around 20% and the bottom 50 percent around 35%.

Shares of top 1, top 10 and bottom 50 for different levels of education from 1970 to 2017

	1970 cohort			2005 cohort		
	Bottom 50	Top 10	Top 1	Bottom 50	Top 10	Top 1
Elementary Cross-sectional	37.0%	18.5%	3.65%	38.3%	18.7%	2.76%
Elementary Longitudinal	40.5%	15.8%	2.86%	40.9%	16.8%	2.68%
College (students)	25.5%	27.7%	6.94%	20.3%	36.3%	10.6%
College (all individuals)	0%	47.8%	12.9%	2.8%	48.3%	14.7%
Global (Instruction)	36.7%	19.3%	3.8%	34.4%	22.9%	4.9%
Global (Average expenditure)	32.3%	24.6%	5.40%	30.0%	28.9%	6.80%

Sample: 1970- 1981 School Districts and 1980 colleges for 1970 cohort; 2005-2017 School Districts and 2017 colleges for 2005 cohort.

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education.

What is striking when decomposing inequalities into a part coming from the length of studies and a part coming from the variance in spending within each level of education is that the length of studies doesn't play much in the the distribution of educational spending. Only a reduction of the variance of spending per grade could significantly reduce the concentration of educational investments observed, whose level for higher education gets close or even higher than the ones observed for wages.

This study is limited in its evaluation of inequalities as I assumed that all schools within a district received the same investment and I assumed that all students in a particular degree level in a college received the same investment. This would be interesting to study within-district inequalities and inequalities between different fields of a university. Zuber [2003] showed that in France, there is a big heterogeneity in spending within a university depending on the curriculums and field people are registered to. Indeed, scientific fields tend to be more expensive. As IPEDS study only presents global expenditure figures, not separating among different subjects (unless for tuition fees), I leave that for future research.

This study aimed at describing the distribution of spending on education at the global level and their evolution over time. Even if causal analysis based on event studies are essential to the understanding of changes occured

in the educational system under the influence of educational policies and to understand what are the drivers of inequalities in education, they should not be a reason to forget about the global picture of what is happening in terms of the distribution of education spending.

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10   Appendix A : Different Definition of education spending

10.1   K-12 Education

Evolution of inequalities with alternative definition of spending

To measure if the stability of spending inequalities holds with an alternative definition of spending, I compute the distribution of spending from 1990 to 2016 with instructional spending (and not global educational ones). I can't go back further in time as data from Historical Finances of Individual Governments (IndFin) used from 1967-1985 doesn't present spending for instruction separately.

Results in terms of distribution are really close to those of table 4.1 showing that the distribution of spending for instruction is fairly similar to the one of total per pupil spending: the stability in the distribution of spending is not linked to spending for buildings or extraccuricular activities for instance.

Table 10.1: Evolution of cost and distribution of per pupil expenditure from 1967 to 2016 in constant 2017 dollars (cross-sectional analysis)

	1967	1970	1975	1980	1985	1990
Total number of students in the data	28,604,772	28,548,784	30,438,324	35,653,084	32,669,830	40,432,080
Total number of districts in the data	5,837	5,869	5,673	14,430	12,016	15,138
Mean of per student spending	$4,841	$5,708	$6,198	$6,782	$7,483	$5,050
Top 0.1% of students	$19,187	$21,766	$19,043	$18,788	$20,715	$14,999
Percentage of the overall spending	0.95%	1.07%	0.70%	0.46%	0.41%	0.34%
Top 0.5% of students	$12,144	$15,975	$15,531	$14,622	$16,800	$12,093
Percentage of the overall spending	2.16%	2.31%	1.75%	1.38%	1.37%	1.38%
Top 1% of students	$10,327	$13,842	$12,989	$13,103	$15,187	$10,671
Percentage of the overall spending	3.28%	3.65%	2.90%	2.43%	2.45%	2.51%
Top 10% of students	$6,584	$7,954	$8,418	$8,913	$9,971	$7,037
Percentage of the overall spending	17.5%	18.5%	17.0%	15.8%	16.1%	16.6%
Bottom 50% of students	$4,540	$5,367	$5,864	$6,556	$7,187	$4,685
Percentage of the overall spending	38.7%	37.0%	39.5%	40.0%	39.7%	39.2%
Bottom 10% of students	$3,242	$3,586	$4,249	$4,744	$5,217	$3,500
Percentage of the overall spending	5.86%	5.44%	6.03%	6.19%	5.78%	6.19%
	1995	**2000**	**2005**	**2010**	**2016**	**Evolution (from 1990)**
Total number of students	43,807,624	46,432,784	48,055,256	48,266,208	48,514,348	+ 20%
Total number of institutions in the data	14,454	14,378	14,105	13,515	13,471	-11%
Mean of per student spending for instruction	$5,417	$6,030	$6,660	$7,139	$7,246	+ 43,4%
Top 0.1% of students	$14,874	$24,785	$22,367	$22,291	$22,403	+ 49.4%
Percentage of the overall spending	0.33%	0.52%	0.48%	0.48%	0.43%	
Top 0.5% of students	$12,321	$13,007	$15,170	$22,291	$22,403	+ 85.2%
Percentage of the overall spending	1.30%	1.51%	1.50%	0.48%	0.43%	
Top 1% of students	$11,103	$11,690	$13,513	$17,281	$19,122	+ 79.20%
Percentage of the overall spending	2.36%	2.51%	2.56%	1.51%	0.99%	
Top 10% of students	$7,830	$8,236	$9,182	$10,055	$10,590	+ 49.2%
Percentage of the overall spending	16.3%	16.2%	17.1%	18.0%	18.7%	
Bottom 50% of students	$4,917	$5,542	$6,023	$6,279	$6,289	+ 34.2%
Percentage of the overall spending	39.7%	40.8%	40.1%	39.0%	37.7%	
Bottom 10% of students	$3,950	$4,555	$4,994	$5,222	$5,107	+ 45.9%
Percentage of the overall spending	6.80%	7.07%	7.32%	6.67%	6.30%	

Reading: In 2016, the top 10% of student for whom the most is spent in instructional spending have spending above $10,590 per year, they have 18.7% of the overall spending.

Sample: 1967-2016 school districts

N.B: spending are total per pupil spending from 1967 to 1985 and spending for instruction only from 1990 to 2016

Sources: Historical Finances of Individual Governments (IndFin) for 1967-1985 and Public Elementary-Secondary Education Finance Data for 1990-2016, US Census Bureau

10.2 Definition of Higher Education spending (IPEDS Definition)

Instructional spending

I compute instructional spending per student based on total instructional expenditure divided by fall enrollment.

Instruction: A functional expense category that includes expenses of the colleges, schools, departments, and other instructional divisions and expenses for departmental research and public service that are not separately budgeted. Includes general academic instruction, occupational and vocational instruction, community education, preparatory and adult basic education, and regular, special, and extension sessions. Also includes expenses for both credit and non-credit activities. Excludes expenses for academic administration where the primary function is administration (e.g., academic deans).

Student oriented resources (without grants and scholarships)

I compute per student spending without grant adding instructional, academic support, institutional support, student services and public service spending divided by fall enrollment. I do not include grants spending in this category.

Academic support: A functional expense category that includes expenses of activities and services that support the institution's primary missions of instruction, research, and public service. It includes the retention, preservation, and display of educational materials (for example, libraries, museums, and galleries); organized activities that provide support services to the academic functions of the institution (such as a demonstration school associated with a college of education or veterinary and dental clinics if their primary purpose is to support the instructional program); media such as audiovisual services; academic administration (including academic deans but not department chairpersons); and formally organized and separately budgeted academic personnel development and course and curriculum development expenses. Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.

Institutional support: A functional expense category that includes expenses for the day-to-day operational support of the institution. Includes expenses for general administrative services, central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management, employee personnel and records, logistical services such as purchasing and printing, and public relations and development. Also includes information technology expenses related to institutional support activities.

Student service: A functional expense category that includes expenses for admissions, registrar activities, and activities whose primary purpose is to contribute to students emotional and physical well-being and to their intellectual, cultural, and social development outside the context of the formal instructional program. Examples include student activities, cultural events, student newspapers, intramural athletics, student organizations, supplemental instruction outside the normal administration, and student records. Intercollegiate athletics and student health services may also be included except when operated as self-supporting auxiliary enterprises. Also may include information technology expenses related to student service activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in institutional support.) Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.

Public service : A functional expense category that includes expenses for activities established primarily to provide noninstructional services beneficial to individuals and groups external to the institution. Examples are conferences, institutes, general advisory service, reference bureaus, and similar services provided to particular sectors of the community. This function includes expenses for community services, cooperative extension services, and public broadcasting services. Also includes information technology expenses related to the public service

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activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in academic support).

Student oriented resources (with grants and scholarships)

I compute per student spending with grant adding instructional, academic support, institutional support, student services and public service spending divided by fall enrollment. I also include grants spending in this category.

Institutional grants: Scholarships and fellowships granted and funded by the institution and/or individual departments within the institution, (i.e., instruction, research, public service) that may contribute indirectly to the enhancement of these programs. Includes scholarships targeted to certain individuals (e.g., based on state of residence, major field of study, athletic team participation) for which the institution designates the recipient.

Federal grants (grants/educational assistance funds): Grants provided by federal agencies such as the U.S. Department of Education, including Title IV Pell Grants and Supplemental Educational Opportunity Grants (SEOG). Also includes need-based and merit-based educational assistance funds and training vouchers provided from other federal agencies and/or federally sponsored educational benefits programs. (Used for reporting on the Student Financial Aid component)

Grants by state government (student aid): Grant monies provided by the state such as Leveraging Educational Assistance Partnerships (LEAP) (formerly SSIG's); merit scholarships provided by the state; and tuition and fee waivers for which the institution was reimbursed by a state agency.

Grants by local government (student aid): Local government grants include scholarships or gift-aid awarded directly to the student.

Per student average total expenditure

I compute per student average total expenditure dividing global expenditure (for education, research, maintenance of plants, etc.) by fall enrollment. I do not take into account hospital expenditure and independent operation expenditure and I only include half of research expenditure. Even if this category doesn't totally separate research and educational component of universities, it has some interest if students also benefit partly from research activities carried on at their institutions.

Per student average public total expenditure

This category include expenditure per student based on the share of public revenue (local, state and federal government) in global expenses. It doesn't include tuition revenue appart from grants and scholarship received by public institutions. This category is unfortunately not very stable over time.

Table 10.2: Number of higher education institutions over time and average spending in 2017 dollars

	Instruction per student	Public per student	Public with grants	Average Tuition	Average Total Expenditure	Public Expenditure	Public for Instruction
Number of institutions - 1980	2,619	2,620	2,603	2,620	2,346	2,345	2,345
Average values	$1,623	$3,035	$3,315	$1,434	$5,497	$2,049	$690
Number of institutions - 1985	2,765	2,769	2,770	2,758	2,771	2,647	2,641
Average values	$2,474	$4,793	$5,785	$2,435	$8,853	$2,947	$927
Number of institutions - 1990	2,991	2,995	2,995	2,983	2,995	2,806	2,805
Average values	$4,896	$9,503	$11,882	$5,668	$17,102	$5,531	$1,980
Number of institutions - 1995	3,039	3,043	3,043	3,031	3,043	2,838	2,839
Average values	$4,018	$8,067	$10,142	$5,033	$14,964	$4,436	$1,410
Number of institutions - 2000	4,569	4,577	4,591	4,591	4,630	4,121	4,087
Average values	$10,622	$19,114	$20,941	$6,746	$40,365	$13,681	$6,766
Number of institutions - 2005	5,044	5,054	5,055	5,035	5,056	4,052	4,042
Average values	$7,997	$15,303	$17,214	$7,323	$26,129	$9,805	$3,317
Number of institutions - 2010	5,756	5,765	5,765	5,740	5,764	4,444	4,443
Average values	$6,344	$13,660	$16,260	$8,901	$19,120	$7,112	$2,468
Number of institutions - 2015	5,756	5,765	5,765	5,740	5,764	4,444	4,443
Average values	$8,044	$17,978	$21,398	$11,658	$25,604	$9,030	$2,863
Number of institutions - 2017	6,411	6,417	6,417	6,396	6,418	4,928	4,925
Average values	$8,814	$20,001	$23,437	$13,592	$28,213	$8,831	$2,802

Reading: In 2017, there are 6,411 higher education reporting positive instruction spending.

In 2017, average instruction per student spending are $8,814.

Sample: 1980-2017 colleges and universities

N.B.: Average spending are in constant 2017 dollars.

Sources: IPEDS, Finance and Enrollment data

10.3 Higher Education Distribution of spending with Alternative Definition of Higher Education spending

To study if the increase in inequalities observed at the higher education level (cf Table 5.1 and 5.2) is linked to a particular definition of spending, I compute the evolution of the distribution of spending with alternative definitions of spending presented in the last section.

Student oriented resources (without grants and scholarships)

The evolution of spending oriented to student resources (instructional spending, academic and institutional support, student services and public services) has known the same evolution as the one of instructional spending only. It has increased more for the higher deciles of spending than for the median students (+190%). The distribution is slightly more equal with in 2017, 8.3% of the spending for the top 1% (compared to 10.6%) and almost 34.5% for the top 10% (compared to the 36.2%) showing that ancillary expenses tends to mitigate slightly inequalities in instructional spending. Over the period, these spending have increased more than instructional spending showing that higher education institutions dedicate a higher share of resources to auxiliary expenses over time.

Student oriented resources (with grants and scholarships)

Focusing on the distribution of student oriented resources with grants and scholarships included, the increase is more evenly distributed among all the deciles of spending (+148% for the bottom 10 and +133% for the top 10). The level of inequalities in spending are slightly lower showing that grants and scholarships are effective at

Figure 10.1: Growth incidence curve of per student spending (without grants and scholarships) between 1980-2017
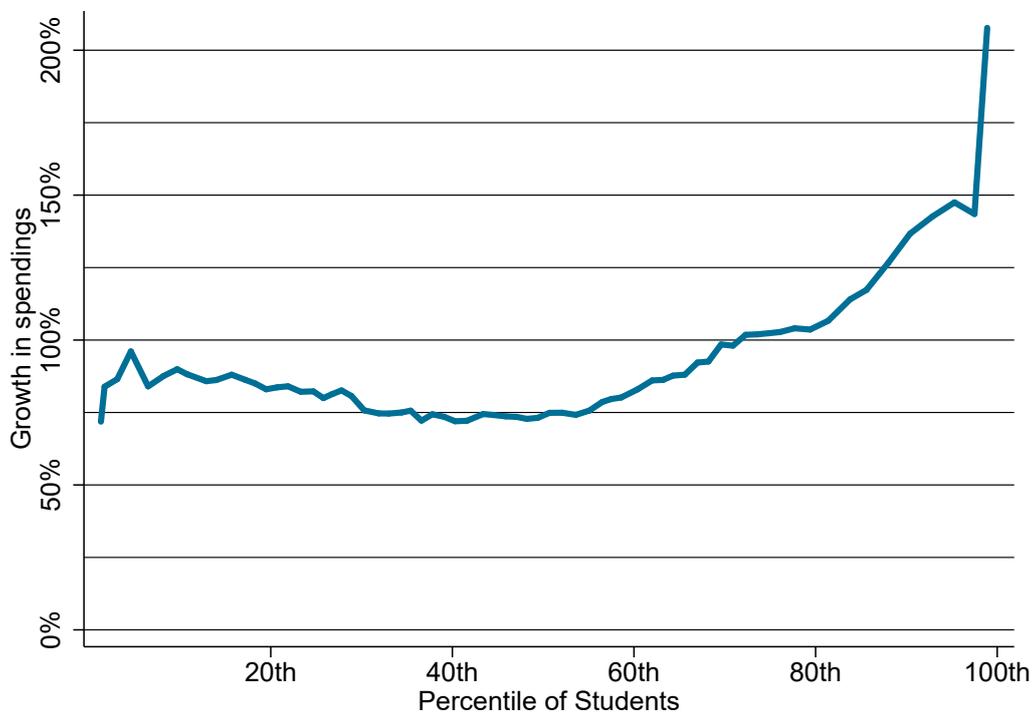
Reading: Between 1980 and 2017, per student average tuitions for those at the 80th percentile of the distribution of spending increased by around 100%.
Sample: 1980 and 2017 colleges

Sources: IPEDS 1980 and 2017

mitigating some of the inequalities in spending.

Figure 10.2: Growth incidence curve of per student spending (with grants and scholarships) between 1980-2017
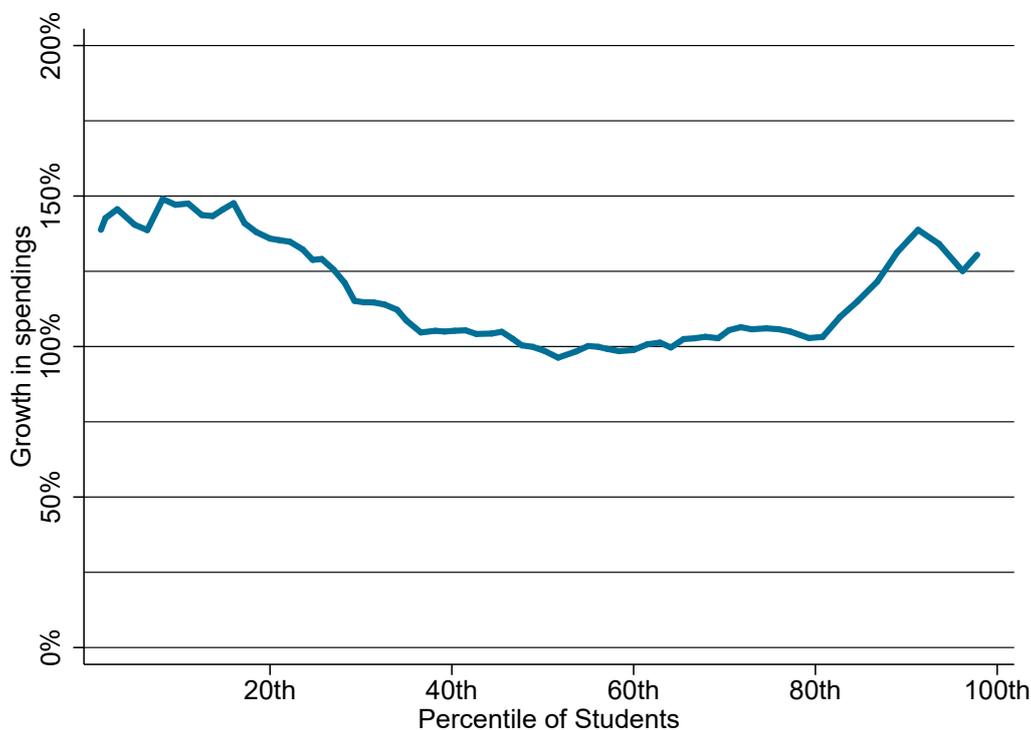
Reading: Between 1980 and 2017, per student average tuitions for those at the 80th percentile of the distribution of spending increased by around 100%.
Sample: 1980 and 2017 colleges

Sources: IPEDS 1980 and 2017

Per student public total expenditure

Focusing on average public expenditure, levels of inequalities are of the same order of magnitude than instructional expenditure showing that the distribution of spending coming from public sources is similar to the one focusing on instruction (coming from tuitions, public sources and donations). Nevertheless, I observe that the increase over the period is smaller than for total average expenditure showing that institutions rely more and more on external sources of fundings. I also observe a decrease in public funding for the lowest decile of spending. This category is less reliable as the definition of what is public is less constant over time than the definition of instructional expenditure for instance. Institutions between the top 10% and the median of spending are the one getting the bigger increase in public spending with more than 100% of increase in these fundings.

Average tuition revenue

Focusing on average tuition revenue, the picture is totally different: the increase in average tuition revenue is higher at the bottom than at the top of the distribution showing that institutions that used to rely less on revenue from tuitions have increased them the most, maybe to compensate for the decrease in public revenue. The distribution of revenue from tuitions is both less concentrated at the top (with smaller share than for instructional

Figure 10.3: Growth incidence curve of average public expenditure between 1980-2017
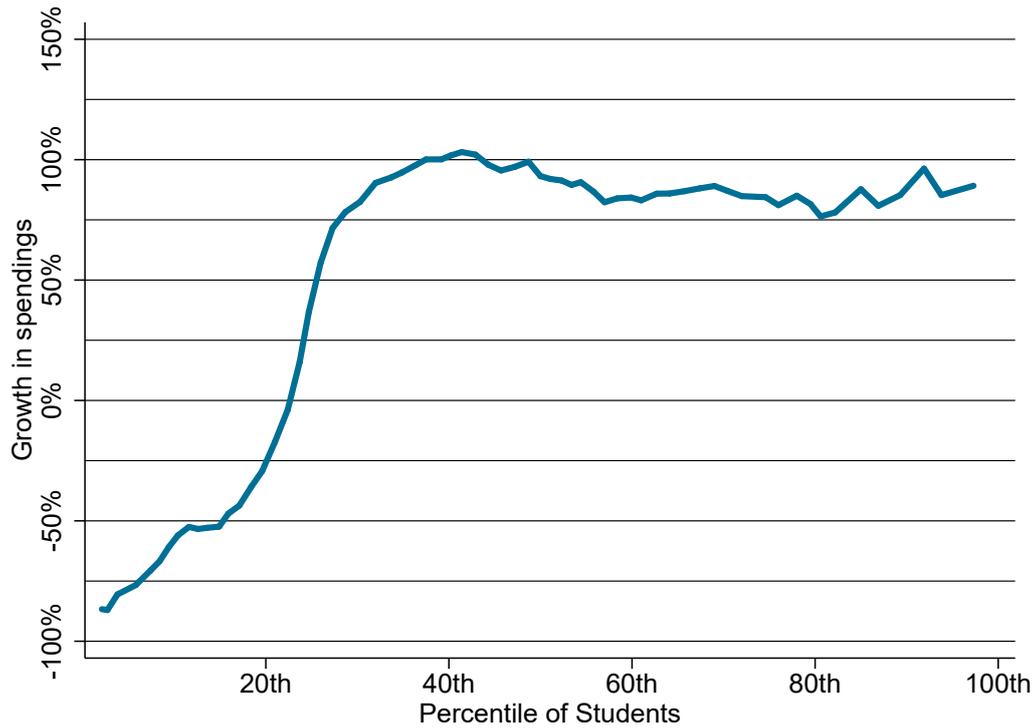
Reading: Between 1980 and 2017, per student average tuitions for those at the 80th percentile of the distribution of spending increased by around 100%.
Sample: 1980 and 2017 colleges

Sources: IPEDS 1980 and 2017

spending for instance) and more unequal at the bottom (with smaller share for the bottom 10 and bottom 50% of students also).

Figure 10.4: Growth incidence curve of average tuition spending between 1980-2017
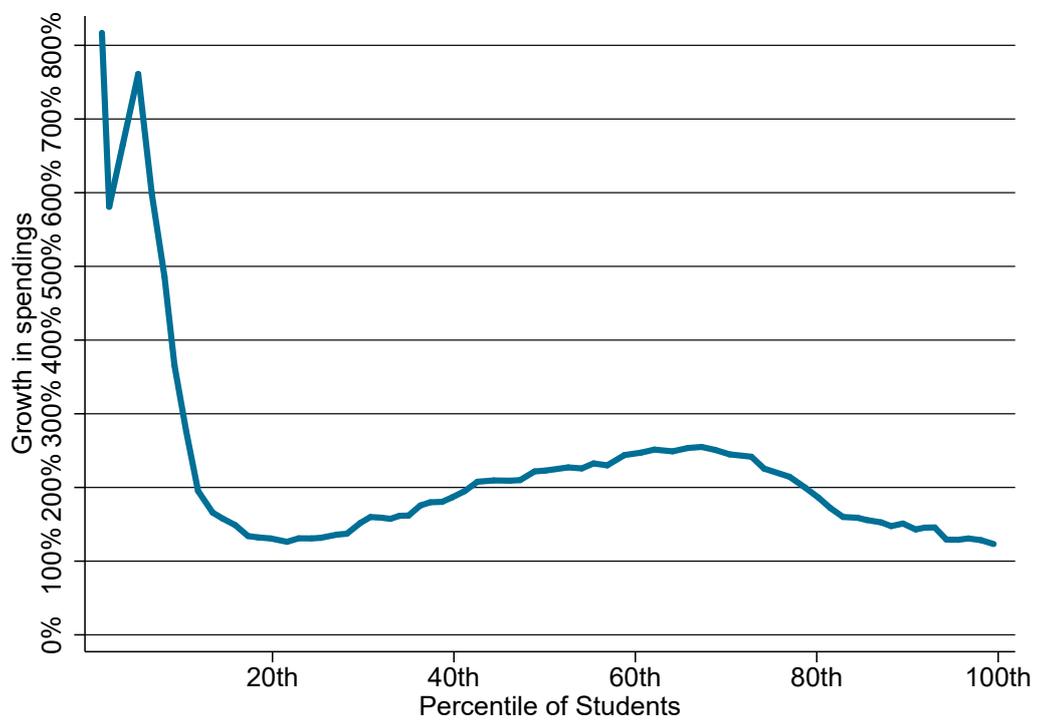
Reading: Between 1980 and 2017, per student average tuitions for those at the 80th percentile of the distribution of spending increased by around 200%.
Sample: 1980 and 2017 colleges

Sources: IPEDS 1980 and 2017

Table 10.3: Evolution of cost and distribution of student oriented resources (without grants) from 1980 to 2017 in constant 2017 dollars (cross-sectional anlaysis)

	1980	1985	1990	1995	2000
Total number of students in the data	11,409,336	11,677,120	13,145,883	13,474,887	14,542,413
Total number of institutions in the data	2,619	2,765	2,866	3,034	4,565
Mean of per student spending	$8271	$9524	$13731	$11386	$13382
Top 0.1% of students	$96,812	$126,750	$194,670	$172,807	$195,118
Percentage of the overall spending	1.27%	1.74%	2.60%	1.92%	2.37%
Top 0.5% of students	$42275	$48,154	$84,557	$71,688	$91,067
Percentage of the overall spending	4.58%	4.96%	5.58%	5.25%	5.91%
Top 1% of students	$35864	$42,536	$70,686	$58,039	$66,565
Percentage of the overall spending	6.78%	6.71%	8.63%	7.92%	8.66%
Top 10% of students	$13856	$16,472	$23,891	$20,314	$23,325
Percentage of the overall spending	28.44%	28.76%	31.28%	30.90%	33.20%
Bottom 50% of students	$6,695	$7,472	$10,275	$8,585	$9,699
Percentage of the overall spending	25.23%	24.72%	24.06%	23.79%	22.79%
Bottom 10% of students	$2921	$3300	$4628	$3891	$4272
Percentage of the overall spending	2.95%	2.85%	2.85%	2.95%	2.69%

	2005	2010	2015	2017	Evolution
Total number of students	17,102,282	20,401,724	20,394,492	20,183,886	+76.9%
Total number of institutions in the data	5,042	5,756	6,539	6,411	+145%
Mean of per student spending	$13,758	$14,786	$16,928	$17,413	+ 110%
Top 0.1% of students	$190,118	$201,201	$218,297	$198,032	+ 104%
Percentage of the overall spending	2.30%	1.32%	1.40%	1.67%	
Top 0.5% of students	$100547	$109,292	$125,243	$140,470	+ 232%
Percentage of the overall spending	5.71%	5.24%	5.51%	5.53%	
Top 1% of students	$85,269	$93,478	$108,245	$104,021	+190%
Percentage of the overall spending	9.25%	8.72%	8.26%	8.34%	
Top 10% of students	$24,554	$28,004	$30,643	$33,299	+ 140%
Percentage of the overall spending	34.86%	34.43%	34.31%	34.47%	
Bottom 50% of students	$9,388	$10,294	$11,464	$11,744	+ 75.4%
Percentage of the overall spending	21.26%	21.17%	21.71%	21.45%	
Bottom 10% of students	$4,214	$4,507	$5,381	$5,498	+ 88.2%
Percentage of the overall spending	2.60%	2.51%	2.67%	2.66%	

Reading: In 2017, the top 10% of student for whom the most is spent have per student spending above $33,299, they have 34.47% of the overall spending.

Sample: 1980's - 2010's colleges and universities

Sources: IPEDS, Finance and Enrollment Data

Table 10.4: Evolution of cost and distribution of student oriented resources (with grants and scholarships) from 1980 to 2017 in constant 2017 dollars (cross-sectional anlaysis)

	1980	1985	1990	1995	2000
Total number of students in the data	11,409,336	11,677,120	13,145,883	13,474,887	14,542,413
Total number of institutions in the data	2,619	2,765	2,866	3,034	4,565
Mean of per student spending	$8852	$11080	$16734	$13876	$15249
Top 0.1% of students	$102,404	$127,166	$208,093	$177,623	$198,536
Percentage of the overall spending	1.20%	1.52%	2.15%	1.79%	2.27%
Top 0.5% of students	$50,198	$53,119	$89,435	$78,634	$91,229
Percentage of the overall spending	4.28%	4.46%	5.09%	4.65%	5.44%
Top 1% of students	$38,509	$48,489	$79,015	$64,966	$71,831
Percentage of the overall spending	6.98%	6.46%	7.48%	6.73%	7.73%
Top 10% of students	$14,866	$18,807	$28,667	$23,723	$25,628
Percentage of the overall spending	28.81%	27.90%	30.06%	29.79%	30.61%
Bottom 50% of students	$7,221	$9,200	$12,828	$10,758	$11,869
Percentage of the overall spending	24.65%	25.31%	24.79%	24.68%	24.75%
Bottom 10% of students	$2,946	$3,647	$5,715	$4,784	$5,346
Percentage of the overall spending	2.82%	2.76%	2.79%	2.94%	2.84%

	2005	2010	2015	2017	Evolution
Total number of students	17,102,282	20,401,724	20,394,492	20,183,886	+76.9%
Total number of institutions in the data	5,042	5,756	6,539	6,411	+145%
Mean of per student spending	$15357	$17082	$19309	$19559	120%
Top 0.1% of students	$192,977	$201,515	$226,221	$205,913	+101%
Percentage of the overall spending	2.019%	1.159%	1.220%	1.490%	
Top 0.5% of students	$100,667	$109,579	$126,964	$140,714	+ 180%
Percentage of the overall spending	5.230%	4.829%	4.900%	5.039%	
Top 1% of students	$87,676	$95,670	$108,406	$104,596	+ 171%
Percentage of the overall spending	8.619%	7.670%	7.539%	7.690%	
Top 10% of students	$26,007	$29,947	$33,139	$34,761	+ 133%
Percentage of the overall spending	32.31%	31%	31.15%	31.76%	
Bottom 50% of students	$11,127	$12,895	$14,269	$14,350	+ 98.7%
Percentage of the overall spending	23.93%	25.04%	25.37%	24.55%	
Bottom 10% of students	$5,415	$6,443	$7,696	$7,313	+148%
Percentage of the overall spending	2.960%	3.059%	3.279%	3.130%	

Reading: In 2017, the top 10% of student for whom the most is spent have per student spending above $34,761, they have 31.76% of the overall spending.

Sample: 1980's - 2010's colleges and universities

Sources: IPEDS, Finance and Enrollment Data

Table 10.5: Evolution of cost and distribution of average public expenditure per student from 1980 to 2017 in constant 2017 dollars (cross-sectional anlaysis)

	1980	1985	1990	1995	2000
Total number of students in the data	11,409,336	11,677,120	13,145,883	13,474,887	14,542,413
Total number of institutions in the data	2,619	2,765	2,866	3,034	4,565
Mean of per student spending	$7,164	$7,789	$10,455	$8,671	$8,982
Top 0.1% of students	$128,610	$150,887	$163,330	$130,586	$156,452
Percentage of the overall spending	1.93%	2.34%	2.64%	2.26%	2.83%
Top 0.5% of students	$53,158	$51,274	$59,634	$50,573	$51,154
Percentage of the overall spending	6.63%	6.80%	6.29%	6.20%	7.24%
Top 1% of students	$37,703	$40,518	$42,825	$40,482	$38,778
Percentage of the overall spending	9.79%	9.80%	9.05%	8.34%	9.13%
Top 10% of students	$13,595	$14,846	$21,553	$17,627	$18,255
Percentage of the overall spending	34.63%	34.08%	33.66%	33.45%	34.70%
Bottom 50% of students	$4,904	$5,438	$7,485	$5,977	$6,368
Percentage of the overall spending	18.53%	18.80%	21.04%	20.60%	19.23%
Bottom 10% of students	$1,132	$1,283	$2,694	$2,086	$1,231
Percentage of the overall spending	0.80%	0.95%	1.53%	1.38%	0.70%

	2005	2010	2015	2017	Evolution
Total number of students	17,102,282	20,401,724	20,394,492	20,183,886	+76.9%
Total number of institutions in the data	5,042	5,756	6,539	6,411	+145%
Mean of per student spending	$12,888	$12,525	$13,131	$13,367	+ 86.5%
Top 0.1% of students	$236,596	$196,358	$196,601	$210,990	+ 64.0%
Percentage of the overall spending	2.62%	2.67%	2.35%	2.17%	
Top 0.5% of students	$70,411	$82,733	$84,024	$82,338	+ 54.8%
Percentage of the overall spending	6.72%	6.52%	6.11%	7.26%	
Top 1% of students	$58688	$55,509	$54,513	$57,009	+ 51.2%
Percentage of the overall spending	9.16%	9.30%	8.93%	9.26%	
Top 10% of students	$28,589	$26,911	$27,719	$27,906	+ 105%
Percentage of the overall spending	36.27%	36.72%	35.13%	35.06%	
Bottom 50% of students	$8,570	$8,364	$9,607	$9,886	+ 101%
Percentage of the overall spending	17.52%	16.67%	16.38%	16.23%	
Bottom 10% of students	$1,047	$892	$552	$503	-55%
Percentage of the overall spending	0.40%	0.30%	0.15%	0.13%	

Reading: In 2017, the top 10% of student for whom the most is spent in public spending (federal, state and local) have spending above $27,906, they have 35.06% of the overall spending.

Sample: 1980's - 2010's colleges and universities

N.B.: Average public spending represent the share of total spending coming from public sources and as such, also include spending for research and not only educational expenditure

Sources: IPEDS, Finance and Enrollment Data

Table 10.6: Evolution of cost and distribution of average revenue from tuition from 1980 to 2017 in constant 2017 dollars (cross-sectional anlaysis)

	1980	1985	1990	1995	2000
Total number of students in the data	11,409,336	11,677,120	13,145,883	13,474,887	14,542,413
Total number of institutions in the data	2,619	2,765	2,866	3,034	4,565
Mean of per student revenue from tuition	$3,117	$4,008	$7,153	$5,935	$6,003
Top 0.1% of students	$20,229	$26,630	$43,513	$33,814	$36,483
Percentage of the overall revenue from tuition	0.44%	0.53%	0.67%	0.67%	1.16%
Top 0.5% of students	$16,555	$21,955	$37,740	$30,646	$27,226
Percentage of the overall revenue from tuition	2.91%	3.08%	2.55%	2.79%	3.01%
Top 1% of students	$15,536	$20,145	$35,696	$28,325	$25,867
Percentage of the overall revenue from tuition	5.36%	5.38%	5.47%	5.23%	5.28%
Top 10% of students	$8,220	$10,127	$18,405	$15,403	$14,102
Percentage of the overall revenue from tuition	37.41%	37.88%	38.27%	37.34%	33.5%
Bottom 50% of students	$1,851	$2,442	$4,166	$3,523	$4,135
Percentage of the overall revenue from tuition	14.10%	14.84%	15.31%	15.21%	16.73%
Bottom 10% of students	$242	$426	$1,087	$908	$1,047
Percentage of the overall revenue from tuition	0.29%	0.70%	0.88%	0.92%	0.89%
	2005	2010	2015	2017	Evolution
Total number of students	17,102,282	20,401,724	20,394,492	20,183,886	+76.9%
Total number of institutions in the data	5,042	5,756	6,539	6,411	+145%
Mean of per student revenue from tuition	$6,452	$7,113	$8,418	$8,543	+ 174%
Top 0.1% of students	$40,783	$42,453	$50,172	$53,048	+ 162%
Percentage of the overall revenue from tuition	0.88%	0.81%	0.89%	0.86%	
Top 0.5% of students	$30,014	$31,924	$35,853	$36,972	+ 123%
Percentage of the overall revenue from tuition	2.90%	2.71%	2.73%	2.42%	
Top 1% of students	$28,605	$31,542	$34,823	$35,642	+ 129%
Percentage of the overall revenue from tuition	4.42%	4.64%	4.66%	4.56%	
Top 10% of students	$16,285	$17,597	$19,867	$19,956	+ 142%
Percentage of the overall revenue from tuition	34.18%	33.41%	31.84%	32.24%	
Bottom 50% of students	$4,194	$4,684	$5,927	$5,977	+ 222%
Percentage of the overall revenue from tuition	14.31%	13.56%	14.39%	14.60%	
Bottom 10% of students	$768	$760	$923	$969	+ 300%
Percentage of the overall revenue from tuition	0.78%	0.64%	0.66%	0.67%	

Reading: In 2017, the top 10% of student having the higher revenue from tuition have revenue from tuition of $19,956, they have 32.24% of the overall revenue from tuition.

Sample: 1980's - 2010's colleges and universities

Sources: IPEDS, Finance and Enrollment Data

10.4 Global Distribution of spending with Alternative Definition of Higher Education spending

Student oriented resources (without grants and scholarships)

Focusing on the global distribution of spending with total student oriented resources, levels of inequalities are slightly higher than the one for instructional expenditure and have increased slightly more over time. The share of the top 10% was between 20.8% and 22.4% (compared to between 18.6% and 20% for instructional expenditure) in the 1970's and between 24.5% and 25.9% (20.8% and 22%) in the 1998.

Student oriented resources (with grants and scholarships)

Including grants and scholarships in the analysis almost doesn't change the global picture: this make sense as in the entire educational career, they only account for a small share of a few years of a long educational career.

Per student public total expenditure

With per student public expenditure, the order of magnitude are the same than for instructional spending or for student-oriented resources with 5% dedicated to the top 1 and bottom 10 shares, respectively; 20% to the top 10 and 35% to the bottom 50. I observe an increase of inequalities in public resources for the 1998 cohort. Nevertheless, this is to be remembered that the definition of "public expenditure" over the years of IPEDS survey varies more than the one for instruction or other categories for instance.

Average tuition revenue

Focusing on the global distribution with average tuition, I observe that order of magnitudes are the same as with instructional expenditure and the distribution is fairly stable over time.

Table 10.7: Distribution of spending with alternative spending for higher education

| | 1970 cohort - Expenditure per student (without grants) | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$88,523		$88,523
Top 0.1%	0.93%	$570,746	1.25%	$541,175
Top 0.5%	2.70%	$307,460	2.99%	$331,110
Top 1%	4.28%	$249,852	4.67%	$268,162
Top 10%	20.8%	$129,619	22.4%	$140,998
Bottom 50%	34.9%	$77,427	33.4%	$75,045
Bottom 10%	4.97%	$50,753	3.80%	$41,675

| | 1998 cohort - Expenditure per student (without grants) | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$163,794		$163,794
Top 0.1%	1.08%	$1,248,229	1.29%	$1,482,988
Top 0.5%	3.42%	$813,948	3.71%	$839,131
Top 1%	5.60%	$601,550	5.91%	$616,017
Top 10%	24.5%	$253,982	25.9%	$278,054
Bottom 50%	32.6%	$131,646	30.7%	$121,803
Bottom 10%	5.10%	$96,886	4.47%	$98,070

| | 2005 cohort - Expenditure per student (without grants) | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$177,896		$177,896
Top 0.1%	1.17%	$1,401,365	1.33%	$1,555,891
Top 0.5%	3.57%	$909,083	3.84%	$944,647
Top 1%	5.80%	$675,303	6.11%	$694,487
Top 10%	25.5%	$281,332	27.0%	$307,907
Bottom 50%	31.9%	$136,625	30.1%	$130,831
Bottom 10%	5.24%	$103,492	4.72%	$101,878

Reading: Among those that entered first grade in 2005, the bottom 50 percent of spending had spending between $130,831 (hypothesis 2) and $136,625 (hypothesis 1). They had between 30.1% and 31.9% of the overall spending.

Sample: 1970- 1982 School Districts and 1982 colleges for the 1970 cohort; 1998-2010 School Districts and 2010 colleges for the 1998 cohort, 2005-2017 School Districts and 2017 colleges for the 2005 cohort

N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are student oriented resources without grants and scholarships.

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education

Table 10.8: Distribution of spending with alternative spending for higher education

| | 1970 cohort - Expenditure per student (with grants) | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$89,447		$89,447
Top 0.1%	.933%	$581,521	1.24%	$541,627
Top 0.5%	2.77%	$319,594	3.07%	$345,099
Top 1%	4.42%	$259,898	4.81%	$276,870
Top 10%	21.2%	$131,711	22.8%	$143,881
Bottom 50%	34.6%	$77,516	33.0%	$75,045
Bottom 10%	4.92%	$50,761	3.76%	$41,675

| | 1998 cohort - Expenditure per student (with grants) | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$165,551		$165,551
Top 0.1%	1.08%	$1,256,118	1.28%	$1,483,266
Top 0.5%	3.42%	$813,948	3.71%	$839,131
Top 1%	5.59%	$601,550	5.90%	$619,136
Top 10%	24.6%	$255,050	25.9%	$281,312
Bottom 50%	32.3%	$131,774	30.4%	$123,023
Bottom 10%	5.07%	$97,195	4.42%	$98,070

| | 2005 cohort - Expenditure per student (with grants) | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$181,725		$181,725
Top 0.1%	1.15%	$1,403,164	1.32%	$1,557,690
Top 0.5%	3.52%	$918,922	3.79%	$953,650
Top 1%	5.73%	$684,598	6.04%	$705,317
Top 10%	25.4%	$288,309	26.9%	$315,478
Bottom 50%	31.6%	$139,623	29.6%	$134,017
Bottom 10%	5.18%	$104,185	4.62%	$101,878

Reading: Among those that entered first grade in 2005, the bottom 50 percent of spending had spending between $134,017 (hypothesis 2) and $139,623 (hypothesis 1). They had between 29.6% and 31.6% of the overall spending.
Sample: 1970- 1982 School Districts and 1982 colleges for the 1970 cohort; 1998-2010 School Districts and 2010 colleges for the 1998 cohort, 2005-2017 School Districts and 2017 colleges for the 2005 cohort
N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are student oriented resources with grants and scholarships.
Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education

Table 10.9: Distribution of spending with public spending (federal, state, local) per student for higher education

| | 1970 cohort - Public (federal, state, local governments) per student expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$86,771		$86,771
Top 0.1%	1.23%	$514,555	1.36%	$557,359
Top 0.5%	3.01%	$296,809	3.20%	$323,837
Top 1%	4.55%	$242,856	4.86%	$268,373
Top 10%	21.2%	$126,199	22.7%	$135,656
Bottom 50%	35.1%	$75,130	34.1%	$75,045
Bottom 10%	5.00%	$50,350	3.88%	$41,675

| | 1998 cohort -Public (federal, state, local) per student expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$171,401		$171,401
Top 0.1%	2.94%	$1,780,682	3.72%	$2,024,361
Top 0.5%	5.63%	$775,680	6.48%	$784,720
Top 1%	7.51%	$564,871	8.37%	$586,561
Top 10%	26.7%	$269,397	28.5%	$295,711
Bottom 50%	31.1%	$131,411	29.2%	$117,349
Bottom 10%	4.79%	$95,063	4.27%	$98,070

| | 2005 cohort -Public (federal, state, local) per student expenditure | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$167,411		$167,411
Top 0.1%	1.18%	$1,269,150	1.36%	$1,423,675
Top 0.5%	3.26%	$631,121	3.50%	$659,882
Top 1%	5.01%	$538,227	5.30%	$558,101
Top 10%	24.0%	$266,609	25.5%	$291,045
Bottom 50%	33.2%	$130,465	31.8%	$125,050
Bottom 10%	5.41%	$101,248	5.02%	$101,878

Reading: Among those that entered first grade in 2005, the bottom 50 percent of public spending had public spending between $125,050 (hypothesis 2) and $130,465 (hypothesis 1). They had between 31.8% and 33.2% of the overall spending.

Sample: 1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 1998-2005 School Districts and 2005 colleges for the 1998 cohort, 2005-2017 School Districts and 2017 colleges for the 2005 cohort

N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are public expenditure [a] only.

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education

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[a]To compute public expenditure I compute the share of federal revenue (federal appropriations and federal unrestricted and restricted grants), state revenue (state appropriations and state unrestricted and restricted grants) and local revenue (local appropriations and local unrestricted and restricted grants) and divide it by fall enrollment to have per student expenditure.

Table 10.10: Distribution of spending with averate tuition revenue per student for higher education

| | 1970 cohort - Average tuition revenue | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$81,593		$81,593
Top 0.1%	0.73%	$307,772	0.87%	$322,114
Top 0.5%	1.97%	$221,545	2.19%	$241,627
Top 1%	3.24%	$194,040	3.58%	$214,584
Top 10%	18.4%	$112,423	19.6%	$116,218
Bottom 50%	37.8%	$75,049	36.8%	$75,045
Bottom 10%	5.77%	$52,238	4.63%	$46,306

| | 1998 cohort - Average tuition revenue | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$140,645		$140,645
Top 0.1%	0.60%	$672,653	0.67%	$771,730
Top 0.5%	1.97%	$415,743	2.09%	$432,431
Top 1%	3.36%	$370,447	3.55%	$389,381
Top 10%	20.1%	$208,555	21.4%	$224,916
Bottom 50%	36.7%	$120,400	35.8%	$115,944
Bottom 10%	6.06%	$95,296	5.43%	$98,070

| | 2005 cohort - Average tuition revenue | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$156,673		$156,673
Top 0.1%	0.66%	$775,184	0.73%	$793,700
Top 0.5%	2.09%	$490,648	2.23%	$518,930
Top 1%	3.56%	$437,035	3.77%	$450,280
Top 10%	21.4%	$248,197	22.8%	$260,027
Bottom 50%	35.0%	$131,681	33.9%	$123,158
Bottom 10%	5.78%	$100,872	5.36%	$101,878

Reading: Among those that entered first grade in 2005, the bottom 50 percent of tuition revenue had tuition revenue between $123,158 (hypothesis 2) and $131,681 (hypothesis 1). They had between 33.9% and 35.0% of the overall spending.

Sample: 1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 1998-2005 School Districts and 2005 colleges for the 1998 cohort, 2005-2017 School Districts and 2017 colleges for the 2005 cohort

N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education tuition revenue divided by fall enrollment only.

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education

10.5 Hypothetical Distribution of spending with Average Total Expenditure for Higher Education

Table 10.11: Hypothetical distribution of spending with average total expenditure for higher education

	1970 cohort - 2005 Educational Attainment			
	Hypothesis 1		Hypothesis 2	
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$115,885		$115,885
Top 0.1 %	0.86%	$1,046,024	1.36%	$819,477
Top 0.5 %	3.17%	$466,191	3.54%	$475,597
Top 1 %	5.14%	$378,585	5.54%	$390,338
Top 10 %	24.2%	$177,818	25.3%	$185,876
Bottom 50 %	30.9%	$84,975	29.0%	$81,042
Bottom 10 %	4.73%	$56,523	4.16%	$55,567
	2005 cohort - 1970 Educational Attainment			
	Hypothesis 1		Hypothesis 2	
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$177,798		$177,798
Top 0.1 %	1.43%	$1,405,440	1.65%	$1,610,716
Top 0.5 %	4.09%	$863,249	4.47%	$917,750
Top 1 %	6.35%	$657,791	6.81%	$672,706
Top 10 %	25.8%	$254,392	28.5%	$285,861
Bottom 50 %	32.8%	$125,891	31.2%	$121,388
Bottom 10 %	5.21%	$97,641	4.31%	$84,899

Reading: If those that entered first grade in 2005 had the educational attainment of 1970, the bottom 50 percent of individuals would have average total expenditure between $121,388 (hypothesis 1) and $125,891(hypothesis 2). They would have between 31.2% and 32.8% of the overall spending.

Sample: 1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 2005-2017 School Districts and 2017 colleges for the 2005 cohort

N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are total expenditure (also include research expenditure).

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education

Table 10.12: Hypothetical distribution of spending with average total expenditure for higher education

| | 1970 cohort - Everyone Bachelor | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$139,818		$139,818
Top 0.1 %	1.59%	$1,274,955	1.59%	$1,274,955
Top 0.5 %	4.12%	$664,618	4.12%	$664,618
Top 1 %	6.16%	$501,194	6.16%	$501,194
Top 10 %	24.6%	$213,125	24.6%	$213,125
Bottom 50 %	31.3%	$118,228	31.3%	$118,228
Bottom 10 %	4.48%	$70,861	4.48%	$70,861
	2005 cohort - Everyone Bachelor			
	Hypothesis 1		Hypothesis 2	
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$250,298		$250,298
Top 0.1 %	2.28%	$3,593,451	2.28%	$3,593,451
Top 0.5 %	5.37%	$1,632,001	5.37%	$1,632,001
Top 1 %	8.05%	$1,100,904	8.05%	$1,100,904
Top 10 %	30.3%	$408,122	30.3%	$408,122
Bottom 50 %	29.1%	$182,887	29.1%	$182,887
Bottom 10 %	4.63%	$128,208	4.63%	$128,208

Reading: If those that entered first grade in 2005 would all go until bachelor studies, the bottom 50 percent of individuals would have $182,887 in spending. They would have 29.1% of the overall spending.

Sample: 1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 2005-2017 School Districts and 2017 colleges for the 2005 cohort

N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are total expenditure (also include research expenditure).

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education

Table 10.13: Hypothetical distribution of spending with average total expenditure for higher education

| | 1970 cohort - Everyone mean spending | | | |
| | Hypothesis 1 | | Hypothesis 2 | |
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$201,349		$201,349
Top 0.1 %	0.13%	$276,403	0.14%	$276,403
Top 0.5 %	0.68%	$274,762	0.69%	$274,762
Top 1 %	1.36%	$273,968	1.36%	$273,968
Top 10 %	13.0%	$242,424	13.0%	$242,424
Bottom 50 %	42.2%	$185,329	42.1%	$200,073
Bottom 10 %	7.12%	$169,272	6.59%	$147,440
	2005 cohort - Everyone mean spending			
	Hypothesis 1		Hypothesis 2	
	Percentage of the overall spending	Amount (in 2017 dollars)	Percentage of the overall spending	Amount (in 2017 dollars)
Mean spending		$186,913		$186,913
Top 0.1 %	0.18%	$335,907	0.18%	$335,907
Top 0.5 %	0.88%	$323,972	0.88%	$323,972
Top 1 %	1.74%	$321,802	1.74%	$321,802
Top 10 %	15.7%	$265,385	15.7%	$265,385
Bottom 50 %	41.0%	$155,806	40.7%	$155,806
Bottom 10 %	7.70%	$105,806	7.39%	$105,806

Reading: If those that entered first grade in 2005 would all have the same spending, the bottom 50 percent of individuals would have $155,806 in spending. They would have 40.7% of the overall spending.
Sample:1970- 1981 School Districts and 1980 colleges for the 1970 cohort; 2005-2017 School Districts and 2017 colleges for the 2005 cohort
N.B.: Expenditure for K-12 education are total educational expenditure whereas expenditure for higher education are total expenditure (also include research expenditure)

Sources: Annual Survey of State and Local Government Finances for K-12 education and IPEDS for Higher Education

11 Appendix B: Robustness check: Constant Coverage of Institutions

11.1 K-12 Education

To study if the stability of inequality would have been the same with a constant sample of district, I compute longitudinal analysis (for the 1970-1982 and 1998-2009 cohorts) based on a constant sample of districts. For the 1970-1982 cohort, among the 15,688 districts that existed at some point in the data, 3,633 report positive enrollment and spending data from 1970-1982. For the 1998-2009 cohort, among the 15,981 districts that existed at some point in the data, 13,814 report positive enrollment and spending data from 1998-2009. With a constant coverage of districts, results are very similar to the one with all districts present in the database. Results for the 1970's cohort are slightly more equally distributed but I am only able to include a few districts over the entire periods.

Table 11.1: Distribution of per pupil spending for 12 years of elementary or secondary Education in the 1970's and in the 1990's-2000's with a constant coverage of Districts

	1970-1981		1998-2009	
	Percentage of the Overall spending	Amount (in 2017 dollar)	Percentage of the Overall spending	Amount (in 2017 dollar)
Mean spending		$78,093		$126,486
Top 0.1%	0.35%	$193,513	0.57%	$571,470
Top 0.5%	1.28%	$161,559	1.52%	$276,027
Top 1%	2.25%	$147,523	2.59%	$248,907
Top 10%	15.4%	$100,966	16.7%	$173,421
Bottom 50%	42.1%	$75,051	41.0%	$114,977
Bottom 10%	6.55%	$56,237	7.15%	$98,073

Reading: In the 1970's, the top 10% of students for whom the most is spent have spending above $100,966 (in 2017 dollars), they have 15.4% of the overall spending.
Sample: 1970-1981 School Districts and 1998-2009 School districts with a constant coverage of districts (3,633 in the 1970's and 15,981 in the 1990's-2000's)
Sources: Historical Finances of Individual Governments (IndFin) for 1967-1985 and Public Elementary-Secondary Education Finance Data for 1990-2016, US Census Bureau

11.2 Higher Education

To study if the increase in inequalities in spending observed at the higher education level is linked to the arrival of new institutions (particularly of private for-profit instituions (Figure 3.4)), I compute the evolution of the distribution of spending (to compare them to Table 5.1 and Table 5.2) based on a constant coverage of institutions. I am left with a sample of 2,478 institutions for the 40 years instead of the 7,121 that existed at some point in the period.

Both for the cross-sectional analysis and the longitudinal analysis, order of magnitude in terms of the concentration of instructional spending are of the same order of magnitude as the one with all institutions presents in the data with in 2017, slightly more than 1% of the spending for the top 0.1% of students, 10% for the top 1%, 35% for the top 10%, 20% for the bottom 50% of students and 2% for the bottom 10% of students for whom the least is spent in instructional spending for higher education.

In real terms, increase in instructional spending are higher with a constant coverage of institutions than for the sample of all institutions. For the cross-sectional analysis, the top 1% of student has known an increase of 275% with a constant coverage of institutions and of 175% with all institutions between 1980 and 2017; the bottom 50% has known an increase of 62% with a constant coverage of institutions and of 49% with all institutions. This means than new institutions arriving in the data and institutions that are only present at some point of the period tends to have lower spending than the one existing all over the period and to mitigate the increase in spending observed over the period. The increase in inequalities observed at the higher education level is thus not linked to the arrival of new institutions like for-profit institutions for instance.

12 Appendix C: Robustness check: Distribution of Educational Expenditure with Trimmed Database

12.1 K-12 Education

To see if the distribution of spending doesn't rely on outliers, especially at the top, I trim outlier values (above $100,000 per pupil per year in 1970 and I then multiply the higher value by the average increase in per pupil spending). As I want to focus on the top of the distribution (top 1%, top 0,5%, top 0,1%), it would not make sense to trim all the value above the 99th percentile of spending for instance.

This doesn't change the distribution a lot. The level of concentration is slightly lower in the 1970's and in the 1980's than in the main specification (due to the nature of the data used, there are more outliers in the 1970's-1980's than in the most recent period), but order of magnitude stay the same.

12.2 Higher Education

To study if the analysis is robust to outliers, I trim the database at five times the 99th percentile for instruction per student and average total expenditure. As I am interested in the concentration at the top, I do not want to trim at the 99th percentile as the 1% represents more than 10% of the spending in 2017.

Trimming the database, the concentration at the top (particularly top 0.1 and top 0.5 % of students) is mechanically smaller but results stay of the same order of magnitude with around 10% at the end of the period for the top 1% of students, 35% for the top 10, 20% for the bottom 50 and a little bit more than 2% for the bottom 10%. Results for the evolution of spending, with the top getting more increase than the bottom, are very similar, and even higher at the top.

Table 12.1: Evolution of cost and distribution of instructional expenditure per student from 1980 to 2017 in constant 2017 dollars with a constant coverage of institutions

	1980	1985	1990	1995	2000
Total number of students in the data	10,839,427	10,925,843	12,290,499	12,521,548	13,165,966
Total number of institutions in the data	2,478	2,478	2,478	2,478	2,478
Mean of per student spending	$4,938	$5,594	$7,869	$6,547	$7,355
Top 0.1% of students	$59,980	$76,390	$104,422	$75,313	$98,776
Percentage of the overall spending	1.35%	1.73%	1.99%	2.02%	1.83%
Top 0.5% of students	$27,790	$32,516	$57,740	$49,348	$52,675
Percentage of the overall spending	4.54%	4.45%	5.84%	5.84%	5.59%
Top 1% of students	$19,392	$22,323	$42,410	$33,275	$39,711
Percentage of the overall spending	6.949%	6.820%	8.199%	7.789%	8.630%
Top 10% of students	$8,208	$9,293	$13,582	$11,397	$12,962
Percentage of the overall spending	27.87%	28.79%	32.27%	32.06%	33.52%
Bottom 50% of students	$4,044	$4,489	$5,897	$4,937	$5,332
Percentage of the overall spending	26.01%	25.63%	24.40%	24.00%	22.88%
Bottom 10% of students	$1,765	$1,950	$2,623	$2,167	$2,315
Percentage of the overall spending	3.06%	2.90%	2.86%	2.89%	2.70%

	2005	2010	2015	2017	Evolution
Total number of students	14,624,836	16,715,148	16,436,194	16,427,054	+51.55%
Total number of institutions in the data	2,478	2,478	2,478	2,478	+0%
Mean of per student spending	$7,792	$8,513	$9,680	$9,868	+ 95.79%
Top 0.1% of students	$91,595	$108,654	$135,969	$130,375	+ 117.36%
Percentage of the overall spending	1.71%	1.18%	0.95%	1.24%	
Top 0.5% of students	$61,907	$71,174	$81,734	$85,767	+ 208.63%
Percentage of the overall spending	5.72%	5.51%	6.67%	5.44%	
Top 1% of students	$56,185	$58,225	$69,368	$72,582	+ 275.32%
Percentage of the overall spending	9.16%	9.43%	9.72%	10.10%	
Top 10% of students	$13,226	$15,395	$16,447	$17,406	+ 112.06%
Percentage of the overall spending	35.63%	34.97%	35.45%	35.68%	
Bottom 50% of students	$5,411	$6,049	$6,594	$6,532	+61.52%
Percentage of the overall spending	21.95%	21.51%	21.65%	21.11%	
Bottom 10% of students	$2,450	$2,584	$2,961	$2,874	+ 62.83%
Percentage of the overall spending	2.75%	2.55%	2.53%	2.38%	

Reading: With a constant coverage of institutions, in 2017, the top 10% of student for whom the most is spent have spending above $17,406, they have 35.68% of the overall spending.

Sample: 1980's - 2010's colleges and universities - constant sample of 3,480 institutions

Sources: IPEDS, Finance and Enrollment data

Table 12.2: Evolution of Cost and Distribution of per pupil Expenditure from 1967 to 2016 in constant 2017 dollars (cross-sectional analysis) with outliers trimmed

	1967	1970	1975	1980	1985	1990
Mean of per student spending	$4,814	$5,673	$6,182	$6,780	$7,480	$8,492
Top 0.1 % of students	$18,453	$21,577	$19,043	$18,788	$20,715	$25,652
Percentage of the overall spending	0.47%	0.47%	0.44%	0.43%	0.37%	0.40%
Top 0.5 % of students	$12,144	$15,975	$15,531	$14,612	$16,800	$20,135
Percentage of the overall spending	1.62%	1.72%	1.5%	1.38%	1.33%	1.42%
Top 1 % of students	$10327	$13,842	$12,984	$13,103	$15,187	$18,081
Percentage of the overall spending	2.75%	3.04%	2.65%	2.39%	2.42%	2.53%
Top 10 % of students	$6,584	$7,954	$8,418	$8,913	$9,971	$12,165
Percentage of the overall spending	16.8%	18%	16.8%	15.8%	16.1%	16.6%
Bottom 50 % of students	$4,540	$5,367	$5,864	$6,556	$7,187	$7,926
Percentage of the overall spending	38.9%	37.2%	38.6%	40.0%	39.7%	39.0%
Bottom 10 % of students	$3,242	$3,586	$4,249	$4,744	$5,217	$5,794
Percentage of the overall spending	5.88%	5.48%	6.05%	6.21%	5.78%	6.19%

	1995	2000	2005	2010	2016
Mean of per student spending	$8,761	$9,723	$10,863	$11,635	$11828
Top 0.1 % of students	$24,641	$45,439	$48,908	$44,358	$38,616
Percentage of the overall spending	0.33%	0.58%	0.65%	0.58%	0.53%
Top 0.5 % of students	$19,815	$20,650	$24,982	$26,713	$27,976
Percentage of the overall spending	1.33%	1.62%	1.67%	1.65%	1.60%
Top 1 % of students	$17,950	$18,773	$21,942	$24,225	$25,547
Percentage of the overall spending	2.40%	2.63%	2.75%	2.71%	2.73%
Top 10 % of students	$12,307	$13,043	$14,968	$16,426	$17,196
Percentage of the overall spending	15.4%	16.2%	17.1%	18%	18.7%
Bottom 50 % of students	$8,108	$8,964	$9,819	$10,326	$10,481
Percentage of the overall spending	40.0%	41.3%	40.4%	39.5%	38.3%
Bottom 10 % of students	$6,435	$7,561	$8,243	$8,613	$8,488
Percentage of the overall spending	6.86%	7.17%	7.01%	6.82%	6.48%

Reading: In 2016, the top 10% of student for whom the most is spent have spending above $17,196 per year, they have 18.7% of the overall spending.

Sample: 1967-2016 school districts

Sources: Historical Finances of Individual Governments (IndFin) for 1967-1985 and Public Elementary-Secondary Education Finance Data for 1990-2016, US Census Bureau

Table 12.3: Evolution of cost and distribution of instruction per student from 1980 to 2017 in constant 2017 dollars with trimmed database at 5*p99.

	1980	1985	1990	1995	2000
Mean of per student spending	$4,787	$5,387	$7,552	$6,284	$7,128
Top 0.1 % of students	$50,742	$58,786	$95,350	$70,156	$98,776
Percentage of the overall spending	1.269%	1.269%	1.350%	1.299%	2.069%
Top 0.5 % of students	$27,790	$32,314	$57,740	$49,348	$52,675
Percentage of the overall spending	3.829%	4%	4.550%	4.829%	5.869%
Top 1 % of students	$19,392	$22,113	$38,212	$31,774	$37,711
Percentage of the overall spending	6.190%	6.340%	8.140%	7.829%	9.15%
Top 10 % of students	$8,213	$9,150	$12,943	$11,249	$12,604
Percentage of the overall spending	27.79%	28.79%	31.69%	31.79%	34.04%
Bottom 50 % of students	$3,932	$4,333	$5,716	$4,776	$5,108
Percentage of the overall spending	25.70%	25.25%	24.29%	23.82%	22.69%
Bottom 10 % of students	$1,716	$1,902	$2,516	$2,107	$2,287
Percentage of the overall spending	3%	2.910%	2.769%	2.900%	2.670%

	2005	2010	2015	2017	Evolution
Mean of per student spending	$7,259	$7,661	$8,681	$8,868	+ 85.2%
Top 0.1 % of students	$91,595	$108,654	$128,743	$127,760	+ 151%
Percentage of the overall spending	1.769%	.6700%	1.320%	1.509%	
Top 0.5 % of students	$61,907	$69,909	$81,734	$83,432	+ 200%
Percentage of the overall spending	5.789%	5.429%	5.769%	6.070%	
Top 1 % of students	$51,760	$44,718	$53,084	$53,346	+ 175%
Percentage of the overall spending	9.609%	9.579%	10.14%	10.02%	
Top 10 % of students	$12,542	$14,315	$15,723	$16,172	+ 96.9%
Percentage of the overall spending	36.20%	35.56%	35.77%	35.88%	
Bottom 50 % of students	$4,983	$5,230	$5,935	$5,882	+ 49.5%
Percentage of the overall spending	21.18%	20.61%	20.82%	20.51%	
Bottom 10 % of students	$2,271	$2,369	$2,571	$2,561	+ 49.2%
Percentage of the overall spending	2.490%	2.309%	2.240%	2.160%	

Reading: In 2017, the top 10% of student for whom the most is spent have average total spending above $16,172, they have 35.88% of the overall spending.

Sample: 1980's - 2010's colleges and universities

Sources: IPEDS (Integrated Postsecondary Education Data System), Finance and Enrollment Data