The Economics of Social Groups

by

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Submitted to the Department of Economics
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Economics

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

May 1997
[June 1997]

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A.B., Economics

Harvard College, 1992

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Abstract

The effects of group membership on outcomes and the endogenous selection of social groups have been recent focuses of both policy and academic research. These three essays explore how choice of social group responds to economic incentives.

In the first essay, I develop a theoretical model of residential segregation by both race and education. This model has the counter-intuitive prediction that racial segregation may increase even as the education levels of different races become more similar. I find some limited empirical support for this model in a cross-section of American cities.

The second essay addresses issues of choice of group more indirectly. To the extent that people choose where they live, they choose a bundle of local public services. This essay explores the market for one such public service, policing. I find that policing responds to increases in crime, that increases in policing are not constrained by the fiscal conditions of city governments, and that increased spending is financed out of new revenues rather than by cutting other types of city government spending.

Finally, the third essay explores how people choose their work environment and co-workers. Kremer and Maskin (1994) have argued that increased dispersion in the abilities of workers should result in more segregation by skill in the work place. I find little empirical support for this view.

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Acknowledgments

My advisers, Ed Glaeser and David Cutler, not only went beyond the call of duty in agreeing to advise this thesis but were also infinitely patient with both the topic's and the author's quirkiness. David was particularly generous with his time.

Michael Kremer was instrumental in inspiring my interests in some areas of my thesis early in grad school. He also offered me the opportunity to learn by doing as his research assistant.

My parents, Neal and Judy Barmack, were very supportive of me throughout graduate school even when they did not understand my behavior (or my work). My younger but wiser brother, Erik Barmack, has provided me with great advice on love, life, and career and has never let me stay down for long. Most of all, Catherine Wolfram has been an endless source of support, companionship, and amusement.

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Chapter 1

Racial Segregation and Income Distribution: Theory and Evidence

1.1 Introduction

There is a growing sense that American society is becoming more socio-economically fragmented. As the black middle class has grown and income inequality for all races has increased, American society has become more stratified by income and less stratified by race. However, a black underclass persists and is growing in major American cities, and while declines in racial segregation have been significant, it remains a puzzle why there is still substantially more segregation by race at a given income level than segregation by income within a given race (Farley 1977a; Farley 1977b). This paper seeks to quantify and explain the modest magnitudes of declines in segregation by race. It also develops an explicit model of residential segregation in which it is possible to predict the effects of increasing black incomes on segregation. I test the model in a cross-section of American metropolitan areas using tract level data from the 1960 and 1990 censuses.

I find some empirical support for this simple model in which demographics and income distribution are the only factors that affect segregation. In the model, there

is a non-monotonic relationship between black incomes and segregation. As black incomes grow, initially high income blacks are more easily assimilated into predominantly white affluent communities, but, as black incomes continue to grow, racially homogeneous affluent black communities emerge. Specifically, I demonstrate that a complementarity between the black population share and income inequality helps explain racial segregation.

For example, think of Washington D.C. which has both an extremely poor black population inside of the city of Washington and a number of extremely affluent black majority suburbs. In fact, Maryland's Prince George's County is the only black majority suburban county in the U.S. (Raspberry 1996)

In addition, I find that Sun Belt cities with large Hispanic populations and buoyant economies have low levels of black residential segregation. These findings are consistent with Frey's (1995) view that black segregation in the Northeast is the result of attitudes that were formed following the mass migration of poor blacks from the rural South to major industrial centers such as Gary, Chicago, and Detroit. More affluent, smaller black populations have been more easily assimilated into the newer cities of today's South and West, where large, poor Hispanic populations are increasingly ghettoized. San Jose, the hub of Silicon Valley, is among the cities in which blacks are the least segregated. (McLaughlin 1997)

This paper is related to a few distinct literatures. First, it extends the sociology literature which seeks to quantify segregation and changes in segregation in American cities. Farley (1977a, 1977b), Frey (1979), Massey and Eggers (1990), Jargowsky and Bane (1991) have documented the persistence of racial segregation in the U.S. over the past several decades. The results in this paper are broadly consistent with their findings.

More specifically, this paper speaks directly to the debate between Wilson (1987) and Massey and Eggers about whether the abandonment of the inner city by upper and middle class blacks has contributed to the problems of the underclass. Wilson is the most prominent exponent of this view, while Massey and Eggers have demonstrated that the segregation of blacks by income is actually lower in the cities that are

the most segregated by race and are commonly thought to be the most "ghettoized." I demonstrate that this outcome can be rationalized in a very simple model of an urban housing market.

This paper is closest in spirit to Cutler and Glaeser (1995) which attempts to quantify and interpret the effects of segregation on different outcome variables such as educational attainment and teenage pregnancy in a more structural framework. I develop a model that is almost identical to theirs, but I use it to examine the question of what causes segregation in the first place.

In examining racial and income segregation jointly, this paper complements the recent empirical literature on growing wage inequality typified by Katz and Murphy (1992), and Juhn, Murphy, and Pierce (1993). While this literature has documented the widening of the income distribution, it has said little about the implications of growing income inequality for residential segregation by race and income. Part of this paper is an effort to extend this literature in that direction.

Finally, this paper speaks to the recent theoretical literature on income distribution, such as Bénabou (1993), Durlauf (1992, 1994), Kremer (1996), and Fernandez and Rogerson (1992) which draws connections between residential sorting by income, the persistence of income inequality and the performance of the aggregate economy. This paper contributes to this literature in two ways: first, it attempts to quantify some of the types of sorting laid out in these models and second, it develops a model which deals with race more explicitly than previous papers in this area. While the model is simple and static, it provides a relatively realistic description of how sorting into multiple communities by multiple characteristics might occur and so is better suited to exploring issues of segregation *per se*. In examining segregation from a structural framework, it is very much like Lam and Schoeni (1993) which develops and tests a model of sorting in marriage by multiple characteristics. While Lam and Schoeni look at matching in marriage, I look at matching in residence. It is also close in spirit to the last chapter of this thesis which examines whether increased inequality has led to increased sorting by education into different industries and occupations.

The next section describes how I measure segregation and the data I use and

documents trends in racial and income segregation in the United States in the past 30 years. Next, I present an explicit model of racial and income segregation which I attempt to calibrate. Finally, I explore a series of other explanations for changes in racial and income segregation.

1.2 Data and Empirical Results

How have racial and income segregation changed over the past 30 years? This section describes one measure of segregation and the tract level data from the 1960 and 1990 censuses I use to measure segregation and presents some descriptive statistics.

1.2.1 The Taeuber and Taeuber Index of Dissimilarity

I use the Taeuber and Taeuber (1965) index of dissimilarity to measure segregation and changes in segregation. While there are more complicated measures of segregation (such as those developed in Ellison and Glaeser (1994)), the Taeuber and Taeuber index is simple and, for my purposes, is highly correlated with other segregation measures.[1]

The Taeuber and Taeuber measure is the following: Suppose one is measuring the segregation of groups W and B over n neighborhoods in a city. The measure is then:

$$1/2 \sum_{i=1}^{n} |w_i/W - b_i/B|$$

where w_i and b_i are the number of people of groups W and B in neighborhood i and W and B are the total number of people of groups W and B in the city.

There are two nice properties of this index: first, it is bounded between 0 (the case of no segregation) and 1 (the case of complete segregation) and second, it is does not vary with the size of the population whose segregation is being measured. It only captures changes in the distribution of a population.

[1]It is also the measure most used by previous authors in this literature and so makes it easy to compare my results to those of previous studies.

1.2.2 Census Tract Level Data

I use data from the 1960 and 1990 Censuses to calculate the Taeuber and Taeuber index for the segregation of the rich from the non-rich and blacks from non-blacks for a set of 106 metropolitan areas in the United States.

I examine segregation at the level of the metropolitan area because that seems to be the level at which people make the type of locational decisions in which I am interested, although sorting by race and income may influence people's choice of metropolitan area as well. [2]

Within metropolitan areas, I examine segregation by census tract. A census tract encompasses an area of roughly 5000 people, and in terms of census geography, most closely approximates what one might think of as a neighborhood. For 1990, it would be possible to calculate segregation over blocks, but much more data are available for tracts, and there are very limited data for blocks in electronic form for 1960.

Because the boundaries of many metropolitan areas have changed since 1960, I create a mapping between 1960 and 1990 metropolitan areas which leaves me with a sample of 106 metropolitan areas with population of at least 100,000 and non-white population of at least 10,000 in each of the two years. [3] [4] [5]

I look at 1960, 1990, and changes between those two years for two reasons. First, 1960 is the earliest year for which tract level data are available for a relatively broad sample of cities. Second, the 1960s and 1970s were periods of rapid black economic gains, so looking at an interval that spans that period enables me to look at the effects of large changes in black income distribution on segregation.

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[2] For example, Frey (1995) presents evidence on the migration of less well educated whites out of major cities on the East and West Coasts during the 1980s.

[3] For example, in 1960, Orange County and Los Angeles are both part of the Los Angeles metropolitan area, but in 1990, are separate metropolitan areas. I calculate measures of segregation for Los Angeles and Orange County together for both 1960 and 1990.

[4] I am missing all metropolitan areas in New Jersey as well as other metropolitan areas which have substantial fractions of their population in New Jersey. These are Newark, Jersey City, Bergen-Pasaic, and Trenton in New Jersey in addition to Philadelphia and Wilmington, DE. I have been unable to find any usable version of the tract data for New Jersey in electronic form.

[5] I am also forced to discard several metropolitan areas that had significant untracted areas in 1960.

Table 1.1: Summary Statistics for Racial Segregation

year	*mean*	*s.d.*	*min*	*max*
1960	.7437553	.101844	.3723446	.9354625
1990	.5256521	.1320158	.152947	.8068899
$\Delta_{1960-1990}$	-.2181033	.1245069	-.4817927	.0612352

1.2.3 Summary Statistics

Table 1.1 shows summary statistics for the Taeuber and Taeuber index of the isolation of blacks from non-blacks in 1960 and 1990 as well as the 1960-1990 difference. Clearly, racial segregation has declined significantly in the past 30 years. The average change is a decline of approximately 0.2 in a measure that is bounded between 0 and 1.

Table 1.2 shows lists of the most and least segregated metropolitan areas in both 1960 and 1990. Major Rust Belt cities such as Gary, Detroit, Milwuakee, and Cleveland are among the most segregated in both years. As manufacturing flourished in these places in the post-war era, they received large black inflows from the rural South. Given racial, cultural, and economic differences, it is hardly surprising that these immigrants were highly segregated in 1960. It is more difficult to explain why these places continue to be so segregated 30 years later.

Table 1.3 shows the metropolitan area that experienced the largest changes in racial segregation over the 1960-1990 period. All of the large decliners are in the Sun Belt or on the West Coast. Since these regions experienced rapid economic growth, this evidence suggests a relationship between rapid economic growth and declines in segregation. These are also regions that have experienced large in-migrations of hispanics. I explore the relationship between, economic growth, hispanic in-migration and racial segregation later in the paper.

Table 1.4 shows overall trends in income segregation defined as the Taeuber and Taeuber index for the segregation of households in the top quartile of the income distribution, where income cutoffs are determined separately for each city in my

Table 1.2: Most and Least Racially Segregated Metropolitan Areas, 1960 and 1990

Most Segregated		*Least Segregated*	
		1960	
Detroit	.8740433	Honolulu	.3723446
Omaha	.8796564	Greenville	.4030326
Wichita	.8849554	Laredo	.4660493
Miami	.8895045	Tyler	.5404236
Los Angeles	.8898961	Pueblo	.5486405
Gary	.8907536	Topeka	.5580884
Milwaukee	.9042752	Raleigh-Durham	.5960355
Cleveland	.9046182	Santa Barbara	.5980868
Chicago	.9138033	Gadsden	.6212157
Muncie	.9354625	Waco	.6223345
		1990	
Indianapolis	.6961829	Laredo	.152947
Birmingham	.7035096	El Paso	.167184
Philadelphia	.7092384	Corpus Christi	.2812115
Buffalo	.7212766	Pueblo	.2878419
St. Louis	.7217009	Spokane	.293171
Milwaukee	.7354644	Albuquerque	.3034057
Flint	.7413038	San Antonio	.3077812
Cleveland	.7802676	Riverside-San Bernardino	.307983
Gary	.7982327	Portland	.3319142
Detroit	.8068899	Honolulu	.3448574

Table 1.3: Racial Segregation: Biggest Changers, 1960-1990

Biggest Decliners		*Smallest Decliners*	
Odessa	-.4817927	Pittsburgh	-.0686492
Portland	-.4808407	Detroit	-.0671534
El Paso	-.4775192	Baton Rouge	-.0652519
Seattle	-.4744248	Memphis	-.0507938
San Antonio	-.4602073	Tyler	-.0357507
Los Angeles	-.4410697	Honolulu	-.0274872
Salt Lake City	-.425279	New Orleans	-.0034267
Denver	-.4131494	Gadsden	.0556211
Riverside-San Bernardino	-.4108316	Greenville	.0599939
Albuquerque	-.4004688	Birmingham	.0612352

Table 1.4: Summary Statistics for Income Segregation

year	*mean*	*s.d.*	*min*	*max*
1960	.2025483	.0472763	.1035637	.322356
1990	.2334923	.0309807	.1519619	.2922937
$\Delta_{1960-1990}$	.030944	.0431649	-.1338325	.1200935

sample, from the population as a whole.[6] Income segregation seems to have increased moderately over the period. This is not surprising given the increase in income inequality over the period. In many theoretical models, rising inequality gives the rich more incentives to isolate themselves, for example, to benefit from neighborhood level externalities as in Bénabou (1993) or to avoid redistributive taxation as in Fernandez and Rogerson (1992).

Table 1.5 shows the cities most and least segregated by income in 1960 and 1990. A preponderance of cities in the Southwest appear to be among the most segregated by income in 1990. The group of the cities least segregated by income remains relatively stable over the 30 year period and includes many smaller cities in the Midwest and Northeast. This could reflect the relatively flat distribution of income in those places.

Table 1.6 shows the cities that experienced the largest changes income segregation over the 1960-1990 period. Every one of the smallest gainers is in the South or Texas. Cities in the South start with high income segregation in 1960 and maintain high levels of income segregation over the 1960-1990 period.

Figures 1-1 and 1-2 show plots of income segregation on racial segregation for the sample of cities with population of more than 1,000,000 in 1990. What is easier to see here than in Tables 5 and 6 is the increases in income segregation in the major cities of the Northeast. Places like Detroit, Cleveland, Buffalo, and St. Louis start with median or below median income and above median racial segregation in 1960, and end with median or above median income and above median income segregation

[6]Defining the rich as those in the top quartile of the income distribution is somewhat arbitrary, but I have obtained similar results with different cutoffs. Allowing the income level at which a household is considered rich vary across cities matters since there is significant cross-city variation in mean income levels.

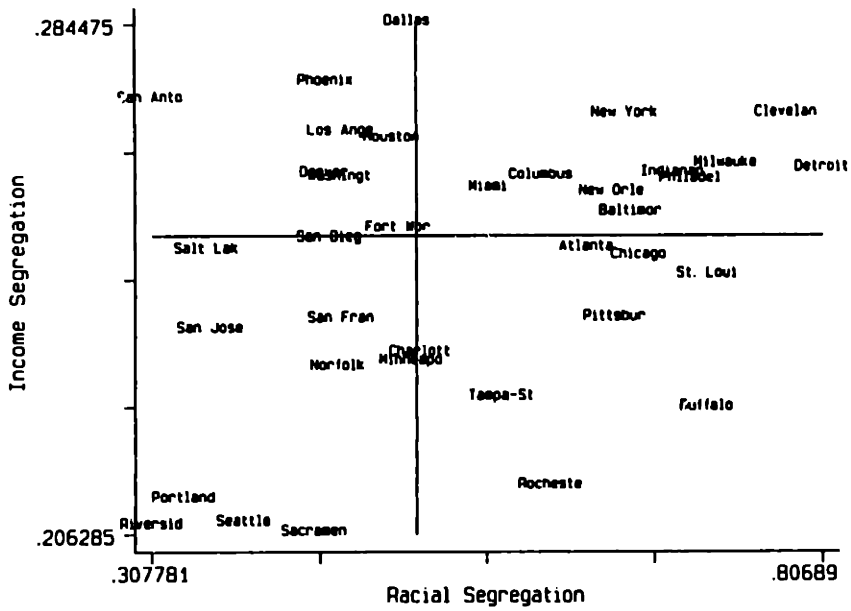
Table 1.5: Metropolitan Areas Most and Least Segregated by Income, 1960 and 1990

Most Segregated		*Least Segregated*	
1960			
Columbus	.2705703	Wilkes-Barre	.1035637
Memphis	.2735012	Reading	.11662
Shreveport	.2778769	Kalamazoo	.1204628
Charleston	.2782405	South Bend	.1235758
Dallas	.2809136	Erie	.1284645
Charlotte	.2878943	Lorain-Elyria	.1353786
Corpus Christi	.2994199	Flint	.1354114
Tyler	.3096395	Binghamton	.1362158
San Antonio	.31379	Santa Barbara	.13888
Montgomery	.322356	Utica-Rome	.1404873
1990			
New York	.2704177	Lancaster	.1519619
Cleveland	.2704635	Wilkes-Barre	.1538463
Omaha	.2712168	Lima	.1559511
San Antonio	.2727439	Steubenville	.1651299
Phoenix	.2752722	Reading	.1706029
Tucson	.2761469	Tyler	.1758069
Birmingham	.279278	Harrisburg	.1792197
Dallas	.2844749	Jackson	.1824229
Memphis	.2905194	Utica-Rome	.1826638
Austin	.2922937	Gadsden	.1876723

Table 1.6: Income Segregation: Biggest Changers, 1960-1990

Biggest Gainers		*Smallest Gainers*	
Spokane	.0784222	Tyler	-.1338325
Binghamton	.0819426	Charleston	-.0850294
Decatur	.0852087	Corpus Christi	-.0701999
Fort Wayne	.0865279	Montgomery	-.0673491
Austin	.0879692	Charlotte	-.0540532
Milwaukee	.0924876	Lexington	-.0466012
Santa Barbara	.0971338	Little Rock	-.0437696
Hamilton	.1034569	San Antonio	-.0410461
South Bend	.1166917	Nashville	-.0406014
Kalamazoo	.1200935	Shreveport	-.0401572

Figure 1-1: Racial and Income Segregation, 1990



For expositional clarity,this graph shows income and racial segregation measures for a subset of metropolitan areas with populations greater than 1,000,000 in 1990. The lines inside of the graph are drawn at the median levels of segregation for this sample in 1990.

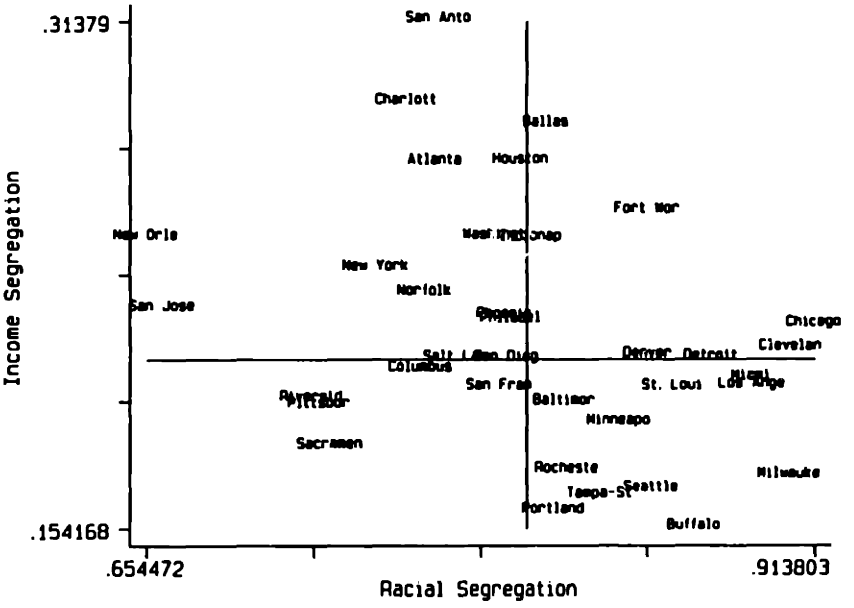
in 1990.

Figures 1-1 and 1-2 also confirm the evidence presented in Tables 1.1-1.3 that many Western cities have gone from being among the most to among the least racially segregated cities in the past 30 years so that in 1990, San Francisco, Seattle, Portland, and San Jose are among the least racially and economically segregated cities.

From Figure 1-1, three groups of cities seem to emerge. Major Rust Belt cities appear to be highly segregated by both race and income, West Coast cities are dis-segregated by both race and income, and large cities in the Sun Belt—such as Los Angeles, Phoenix, and Dallas—are highly segregated by income but less so by race.

The remainder of the paper seeks to disentangle and interpret some of these patterns. First, I present a simple model that relates income and racial segregation.

Figure 1-2: Racial and Income Segregation, 1960



For expositional clarity,this graph shows income and racial segregation measures for a subset of metropolitan areas with populations greater than 1,000,000 in 1990. The lines inside of the graph are drawn at the median levels of segregation for this sample in 1960.

1.3 The Model

A number of the observed patterns of racial and income segregation described in the previous section seem to suggest relationships between income inequality, the size of the black population, and racial and income segregation. The following is an attempt to relate these different factors in a simple model.

The model laid out below is close in spirit to the model of Bénabou (1993). However, while Bénabou assumes that individuals are *ex ante* identical, this model assumes that individuals are *ex ante* different. Further, while Bénabou looks at segregation by human capital—which can be thought of as segregation by either income or education, this model looks at segregation both by human capital and another characteristic which I think of as race, but might just as easily be ethnicity, religion or some other characteristic.

It is very similar to the model in Cutler and Glaeser (1995) although we each interpret the model in different ways. While they are most concerned with issues of how segregation affects different outcome variables such as educational attainment, I focus on the question of how changes in different demographic characteristics affect segregation.

1.3.1 The Market

The model describes a housing market—which I think of as a city—which is divided into two equally sized neighborhoods. The population of the city is unity and each of the neighborhoods contains half of the population. People of two different races, white and black, live in this city. Blacks and whites constitute fractions B and $1 - B$ of the population respectively.

There are income levels: $h > 1$ and 1. A fraction b of blacks and w of whites have income level h. So there are four groups living in the city: high and low income blacks and high and low income whites.

The utility functions of blacks and whites are as follows:

$$\begin{aligned} u_{wij} &= \ln(h_i - p_j) + H_j - B_j \\ u_{bij} &= \ln(h_i - p_j) + H_j \end{aligned}$$

where b and w index race and i indexes the individual so that h_i can take on the two values h and 1. j indexes the neighborhood in which individual i lives. p_j is the price of housing in neighborhood j. I normalize the price of housing in neighborhood 1 to 0. H_j is the number of high types in neighborhood j. It enters positively in both races' utilities crudely capturing some positive externality of being around other well educated people.

B_j is the number of blacks in community j. The fact that this enters negatively into whites' utility and not at all into blacks' is intended to capture some desire of people of the same race to live with one another. It needn't be thought of as out and out racism. Further, a model in which both races' utilities depended on the racial composition of the neighborhoods in which individuals live would have similar implications. I choose the above characterization for analytical tractability.

1.3.2 Equilibrium

A solution to this model is a price in the second neighborhood and an allocation of the four groups across the two neighborhoods such that no member of any group would want to move.

In the following, I assume that no group ever comprises more than a half of the total population and that whites comprise more than half of the population ($B < 1/2$) to avoid the case where one neighborhood is completely homogeneous.

Initially I assume that poor blacks and rich whites live in separate communities. I then show that is in fact the case in the equilibria I consider. This greatly simplifies the problem. There are then four cases to consider:

1. There are more rich blacks than poor whites ($bB > (1 - w)(1 - B)$) and poor

whites live in the same neighborhood as poor blacks.

2. There are more rich blacks than poor whites ($bB > (1-w)(1-B)$) and poor whites live in the same neighborhood as rich whites.

3. There are fewer rich blacks than poor whites ($bB < (1-w)(1-B)$) and rich blacks live in the same neighborhood as rich whites.

4. There are fewer rich blacks than poor whites ($bB < (1-w)(1-B)$) and rich blacks live in the same neighborhood as poor blacks.

I focus on the more empirically relevant cases where there are fewer rich blacks than poor whites *i.e* cases 3 and 4. I call case 3 the integrated equilibrium and case 4 the segregated equilibrium. I will show that two simple conditions determine which of the two equilibria prevail.

Case 3

I begin by assuming that poor blacks live in neighborhood 1 and rich whites live in neighborhood 2. I verify that this will in fact occur in equilibrium. Since $bB < (1-w)(1-B)$ and $B < 1/2$, poor whites will live in both neighborhoods. Hence, p_2 must be such that the utility of poor whites is equalized in the two neighborhoods so:

$$\ln(1-0) + \overbrace{0}^{h_1} - \overbrace{(1-b)B}^{B_1} = \ln(1-p_2) + \overbrace{bB + w(1-B)}^{h_2} - \overbrace{bB}^{B_2}.$$

Solving for p_2 yields

$$p_2 = e^{-(w(1-B)+(1-b)B)}.$$

I then verify that poor blacks would in fact want to live in the first neighborhood. They will if:

$$\ln(1-0) > \ln(1-p_2) + bB + w(1-B)$$

Substituting for p_2 this condition simplifies to $w(1-B) + (1-b)B > w(1-B) + bB$ which holds for $b < 1/2$ so poor blacks will be willing to live in the first neighborhood so long as less than half of all blacks are high types.

Next, I check that rich whites in fact will choose to live in the second neighborhood given the price, p_2, and the distribution of the other groups across the two neighborhoods. The condition is

$$\ln(h - p_2) + w(1 - B) > \ln(h) - (1 - b)B,$$

which simplifies to $(h-p_2)/h > 1-p_2$ which holds for any $p_2 > 0$ since I have assumed $h > 1$.

Finally, I check that rich blacks would not want to move in this equilibrium. That condition is

$$\ln(h - p_2) + w(1 - B) + bB > \ln(h).$$

Substituting for p_2, this simplifies to

$$h > \frac{1 - e^{-(w(1-B)+(1-b)B)}}{1 - e^{-bB-w(1-B)}}. \tag{1.1}$$

Given that $w, b, B > 0$ and $B < 1/2$, the right-hand side of (1.1) will be a number greater than 1, so that (1.1) is a non-trivial condition on the various parameters of the model.

Before discussing (1.1), I want to work through the analytics of case 4, the segregated equilibrium, since the two cases turn out to be closely related.

Case 4

In the segregated equilibrium, rich and poor blacks live together in community 1, poor whites live in both communities, and rich whites live in community 2.

The utility of poor whites in both neighborhoods is equalized

$$\ln(1) - (1 - b)B = \ln(1 - p_2) + w(1 - B)$$

which implies $p_2 = 1 - e^{-(w(1-B)+(1-b)B)}$, the same as in the segregated equilibrium.

Poor blacks will not want to move so long as

$$bB > \ln(1 - p_2) + w(1 - B)$$

which holds for any b.

Rich whites will not want to move if

$$\ln(h - p_2) + w(1 - B) > \ln(h) - (1 - b)B.$$

This is the same condition as for the segregated equilibrium and it always holds for the parameter values that I consider.

Finally, rich blacks will not want to move if

$$\ln(h - p_2) + w(1 - B) < \ln(h) + bB$$

which amounts to

$$h < \frac{1 - e^{-(w(1-B)+(1-b)B)}}{1 - e^{bB-w(1-B)}}. \tag{1.2}$$

Notice that for the same values of w,b and B, the right-hand side of (1.2) will be greater than the right hand side of (1.1). Thus, the inequalities in (1.1) and (1.2) define three regions (see Figure 1-3): (a) an area above the right hand side of (1.2) where segregation is a unique equilibrium (b), a region between (1.1) and (1.2) where either equilibrium might prevail, and a region below (1.1) where segregation is the unique equilibrium.

Figure 1-4 provides another representation of these conditions. In Figure1-4, (2) divides the region of relevant parameter values into two areas: (a) an area above (2) where the segregated equilibrium is unique and (b) an area below (2) where the integrated equilibrium is unique.

Figure 1-3: Conditions for Equilibria I.

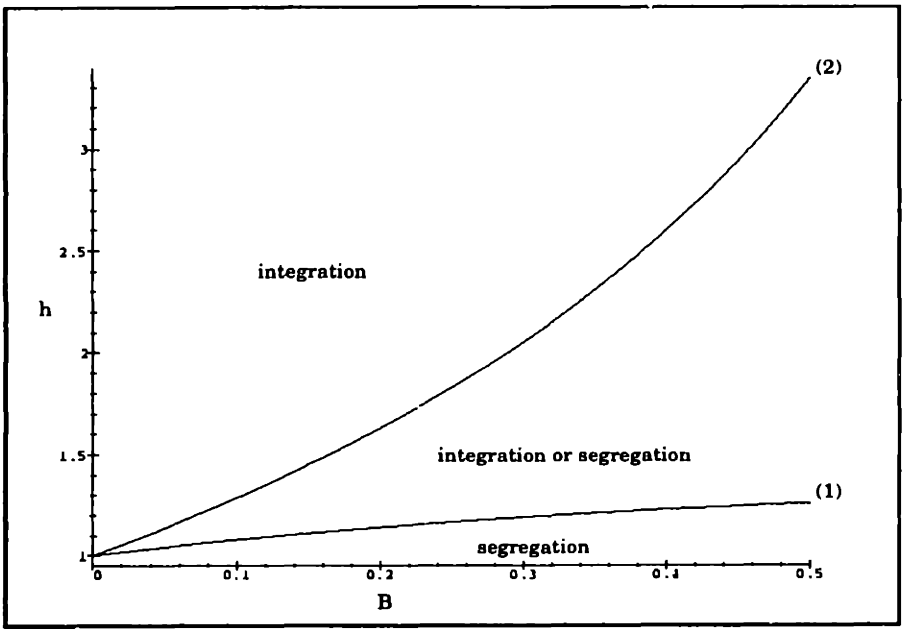
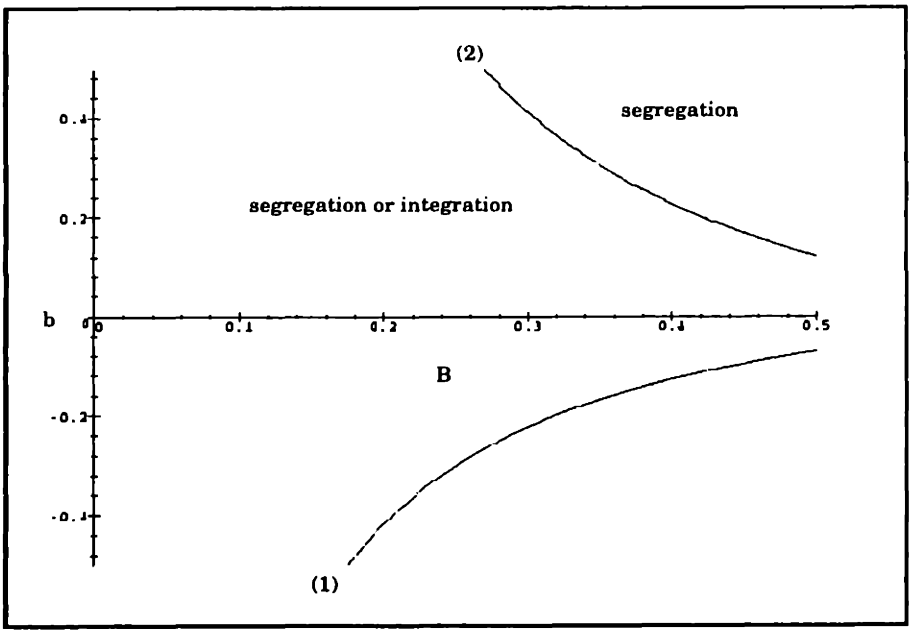


Figure 1-4: Conditions for Equilibria II.



1.3.3 Empirical Implications

Figures 1-3 and 1-4 illustrate two sets of plausible empirical implications of this model.

h measures the ratio of the income of a rich type to that of a poor type. An increase in h is in some sense an increase in income inequality. Figure 1-3 shows that when there is a lot of income inequality, segregation tends to be lower. In other words, when incomes are very disparate, people are more likely to match in residence with others of the same income rather than others of the same race.

The slope of (2) in Figure 1-4 also implies that this relationship should be less pronounced where blacks constitute a larger fraction of the overall population. In other words, it is easier for an affluent white community to assimilate a smaller number of affluent blacks. So, in a regression of the form:

$$segregation = \beta_1 varinc + \beta_2 varinc * \%black \tag{1.3}$$

where *varinc* is some measure of income inequality, I would expect to observe $\beta_1 < 0$ and $\beta_2 > 0$.

Figure 1-4 illustrates the relationship between the fraction of blacks who are high types (b) and the overall fraction of blacks (B) in the two equilibria. It shows that the higher proportion of blacks who are high types, the more likely is segregation. More intuitively, this says that when there are enough high-type blacks to support a racially homogeneous affluent black community, affluent blacks will choose to live with other blacks rather than affluent whites.

The downward slope of (2) in Figure 1-4 implies that segregation is more likely when the black population constitutes a larger fraction of the population. For higher B a given b corresponds to a larger proportion of high-type blacks in the overall population making segregation more attractive to affluent blacks.

Figure 1-4 implies that in a regression of the form:

$$segregation = \beta_1 b + \beta_2 b * B \tag{1.4}$$

I should find $\beta_1 > 0$ and $\beta_2 > 0$.

1.4 Testing the Model

What do I find? Table 1.7 presents estimates of equations 1.3 and 1.4, for my cross-section of 106 metropolitan areas.

I use the *nonwhite/white income ratio* as a proxy for b. I look at non-whites rather than blacks because the 1960 data include detailed information on household income for nonwhites but not for blacks. I normalize nonwhite income by white income in an effort to control for levels of income across cities.

%nonwhite is the proportion of households that are categorized as nonwhite. Again, I examine nonwhites rather than blacks because data on nonwhites is more readily available. I have checked my results using the percentage of blacks instead, and it does not matter.

Finally, I use the standard deviation of household income (*s.d. income*) as a measure of the dispersion of income analogous to h in the model.

The cross-section results are not particularly illuminating. Nothing is really significant besides the constant, and the $\bar{R}^2$ is practically 0. On other hand, the first-difference results (in Table 1.9) provide some limited support for the model. In particular, the interaction between *s.d. income* and *%nonwhite* is significant and positive as the model predicts.

Interestingly, the linear coefficient on *%nonwhite* is highly significant and negative in the first-differences estimation. The model does not have clear predictions about how the proportion of the population that is black—independently of the income of the black population and disparities between the rich and the poor—should affect segregation, but this is an interesting finding in and of itself. Moreover, it is not merely an artifact of this particular specification. The raw correlation between the 1960-1990 change in *%nonwhite* and the 1960-1990 change in racial segregation is -0.3998.

In other words, places that became proportionately more nonwhite over the 1960-

Table 1.7: Cross-Section Estimation of the Model

$racial\ seg._{1990}$	
nonwhite/white income ratio	.2693909
	(.3643632)
%nonwhite	-.5819496
	(1.37259)
s.d. income	-.006484
	(.006769)
*nonwhite/white income ratio * %nonwhite*	-1.671758
	(1.850453)
*s.d. income * %nonwhite*	.0483709
	(.0424858)
constant	.593808
	(.2874364)
n	106
$\bar{R}^2$	-.03

Standard errors are in parenthesis.

Table 1.8: Changes in the Proportion of Nonwhites, 1960-1990

Largest Gainers		Smallest Gainers	
Stockton	.1222528	Birmingham	-.0422524
Corpus Christi	.1362849	Chattanooga	-.0370912
San Diego	.1389721	Charleston	-.027129
San Francisco	.1552506	Lexington	-.0250275
Riverside-San Bernadino	.1582049	Charlotte	-.0179774
Bakersfield	.1652974	Tyler	-.0116121
El Paso	.1662858	Nashville	-.0086337
New York	.2011263	Montgomery	-.0042527
Fresno	.2072428	Greensboro	-.000751
Los Angeles	.2230457	Baton Rouge	-.0007282

1990, also became much less segregated. Table 1.9 presents a list of the cities with the largest increases and decreases in the proportion of nonwhites over the 1960-1990 period.

It is striking that seven out of ten of the fastest gainers are in California and that every single one of the smallest gainers is in the South or Texas. This is consistent with the strong regional pattern in changes in racial segregation exhibited in Table 3. However, as demonstrated in the first column of Table 9, the finding that changes in the interaction between *s.d. income* and *%nonwhite* are positively and significantly related to increases in segregation is robust to the inclusion of region dummies and hence is more than just a regional phenomenon.

So, a model in which changes in demographics and income distribution are the only factors affecting segregation can go some distance towards explaining changes in racial segregation, but clearly other factors matter as well. The following section explores some different explanations for changes in income and racial segregation over the past 30 years.

Table 1.9: First-Difference Estimation of the Model

	Δ *racial seg*$_{1960-1990}$	
Δ *nonwhite/white income ratio*	.0367794	-.0401391
	(.0654571)	(.0666862)
Δ%*nonwhite*	-7.433967	-6.298961
	(2.33836)	(2.486456)
Δ *s.d. income*	-.009573	-.0029113
	(.0063366)	(.0063772)
Δ *nonwhite/white income ratio* $*$ Δ%*nonwhite*	-1.86223	-1.030116
	(1.022346)	(1.065861)
Δ *s.d. income* $*$ Δ%*nonwhite*	.1925233	.1681255
	(.065783)	(.0699488)
constant	.0201378	-.1282934
	(.2016271)	(.1997885)
East	.1566621	-
	(.0393302)	
Midwest	.0950687	-
	(.0357389)	
South	.057967	-
	(.0369947)	
n	106	106
$\bar{R}^2$	.3304	.222

Standard errors are in parenthesis. The omitted region is the West.

1.5 More Explanations for Changes in Segregation

1.5.1 Demand Shocks

In the previous section, we saw that, on the West Coast, racial segregation has fallen even as the black population has increased. In what types of cities has the black population share grown? What kind of blacks are moving to cities where the black share of the population has grown?

Table 1.10 addresses the first question. It shows the first-difference estimation from the previous section with an added variable (*shock*) designed to capture exogenous demand shocks to a city's economy. To construct *shock* I multiply the employment shares in different one digit industries in 1960 by their national growth rates in the subsequent, 1960-1990 period. In other words, *shock* reflects how rapidly a city's economy would have grown had it maintained its 1960 industrial structure and had each sector in that city grown at the national rate. Cities in the Rust Belt with large 1960 shares of employment in durables manufacturing have low values of *shock*. Cities with low 1960 shares in durables manufacturing and high values in services, government, and high tech manufacturing have high values of *shock*.

shock is highly significant in specifications both with and without region dummies. Cities with declining industries have grown much more segregated, even controlling for changes in the racial composition and income distribution.

I have estimated specifications similar to the ones in Table 1.10 using a variable which only captures the variation in the 1960 shares in durables manufacturing and got very similar results. So, durables manufacturing really drives these findings. The behavior of segregation in major Rust Belt cities like Detroit, Chicago, and Cleveland is just clearly different.

Interpreting the *shock* variable is difficult. I have included variables that should captures changes in both black and white income distributions caused by changes in a city's industrial structure. Perhaps segregation in the Rust Belt is a legacy of the huge influx of poor uneducated blacks to these places during the first half of this century. Those migrants were not easily assimilated, but even as black incomes and

Table 1.10: First-Difference Estimation of the Model with Demand Shock Variable

	$\Delta\, racial\ seg_{1960-1990}$	
Δ *nonwhite/white income ratio*	.0641361	.0806993
	(.0633663)	(.0633531)
Δ%*nonwhite*	-7.4554	-8.077705
	(2.243631)	(2.224882)
Δ *s.d. income*	-.0031815	-.0075528
	(.0057242)	(.0060363)
Δ *nonwhite/white income ratio* $*$ Δ%*nonwhite*	-2.021908	-2.387202
	(.9769168)	(.9811745)
Δ *s.d. income* $*$ Δ%*nonwhite*	.1747282	.1950644
	(.0627969)	(.0623746)
shock	-7.612529	-6.05007
	(1.51858)	(1.753401)
constant	.1582741	.1756388
	(.1882133)	(.1964071)
East	-	.1063256
		(.0400418)
Midwest	-	.0589353
		(.0354661)
South	-	.0571173
		(.0350763)
n	106	106
$\bar{R}^2$	.3732	.3981

Standard errors are in parenthesis. The omitted region is the West.

education has risen, attitudes towards race in the industrial centers of the Midwest seem to have been slow to change.

Conversely, perhaps attitudes towards race in the burgeoning cities of the South and West are more liberal. Many of the cities of the West in particular are relatively new. Few families have lived there for more than one or two generations. Consequently, various ethnic and other group identities are weaker there than in other regions. Maybe race is viewed more flexibly where other group identities are less strong. Rapid economic growth may have further minimized racial and ethnic conflict.

1.5.2 Hispanics

This paper has pointed out certain regional patterns in segregation, in particular falling segregation of blacks in the West and South. Coincidentally, those are also regions where the hispanic population has grown rapidly.

Unfortunately, because of changes in the way the Census Bureau categorizes hispanics, it is not possible to track changes in hispanic population shares over the period I examine. Nonetheless there are some interesting relationships between changes in segregation and 1990 hispanic population shares.

To a certain extent, blacks and hispanics seem to be segregated in the same places. The raw correlation between black segregation and hispanic segregation in 1990 is .3103, but black segregation is low where the proportion of hispanics is high. Further, this is not merely a regional relationship. Table 1.11 shows the first-difference specification 1990 $\%hispanic$ included. The 1990 $\%hispanic$ variable is significant even controlling for regions and including the *shock* variable which maintains its significance.

In other words, the moderately large correlation between black and hispanic segregation masks the fact that blacks in cities with large hispanic populations tend to be more easily assimilated. This might reflect the fact that black populations are smaller and/or more affluent in cities with large hispanic populations.

Table 1.11: First-Difference Estimation of the Model with Demand Shock Variable

	Δ *racial seg*$_{1960-1990}$	
Δ *nonwhite/white income ratio*	.0559875	.0435523
	(.183471)	(.0614753)
Δ%*nonwhite*	-4.377973	-4.774493
	(2.393735)	(2.351665)
Δ *s.d. income*	-.0019454	-.0062849
	(.0055249)	(.0057687)
Δ *nonwhite/white income ratio* $*$ Δ%*nonwhite*	-1.06777	-1.372271
	(.993287)	(.98614)
Δ *s.d. income* $*$ Δ%*nonwhite*	.1129115	.1304949
	(.0639015)	(.062695)
shock	-6.002506	-4.998928
	(1.558272)	(1.702758)
1990 %*hispanic*	-.3462147	-.3888428
	(.1162108)	(.1194674)
constant	.0559875	.0744121
	(.184371)	(.1898373)
East	-	.103392
		(.038190)
Midwest	-	.0454251
		(.0340704)
South	-	.0704692
		(.0336956)
n	106	106
$\bar{R}^2$	.4194	.4528

Standard errors are in parenthesis. The omitted region is the West.

1.6 Conclusion

This paper developed and tested a very simple model of racial and income segregation. I find some support for the model. In particular there seems to be a complementarity between the black population share and income inequality in the raising racial segregation. One possible interpretation of this finding is that self-segregation is attractive to blacks when there are enough other well educated blacks.

I also find that metropolitan areas with rapidly growing black population shares have exhibited the largest declines in racial segregation. These are also the cities with economies that have experienced favorable demand shocks and with large 1990 hispanic populations.

The stability of aggregate segregation represents the net effect of these two opposing trends. On the one hand, rising income inequality within the black population may have contributed to the emergence of new middle-class black communities resulting in the increased segregation of affluent blacks from affluent whites in the major cities of the Northeast, but the migration of smaller numbers of relatively affluent blacks to the Sun Belt has probably reduced racial segregation in the smaller, newer cities of the South and West.

Chapter 2

The Response of Policing to Crime

2.1 Introduction

As crime or the perceived threat of crime has increased, spending on policing has increased. At the same time, state and local governments, the primary providers of policing, have experienced increasing fiscal strain precipitated by decreased federal aid and a spate of state and local tax and expenditure limits. This paper documents how increases in crime have induced more spending on policing by cities in this difficult fiscal environment.

I find that cities increase spending on police in response to increases in crime, consistent with neo-classical models of the demand for police pioneered by Becker (1968).

In addition, I find some evidence that the fiscal health of cities affects their ability to increase police spending. Poorer cities are less able to respond to crime by increasing policing or may be forced to cut other services to finance policing, perpetuating a downward spiral of crime, inadequate public services, and upper and middle class flight to the suburbs. In fact, one crucial element of Clinton's 1994 crime bill was the $8.8 billion COPS program to put 100,000 new police on the streets of America's cities (Johnston and Weiner 1996). This program has already helped crime-ridden

fiscally strapped cities like New Orleans, where the COPS program freed $11.5 million for non-police spending (Schleifstein 1996).

Further, I explore how cities finance increases in policing. I find that policing is financed both from increases in revenues and from cuts in other categories of spending. These revenue increases and spending cuts may be more onerous for the poorest cities. High tax rates may further erode already depleted tax bases. Inadequate services may be cut back even more. For example, in his most recent budget for the City of Los Angeles, Mayor Riordan proposed to eliminate 1,100 jobs in other areas of city government in order to finance new policing (Merl and Wilgoren 1996). In contrast, Aurora, Illinois, a comparatively affluent suburb of Chicago, increased police spending along with other categories of spending as total spending increased by 13% while property taxes remained constant. Aurora was able to finance these increases with taxes on new property owners, from the previous fiscal year's budget surplus, and by issuing $17 million in new bonds (Dardick 1996).

I also look for evidence of the response of private policing to changes in crime. While I expected to find some substitution away from public policing to private policing where public police have more "market power," I find that the magnitude of the response of private policing to increases in crime is similar to the magnitude of increases in public policing—even controlling for measures which I posit ought to raise the market power of public police, such as police unionization rates and the extent of intergovernmental competition in a city's metropolitan area.

Finally, I find that the extent of intergovernmental competition in a city's metropolitan area reduces the responsiveness of both public and private policing to changes in crime. One possible interpretation of this result for public policing is that in metropolitan areas composed of many separate municipalities, there is a free-rider problem. If one city's enforcement efforts also benefits surrounding cities, levels of policing will tend to be socially sub-optimal. Why this result obtains for private policing remains a puzzle.

This work touches on several extant literatures.

Within economics there is large literature on the demand for public goods be-

ginning with the theoretical work of Tiebout and typified by the recent empirical work of Minter-Hoxby (1994). There is less work on the demand for police specifically. Cameron (1985) examines the supply and demand of policemen in the 42 Police Force Areas of England and Wales, but he focuses more on how supply responds to wages than on determinants of demand. Clotfelter (1977) attempts to measure the elasticity of substitution between private and public police with respect to their relative wages in a cross-section of American states in 1970. I attempt to address similar questions in a larger panel of American cities.

While this paper seeks to measure how crime affects the demand for police, another literature explores the opposite facet of this relationship and attempts to quantify the deterrent effect of police on crime. Prime examples of this literature are Levitt (1995) and Craig (1987).

To the extent that I attempt to quantify the effect of fiscal variables on cities ability to spend, this paper is also related to the recent political economy literature including Poterba (1994) and Besley and Case (1995) which quantify the effect of state-level balanced budget amendments and term limits respectively on state spending.

Within political science, a number of authors have looked at the political determinants of police spending. Jacob (1984) attempts to test whether budgeting is done incrementally as in Wildavsky (1996) so that the budget shares of different categories of spending change only slowly even as spending priorities shift. Jacob performs case studies of a limited set of cities and finds that even as crime has risen, police budgets have not grown as a share of total city government budgets. He interprets this as confirmation for the incremental view.

Other political scientists have tried to measure how specific institutions affect the response of policing to crime. For example, Beecher, Lineberry, and Rich (1981) argue that the structure of city politics influences how policing responds to crime. They examine ten cities divided into four categories based on whether their city governments are controlled by business interests, politicians, multiple interest groups, or bureaucrats. They show that there are differences in the levels and intensity of policing across these four different types of city governments *even after controlling*

for the level of crime.

Walker, Chaiken, Jiga, and Polin (1981) and Hoffman (1981) come closer to my emphasis on the effect of fiscal conditions on the response of policing to crime. They both examine the response of spending on police to one particular fiscal institution, California's Proposition 13. Hoffman presents a detailed case study of how San Francisco adjusted to Proposition 13 while Walker, *et al.* provide a broad statistical overview of how California communities adjusted to the property tax limitation measure.

The next section discusses a few simple theories of how police spending might respond to crime. The following section provides a brief overview of the data used in the empirical section of the paper. The penultimate section presents empirical results and a final section concludes.

2.2 Theories of Police Spending

How should a city government adjust its level of police spending in response to increases in crime?

2.2.1 A Price Theoretic Model

Simple price-theoretic models of crime date back to Becker (1968) and include subsequent contributions by Ehrlich (1981, 1996). In these models, crime increases as its expected payoff increases. This implies an upward sloping supply schedule of offenses in offense-expected payoff space. Individuals and governments can take (costly) actions to decrease the expected payoff to criminals committing crime. This tradeoff between costly enforcement and the cost of crime itself implies a downward sloping demand (or tolerance) schedule for crime in offense-expected payoff space. Equilibrium in this "market" for crime occurs at the intersection of these supply and demand schedules.

The comparative statics of this model are analogous to those of conventional partial equilibrium models of markets for goods. An exogenous increase in the tendency

of criminals to commit crime can be modeled as an outward shift in the supply of crimes. In equilibrium, this will result in a higher level of crime and in a lower expected payoff from crime (price). Ehrlich (1981) has also demonstrated that this will result in a higher level of expenditure on law enforcement under reasonable assumptions.

So price-theoretic models predict that police expenditures ought to rise with exogenous increases in crime but not sufficiently to choke off any increase in the number of offenses.

While this model provides a plausible description of how decisions about the level of law enforcement are made, clearly these decisions take place in a much richer and more complicated institutional environment.

2.2.2 Fiscal Traps and Intergovernmental Grants

The Becker model assumes that individuals and the governments that represent them are actually able to alter spending on law-enforcement to optimal levels. However, cities may be unable to alter spending if they have substantial debt to service as the result of adverse shocks or poor financial decisions in the past. Similarly, individuals may choose lower levels of self-protection or demand lower levels of law enforcement from their governments if they are liquidity constrained.

On the other hand, cities may receive intergovernmental grants from state or federal governments that are tied to city income or crime levels. To the extent that intergovernmental grants buffer adverse shocks to cities, cities may be able to adjust levels of law enforcement to increased levels of crime even when they have high levels of debt.

2.2.3 Political Economy

The Becker model implicitly assumes that police services are provided competitively. In contrast, political economy models of policing emphasize the market power of policemen or city government bureaucrats.

Police and city government bureaucrats with budgetary authority for policing may have market power for at least two reasons. First, policing is a public monopoly. Second, the ability of the public to control the police through indirect democracy is limited by the fact that police have better information about their own effort levels and the underlying level of criminality in their communities than their public overseers.

If police departments have market power, we might expect them to be able to expropriate rents when the demand for security increases. In fact, Jacob (1984) shows that most increases in police spending go towards raising the salaries of existing police officers rather than the hire of new officers. Moreover, these increases in police salaries do not seem to be correlated with measures of police performance such as arrests relative to reported crimes or increased patrolling.

If bureaucrats have market power, they might use increases in crime as a pretense to increase the size of government and extend the scope of their responsibilities as documented by Niskanen (1975) and Peltzman (1980) and explained by Romer and Rosenthal (1979). The extent to which increases in police spending are financed out of new revenues resulting in higher total spending is potentially a measure of bureaucrats' power.

Where the public provision of policing is particularly inefficient, we might see people turn to private alternatives. In addition, to the extent that intergovernmental competition reduces the market power of policemen and bureaucrats, we might expect to see more efficient public provision and less "opting out" to private alternatives where there is more intergovernmental competition.

2.3 The Data

I use data from the FBI's *Uniform Crime Reports* and from the *Census of Governments* to explore the reaction of policing and other government spending to increases in crime over a 10 year period from 1980 to 1990 in a sample of 322 cities with 1980 populations of at least 50,000. I look at both ten year differences (in other words city

fixed-effects estimates) as well as a cross-section of cities in 1990.

The *Uniform Crime Reports* records offenses and arrests for seven index crimes[1] as well as various measures of policing for almost every police department in the U.S. My measure of crime is the per capita property crime rate.[2] I ignore violent (non-property) crimes because there are many fewer violent crimes and they tend to be much less responsive to policing.[3] I also use some measures of policing from the *Uniform Crime Reports* including the total number of police employees per capita, the number of police officers per capita, and the number of civilian employees per capita.

Table 2.1 provides summary statistics for the data I use from the *Uniform Crime Reports.* The means of my measures of crime and policing are relatively stable across the two years in my sample. In fact most of my results will be identified from cross-sectional variation in different cities experiences rather than differences within cities over time.

The *Census of Governments* provides measures of police and other local government spending and employment, the pattern and level of local taxation and other local government revenues, and local government financial conditions including debt levels and credit ratings. Table 2.2 shows summary statistics of selected variables from the *Census of Governments.* Policing is a significant and stable part of spending by local governments.

I obtain information on private police from Public Use Micro-Samples of the 1980 and 1990 decennial censuses. I identify private police as workers with census occupation code 426 (guards and police, except public service).[4] Unfortunately, while my public policing measures are measured at the city level, I only know the metropolitan area, not the specific city, in which private police live. More importantly, I do not

[1]The index crimes are: murder, forcible rape, robbery, aggravated assault, burglary, larceny, and motor vehicle theft

[2]Index property crimes are burglary, larceny, and motor vehicle theft

[3]For the specifications in the empirical section that follows, I have obtained similar but less precise results for violent index crimes and all index crimes to what I find for property crimes.

[4]Other studies, such as Cunningham (1985) have identified private policing with these occupations.

Table 2.1: Summary Statistics of *Uniform Crime Reports* Data

variable	mean	standard deviation
1980		
per capita property crimes	0.067	0.02
police employees per capita	0.002	0.0008
police officers per capita	0.0018	0.0007
1990		
per capita property crimes	0.071	0.027
police employees per capita	0.003	0.0008
police officers per capita	0.002	0.0007
1980-1990 changes		
per capita property crimes	0.003	0.02
police employees per capita	0.0002	0.0005
police officers per capita	0.00009	0.0003

Table 2.2: Summary Statistics of *Census of Governments* Data

variable	mean	standard deviation
1980		
police spending per capita	103.20	37.52
total government spending per capita	939.52	519.52
1990		
police spending per capita	103.19	37.52
total government spending per capita	1060.42	627.24
1980-1990 changes		
police spending per capita	0.19	4.94
total government spending per capita	120.90	342.59

All measures are in 1990 dollars.

know in which cities private police work.

A problem with much empirical work in crime is the potential endogeneity between crime and policing. This paper does not propose any novel way of addressing this problem. Many of my results are in un-instrumented OLS form. I make some crude efforts to instrument for crime using socio-economic variables like the racial composition of cities and local unemployment rates which I take from the *County and City Data Book*. While these are of dubious exogeneity, previous authors (Fox 1981) have found positive correlations between both the proportion of the population consisting of young black males as well as local economic conditions and crime.

Tables 2.3 and 2.4 present the first stages on which my IV results are based. The first-difference and cross-section results are broadly similar. As expected, crime is positively correlated with the unemployment rate in both specifications. As opportunities in the legitimate sector decrease, more people turn to the illegitimate sector. In addition, Table 2.3 shows that young blacks—whether because of racist law enforcement practices or because they are truly more prone to commit crime—commit a disproportionate number of measured crimes. While the coefficients on Δ log *med. age* and Δ log *black%* seem to have the wrong signs, the interaction between the two is significant and has the right sign. Table 2.4 supports the assertion that a young population is associated with a high crime rate while the inclusion of the interaction term obscures the relationship between %black and crime.

2.4 Empirical Results

This section presents empirical evidence on the relationship between police expenditures and crime. I examine: the univariate relationship between policing and crime, the effect of city fiscal conditions on the ability of cities to raise police spending in response to increases in crime, how increases in police spending are financed, the effect of unionization and intergovernmental competition on the responsiveness of policing to crime, and, finally, the relationship between the responsiveness of public and private policing to crime.

Table 2.3: First Stage: Crime on Demographics, 1980-1990

Δ log *unemp. rate*	0.1132
	(0.0502)
Δ log *med. age*	0.9076
	(0.445)
Δ log *black%*	-0.0337
	(0.0466)
Δ log *med. age* x Δ log *black%*	-1.1184
	(0.4594)
N	322
$\bar{R}^2$	0.0393

Standard errors are in parenthesis.
The dependent variable is the change in the log of the property crime rate.
Δ log *unemp. rate* is the change in the log of the civilian unemployment rate.
Δ log *med. age* is the change in the log of the median age of the population of a city.
Δ log *black%* is the change in the log of the proportion of a city's population that is black.

Table 2.4: First Stage: Crime on Demographics, 1990

unemployment rate	0.0303
	(0.0091)
log median age	-0.5399
	(0.2781)
%black	-0.0512
	(0.0556)
log med. age x %black	0.0171
	(0.0161)
N	322
$\bar{R}^2$	0.2336

Standard errors are in parenthesis.
The dependent variable is the log of the 1990 property crime rate.

Table 2.5: The Effect of Crime on Policing, 1980-1990

$\Delta \log officers$	$\Delta \log police$	$\Delta \log spending$
	OLS	
0.0931	0.0787	0.0927
(0.0264)	(0.0281)	(0.0399)
	IV	
0.131	0.1412	0.6147
(0.1598)	(0.1743)	(0.2183)

The independent variable is the change in the log of the per capita property crime rate. Standard errors are in parenthesis.

Table 2.6: The Effect of Crime on Policing, 1990

log officers per capita	log police per capita	log spending per capita
	OLS	
0.3112	0.3511	0.2296
(0.0416)	(0.0367)	(0.0457)
	IV	
0.9236	0.7814	0.2792
(0.1095)	(0.0891)	(0.0928)

The independent variable is the change in the log of the per capita property crime rate. Standard errors are in parenthesis.

2.4.1 The Effect of Crime on Policing

Tables 2.5 and 2.6 show the response of various measures of policing to crime. From left to right, the dependent variables are: the change in the log of the number of police officers per capita, the change in the log of the number of police employees per capita, and the change in the log of police spending per capita. In first differences, the OLS results for the three variables are similar. The elasticity of policing with respect to the property crime rate is on the order of 0.1. The number of actual police officers seems to be somewhat more responsive to crime than police employment overall. The similarity between the coefficients in the officers and spending regressions suggests that new police expenditures go towards hiring new officers rather than increasing the pay of currently employed officers in contrast to Jacob (1984).

The lower panel of Table 2.5 attempts to account for the simultanaiety of policing

and crime using the instruments described in the previous section. To the extent that police deter crime, I would expect my OLS results to understate the true responsiveness of policing to crime. Controlling for the endogeneity of crime and policing results in slightly larger point estimates. In addition, instrumenting changes the coefficient in the spending regression by more than the coefficients in the officers and police employment regressions. These IV results suggest that spending increases significantly more rapidly than employment or officers in response to increases in crime lending credence to the Jacob (1984) view that police unions are able to appropriate rents when the threat of crime increases.

Table 2.6 shows similar specifications for the cross-section in 1990. The point estimates in the cross-section are much larger than in first differences. Moreover, while instrumenting in first-difference changes the coefficient in the spending regressions by much more than in the police and officers regressions, the reverse is true in the cross-section.

Table 2.7 adds a set of covariates to the cross-section regression. Including more controls slightly reduces the responsiveness of policing to crime. *old* and *middle* are included to capture the age distribution of the population. Communities with higher proportions of the old and middle aged tend to have higher levels of policing. Perhaps the old are less able to protect themselves or value police more than other public services. For example, communities with older populations will have less need to spend on education. Higher per capita income is associated with *lower* levels of both police officers and total police employment, but *higher* levels of per capita police spending. High income cities may employ a different relatively capital intensive patrolling technology or may simply choose to pay their police more. Density is associated with higher levels of policing even controlling for crime, suggesting that dense areas may actually be harder to patrol. Finally I include log population as a control for size. Recent work (Glaeser and Sacerdote 1996) has documented the relationship between city size and crime rates. Table 2.7 corroborates this work.

Table 2.8 replicates Table 2.7 but includes region dummies. Levels of police employment are highest in the East and the Southeast and lowest in the West with the

Table 2.7: Determinants of Policing, 1990

	log officers	log police	log spending
log crime rate	0.283	0.3463	0.3041
	(0.0384)	(0.0344)	(0.0379)
old	0.0404	0.0329	0.0101
	(0.0047)	(0.0042)	(0.0046)
middle	0.0165	0.0138	-0.0013
	(0.0049)	(0.0044)	(0.0049)
log per capita income	-0.2489	-0.0552	0.6237
	(0.0749)	(0.0671)	(0.0737)
log density	0.0979	0.0834	0.1704
	(0.0215)	(0.0192)	(0.0211)
log population	0.0778	0.08	0.1161
	(0.0197)	(0.0177)	(0.194)

log officers is the number of police officers per capita.
log police is the number of police employees per capita.
log spending is the log of police spending per capita.
log crime is the log of the property crime rate.
old is the proportion of people aged 65+ in the population.
middle is the proportion of people aged 19-64 in the population.
log density is the log of a city's population per sq. mile.
log population is the log of a city's population.

Midwest somewhere in between. On the other hand, there are fewer disparities in actual police spending across regions. Controlling for region, the negative relationship between income and real measures of policing no longer obtains, but other coefficients in Table 2.8 look similar to those in Table 2.7.

2.4.2 Do Fiscal Conditions Matter?

The results in the previous sub-section suggest that cities increase police resources in response to increases in crime. However, these results may understate the "true" responsiveness of policing to crime if cities are differentially able to increase police spending. For cities with very high levels of debt and poor credit ratings, it may be difficult to finance new spending by borrowing, and the fact these cities have borrowed in the past suggests that it may be difficult for them to raise new revenues from other sources as well.

This has serious policy implications. If cities are constrained by debt from expanding policing, one can imagine a vicious circle whereby crime increases, perpetuating an erosion of the tax base as businesses and individuals flee, resulting in even lower levels of police spending, which further increases crime, etc. If the dislocation caused by unpoliced crime is costly and if residents of cities are unable to coordinate to prevent crime themselves when policing is inadequate, higher levels of government may have an interest in preventing these "runs" on cities.

Table 2.9, however, shows little or no effect of credit on the response of policing to crime. The top panel of Table 2.9 uses the log of the Moody's credit rating at the beginning of the period in 1980 as a measure of credit. The bottom panel presents similar results using the log of beginning of period debt per capita. In no specification of either panel does credit seem to have any effect on cities' responsiveness to crime.

On the other hand, the cross-section results in Table 2.10 present conflicting evidence of the effect of credit in policing. I measure the effect of the log of the Moody's credit rating and the log of per capita debt *in 1980* on the cross-section of policing

Table 2.8: Determinants of Policing with Region Dummies, 1990

	log officers	log police	log spending
log crime rate	0.2756	0.3199	0.3137
	(0.0326)	(0.0329)	(0.0409)
old	0.0248	0.0233	0.0128
	(0.0039)	(0.0039)	(0.0048)
middle	0.0091	0.009	0
	(0.0039)	(0.004)	(0.0049)
log per capita income	0.0061	0.1009	0.5705
	(0.0623)	(0.0629)	(0.0779)
log density	0.0796	0.0821	0.1552
	(0.0203)	(0.0205)	(0.0254)
log population	0.1014	0.0934	0.1136
	(0.0156)	(0.0158)	(0.0195)
East	0.484	0.2954	-0.0578
	(0.0383)	(0.0387)	(0.048)
Midwest	0.212	0.0939	-0.0755
	(0.0351)	(0.0354)	(0.0439)
Southeast	0.3376	0.2428	-0.0949
	(0.035)	(0.0354)	(0.0439)

East, Midwest, Southeast are region dummies. The omitted region is the West.

Table 2.9: The Effect of Credit on the Response of Policing to Crime, 1980-1990

	$\Delta \log officers$	$\Delta \log police$	$\Delta \log spending$
$\Delta \log crime\,rate$	0.025	0.0178	-0.0004
	(0.0523)	(0.0558)	(0.0802)
$\Delta \log crime\,rate$ x $\log credit$	0.0747	0.0661	0.0515
	(0.0407)	(.0434)	(0.0625)
$\Delta \log crime\,rate$	0.09	0.0753	0.1138
	(0.0413)	(0.0439)	(0.0623)
$\Delta \log crime\,rate$ x $\log debt$	-0.0034	-.0041	0.0186
	(0.0283)	(0.03)	(0.0429)

Standard errors are in parenthesis.

and police spending ten years later in 1990.[5] While poor credit ratings (i.e. high values of the Moody's rating) are associated with a lower responsiveness of policing to crime, high values of per capita debt seem to lead to a higher responsiveness of policing to crime.

In fact, as demonstrated in Table 2.11, debt is a poor measure of credit. While some heavily indebted cities are both heavily indebted and have poor credit ratings (e.g. New York and Boston). Other rapidly growing cities (e.g. Atlanta) borrow in anticipation of future growth. There is almost no correlation (-0.0273) between the two credit measures in the full sample.

Table 2.12 replicates Table 2.10 but includes a set of control variables and region dummies. Including the controls substantially reduces the effect of credit on real measures of policing but actually makes the effect of credit on police spending negative and significant.

Intergovernmental aid should be particularly valuable for cities that are unable to borrow. Table 2.13 shows specifications including per capita intergovernmental revenue interacted with the crime rate and my credit measure on the right hand side. In the specification without any controls, intergovernmental aid has the predicted

[5]Since contemporaneous debt and policing are determined simultaneously by city governments' budgeting decisions, contemporaneous debt is a poor measure of cities' ability to borrow.

Table 2.10: The Effect of Credit on the Response of Policing to Crime, 1990

	log officers	log police	log spending
log *crime rate*	0.3589	0.3798	0.2276
	(0.0442)	(0.0392)	(0.0492)
log *crime rate* x log *credit*	-0.0412	-0.0243	0.0018
	(0.014)	(0.0125)	(0.0156)
log *crime rate*	0.2771	0.3226	0.211
	(0.0405)	(0.0357)	(0.0454)
log *crime rate* x log *debt*	0.0549	0.0461	0.031
	(0.0103)	(0.0091)	(0.0116)

Standard errors are in parenthesis.
log officers is the log of per capita officers.
log police is the log of per capita police.
log spending is the log of per capita police spending.

Table 2.11: Credit Measures: Top 10 Cities (1980 pop. > 250,000)

Cities with Worst 1980 Moody's Ratings	
1.	Detroit, MI
2.	Boston, MA
3.	Cleveland, OH
4.	New York, NY
5.	Buffalo, NY
6.	Philadelphia, PA
7.	Pittsburgh, PA
8.	St. Louis, MO
9.	New Orleans, LA
10.	Miami, FL
Cities with Highest 1980 Debt Per Capita	
1.	Atlanta, GA
2.	Wichita, KS
3.	St. Paul, MN
4.	Minneapolis, MN
5.	San Francisco, CA
6.	Birmingham, AL
7.	New York, NY
8.	New Orleans, LA
9.	Oakland, CA
10.	Boston, MA

Table 2.12: The Effect of Credit on the Response of Policing to Crime with Controls, 1990

	log officers	log police	log spending
log crime rate	0.2772	0.3261	0.3468
	(0.035)	(0.0353)	(0.0435)
log crime rate x log credit	-0.0013	-0.0054	-0.0287
	(0.0108)	(0.0109)	(0.0134)
old	0.0248	0.0232	0.0127
	(0.0039)	(0.0039)	(0.0048)
mid	0.0091	0.0092	0.0008
	(0.0039)	(0.0039)	(0.0049)
log per capita income	0.0077	0.1073	0.6042
	(0.0637)	(0.0643)	(0.0791)
log density	0.0792	0.0807	0.1473
	(0.0206)	(0.0208)	(0.0255)
log population	0.1018	0.0951	0.1228
	(0.016)	(0.0162)	(0.0199)
East	0.4833	0.2927	-0.0718
	(0.0387)	(0.0391)	(0.0481)
Midwest	0.2124	0.0956	-0.0665
	(0.0353)	(0.0356)	(0.0439)
Southeast	0.3376	0.2423	-0.0944
	(0.0351)	(0.0354)	(0.0437)

Table 2.13: The Effect of Intergovernmental Revenue and Credit, 1990

	log officers	log police	log spending
Without Controls			
log crime rate	0.4024	0.4124	0.2651
	(0.0389)	(0.0361)	(0.046)
log crime rate x log credit	-0.0855	-0.0581	-0.0366
	(0.0131)	(0.0121)	(0.0155)
log crime rate x log credit x log intergov.	0.1025	0.0769	0.0882
	(0.0104)	(0.0096)	(0.0123)
With Controls			
log crime rate	0.2565	0.3104	0.3167
	(0.0339)	(0.0348)	(0.0416)
log crime rate x log credit	-0.0307	-0.0278	-0.0713
	(0.0119)	(0.0122)	(0.0146)
log crime rate x log credit x log intergov.	-0.0181	-0.0138	-0.0263
	(0.0036)	(0.0037)	(0.0044)

Standard errors are in parenthesis
log officers is the log of per capita officers.
log police is the log of per capita police.
log spending is the log of per capita police spending.
log crime rate is the log of the per capita property crime rate

effect and roughly offsets the effects of credit constraints on police spending. However, once I include controls and region dummies, the intergovernmental revenue interaction has the wrong sign.

2.4.3 The Effect of Increases in Crime on City Budgets

In addition to constraining cities' spending on police, credit may also force cities to divert resources from other areas of government spending.

Exploring the effect of crime on the composition of the bundle of public services provided by different cities is complicated by the fact that different cities provide different sets of services. Table 2.14 examines the effect of crime on changes in spending

Table 2.14: The Response of non-Police Spending to Crime, 1980-1990

Δ log *sewers*	Δ log *roads*	Δ log *other*
	OLS	
-0.1529	-0.0085	-0.0363
(0.136)	(0.0998)	(0.062)
	IV	
1.2136	-0.1426	0.4839
(0.6859)	(0.4409)	(0.3026)

Δ log *sewers* is the change in the log of per capita spending on sewers.
Δ log *roads* is the change in the log of per capita spending on roads and highways.
Δ log *other* is the change in the log of per capita spending on all types of spending besides police.
The independent variable is the change in the log of the per capita property crime rate. In the lower panel, I instrument with the change in the log of the civilian unemployment rate and the change in the fraction of the population that is black.
Standard errors are in parentheses.

in two areas, sewers and highways, which nearly all of the cities in my sample provide, as well as its effect on an aggregate of all other spending besides policing. The results are underwhelming. While the OLS results provide some limited evidence that cities reduce other spending in response to increases in crime, the IV results suggest the opposite and are at least as precisely estimated.

Table 2.15 shows analogous specifications in levels in addition to examining the effect of credit on non-police spending. In levels, crime, rather than reducing spending on non-police items, seems to actually increase certain categories of non-police spending. Moreover, poor credit (i.e. high values of log credit) seems to facilitate rather than hinder spending. However, including controls and region dummies in the bottom panel of Table 2.15, crime still seems to lead to higher non-police spending, but this effect is lower in cities with worse credit. Unfortunately, the coefficient on the intergovernmental revenue interaction term has the reverse of the predicted sign in theses specifications.

If increases in police spending are not financed by cuts in other types of spending, then the money must come from increased revenues or debt. Table 2.16 demonstrates the relationship between crime, revenue sources, and debt. While the OLS

Table 2.15: The Response of non-Police Spending to Crime and Credit, 1990

	log sewers	log roads	log other
Without Interactions and Controls			
log crime rate	0.4283	-0.011	0.1608
	(0.11)	(0.0809)	(0.0762)
With Interactions			
log crime rate	0.2683	-0.1895	0.0671
	(0.1133)	(0.0832)	(0.0567)
log crime rate x log credit	0.0497	0.1311	-0.1187
	(0.0385)	(0.0283)	(0.0193)
log crime rate x log credit x log intergov.	-0.05	-0.0121	-0.1053
	(0.0112)	(0.0083)	(0.0056)
With Interactions and Controls			
log crime rate	0.2449	0.0456	0.131
	(0.1324)	(0.0888)	(0.0603)
log crime rate x log credit	0.0326	-0.0112	-0.1277
	(0.0465)	(0.0312)	(0.0211)
log crime rate x log credit x log intergov.	-0.0482	-0.0323	-0.094
	(0.0141)	(0.0095)	(0.0064)

log sewers is the log of per capita spending on sewers.
log roads is the log of per capita spending on roads.
log other is the log of per capita spending on non-police spending.
log crime rate is the log of property crimes per capita.
log credit is the log of the Moody's bond rating.

Table 2.16: Crime, Spending, Revenues, and Debt, 1980-1990

Δ log *expenditure*	Δ log *revenues*	Δ log *intergov.*	Δ log *deficit*
	OLS		
-0.18	0.0411	0.0925	0.0789
(0.6069)	(0.049)	(0.1033)	(.3477)
	IV		
0.5055	0.4961	-0.4031	-0.4707
(0.6165)	(.5787)	(0.4731)	(1.5283)

Δ log *revenues* is the change in the log of all revenues per capita.
Δ log *intergov.* is the change in the log of intergovernmental revenues per capita.
Δ log *deficit* is the change in the log of the annual deficit per capita where the deficit is defined as the difference between all expenditures and all revenues.
The independent variable is the change in the log of the per capita property crime rate. In the lower panel, I instrument with the change in the log of the civilian unemployment rate and the change in the fraction of the population that is black.
Standard errors are in parentheses.

results show that revenues and debt increase moderately with crime, the IV results show a much larger response of revenue to crime providing support for the view that bureaucrats use the threat of crime to increase the budgets they oversee.

Table 2.17 presents evidence on revenues and spending in the cross-section. Crime triggers increases in spending, revenues, and taxes. In other words, confirming the results in Tables 2.15 and 2.16, crime seems to be associated with larger government rather than a reallocation of government resources towards policing. Once again, the credit interaction enters theses specifications with the expected sign while the intergovernmental interaction has the opposite of the expected sign.

2.4.4 Unions

To the extent that unions are able to more effectively organize policemen into a cartel and reduce competition, we should see a reduced responsiveness of public policing to increases in crime where police are more heavily unionized. Table 2.18, however, provides little support for this view. In no specification, does the fraction of police employees who are unionized seem to have a significant effect on the demand

Table 2.17: Crime, Spending, Revenues, and Debt, 1990

	log expenditure	log revenues	log taxes
Without Interactions and Controls			
log crime rate	0.1673	0.1742	0.0442
	(0.694)	(0.0686)	(0.0736)
With Interactions			
log crime rate	0.083	0.0878	-0.218
	(0.0512)	(0.05)	(0.0706)
log crime rate x log credit	-0.1108	-0.1085	-0.0654
	(0.0175)	(0.017)	(0.0241)
log crime rate x log credit x log intergov.	-0.0969	-0.0967	-0.0646
	(0.005)	(0.005)	(0.007)
With Interactions and Controls			
log crime rate	0.1549	0.1518	0.1003
	(0.0535)	(0.053)	(0.0677)
log crime rate x log credit	-0.1235	-0.1247	-0.0577
	(0.0188)	(0.0185)	(0.0238)
log crime rate x log credit x log intergov.	-0.0864	-0.0873	-0.0375
	(0.0057)	(0.0056)	(0.0072)

log expenditure is the log of total government spending per capita.
log revenue is the log of total government revenues per capita
log intergov. is the log of intergovernmental revenues per capita
log crime rate is the log of property crimes per capita.
log credit is the log of the Moody's bond rating.

Table 2.18: The Effect of Unions on Police Spending, 1980-1990

	Δ log *officers*	Δ log *police*	Δ log *spending*
Δ log *crime rate*	0.1476	0.1141	0.1681
	(0.0596)	(0.0635)	(0.0887)
Δ log *crime rate* x *%organized*	-0.0811	-0.0528	-0.1097
	(0.0794)	(0.0845)	(0.1182)

%organized is the fraction of police employees covered by collective bargaining at the beginning of the period.

Table 2.19: The Effect of Unions on Police Spending, 1990

	log officer	log police	log spending
	Without Controls		
log crime rate	0.3459	0.3706	0.3011
	(0.0457)	(0.0405)	(0.0496)
log crime rate x % unionized	-0.0312	-0.0158	-0.0617
	(0.0187)	(0.0165)	(0.0203)
	With Controls		
log crime rate	0.2609	0.3063	0.3203
	(0.0339)	(0.0343)	(0.0424)
log crime rate x % unionized	0.0196	0.0228	-0.0059
	(0.0143)	(0.0145)	(0.0179)

for police.

Table 2.19 effect of unionization rates on police spending in the cross-section. Without including controls, unionization rates appear to reduce the demand for police, but including controls and region dummies breaks this correlation.

2.4.5 Intergovernmental Competition

To the extent that intergovernmental competition weakens the market power of bureaucrats and policemen, I would expect the demand for public policing to be more responsive to increases in crime where there is more competition. I measure the extent of competition in the market for publicly provided security by the per capita number

of municipalities and police departments in a city's metropolitan area.

The upper panel of Table 2.20 shows the results for cities and the lower panel shows the result for police departments. When I measure the extent of intergovernmental competition with the log of the number of governments or police departments per capita in a city's metropolitan area, I find little effect of competition on crime. However, when I measure competition as just the number of governments, I find that more competition actually reduces the responsiveness of public policing to crime. Table 2.21 shows similar results in levels although the effect is smaller when I include controls and region dummies.

One possible interpretation of this result is that, while more governments may result in more competition in the provision of public services, it may also lead to a free-rider problem when one jurisdiction's enforcement efforts also reduce crime in neighboring jurisdictions. This free-rider problem will reduce the incentive of any one jurisdiction to respond to increases in crime.

2.4.6 Private Policing

Finally, I present some suggestive evidence on private policing. As previously mentioned, I only have measures of private policing at the metropolitan area not the city level. So, for each city in my sample I use the ratio of the number of private police in that city's metropolitan area to that city's metropolitan area's population as my measure of private policing. This measure would be equivalent to a city's true private policing rate if private police were distributed proportionately to population.

Table 2.22 shows the responsiveness of the private policing rate to the various fiscal measures examined in previous parts of this paper. The first column presents the univariate relationship between private policing and crime. The responsiveness of private policing to crime is similar in magnitude to that of public policing.

In columns 2-4 I do not find any effect of fiscal measures on the responsiveness of private policing to changes in crime, but in columns 5 and 6, the number of governments in a metropolitan area seems to affect private policing in much the same way

Table 2.20: The Effect of Intergovernmental Competition on Police Spending

	$\Delta \log officers$	$\Delta \log police$	$\Delta \log spending$
Governments			
$\Delta \log crime\ rate$	0.4843	0.7617	0.1472
	(0.406)	(0.43)	(0.6124)
$\Delta \log crime\ rate$ x $\log governments\ per\ capita$	0.0383	0.0669	0.0053
	(0.0397)	(0.0421)	(0.0598)
$\Delta \log crime\ rate$	0.1805	0.1491	0.1021
	(0.0333)	(0.0358)	(0.0515)
$\Delta \log crime\ rate$ x $governments$	-0.0008	-0.0006	-0.0004
	(0.0002)	(0.0002)	(0.0004)
Police Departments			
$\Delta \log crime\ rate$	0.3032	0.6033	0.7976
	(0.2809)	(0.2976)	(0.4243)
$\Delta \log crime\ rate$ x $\log police\ departments$	0.0203	0.0512	0.0698
	(0.0274)	(0.0291)	(0.0414)
$\Delta \log crime\ rate$	0.1888	0.1642	0.1239
	(0.0373)	(0.0399)	(0.0573)
$\Delta \log crime\ rate$ x $police\ departments$	-0.0014	-0.0013	-0.0012
	(0.0005)	(0.0005)	(0.0007)

Table 2.21: The Effect of Intergovernmental Spending on Policing, 1990

	log officer	log police	log spending
Without Controls			
log crime rate	0.3965	0.4228	0.3299
	(0.0483)	(0.0427)	(0.0529)
log crime rate x log governments	-0.0163	-0.0139	-0.0195
	(0.0049)	(0.0044)	(0.0054)
log crime rate	0.4301	0.4706	0.4359
	(0.0472)	(0.0412)	(0.0489)
log crime rate x log police departments	-0.0256	-0.0257	-0.0443
	(0.0053)	(0.0046)	(0.0055)
With Controls			
log crime rate	0.2681	0.3292	0.3327
	(0.0375)	(0.0379)	(0.047)
log crime rate x log governments	0.0022	-0.0014	-0.0039
	(0.0041)	(0.0042)	(0.0052)
log crime rate	0.2888	0.346	0.3903
	(0.038)	(0.0383)	(0.0469)
log crime rate x log police departments	-0.0029	-0.0058	-0.0172
	(0.0043)	(0.0044)	(0.0054)

as public policing. This is puzzling since, given that public policing is less responsive in cities in fragmented metropolitan areas, one might expect to see some substitution towards private policing in these places. The similarity between the public and private results suggests that there is something else intrinsic to divided metropolitan areas which attenuates the response of policing to crime.

2.5 Conclusion

Policing does respond to crime, and cities with poor credit are less able to respond to crime. Controlling for crime, credit-constrained cities spend less on police and are forced to cut other spending to finance policing.

The welfare implications of these credit constraints are ambiguous. If there is a tendency for government to grow too large, binding credit constraints might prevent the size of government from diverging too far from optimal levels. On the other hand, there is an equally compelling argument that the desertion of central cities—spurred at least partly by high crime rates—is the result of a coordination failure: high crime precipitates out-migration eroding the tax base from which adequate enforcement can be financed. Because the actions of leavers affect stayers, there is scope for government intervention to help cities stop crime and stem out-migration.

In addition, I find that communities in divided metropolitan areas police less for a given level of crime. This evidence that communities "free ride" on neighboring communities enforcement efforts provides yet another motivation for more intergovernmental coordination of local law enforcement.

Table2.22: Private Policing

	(1)	(2)	(3)	(4)	(5)	(6)
Δ log property crime rate	0.1377	0.1625	0.1613	0.0653	0.2034	0.3439
	(0.0625)	(0.1232)	(0.0822)	(0.1481)	(0.0838)	(0.0922)
Δ log property crime rate **x** log Moody's credit rating		-0.023				
		(0.0984)				
Δ log property crime rate **x** log debt per capita, 1981			0.0225			
			(0.06)			
Δ log property crime rate **x** %unionized				0.1133		
				(0.193)		
Δ log property crime rate **x** governments					-0.0007	
					(0.0006)	
Δ log property crime rate **x** police departments						-0.0034
						(0.0011)

The dependent variable is the log of the change in per capita private police in a city's metro area.

Chapter 3

Sorting and the Growth in Inequality

3.1 Introduction

Labor market sorting, the tendency of people of similar ability to work together, is one explanation for the growing income inequality of the past 20 years. This paper presents some empirical estimates of the extent of labor market sorting finding little evidence for sorting by highly aggregated groups such as 2-digit industries or occupations. In addition, a method for doing inference on a particular index of sorting is developed.

A large recent literature has sought to explain the growth in income inequality in the U.S. over the past twenty years. This literature, exemplified by Katz and Murphy (1992), Juhn, Murphy, and Pierce (1993), Davis and Haltiwanger (1991) has generally appealed to simple price theoretic explanations of changes in inequality, e.g. more educated workers have been earning more because technological change has been skill biased. While some of these explanations have empirical support, the magnitude of recent changes in inequality seem too large to reconcile with these kinds of explanations. Further, while some of the growth in inequality has been due to changing returns for observable attributes, much of the increase can be attributed to increasingly unequal payments to workers who are observationally equivalent.

This paper explores an additional explanation for the growth in inequality, increased labor market sorting of the type elaborated in Kremer and Maskin (1994). Labor market sorting of this type can make the effect of skill-biased technological change larger. If sorting obtains, then skill-biased technological change will not only make skill more valuable but will also increase the size of the positive externality from which a skilled worker's co-workers benefit. Hence, in a competitive equilibrium, skilled workers will be more likely to work together and make each other more productive. This sorting explanation of the growth in inequality does not address the problem of why people who are observationally equivalent have been receiving increasingly unequal incomes. However, it does make the magnitude of overall changes in inequality more theoretically plausible.

The measure of sorting examined in this paper is the correlation between the education or wage of a worker and the education or wages of her co-workers in the same industry or occupation. Previous papers such as Davis and Haltiwanger (1991) have reported similar statistics without confidence intervals. This paper proposes a crude way of calculating confidence intervals for these statistics using a bootstrap.

In the next section, labor market sorting will be explained within the framework of the Kremer and Maskin model. In section 3, some of the existing empirical literature on inequality will be surveyed. Section 4 lays out the empirical methodology, describes the data, and presents the results of some attempts to measure sorting. Section 5 concludes.

3.2 A Model of Sorting

Sorting in the Kremer and Maskin model (as in other matching models including Becker's model of the marriage market and Kremer's model of the spread of AIDS) is driven by the interplay between the complementarity of different workers' skills in production and their substitutability. A good manager makes a worker more productive, but can three workers be substituted for one good manager?

Kremer and Maskin posit a simple production function of the form:

$$Y = q_m^{\alpha} q_a^{\beta} \tag{3.1}$$

where q_m is the ability of the "manager" and q_a is the ability of her "assistant" and $\alpha > \beta$. This is clearly an abstraction from reality where production depends on the abilities of many people and the amount and quality of capital, but it captures the idea that output depends multiplicatively on the abilities of many and that the ability of more skilled workers, here "managers," matters more.

Supposing production is of this form, and assuming a certain distribution of people with different abilities. Kremer and Maskin ask: how will these people match together in production pairs in a competitive market? They find that when the distribution of types is relatively tight, relatively high ability types will be "managers" in firms with relatively low ability types as "assistants."

However, when the distribution of abilities gets more spread out (or, when the coefficient on manager's ability decreases relative to the coefficient on assistant's ability) relatively high ability types will start to match together as "managers" and "assistants" in the same firms. In other words, on the margin, workers of medium ability will prefer to be "assistants" in firms managed by high ability managers to being "managers" in firms with low ability "assistants."

Kremer and Maskin argue that this is exactly what happened during the eighties, that production changed in such a way that whereas before, highly educated workers might have been managers in large firms, for example in manufacturing, employing a wide range of people with different abilities, in the eighties, partly because of the increased use of computers and partly because of the shift towards services, able people increasingly worked together in industries like computer software and investment banking. This technological shift not only increased the returns to education directly, but also made it increasingly likely that more able people would work together and make each other more productive further increasing the return to education.

3.3 Existing Empirical Evidence on Equality

A large recent literature has documented changes in inequality in the U.S. over the past 20 years. The following summary highlights a few papers.

Davis and Haltiwanger (1991) use plant data from the *National Survey of Manufactures* to decompose changes in the variance of wages into within plant and between plant components. They analyze changes in the distribution of production and non-production wages separately. The National Survey of Manufacturers data do not include information about individual workers' education or socioeconomic background, but they do include the entire distribution of wages within a plant.

Davis and Haltiwanger find that the between plant variance in wages has increased more rapidly than the total variance in wages. In other words, even as the distribution of wages has widened, production workers have increasingly worked in plants employing relatively homogeneous workforces. This is evidence for sorting, although the authors do not frame their results that way.

Katz and Murphy attempt to interpret some of these phenomena within a simple supply and demand framework. For example, they argue that one reason the college premium did not increase in the seventies was the rapidly increasing supply of college grads as the large cohorts finished college and well educated women increasingly chose to work.

The following section extends the decomposition of changes in the variance of wages developed by Davis and Haltiwanger to the *Current Population Survey* and shows its relationship to theoretical models of sorting.

3.4 Estimates of Sorting Using the CPS

3.4.1 Empirical Strategy

Sorting implies that over time people will increasingly tend to work with people similar to themselves. This process is difficult to characterize empirically. One might think that the most appropriate way to quantify sorting might be to observe labor

market transitions and see whether people tend to move towards jobs in which they interact with people more like themselves. But, this approach is confounded by the fact that even if we think sorting has been occurring, people routinely drop in and out of the labor force for reasons other than sorting.

Instead, Kremer and Maskin (1994) propose looking at aggregate measures of skill segregation in work. If aggregate skill segregation is increasing over time, then sorting is occurring. The specific measure they propose is the correlation of a worker's ability with the abilities of workers in the same work group. Mathematically,

$$\rho = \sqrt{\frac{E_j E_{i,k}(w_i^j - \bar{w})(w_k^j - \bar{w})}{E_{i,j}(w_i^j - \bar{w})^2}} \tag{3.2}$$

where j indexes groups and i and k index workers within groups. The inner term of the numerator is the within group covariance in the attribute w. The expectation of this within group correlation is then taken over all groups. The denominator is the total variance in the attribute taken over all workers in all groups.

This correlation is difficult to grasp. The sample analog is somewhat easier to understand. It is:

$$\rho = \sqrt{\frac{\sum_{j=1}^{J} I_j \left[\frac{\sum_{i=1}^{I_j} \sum_{k=1}^{I_j} (w_i^j - \bar{w})(w_k^j - \bar{w})}{I_j^2} \right]}{\sum_{j=1}^{J} \sum_{i=1}^{I_j} (w_i^j - \bar{w})^2}} \tag{3.3}$$

where I_j is the number of workers in the j'th group. This expression simplifies to:

$$\rho = \sqrt{\frac{\sum_{j=1}^{J} I_j (\bar{w}^j - \bar{w})^2}{\sum_{j=1}^{J} \sum_{i=1}^{I_j} (w_i^j - \bar{w})^2}} \tag{3.4}$$

where $\bar{w}^j$ is the group j average of the attribute w. This is essentially the ratio of the between group sample variance (appropriately weighted for the size of the j groups) to the total sample variance of the attribute w.

If this ρ is increasing over time, then there has been sorting. In other words, if the between group variance is growing faster than the total variance, people who are more similar in terms of some attribute are increasingly working together.

In the next section, I estimate ρ's for workers' years of schooling. ρ's are calculated for groupings of workers into one-digit industry occupation cells. These groupings are crude attempts at defining the workplace. Ideally, we would like to observe a worker and each of the people with whom they interact on a regular basis. Instead, we observe only a worker's industry and occupation, which tell us something about her co-workers.

3.4.2 The CPS Data

These ρ's are estimated using data from the Mare-Winship matching extracts of the *Current Population Survey* (CPS). I restrict my attention to employed males between the ages of 25 and 44 to abstract from labor supply issues as well as from the fact that the content and quality of education has varied over time so that a current 65 year old with a high school education has very different skills than a current high school graduate. I measure schooling in years of education. Edcuation is top-coded at 18.

The data begin in 1983, the earliest year for which I have industry and occupation coded according to current Standard Industrial Classifications, and go through 1991. I break the data into 11 industries (construction; manufacturing; transportation, communications, and other public utilities; wholesale trade; retail trade; finance, insurance and real estate; business and repair services; personal services; entertainmentand recreation services; professional and related services; and public administration) and five occupations (managerial and professional specialty occupations; technical sales and administrative support occupations; service occupations; precision production, craft, and repair occupations; and operators fabricators and laborers) giving me 55 industry/occupation cells.[1]. I examine industry occupation-occupation cells because I believe those to be the best empirical analogs of the workplace. I limit myself to relatively aggregated industry and occupation classifications so that I have reasonable numbers of observations in each cell.

[1]I exclude observations in the agriculture, forestry, and fisheries and mining industries and the farming, forestry, and fishing occupations

Summary statistics of education by industry/occupation cells are for the beginning and end of my sample are presented in Tables 3.1 and 3.2. Some of the cells are small, but recall that my measure of sorting weights these small cells accordingly less. As one might expect, the best educated workers tend to be managers or professionals (including scientists and engineers) in professional services, government, and manufacturing and the least educated workers are unskilled manual laborers and service workers in all industries.

3.4.3 Results

Calculated ρ's are presented in Table 3.3. Assuming the data are drawn from a joint normal distribution, ρ has a complicated finite-sample distribution (Anderson 1968). However, ρ is asymptotically normal. The standard errors in Table 3.3 are bootstrapped and inference is done assuming the asymptotic approximation is valid. For each year, 100 simulated samples are drawn from the actual data and ρ's are calculated for each of these simulated samples. Standard deviations are then calculated from these simulated ρ's.[2]

This is a contribution to this literature since previous authors (e.g. Davis and Haltiwanger (1991)) who have looked at this statistic have not reported confidence intervals.

The test statistic is then the difference between ρ's in different years over the standard error of the difference, which is distributed normally.

The results provide mixed support for the sorting story elaborated in section 2. Within occupation/industry cell correlation in education actually seems to increase significantly from 0.5667 to 0.6013 between the two end years, but the change is less dramatic comparing other years and, in fact, the measure actually peaks in the middle of the period in 1987. So, while it appears that industry/occupation by education has changed in the recent past, it would be hard to conclude that there is any secular trend.

[2]The distributions of the simulated rho's actually look normal after 100 iterations, so given that the bootstrap is computationally intensive, I limit myself to 100 iterations.

Table 3.1: Mean and Standard Deviation of Years of Schooling and Number of Observations by Industry/Occupations Cell, 1983

industry:	occupation				
	managerial/professional	technician	service	skilled manual	unskilled manual
construction	13.283	13.462	6.333	11.813	11.203
	3.179	1.450	6.658	2.706	2.438
	60	13	3	300	128
manufacturing	15.277	13.170	11.412	11.891	11.288
	2.083	3.499	4.317	2.425	2.505
	213	141	17	230	451
transport/comm.	14.797	13.811	13.333	12.337	12.170
	2.392	2.028	2.066	1.895	2.121
	69	95	6	86	153
wnolesale	14.406	14.006	12.286	12.000	11.695
	2.394	2.140	0.951	2.782	2.686
	32	162	7	39	95
retail	14.074	13.236	11.609	11.656	11.262
	2.547	2.400	2.629	2.845	3.012
	54	229	215	61	126
FIRE	14.446	14.924	11.474	12.500	11.000
	2.675	2.086	3.272	0.850	1.732
	65	79	19	10	5
business service	15.194	14.279	12.271	11.526	11.944
	2.331	2.453	2.482	2.231	1.941
	67	43	48	114	36
personal service	13.731	13.909	12.220	11.385	11.682
	3.424	2.427	3.353	2.663	3.497
	26	11	59	13	22
entertainment	14.027	12.857	12.632	12.000	13.500
	2.598	3.078	3.905	2.366	2.121
	37	7	19	6	2
professional services	16.832	14.535	11.875	12.533	11.357
	1.753	2.893	3.397	2.460	2.198
	363	71	120	30	28
public administration	15.756	13.529	13.169	12.067	11.667
	2.477	2.755	1.746	2.738	2.059
	82	34	65	15	15

Table 3.2: Mean and Standard Deviation of Years of Schooling and Number of Observations by Industry/Occupations Cell, 1991

industry:	occupation				
	managerial/professional	technician	service	skilled manual	unskilled manual
construction	13.512	14.545	12.000	11.855	10.962
	2.434	2.018	0	2.402	2.928
	86	11	1	387	132
manufacturing	15.637	13.331	11.081	12.034	11.597
	1.905	2.698	2.302	2.515	2.434
	259	160	37	263	496
transport/comm.	14.747	13.848	12.923	12.655	12.115
	2.289	1.880	1.256	1.438	2.330
	87	125	13	113	191
wholesale	14.209	13.779	11.364	12.545	12.009
	2.231	2.387	2.656	1.563	2.098
	43	190	11	33	108
retail	14.050	13.139	11.110	12.288	11.850
	2.495	2.271	3.247	2.234	2.655
	80	296	281	80	153
FIRE	15.598	15.115	11.407	11.350	12.778
	1.798	1.872	2.275	3.558	2.438
	102	148	27	20	9
business services	15.174	13.549	10.833	11.713	12.541
	2.372	2.161	3.086	2.375	1.876
	121	82	66	143	61
personal services	14.344	13.882	11.923	12.923	11.722
	1.994	1.691	2.613	2.431	2.137
	32	17	91	13	18
entertainment	14.324	13.000	12.524	10.000	12.333
	3.121	3.055	2.182	4.359	0.577
	34	7	21	3	3
professional services	16.745	14.371	12.124	12.176	11.935
	1.751	2.525	2.619	1.381	3.286
	486	116	121	34	31
public administration	16.357	14.186	13.570	12.188	11.714
	1.869	2.196	2.428	1.642	2.217
	115	43	86	16	21

Table 3.3: Correlation of Education within Industry/Occupation Cells

year	ρ_{ed}
83	0.5667
	(0.0098)
84	0.5849
	(0.0092)
85	0.5992
	(0.0082)
86	0.5870
	(0.0098)
87	0.6030
	(0.0102)
88	0.5766
	(0.0092)
89	0.5908
	(0.0077)
90	0.6013
	(0.0090)
91	0.6013
	(0.0087)

The number ρ is the within group (i.e. industry or occupation) correlation in the attribute (i.e. education, wages, blue-collar status). An industry ρ_{ed} of 1 indicates that all sample workers work in industries that employ sample workers who have exactly the same level of education.

3.5 Disaggregating Sorting

While overall segregation by skill does not seem to be increasing, that does not preclude the possibility that certain specific education groups have become more isolated in work.

To measure the segregation of specific education groups, I use another measure, the Taeuber and Taeuber index of segregation which is

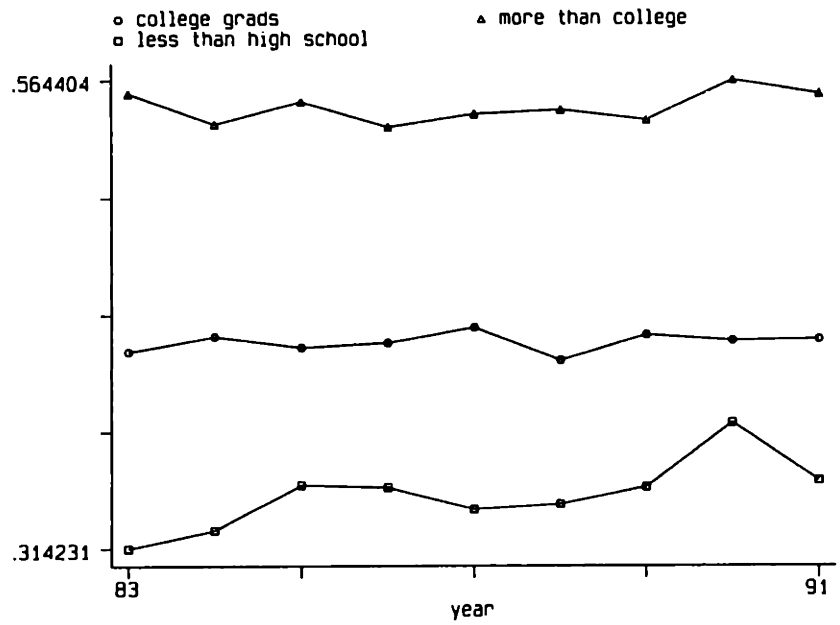
$$T = 1/2 \sum_{i=1}^{N} |x_i/X - p_i/P|$$

where X is the total population of the group whose segregation is being measured, x_i is the population of the group whose segregation is being measured in unit i, P is the aggregate population of all groups in all units, and p_i is the population of all groups in unit i. This measure captures the extent to which the distribution of a particular group diverges from the distribution of the general population and is naturally bounded between 0 and 1.

While this measure was originally developed to measure the spacial segregation of different racial and ethnic groups, here I use it to measure the segregation of different skill groups into various industry occupation cells. Table 3.4 shows measures of "workplace" segregation for three education groups: college graduates, workers with some post-college education, and workers who have not completed high school. While college grads and people with more than a college degree do not seem to have become any more segregated in work, there seems to have been some trend towards the isolation the less than high school educated over the course of my sample. (Figure 3-1 presents the same data graphically.)

Where are the less than high school educated the most concentrated? Table 3.5 shows the industry occupation cells in which the less than high school educated are the most concentrated at the beginning and end of my sample. While in both years many less than high school educated workers are concentrated in the retail/service and manufacturing/laborer cells, retail/service accounts for more of the segregation of the less than high school educated later in the period suggesting that the types of

Figure 3-1: Workplace Skill Segregation by Education Group, 1983-1991



sectoral shifts hypothesized by Kremer and Maskin may explain at least some of the growth in segregation of the unskilled.

3.6 Conclusion

This paper has argued that increased sorting of the type in Kremer and Maskin (1994) might explain the recent growth in inequality. Using a bootstrap to calculate standard errors for one measure of education and wage segregation by industry and occupation groups, it is empirically demonstrated that workplace segregation by skill has remained relatively unchanged over the course of the eighties. I find some evidence that the less than high school educated have become more isolated in work, but this trend is offset by the relative stability in the workplace segregation of other skill groups in aggregate measures of skill segregation.

This evidence is not necessarily damning to sorting explanations of the growth in inequality. First, the Kremer and Maskin model is really a model about the workplace and it is arguable that a worker's industry and occupation adequately characterize

Table 3.4: Workplace Skill Segregation by Education Group, 1983-1991

year	college	post-college	less than high school
83	0.4198	0.5576	0.3142
	(0.0107)	(0.0152)	(0.0109)
84	0.4280	0.5415	0.3240
	(0.0105)	(0.0136)	(0.0120)
85	0.4222	0.5532	0.3484
	(0.0101)	(0.013)	(0.0124)
86	0.4246	0.5399	0.3471
	(0.0091)	(0.0119)	(0.0114)
87	0.4328	0.5468	0.3353
	(0.0091)	(0.0148)	(0.0128)
88	0.4152	0.5489	0.3382
	(0.0109)	(0.0141)	(0.0099)
89	0.4290	0.5437	0.3475
	(0.01)	(0.014)	(0.0133)
90	0.4259	0.5644	0.3818
	(0.0087)	(0.0128)	(0.0108)
91	0.4266	0.5572	0.3509
	(0.0096)	(0.0122)	(0.0113)

Table 3.5: Industry/Occupation Cells in which the Less than High School Educated are the Most Concentrated

industry/occupation	concentration
1991	
retail/service	0.0872
manufacturing/laborer	0.0554
construction/craft	0.0386
construction/laborer	0.0277
retail/laborer	0.0264
business services/craft	0.0212
business services/service	0.0173
manufacturing/craft	0.0106
tranport/laborer	0.0105
manufacturing/service	0.0074
1983	
manufacturing/laborer	0.0787
retail/service	0.0560
construction/laborer	0.0252
construction/craft	0.0252
retail/laborer	0.0245
business services/craft	0.0224
professional services/service	0.0151
manufacturing/craft	0.0133
wholesale/laborer	0.0111
retail/craft	0.0091

her work environment. Second, the allocation of different people with different levels of education into different jobs changes only slowly. It is hard to assess the economic significance of the changes in aggregate skill segregation indices measured in this paper.

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