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ABSTRACT

In recent decades, educated workers have become increasingly concentrated in order to benefit from job market, peer effects, and social spillovers. Differences in education attainment across communities can result in socioeconomic segregation. I apply the Benabou location choice framework to national data and view it in the context of school finance policies. I find that 1) at the state level, there is no relationship between school revenue redistribution and spending equity, 2) neither school revenue redistribution nor spending have a relationship with segregation, and 3) achievement equity has a weak relationship with segregation.

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Introduction

Between 1990 and 2000, the percentage of workers with at least a bachelor's degree in the US increased from 26% to 34% (Census). The majority of this increase took place in metropolitan areas, where there was a .52 correlation between the initial share of workers with a college degree and the growth in the share of workers with a college degree (Glaeser 2005). Labor demand theory explains this as the desire for workers to move to areas that better support their scarce qualifications. Cities, with larger populations, more high-skill job opportunities, and higher wage premia than suburban and rural areas, are thus more attractive to educated workers. Literature also explains this trend as the desire for skilled workers to work among other skilled workers for positive peer effects on productivity and innovation.

The concentration of human capital has both positive and negative effects. A notable negative effect is inequality. As areas with a high share of educated workers become wealthier, other areas may become worse off. Inequality caused by human capital concentration is especially evident among public school districts, where expenditures per student can vary by over a factor of two between neighboring communities. In the US, school funding is provided primarily through local property taxes, meaning the concentration of educated workers improves the quality of public education through taxes and peer effects. This creates disparities between school districts with different shares of educated workers. When the children in disparate school districts receive an education and become adults, the next generation's educational attainment and incomes are shaped.

Therefore, the location choices of educated workers are important because if such choices segregate educated workers from non-educated workers, even greater disparities can be created. The goal of this paper is to determine some of the causes of socioeconomic segregation within the scope of human capital accumulation and school finance policies.

In Chapter 1, I review the literature and introduce the framework, a combination heavily based on Benabou's Human Capital Investment model (1996) and Tiebout's Local Expenditures model (1956). Using these models, I simplify location choices using a framework where the first location choice a household makes is between metropolitan areas and the second choice is between school districts.

In Chapter 2, I apply this framework to national data and analyze the effects of various inputs on location choices. The objective of this section is to determine if communities in real life behave the same way as communities in the Benabou model. Using national data, I collect proxies for variables in the Benabou model and compare their correlations in metropolitan areas that differ in education attainment.

In Chapter 3, I introduce school finance into the location choice framework. I overview school finance policies in the US and adjust the framework to reflect education finance reforms. I then collect data on funding redistribution, spending equity, and income dispersion for metropolitan areas and US states. My objective is to determine the relationship between school finance policies and community formation.

In Chapter 4, I conclude my paper. I confirm my results using a regression. I interpret my results using the framework and evaluate the framework using the data. I consider implications of my results, discuss possible error, and propose areas of further research.

Chapter 1

Literature Review

Literature on education economics generally supports a positive relationship between education attainment and future income. Barro's *International Data on Educational Attainment and Implications* (2000) reveals a strong correlation between education and future income in an international dataset. For this purposes of this paper, education attainment and future income are assumed to be increasing with each other.

Literature also supports the existence of positive peer effects stemming from an educated population. Glaeser's *Divergence of Human Capital* (2005) presents a theory of education peer effects where the number of entrepreneurs in an area is a function of the number of skilled workers. Glaeser concludes that the concentration of skilled people in metropolitan areas is driven by "the tendency of skilled entrepreneurs to innovate in ways that employ other skilled people". The result is an economy where educated workers are attracted to each other and form concentrated areas of high human capital. Glaeser's peer effect assumption, along with Barro's education-income relationship, are the two assumptions underlying this paper.

1.1 Framework

Tiebout's Local Expenditures model (1956) is a location choice framework where communities within a region each offer a basket of public goods at various prices, or taxes. Because individuals have different preferences for these goods and varying abilities to pay for them, individuals will move from one community to another, or "foot-vote", until they

maximize their personal utility. Through individual location choices, an equilibrium will be reached and the population will be sorted into optimal communities. The primary assumptions of the Tiebout model are that public goods do not spill over between communities, individuals are free to choose their communities at no movement cost, and individuals have perfect information about the goods and taxes offered by local governments.

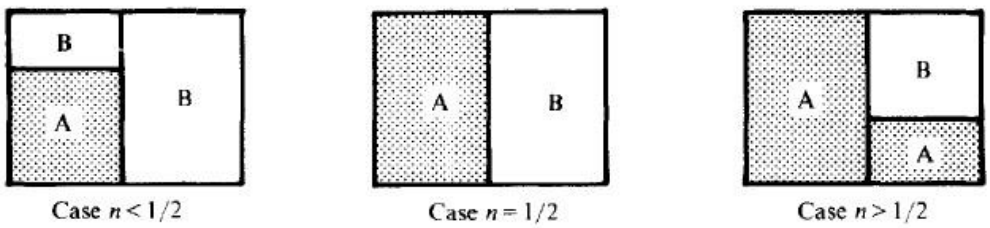
Benabou's Human Capital Investment model (1996) expands on Tiebout's framework by adding human capital as an input of community formation. In the Benabou model, there are two types of households, type A and type B, with human capital and income endowments $h_A > h_B$. These can be viewed as households with high income and high education attainment and households with low income and low education attainment. The number of type A households is n, the number of type B households ($1-n$), and the proportion of type A adults in a community, or island, x. There are two islands that households can choose to live in, island 1 and island 2. Each island is identical ex-ante and has the same number of housing units (½), size, and property values.

There are two periods in the model. In the first period, households makes a simultaneous decision on which island to locate. After choosing an island, households consume and pay rent and taxes using their initial resources, with debt being allowed. In the second period, the resources available for consumption equal a household's current income after debt repayments, and their child's human capital is determined by the parent's human capital, the quality of social interactions in the chosen community, and the resources dedicated to the child's schools. The parents goal is to maximize utility as a function of their two-period consumption and their child's human capital. Therefore, the location choice a

household makes is based on the trade-off between the cost of living in a high human capital community and the benefits to their children's education.

The segregation of type A and type B households occurs whenever type A households are willing to pay more than type B households to live in a high human capital community. This is true whenever the number of type A households in a community exceeds the number of type B households ($x_1 > x_x$), making the community more desirable to all households and creating a rent premium. Because rich households are more willing and capable of trading a higher rent for a higher *x*, they will outbid poor households. This further raises x in the community, increases rent, and displaces the poor to the other community, where the opposite effect is taking place. Stratification occurs until one community is completely homogeneous. Only three types of community formations are possible. 1) When the proportion of type A households is less than ½, one community is comprised of all type B households and the other community a mix of Type A and Type B households 2) When the proportion of type A households is equal to ½, communities are completely segregated. 3) When the proportion of type A households is greater than ½, one community is comprised of all type A households and the other community is a mix. These formations are illustrated below.

Figure 1: Possible Community Formations in the Benabou Model



Because segregation occurs whenever type A households are more sensitive to community quality than type B households, any equilibrium typically involves some level of segregation. In this situation, the rich tend to over-consume "exclusive" public goods, or high quality education, and equity is only achievable through "citywide coordination" (Becker 1994), or school finance. Benabou concludes that minor differences in preferences, wealth, and school financing can all lead to a high degree of socioeconomic segregation.

In order to view Benabou's framework in a way that fits reality, households initially make a location choice between metropolitan areas. This is taken as given. Households then make a second location choice between school districts. This is where the Benabou model exists. This two-choice process can be viewed as households moving to a metropolitan area for its job opportunities, but being willing to move to any neighborhood within the area and commute to their job. Additionally, inputs on a child's human capital will be simplified into two variables, social spillovers and school funding. Social spillover include peer effects from the child's parents, role models or professional networks, and negative effects such as crime, welfare dependency, and unemployment. Because social spillovers represent the overall effects of living in a high human capital community, social spillovers and school funding are both increasing with the human capital of a community.

Chapter 2

Data

Using data from the 2010 American Community Survey, Global Report Card, and National Center for Education, variables in the Benabou model were obtained. These include educational attainment, per capita income, expenditures per student, housing value, math and reading test scores, and crime index for US school districts. The key variable is education attainment, which is equivalent to *x* in the Benabou model. Education attainment is defined as the percentage of workers over age 25 with a bachelor's degree or higher. The size of each community is the total number of housing units. Rent is the median housing value. The quality of education is the standardized high school math and reading test scores of the school district compared to the national average, where a rating of 100 means 100% of students performed above the national average. School budget is measured through expenditures per student. The social spillovers of a community are represented by education attainment and the crime rate, which is also indexed to a national level of 100.

I expect education attainment to have a strong positive correlation with income per capita, expenditures per student, housing value, and test scores. I expect education attainment to have a strong negative correlation with crime. A positive correlation would suggest that the variable either motivates or responds to the location choices of households. This is because a positive correlation indicates a positive relationship between the variable and the share of type A households in the school district. Zero correlation would suggest that the variable has a negligible relationship, and a negative correlation would suggest that the

variable has a negative relationship with household location choices. Causation is not implied by any result.

2.1: Silicon Valley vs. Detroit

I first collect school district data for Silicon Valley and Detroit to see how variables in the Benabou model differ in a high education attainment area versus a low education attainment area. Education attainment in Silicon Valley, represented by the San Jose-Sunnyvale-Santa Clara metropolitan area is 52.42 %. Education attainment in Detroit, represented by the Detroit-Warren-Livonia metropolitan area, is 34.41%. Silicon Valley and Detroit were chosen because they represent the extremes of education attainment, and because of their similarities in population and school funding. Their populations are both around 3.7 million. California derives 29.6% of its school funding from the local level, 57.4% from the state level, and 13.0% from the federal level. Michigan derives 32.8% from the local level, 55.7% from the state level, and 11.5% from the federal level (NCES 2013). These similarities allow for better comparison. Silicon Valley and Detroit data are shown below.

Table 1: Silicon Valley Data

San Jose-Sunnyvale-Santa Clara Metropolitan Area (Silicon Valley)

School District	Educational attainment	Per Capita Income	Expenditures per Student	Housing Units	Median House Value	Math/Reading	Crime Index
East Side	43.0	26,221	10,502	146,446	649,300	41	80
San Jose	47.4	35,542	10,671	88,080	737,400	43	88
Fremont	48.9	42,020	12,556	81,347	846,300	68	45
Campbell	55.8	36,278	13,577	85,553	755,300	51	81
Santa Clara	60.7	37,778	12,497	52,964	641,600	41.5	65
Los Gatos-Saratoga	66.1	56,094	14,796	20,350	950,000	75	46
Mountain View	69.8	56,065	16,418	42,417	988,100	63	32
Palo Alto	70.7	59,637	15,260	29,455	1,000,000	77.5	52
				546,612			
Corr. with Ed. Attainment		0.8075	0.8581		0.5583	0.4186	-0.462

Table 2: Detroit Data

Detroit Metropolitan Area

School District	Educational attainment	Per Capita Income	Expenditures per Student	Housing Units	Median House Value	Math/Reading	Crime Index
River Rouge	14.6	13,389	13,778	3,200	61,900	15.5	258
Warren	16.4	25,445	11,551	45,408	159,600	50.5	51
Van Dyke	16.9	16,004	11,938	7,982	87,000	34.5	121
East Detroit	20.6	20,091	10,422	14,911	102,100	40.5	83
Detroit City	20.8	15,063	13,064	271,063	80,400	22.5	355
Fitzgerald	21.6	18,090	12,130	6,738	93,300	39.5	94
Harper Woods	22.7	21,468	10,486	3,386	103,400	46.5	299
South Lake	27.5	27,640	11,904	9,253	133,800	55	56
Crestwood	28.9	23,499	9,024	10,883	150,400	50.5	95
Redford	31.1	24,026	13,539	9,514	112,000	30.5	25
South Redford	31.6	24,589	10,936	9,084	126,000	50	45
Dearborn	34.4	23,130	12,138	37,274	144,100	44.5	117
Hazel Park	38.1	18,758	11,343	8,704	96,100	39	125
Center Line	38.9	21,103	11,671	8,612	117,200	53.5	78
Livonia	42.0	30,176	11,074	44,940	176,400	58	15
Ferndale	46.4	30,482	11,974	11,627	142,300	36.5	99
Oak Park	46.6	22,443	13,459	8,886	129,300	26	142
Clarenceville	49.4	24,373	11,335	5,189	141,400	52.5	56
Southfield	52.1	29,736	14,919	31,477	164,400	43.5	127
Gross Pointe	57.1	46,740	12,580	19,607	258,600	70.5	43
Farmington	60.2	39,636	13,977	35,237	231,900	65	46
Royal Oak	63.4	36,959	14,082	28,645	176,300	61	48
Troy	66.1	41,844	12,836	23,988	254,100	75.5	58
Birmingham	69.8	62,345	16,141	22,630	361,200	77.5	51
				678,238			
Corr. with Ed. Attainment		0.6925	0.2777		0.6571	0.4849	0.208

At first glance, the communities in Silicon Valley and Detroit are far from homogenous. Each community is a mix of educated workers and uneducated workers; education attainment ranges from 43% to 71% in Silicon Valley and 15% to 70% in Detroit. This contrasts sharply with Benabou islands, which have a high degree of segregation. An explanation for this is that the perfect mobility assumption does not hold true in real life. Households may put a significant value on living within close proximity to their workplace. If this value is high enough, a household may choose to live in a lower human capital community if the costs of commuting to work are too high. Silicon Valley and Detroit deviate less than two minutes from the average commute time in the US, 25.4 minutes (Census 2010). Both metropolitan areas span distances requiring commute times above the national average, and the probability that many households take long commutes between school districts is low. Rather, most commutes in these two metropolitan areas likely do not

span more than a few school districts. An alternative explanation is that low skill jobs, especially in the service industry, exist in communities regardless of their education attainment. The existence of these jobs means the share of educated households in high human capital communities will reach a limit below one. Moreover, where there are only two communities in the Benabou model, there are eight in Silicon Valley and twenty-four in Detroit. These differences are likely due to the diseconomies of scale of having large school districts in a physically large and populated area. Regardless, there are noticeable differences between the model and reality, and this poses some analysis problems.

Even though Silicon Valley and Detroit are not identical to Benabou islands, they do share some similarities. First, it is possible to identify high human capital and low human capital communities. Because the range of education attainment is high in both cities, most communities fit into one category or the other, which is akin to type A and type B communities. Silicon Valley and Detroit are two areas that are clearly under some forces of segregation. They might have a large number of school districts, but each school district has a unique composition of educated and uneducated households that equate to different levels of segregation in the three possible Benabou equilibriums. These metropolitan areas can be viewed as an expanded version of Benabou's two community model where each community represents a different degree of human capital attainment.

Correlations between education attainment and each variable are shown at the bottom of Tables 1 and 2. In Silicon Valley, there was a correlation of .8 between education attainment and per capita income, which supports the positive education-income relationship. There was a correlation of .85 between education attainment and expenditures per student, which suggests the existence of local funding in Silicon Valley. Education

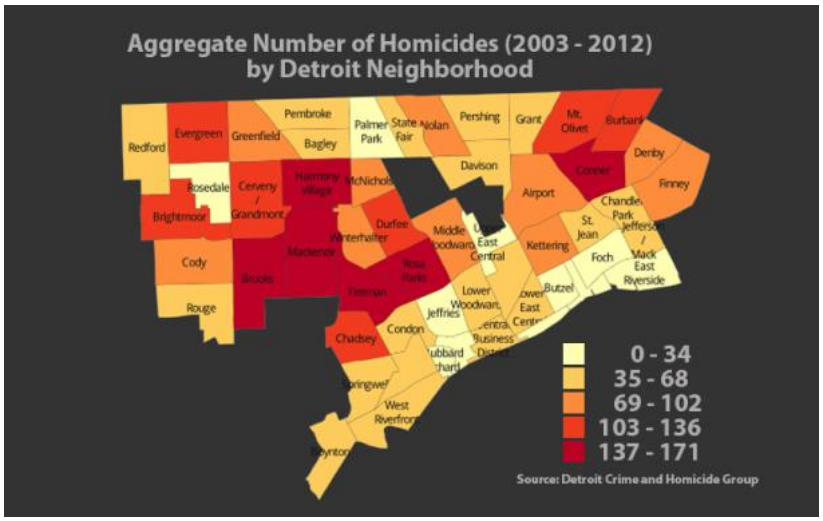
attainment had a .55 correlation with housing value at and a .41 correlation with math/reading scores. There was a negative .46 correlation between education attainment and crime. The signs of these correlations were all expected, but the magnitude of housing value and math/reading correlations weaker than predicted. In Detroit, education attainment had a correlation of .69 with per capita income, .65 with housing value, .48 with math/reading scores, .27 with per student expenditures, and .21 with crime. The math/reading and student expenditure correlations were lower than expected in magnitude. The crime correlation was low in magnitude and opposite of its expected sign.

The low correlation between education attainment and student expenditures in Detroit is likely a result of school finance laws. In Michigan, school funding is centralized, meaning the state has control over revenue distribution. In 1994, Michigan abolished the use of local property taxes in school funding (Lockwood, 2012). This reform led to a shift from property taxes to sales taxes as the primary source of education revenue. The goal of this reform was to "increase school equity and lower net taxes" (Courant, 1997). In this system, the state provides an operating grant that emphasizes equity to each school district. As a result, it is understandable why per capita income has a low effect on expenditures per student. The tax sources of school funding in Michigan and California also help tell the story. In Michigan, 43.0% of school funding in 2012 comes from sales taxes, 16.3% from income taxes, and 13.9% from property taxes (Michigan 2013). In California, 53.0% of school funding comes from income taxes and 30% from sales taxes (California 2012). Income taxes comprise 36.7% more of school funding in California than in Michigan. Because income taxes are directly dependent on the per capita income of residents while

other tax types are not, this explains the disparities in the expenditures per student and education attainment correlations between the two states.

The positive correlation between education attainment and crime is not so easily explainable. The majority of crimes occur in the city of Detroit, the most impoverished part of the metropolitan area (Detroit 2013). A map of aggregate homicides between 2003 and 2012 is shown below.

Figure 2: Homicide in City of Detroit (Detroit Crime and Homicide Group 2003-2012)



The business and financial districts, denoted by the Central Business District, holds the majority of high-skill jobs in Detroit. Even though homicide in this neighborhood is below average, the neighborhoods to the west and northeast of this zone are incredibly high in crime. It is conceivable that the rich, who prefer short commute times, live in proximity to the poor and share school districts, resulting in areas with high education attainment as well as high crime rates.

In both Silicon Valley and Detroit, math/reading scores had a less significant correlation with educational attainment even though expenditures per student was closely correlated with education attainment. This could be because expenditures per student and the human capital of parents do not reflect the ability of students, which may be the most important factor in academic success.

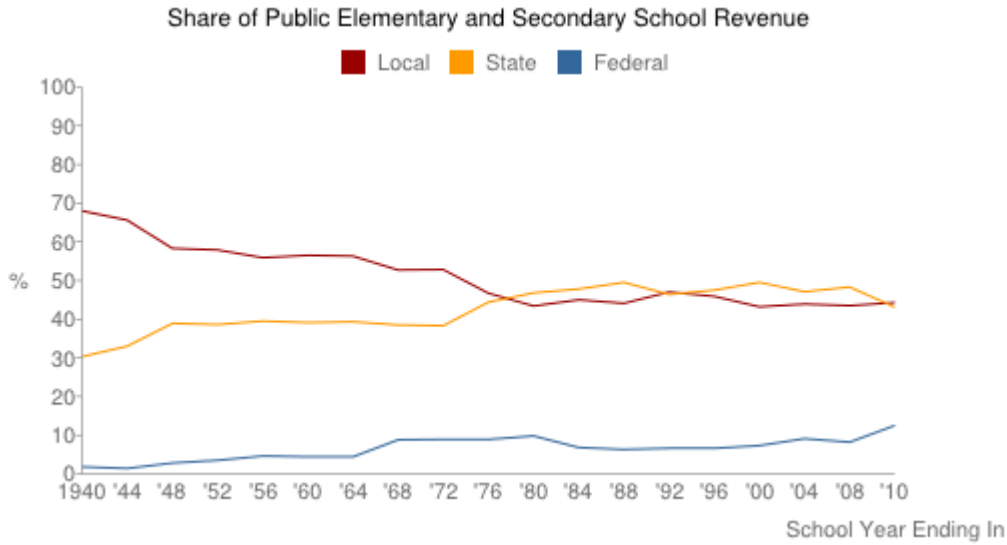
Although the Benabou model predicted the majority of correlations in Silicon Valley and Detroit, some variables had slight deviations, and it is clear that school finance plays a huge role in explaining these deviations.

Chapter 3

School Finance

Historically, the majority of US public school funding has come from the local level where it is primarily funded by property taxes. In the past century, the share of public school revenue from the local level has been decreasing while the shares from the state and federal levels have been increasing:

Figure 3: Sources of US Public School Revenue 1940 to 2010 (NCES)



Although the share of local school funding is decreasing, local taxes still comprise a significant portion, ½, of all school revenue. The effect of this is that wealth plays a large role in school spending in the US. Wealthier communities will collect more school funding while poorer communities collect less. The issue with this is a matter of equity. Children from low-income communities typically go to schools with less resources, less qualified

teachers, and below standard facilities. A high degree of local funding can not only lead to segregation but also cause low-income households to remain poor for multiple generations.

Disparities between school district spending has been argued as being inefficient because it is disadvantageous to poorer schools with inadequate resources, contradicts equal opportunity, and violates the Fourteenth Amendment's equal protection clause. School finance reforms in the past few decades, notably the No Child Left Behind Act, have taken measures to increase equity in school funding. The trend of local taxes comprising a lower share of school revenues while state and federal taxes comprise a higher share of school revenues reflects constitutional debates over equal opportunity and resulting reforms. The majority of reforms were at the state level in the form of redistributive policies, or the "recycling" of funds that occurs when local funding is distributed across school districts. The extent of recycling varies vastly between states and is an important issue because, as seen in Detroit and Silicon Valley, small differences in school funding policies can have large effects on expenditures per student and education quality.

I*ncome Distribution, Communities, and the Quality of Public Education* (Fernandez, Rogerson 1994) expands on the school finance portion of the Benabou model by assessing the impact of several reforms, notably the shift from a locally funded community to a community with redistributive policies, and the shift from a locally funded community into an equitably funded community. This model allows for local taxes to be decided through a majority vote where the median voter's preferences are enacted. The paper concludes that redistribution policies have the effect of lowering tax rates and increasing education quality in both communities while in equitable financed communities, households do not care where they live.

In Benabou islands, if recycled school funds are distributed to create equity, then as recycling increases, income will have less influence on expenditures per student and education quality. If communities are equitably funded, then social spillovers will be the only factor that attract households. If the utility households receive from social spillovers is less than the cost of living in a high human capital community, then communities will be perfectly integrated and have an equal share of type A and type B households. In real life, equitably funded communities should have zero correlation between education attainment and expenditures per student, while purely locally funded communities should have a correlation of one between education attainment and expenditures per student.

Outcomes will again be contrasted in Silicon Valley and Detroit after their school finance policies are overviewed. As mentioned before, the two areas are almost identical in their source of school funding by jurisdiction, but not by tax source:

Table 3: Source of School Financing in California & Michigan by Level (2013)

State	Local	State	Federal
California	29.6%	57.4%	13.0%
Michigan	32.8%	55.7%	11.5%

Source of School Financing in California & Michigan by Tax Type (2013)

State	Sales	Income	Property
California	30.0%	53.0%	N/A
Michigan	43.0%	16.3%	13.9%

Silicon Valley and Detroit have similar distributions of school funding by jurisdiction. This implies that they have similar redistribution policies. However, Detroit has a .28 correlation

between education attainment and expenditures per student while Silicon Valley has a .86 correlation. These correlations are identical when income is substituted for education attainment. These correlations suggest that Detroit has high school finance equity while Silicon Valley has low school finance equity, which goes contrary to their school funding sources in Table 3. On the other hand, Table 4 fits these correlations much better. California's high correlations between education attainment and expenditures per student make sense with its high use of income taxes. Hence it is possible that where school funding comes from is not as important as the proportion of sales, income, and property taxes that comprise it.

In Silicon Valley and Detroit, recycling is not a strong indicator of equitable redistribution. Whether or not recycling leads to equitable redistribution is important because school funding is a major factor in the Benabou model. The next section tests this relationship on additional areas.

3.2: Burlington vs. Springfield

If recycling equates to equitable redistribution, then I expect school districts in areas with high recycling to have more equitable spending than areas with low recycling. To address this hypothesis, two metropolitan areas, Burlington, Vermont, and Springfield, Illinois, will be tested prior to a broader analysis. Vermont has the lowest reliance on local funds among US states while Illinois has the highest. These areas represent the two extremes of reliance on local funding. Because state level funds are recycled and local funds are not, Burlington should represent a high recycling area while Springfield should represent a low recycling area. It is expected that Burlington will have more equitable spending than Springfield. This hypothesis will be tested through their correlations between per capita

income and expenditures per student. Burlington is expected to have an insignificant correlation and Springfield is expected to have a correlation close to one. The table below shows their funding sources by jurisdiction and tax source. Vermont operates on a variable tax system where taxpayers choose what tax source they want to use to fund their schools each year, so these percentages may be off. Nonetheless, Vermont and Illinois exhibit similar tax sources but contrasting jurisdiction sources:

Table 4: Source of School Financing in Vermont & Illinois by Jurisdiction (2013)

State	Local	State	Federal
Vermont	7.8%	85.7%	6.5%
Illinois	60.5%	27.6%	11.9%

Source of School Financing in Vermont & Illinois by Tax Type (2013)

State	Sales	Income	Property
Vermont	13.8%	27.7%	55.4%
Illinois	18.7%	25.2%	52.0%

Correlations were calculated in Burlington and Springfield.

Table 5: Burlington School District Data

Burlington Metropolitan Area

School District	Educational attainment	Weighted	Per Capita Income	Expenditures per Student	Housing Units	Median House Value	Math/ Reading	Crime Index
Milton	21.8	82229.6	26,029	14,880	3,772	237,200	53	46
Bellows Free	22.2	115262	25,076	15,860	5,192	210,500		20
Fairfax	28.6	43500.6	28,389	13,147	1,521	228,400	59	28
Essex Community	31.9	237878	32,035	28,425	7,457	254,900		63
Colchester	40.2	249722	28,343	15,461	6,212	230,500	67	5
Burlington	41.3	695946	24,025	19,847	16,851	253,300	55.5	50
Mount Mansfield	46.8	274903	33,628	14,929	5,874	244,500	71	22
South Burlington	50.3	383990	34,293	19,109	7,634	252,800	77	110
Champlain Valley	58.4	555034	44,782	16,270	9,504	323,400		13
Mean		41.2151			64,017			
Corr. with Ed. Attainment			0.6019	0.0015		0.5978	0.6839	0.0082

Table 6: Springfield School District Data

Springfield Metropolitan Area

School District	Educational attainment	Per Capita Income	Expenditures per Student	Housing Units	Median House Value	Math/ Reading	Crime Index
Tri-City Communit	33.1	27,199	12,051	1,246	125,600	57	9
Auburn	33.7	22,830	9,170	2,648	107,200	58.5	18
Riverton	37.7	22,831	9,251	2,853	96,100	51.5	25
Pawnee	38.7	27,535	5,843	1,303	100,200	68.5	28
Williamsville	40.1	34,028	10,302	2,713	160,900	75	16
Athens	40.5	28,949	9,495	2,177	145,400	57	20
Pleasant Plains	42.6	35,194	9,848	2,987	185,100	71	22
Springfield	42.9	26,144	12,729	50,666	95,900	38	106
Ball-Chatham	47.6	35,335	10,402	10,030	170,900	74.5	47
Porta	48.8	25,811	10,499	2,778	111,300	60	10
Rochester	53.9	33,854	13,935	3,651	167,000	72.5	47
New Berlin	55.4	30,177	11,700	2,330	136,100	59.5	19
				85,382			
Corr. with Ed. Attainment		0.2364	0.2289		0.1485	0.0595	0.0406

Expenditures per student in Burlington school districts reveal that education spending is not as equitable as expected. School district expenditures range from $13,147 to $28,425 per student. Therefore, even though Vermont has high recycling, its school districts are not funded equitably. However, per capita income has a .0047 correlation with expenditures per student, indicating that high redistribution is taking place.

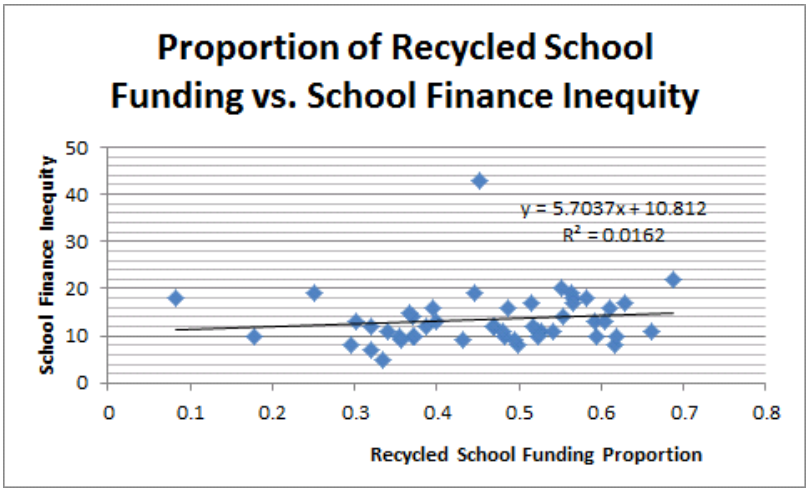
Vermont education finance laws show that although the state is responsible for 85.7% of school funding, each school district operates on independent budgets (Vermont 2013). This can be viewed as the state collecting local taxes but allowing each community to distribute them independently, leading to budgets that are similar to a locally funded system. Vermont also gives additional funding to school districts that underperform through non-property tax sources (Act 60). This explains the insignificant correlation between expenditures per student and education attainment, and expenditures per student and per capita income. Not surprisingly, two of Vermont's school funding goals are to "reduce the disparity in academic achievement among Vermont's school children" and "allow school district voters to choose to spend as much as they wish on their children's education" (Act 68). It is possible to assume that Vermont not only plays a limited role in funding redistribution, but attempts to equalize the results, not inputs, of its schools.

In Springfield, per capita income correlated with expenditures per student by .0638. Like Burlingtons, it is insignificant and indicates high redistribution. Burlington met its expectation of having a zero correlation, but Springfield did not meet its expectation of having a correlation of one. This provides evidence against the hypothesis and supports the idea that the percent of school revenue that comes from the local, state, and federal levels is not equivalent to the equity in which those funds are distributed.

Section 3.3: State Level

To test the hypothesis on a broader level, a dataset of all 50 states was created, excluding single-school district states such as the District of Columbia and Hawaii. In this dataset I compare each state's level of recycling with their school finance equity. Recycling will be represented by the ratio of state funding to local funding. This measure is useful because the percent of school funding from the local level represents the extent that schools are directly funded by local households, the percent of school funding from the state level represents the extent of recycling, and the percent of school funding from the federal level represents government aid. Therefore, the higher local funding is relative to state funding, the less recycling there is. School finance equity is a metric calculated by the US Department of Education. It is the degree to which per-pupil spending varies across districts within a state relative to the state's average per-pupil expenditure (FEBP 2013). This number represents the dispersion of spending within a state. A state with 0% school finance equity has perfectly equitable spending and all school districts have equal expenditures per student. If the correlation between recycling and school finance equity is positive, then the assumption that recycled funds are spent equitably across school districts is correct. Below is the correlation between recycling and school finance inequity:

Figure 4: Recycling vs. School Spending Inequity in US States (NCES 2013)



Recycling has a .0162 correlation with school finance equity, meaning the amount a state recycles has an insignificant relationship with spending inequity across school districts. There are many possible interpretations of this result, each with implications for the Benabou model and school finance policy. This result could mean that states are distributing funding in an attempt to achieve equity but school districts are not spending additional funding. If this is the case, then state attempts to achieve equity through funding redistribution are unsuccessful. On the other hand, it is possible that states are not trying to promote equity but another goal, such as outcome. If this is the case, then achievement equity is more useful to measure.

The first interpretation can be explained from a school district optimization viewpoint. Suppose a school district with below average student expenditures receives state aid as a result of redistribution policies. That school district does not need to increase its expenditures per student. It is possible that in response to aid, a school district will lower local property taxes, meaning recycled funding is a substitute for local taxes. This makes

sense from the perspective of the Benabou model, where households are trying to maximize results while minimizing costs. If the median voter's preferences are acted upon, as in Rogerson Fernandez, then the substitution of recycled funds with local taxes is rational behavior.

The second interpretation can be explained as states having school finance policies with other motivations. Some states may be using school funding to promote equity, but others may be trying to achieve equitable student outcomes, as evidenced in Vermont. If there are a substantial amount of states trying to achieve equitable outcomes, then recycling may not correlate with spending equity but rather outcome equity. Both interpretations will be explored in later chapters.

There is also much possibility of error. Data from the state level can suffer from aggregation. Attempts by states to equalize budgets could be diluted at the state level and be more clear at the metropolitan level. For example, if there are large spending differences between individual schools in a school district, these differences are aggregated into one school district. In areas with large school districts, such as Detroit and Springfield, this is a possibility. Also, tax source was shown to have a strong effect on school equity in Silicon Valley and Detroit, but not in Burlington and Springfield. It is possible that the composition of taxes could have a significant impact on the correlation between recycling and spending. For example, if a state has high recycling but the majority of those funds come from sales taxes, then recycling may not affect the actual distribution of local funding.

Data from Burlington and Springfield supports the result that recycling does not lead to equity. Illinois' school finance inequity is 22%, the second highest among all states. Vermont's school finance inequity is 18%, the eighth highest (FEBP 2013). This explains

their insignificant correlations between income and expenditures per student. Even though the two states differ on source of school revenue, their school finance equity indicates similarity in spending dispersion. Although Illinois and Vermont are on opposite ends of recycling, both are states with high spending inequity.

Before exploring whether education policies are motivated by outcome, I further explore whether education policies are motivated by spending equity. To do so, I determine what states do with the revenue they collect. Although school finance inequity shows the level of spending equity within a state, how this equity is achieved is more important. A measure for spending dispersion that takes into account how much revenue is collected by the state as well as where it goes is necessary to determine true spending dispersion. Although school finance inequity measures redistribution, it does not measure where those funds go. Inequality can be a result of a purely locally funded system or a purely state funded system. As shown in Vermont, the state can distribute as much or as little as it wants. In order to isolate the movement of local funds within a state, the percent of inequality accounted for by local taxes will be measured using the decomposition of spending inequality, obtained from a dataset by Baker and Corcoran (2012). In this dataset, the percent of spending inequality caused by local taxes gives insight on whether inequality is caused by local funding or redistribution. The higher this percentage, the more inequality is a result of school district differences in income rather than state redistribution. Hence, this measure along with school finance inequity will determine how school district inequity is caused in each state.

Section 3.4 Income Dispersion

Income dispersion will be used to measure the segregation of type A and type B households. Theoretically, a community with high income dispersion has high segregation of rich and poor households, and a community with low income dispersion has low segregation of rich and poor households. Income dispersion is only available at the state level in the form of the Gini Coefficient. The Gini Coefficient is a measure of income distribution where a coefficient of zero represents perfect equality and a correlation of one represents perfect inequality. It is expected that spending inequity as well as the percent of spending inequity caused by local taxes are increasing with income dispersion. This is because an area with high spending inequity gives rich households a stronger incentive to move to high human capital communities. The results are shown below.

Figure 5: Income Dispersion vs. Spending Inequity

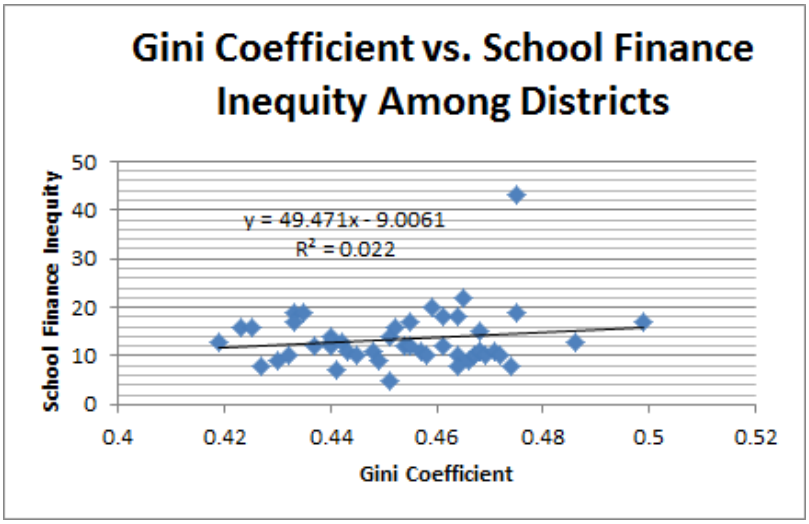
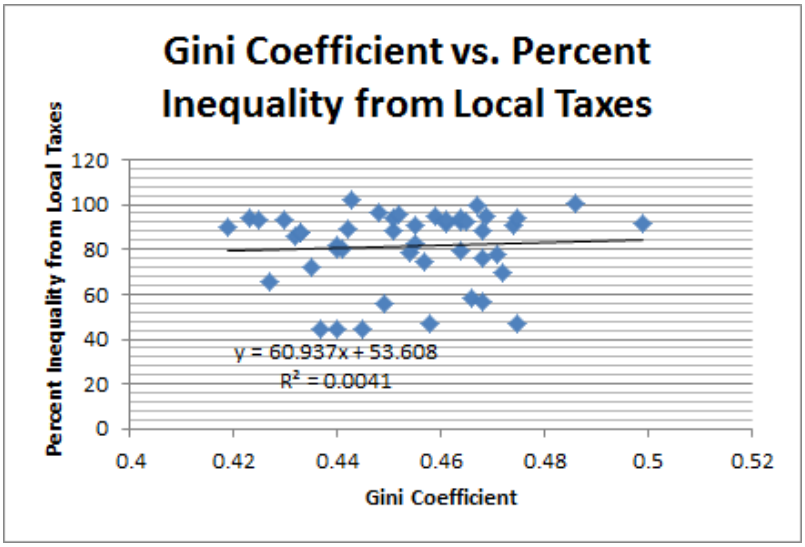


Figure 6: Income Dispersion vs. Percent of Inequity caused by Local Taxes

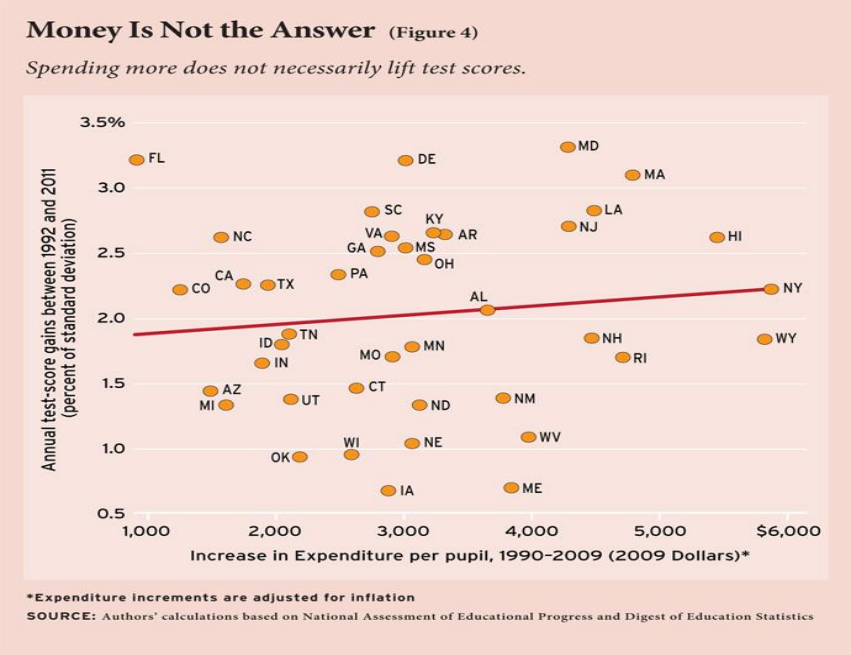


The data shows that there is no relationship between a state's Gini Coefficient and a state's inequity across districts, nor between a state's Gini Coefficient and the percent inequality accounted for by local taxes. This result suggests that at the state level, school funding redistribution has a negligible effect on where people decide to live. The idea that people do not care how their school system is funded goes contrary to Benabou's model, where human capital plays a large role in dictating where people live. In the Benabou model, the only time people would not care where they live is when school spending and quality are perfectly equitable. The data shows that this is not true at the state level, suggesting that in the real world, school funding does not have a significant impact on location choices. Although this result is surprising, it makes some sense. The US is a highly mobile country, both geographically and economically. Households may prioritize income and be unwilling to invest in improving their children's education if the cost to their income is too high. Also, because the mean age of marriage has been increasing in recent decades, households with

children may be outweighed by households without children. The assumption that each household has a child is not completely realistic.

Possible error includes the lack of gender, race, and occupation in the location choice framework. It is conceivable that individuals may want to live near people similar to them, e.g. Chinatown, Silicon Valley, LGBT districts, etc. Also, education technologies, capital markets, and preferences, were all disregarded in my framework. These effects could be strong enough to create differences between communities that outweigh the effects of school finance on location choices. Alternatively, it is possible that school funding does not improve school quality as greatly expected. Figure 8 shows state NAEP test scores versus expenditures per pupil at the state level between 1992 and 2011.

Figure 7: Expenditures per pupil vs. Test Scores (NAEP 2011)



This figure reveals that although there is a positive correlation of .12, it is low in magnitude. This suggests that school funding has a small effect in determining education quality and

resultingly, the location choices of households. Several papers support this hypothesis. An empirical study found police protection to be the most important factor influencing households, followed by education and fire protection (Welch, Carruthers, Waldorf 2007). Another paper found that a household is willing to pay less than 1% more for a home if the school district's performance is 5% better (Bayer, Ferreira, McMillan 2007). Both suggest that education is not a strong driving force behind community formation.

Section 3.5: School District Optimization Problem

It is possible that from a school district point of view, state aid in the form of recycled funding is a substitute good for the local tax rate. Because school districts have the choice of lowering taxes rather than increase expenditures, administrators face a trade-off between expenditures per student and the tax burden on local households. If recycled funds and local taxes are highly substitutable, then recycling would have little effect on spending equity. This possibility is explored in *Theoretical Models of School District Expenditure Determination (*Barro 1972). In this framework, marginal rate of tradeoff is the amount of additional taxes per household a school district is willing to raise in order to gain an additional dollar in expenditures per student. Marginal tradeoff is a function of expenditures per student and the tax burden, which is increasing with the local tax rate and decreasing with income, shown as $m\{e, b(l, y)\}$. The marginal rate of substitution is the price ratio between the two quantities, which is based on the number of students to households and the price of inputs to education. The price ratio is p. Maximization theory tells us that the school district is optimizing when the marginal rate of transformation is equal to the marginal rate of substitution. The budget constraint for a school district is equal to its local taxes, state aid, and federal aid, $e = l + s + f$.

The marginal rate of tradeoff is set equal to the marginal rate of substitution.

1) $m\{e, b(l, y)\}=p$

The budget constraint is substituted in for local taxes.

2) $m\{e, b(e\text{-}s\text{-}f), y)\}=p$

The entire equation is differentiated.

3) $\partial m/\partial e * de + \partial m/\partial b * \partial b/\partial t\ [p(de\text{-}ds+(e\text{-}s\text{-}f)dp] + \partial m/\partial b * \partial b/\partial y * dy = dp$

Using this equation, the solution for *de* can be found. The signs of each variable are:

$\partial m/\partial e < 0$ *A negative relationship between expenditures and the marginal rate of tradeoff*
$\partial m/\partial b < 0$ *A negative relationship between tax burden on the marginal rate of tradeoff*
$\partial m/\partial y > 0$ *A positive relationship between income on the marginal rate of tradeoff*
$de/dp < 0$ *A negative relationship between expenditures and the price of education*
$de/dy > 0$ *A positive relationship between expenditures and income*
$de/d(s+f) > 0$ *A positive relationship between expenditures and state and federal aid*

This result suggests that whenever a school district is given state aid, the school district will use some aid to increase expenditures and some to reduce the tax rate. Therefore, depending on income and preferences, the injection of recycled funds into a school district may not reach the goal of increasing spending. This is one explanation for the lack of correlation between recycling and spending equity in US States.

Section 3.6: Outcome

Because recycling does not equate to equitable spending, an important distinction is created between the types of school finance. In the Benabou model, there are perfectly locally funded communities and perfectly equitable communities. Burlington is neither. It is a community where the state manages all the financing, but instead of equalizing spending, it seeks to equalize outcomes. Other states may do the same thing. In this sense they are equalizing the marginal product of spending rather than spending itself. The tables below

illustrate a Benabou community with equalized school spending but different outcomes, and a community with equalized outcomes but different school spending:

Table 7: Equitable Spending vs. Equitable Results

Equitable Spending

Community 1	Community 2
Spending: 2	Spending: 2
School Quality: 2	School Quality: 1

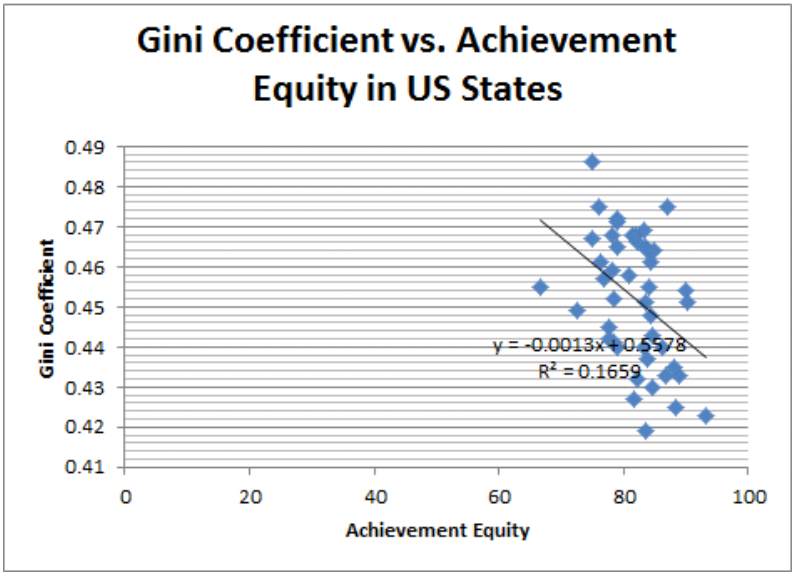
Equitable Results

Community 1	Community 2
Spending: 2	Spending: 1
School Quality: 2	School Quality: 2

If these two tables represent Benabou communities with different school finance policies ex-ante, it is possible to predict how communities will sort. In the area with equitable spending, households will prefer the schools with the highest education quality. That community will be preferred by all households and thereby be populated by type A households. In the area with equitable results, households will prefer the community with the lowest spending. That community will be preferred by all households and be populated by type A households.

States that equalize student achievement should have more integration of type A and type B households. If a significant number of US states engage in these types of policies, then there should be less income dispersion in states with high achievement equity. To test this, income dispersion will again be measured by a state's Gini Coefficient and achievement equity will be measured as the dispersion of student test scores across school districts within a state. Similar to school finance equity, a value of zero means that school districts have completely equitable test scores and a value of one means that school districts have highly inequitable test scores. Achievement equity data was taken from a dataset by Lloyd and Swanson (2014).

Figure 8: Income Dispersion vs. Achievement Equity



Income dispersion has a .16 correlation with achievement equity. This is a weak relationship, but indicates that a relationship exists between the two. As expected, income dispersion decreases as achievement equity increases. Compared with the insignificant relationships between recycling, spending equity, and income dispersion, this data provides some insight. While households location choices are not affected by the recycling or spending policies of their community, they are affected by the quality of schools in their community. Although a correlation of .16 is weak, in relation to other variables, it is quite significant. It could also be lessened by aggregation. Regardless, achievement equity has a relationship with income dispersion in real life and the location choice framework can be re-evaluated using this knowledge.

Chapter 4

Analysis

A regression was run of all the variables to see if their overall relationship. Here, income dispersion is the dependent variable and recycling, spending equity, and outcome equity are the independent variables.

Table 8: Regression of all Variables

Source	SS	df	MS	Number of obs =	49
				F(3, 45) =	1.17
Model	.001099702	3	.000366567	Prob > F =	0.3326
Residual	.01412593	45	.00031391	R-squared =	0.0722
				Adj R-squared =	0.0104
Total	.015225632	48	.000317201	Root MSE =	.01772

income	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
recycling	.0195456	.0199883	0.98	0.333	-.0207128	.0598041
spending	.0005145	.0004523	1.14	0.261	-.0003965	.0014255
outcome	-.0005584	.0004807	-1.16	0.252	-.0015266	.0004099
_cons	.4823611	.0398346	12.11	0.000	.4021302	.562592

This regression has an R-squared of .0722 and an adjusted R-squared of .0104, indicating recycling, spending, and outcome are not good predictors of income dispersion. Almost all income dispersion cannot be explained through these variables, as seen in the high constant. The entire dataset is shown below the chapter.

Conclusion

In the context of the Benabou model, the segregation of high income and low income households in the US are not significantly affected by differences in recycling, spending, and outcome. This result was obtained using data from the state level, but can still help to understand the effect of school finance on community formation. This result suggests that households put a negligible weight on recycling and spending equity, and a small weight on outcome equity when they make location choices.

The data revealed that households do not care whether they live in equitably funded communities or locally funded communities. Each school district studied has a high degree of integration, suggesting households are motivated by other factors when making location choices. This could be a result of school districts treating aid as a substitute for local taxes or school policies aiming for achievement equity rather than spending equity. This could also be a result of factors such as police protection, fire protection, or rent and commute time. In the Benabou model, the cost of living in a community is inversely proportional to its education attainment and education quality. It appears that this is not true, as low income and high income households are often integrated within the same communities.

After studying the data through the lens of the Benabou location framework and the Rogerson Fernandez counterpart, I find a lack of support for the implications of the model and the hypotheses that 1) recycling leads to equity in spending 2) spending inequity leads to income dispersion and 3) outcome inequity leads to income dispersion. Households do not make location choices simply based off the cost of living in a community and its school quality. There are too many factors to account for to explain how households of different education attainments form communities. Although it is reasonable that households with

children are making location choices with recycling, school spending, and education quality in mind, on a broad level, these motivations do not appear in the data.

There are few policy implications for this result. First, policies with the goal of achieving spending equity by recycling funds are not as successful as planned. Not only does recycling not correlate with spending, but achievement is equity not affected by either. A successful policy is one that obtains achievement equity at a low cost to high achieving school districts. Recycling school revenue without making sure schools spend additional aid is an inefficient strategy. Alternatively, the human capital of a child's parents may be the most important determinant of a child's education, and school policies may play a limited role in dictating outcomes altogether.

Nonetheless, further research must be done before a conclusive statement is made about the intersection of location choices, human capital accumulation, and school finance. Because redistributive policies are relatively new, communities may need time to adjust into their equilibrium formation. Time is not a variable in the Benabou framework, but could be mportant. A case study of areas that initiated redistributive policies and have had ample time to develop would be useful to complement this paper. Additionally, research on factors that were left out, including occupation, ethnicity, etc, may reveal what truly motivates household location choices.

In conclusion, at the state level, there is no relationship between school revenue redistribution and spending equity, neither school revenue redistribution nor spending have a relationship with segregation, and achievement equity has a weak relationship with segregation. These findings suggest that national data is not supported by the Benabou model.

Table 9: State Level Data

state	income	recycling	spending	outcome
Alabama	0.472	0.483407	10	79
Alaska	0.422	0.355381	10	71.2
Arizona	0.455	0.467724	12	66.6
Arkansas	0.458	0.371041	10	81
California	0.471	0.34023	11	79
Colorado	0.457	0.527957	11	77
Connecticut	0.486	0.59267	13	74.9
Delaware	0.44	0.321001	12	83.3
Florida	0.474	0.616926	8	89.5
Georgia	0.468	0.523179	11	81.5
Idaho	0.433	0.250557	19	88.9
Illinois	0.465	0.68672	22	79.1
Indiana	0.44	0.554176	14	86.2
Iowa	0.427	0.498368	8	81.7
Kansas	0.445	0.373507	10	77.8
Kentucky	0.466	0.35618	9	82.3
Louisiana	0.475	0.452607	43	87
Maine	0.437	0.516022	12	83.8
Maryland	0.443	0.540655	11	84.6
Massachusetts	0.475	0.563319	19	76.2
Michigan	0.451	0.370621	14	83.5
Minnesota	0.44	0.302128	13	78.9
Mississippi	0.468	0.366864	15	82.1
Missouri	0.455	0.628135	17	84.2
Montana	0.435	0.445714	19	88.2
Nebraska	0.432	0.618063	10	82.3
Nevada	0.448	0.660754	11	84.5
New Hampshire	0.425	0.609937	16	88.5
New Jersey	0.465	0.566215	18	83.6
New Mexico	0.464	0.177438	10	83.8
New York	0.499	0.515924	17	88.6
North Carolina	0.464	0.294972	8	84.8
North Dakota	0.433	0.566237	17	86.9
Ohio	0.452	0.486516	16	78.4
Oklahoma	0.454	0.386127	12	89.9
Oregon	0.449	0.430976	9	72.6
Pennsylvania	0.461	0.582524	18	84.4
Rhode Island	0.467	0.594684	10	75
South Carolina	0.461	0.469478	12	76.4
South Dakota	0.442	0.605263	13	77.7
Tennessee	0.468	0.481398	11	78.1
Texas	0.469	0.524076	10	83.4
Utah	0.419	0.399543	13	83.5
Vermont	0.444	0.083422	18	76.3
Virginia	0.459	0.551651	20	78.2
Washington	0.441	0.320498	7	78.4
West Virginia	0.451	0.335208	5	90.4
Wisconsin	0.43	0.495455	9	84.6
Wyoming	0.423	0.396146	16	93.2

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