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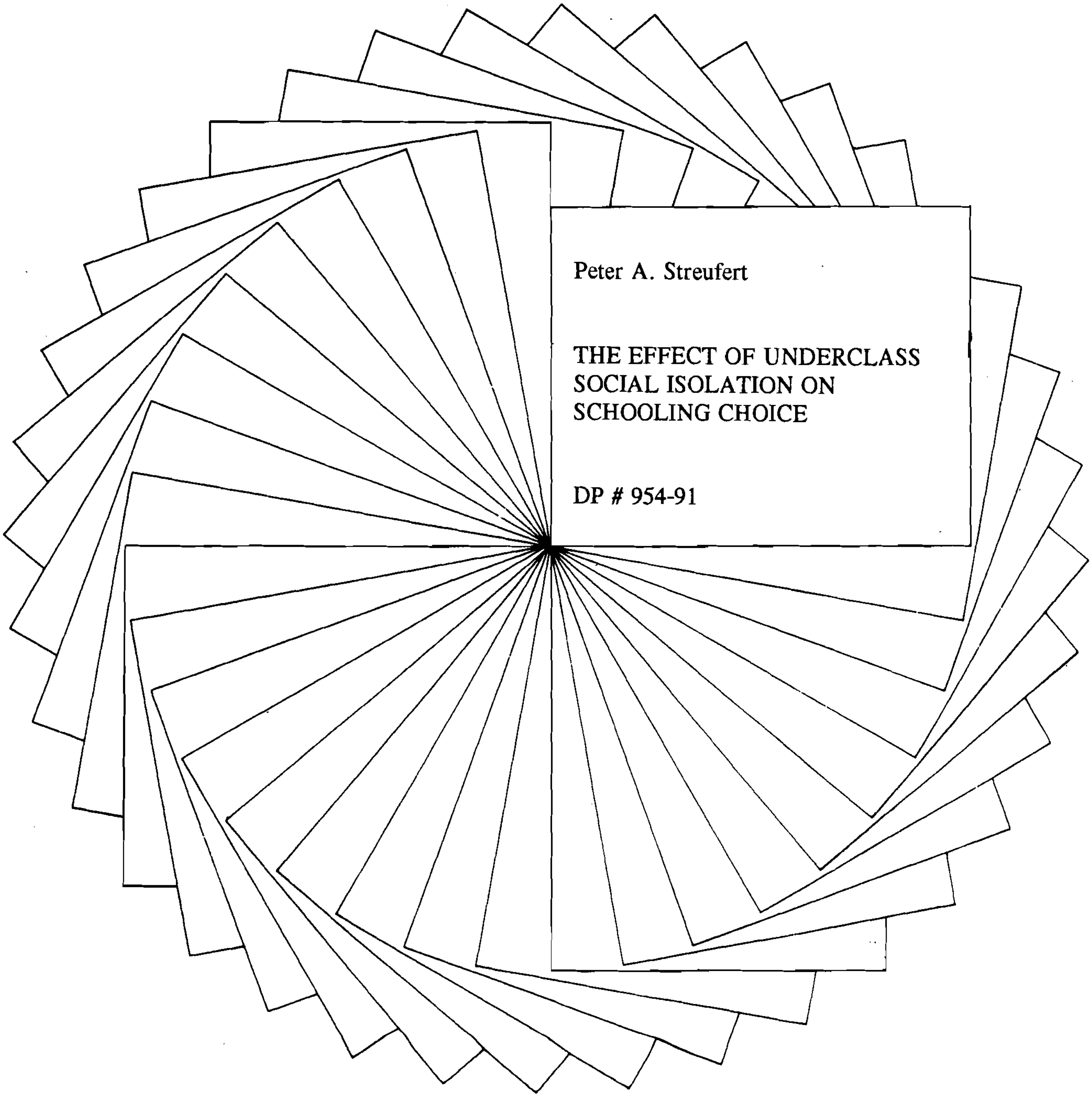

Peter A. Streufert

THE EFFECT OF UNDERCLASS SOCIAL ISOLATION ON SCHOOLING CHOICE

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The Effect of Underclass Social Isolation on Schooling Choice

Peter A. Streufert
Department of Economics and
Institute for Research on Poverty
University of Wisconsin-Madison

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Abstract

I model underclass social isolation as the loss of high-income role models, and study the plausible conjecture that this truncation depresses schooling choice. Although the conjecture stands in calibrated simulations, it fails at many other parameter values: truncation might not decrease a youth's estimate of incremental postschool income, and it always decreases a youth's estimate of forgone income. I also show that the introduction of untruncated role models during college can polarize underclass youth, and that welfare depresses schooling choice through a distinct and reinforcing channel. Numerous simulations exhibit the severity of these effects, and suggestions for empirical testing are offered.

THE EFFECT OF UNDERCLASS SOCIAL ISOLATION ON SCHOOLING CHOICE

1. Introduction

In this paper, I formally analyze one central thesis of Wilson's (1987) book The Truly Disadvantaged, namely, the thesis that the social isolation of the underclass causes underclass youth to underestimate the effect of schooling on income, and consequently, to choose too little schooling.

When he states this thesis most precisely (pp. 56-58), Wilson argues that "a perceptive ghetto youngster in a neighborhood that includes a good number of working and professional families . . . can see a connection between education and meaningful employment." Yet, "in a neighborhood with a paucity of regularly employed families . . . the relationship between schooling and postschool employment takes on a different meaning." This results in "a shockingly high degree of educational retardation."

I begin my work by modeling how role models shape a youth's perception of the relationship between schooling and income. A role model is taken to be a single observation of the schooling and income of an adult worker in the labor force, and many such observations enable a youth to (nonparametrically) regress schooling on income. Thus a youth's information-gathering process resembles a labor economist's estimation of the earnings function. If the role models that a youth observes are representative of the labor force, then the youth will choose an efficient amount of schooling as a consequence of utility maximization. Section 2 defines schooling choice in this ideal "benchmark" model, Theorem 1 provides a useful marginal characterization of this choice, and Simulation 1 calibrates the benchmark model to fit Mincer's earnings function and the schooling distribution of the U.S. labor force.

I then model underclass social isolation as the elimination of high-income observations at each level of schooling. That is, I assume that an underclass youth observes a sample of role models that is truncated from above. Wilson's thesis suggests that the resulting bias in the regression unambiguously depresses schooling choice. Yet Section 3 demonstrates that this is not a logical necessity for two substantive reasons.

First, if Wilson's conjecture stands, it stands because social isolation reduces the perceived increment to postschool income that would result from an additional year of schooling. In other words, the thesis hinges on the idea that truncation reduces the slope of the regression. But truncation doesn't always reduce the slope. Counterexample 1 exhibits a very plausible instance in which the slope steadily increases with social isolation.

Second, social isolation inevitably decreases the level of the regression. This serves to increase, rather than decrease schooling by making a youth underestimate the income she forgoes in attending another year of school. Thus social isolation depresses schooling choice only if (1) it leads to a decrease rather than an increase in the perceived incremental postschool income resulting from another year of schooling, and (2) the magnitude of this decrease is sufficiently great to overcome the underestimation of forgone income. Thus, the consequences of social isolation are quite ambiguous theoretically.

On the other hand, Simulation 2 suggests that Wilson's thesis has considerable empirical relevance in spite of its theoretical ambiguity. For instance, a youth who would have completed high school in Simulation 1's calibrated benchmark model only completes eighth grade in Simulation 2's model of social isolation. This precipitous drop in schooling choice results from the lack of any role models earning more than 16 thousand dollars per year.

In a nutshell, an economist would say that representative role models are a "neighborhood" public good. Alternatively, a sociologist might rejoice in hearing an economist argue that a "rational" individual's schooling choice depends critically on that individual's social environment.

Section 4 extends the model by allowing a youth's collection of role models to change as she proceeds through school. For instance, Simulation 3 assumes that an underclass youth's social isolation is lifted when and if she enters college. Such changing role models can split underclass youth into two disparate groups: one whose schooling is stunted by underclass social isolation, and another that is ultimately unaffected by its underclass origins. This accords well with empirical studies suggesting that the income distribution of American blacks is becoming increasingly polarized.

Finally, Section 5 further extends the model to incorporate the effects of welfare on schooling choice. While social isolation truncates role models from above, welfare censors role models from below. In contrast to social isolation, welfare unambiguously reduces incremental postschool income (i.e., the slope of the regression) and increases forgone income (i.e., the level of the regression). It thereby unambiguously depresses schooling choice (Theorem 2). Simulations 4 and 5 show that social isolation and welfare are very likely to depress schooling choice through distinct and reinforcing channels. One squeezes the regression from above, the other squeezes from below, and the effect of a distortion on one side is exacerbated by a distortion on the other.

Section 6 tabulates about 30 simulations which attest to the severity of the effects brought about by social isolation and welfare. Section 7 discusses the scant empirical evidence that can be linked to the model and makes several suggestions for further empirical research. One key suggestion is that researchers question how well mean neighborhood income correlates with social isolation.

Finally, I make two comments about my methodology. First, my stylized mathematical model makes many implicit and explicit assumptions in order to derive sharp statements about the effect of social isolation on schooling choice. These assumptions are discussed in some detail in Section 2.3. Second, my simulations have been generated numerically by thoroughly documented GAUSS programs which I myself have written and tested. I will be very happy to provide the reader with a diskette at no cost.

2. Benchmark Model

2.1. Theory

Imagine that a young person must choose a level of schooling s from the 15-element set $S = \{5,6,\ldots 19\}$. Let $s = 5$ mean that she drops out after the fifth grade, and let $s = 19$ mean that she completes high school (i.e., twelfth grade), four years of college, plus three years of postgraduate training.

One key factor in her decision is the effect that s will have upon her future annual income y. For simplicity, I ignore nonwage income (so that "income" and "earnings" are synonymous) and I assume that annual income y is constant throughout her working career. The actual relationship between s and y is given by the random function $F = \langle F(s)\rangle_{s\in S} \in \mathbf{F}^S$, where $\mathbf{F}$ is the set of all cumulative distribution functions which have nonnegative support, have a finite mean, and assume a positive value everywhere but zero. Thus for every schooling s, F(s) is a c.d.f. over incomes y, and F(s)(y) is the conditional probability that a person with schooling s will have an income less than or equal to y.

Imagine that a young person learns about F by observing role models in the labor force. Formally, each role model is taken to be a single observation of schooling s and income y. Thus, for every s, the collection of role models with schooling s constitutes a sample from the population described by F(s). As elucidated by Manski ((1990), Section 3.1), this mathematical concept of role models accords with the sociological concept of role models, and a collection (i.e., sample) of such role models accords with the sociological concept of a reference group.

For simplicity, I assume asymptotic sampling. That is, I assume that for every s, the young person learns the entire c.d.f. rather than needing to draw statistical inferences from a finite sample. Thus, at every s, the sample mean income and the population mean income coincide at E[F](s), where the expectation operator E: $\bar{\mathbb{F}}^S \to \mathbb{R}_+^S$ is defined by

$$(\forall s)\ E[F](s) = \int_0^{+\infty} y\ dF(s) = \int_0^{+\infty} [1-F(s)(y)]\ dy$$

and $\bar{\mathbb{F}}$ is the set of all cumulative distribution functions having nonnegative support and finite mean. The function E[F] is a perfect nonparametric regression of income on schooling. [The second of the above integrals is equal to the first by Mood, Graybill, and Boes ((1974), p. 65); and $\mathbb{F} \subsetneq \bar{\mathbb{F}}$ since $\mathbb{F}$ also requires that the cumulative distribution function assumes a positive value everywhere but zero (I will need the generality of $\bar{\mathbb{F}}$ to accommodate C's range in Section 5).]

Let $\delta \in (0,1)$ and $\theta \in \mathbb{R}$ be a person's discount factor and taste for attending school, respectively. Both are preference parameters. The parameter δ is familiar, and the simulations will assume that all individuals share the same δ. The parameter θ is new. It may be regarded as the utility of attending a year of school, measured in units of annual income. Thus it decreases with tuition and increases with financial aid and the pleasure one takes in learning and in the classroom environment. I assume that a person knows her θ from birth and that θ is constant over time. The simulations will assume that different persons have different θ's.

Given these preference parameters and the agent's knowledge of the actual relationship between schooling and income, I suppose that the agent chooses schooling (s) to maximize the utility function defined by

$$\begin{aligned} &\int \Sigma_{a=1}^{s} \delta^{a-1}\theta + \Sigma_{a=s+1}^{59} \delta^{a-1} y\ dF(s) \\ &= \Sigma_{a=1}^{s} \delta^{a-1}\theta + \Sigma_{a=s+1}^{59} \delta^{a-1} \int y\ dF(s) \\ &= \Sigma_{a=1}^{s} \delta^{a-1}\theta + \Sigma_{a=s+1}^{59} \delta^{a-1}\ E[F](s). \end{aligned}$$

The index a denotes age minus six (i.e., age measured by one's grade in school). Thus a = 59 coincides with retirement at 65 years from birth. Notice that the objective function satisfies the familiar assumptions of expected utility, it is dynamically consistent, and it is risk-neutral. The choice problem outlined in this paragraph closely resembles that of Rosen ((1977), p. 9-13). Numerous variations appear elsewhere in the labor economics literature (e.g., Heckman (1976) and Ryder, Stafford, and Stephan (1976), to name but two).

In order to denote this and other choice problems more concisely, define the utility function U: $(0,1)\times\mathbb{R}\times\mathbb{R}_+^S\times S \to \mathbb{R}$ by

$$U^{\delta,\theta}[\bar{Y}](s) = \Sigma_{a=1}^{s}\delta^{a-1}\theta + \Sigma_{a=s+1}^{59}\delta^{a-1}\ \bar{Y}(s).$$

The third argument of U, namely $\bar{Y} \in \mathbb{R}_+^S$, is an expected income function with domain S={5,6,...19}. For example, $\bar{Y}$ = E[F] in the benchmark model. Then define the maximization operator M_5: $(0,1)\times\mathbb{R}\times\mathbb{R}_+^S \to S$ by

$$M_5^{\delta,\theta}[\bar{Y}] = \max\{\ \text{argmax}\{\ U^{\delta,\theta}[\bar{Y}](s)\ |\ s \in S=\{5,6,...19\}\ \}\}.$$

The "max{ argmax{" simply means that if several schoolings maximize utility, then M_5 (arbitrarily) picks the highest schooling. This detail assures that M_5 is single-valued and thereby avoids many tedious technicalities. The subscript 5 denotes that the agent is constrained to choose an s no lower than 5, that is, she can't drop out any earlier than after the fifth grade (this lower bound will become a variable in Section 4). The existence of M_5 is obvious because the choice set is finite. It is also obvious that M_5 is weakly increasing in the scalar argument θ. The effects of the scalar argument δ and the functional argument $\bar{Y}$ are quite a bit more subtle.

To summarize this section's benchmark model, a random function F describes the true relationship between schooling s and income y, and a person with discount δ and taste θ will choose schooling s equal to $M_5^{\delta,\theta}\circ E[F]$.

This section concludes with an intuitive marginal characterization of the maximization operator M_5 (this result will later facilitate the analysis of social isolation). For any discount factor $\delta \in (0,1)$ and expected income function $\bar{Y}: \{5,6,\ldots 19\} \rightarrow \mathbb{R}_{+}$, define the <u>incremental net cost function</u> $N^{\delta}[\bar{Y}]: \{6,7,\ldots 19\} \rightarrow \mathbb{R}$ by

$$N^{\delta}[\bar{Y}](s) = \bar{Y}(s-1) - \delta \cdot (\bar{Y}(s) - \bar{Y}(s-1)) \cdot (1-\delta^{59-s})/(1-\delta).$$

$N^{\delta}[\bar{Y}](s)$ gives the incremental net cost of attending grade s given that you have already completed grade s-1. This incremental cost has two terms. First, there is the income you forgo while attending grade s, namely $\bar{Y}(s-1)$. Second, there is the increase in future income that you will enjoy as a result of investing in another year of schooling. The present discounted value of this increase appears in the second term. $N^{\delta}[\bar{Y}]$ accounts for all costs and benefits except for the pleasure one takes in attending school. Accordingly, the taste parameter θ does not appear in the definition of N. Rather, the separability of the objective function will allow Theorem 1 to straightforwardly characterize $M_5^{\delta,\theta}[\bar{Y}]$ by comparing θ with $N^{\delta}[\bar{Y}]$.

The incremental net cost function $N^{\delta}[\bar{Y}]$ is weakly increasing (in s) if the expected income function $\bar{Y}$ is weakly increasing and concave in the sense that

$$(\forall\ s \in \{7,8,\ldots 19\})\quad \bar{Y}(s) - \bar{Y}(s-1) \leq \bar{Y}(s-1) - \bar{Y}(s-2).$$

This occurs because forgone income is increasing with each additional year of schooling (since $\bar{Y}$ is increasing) and because the increment to future income is declining with each additional year of schooling (since $\bar{Y}$ is concave).

However, the function $N^{\delta}[\bar{Y}]$ can be weakly increasing even if $\bar{Y}$ is not concave. For example, Simulations 1 and 2 have increasing incremental net cost even though the expected income function $\bar{Y}$ is convex. This observation is important because $\bar{Y}$ is convex in the large literature which regresses the <u>logarithm</u> of income on schooling. To be precise, $N^{\delta}[\bar{Y}]$ increases with s if the magnitude of the first differences in $\bar{Y}$ "outweighs" the magnitude of the second differences in $\bar{Y}$ in the sense that for all $s \in \{7,8,\ldots 19\}$

$$\begin{aligned} 0 &\le N^{\delta}[\bar{Y}](s) - N^{\delta}[\bar{Y}](s-1) \\ &= \bar{Y}(s-1) - \delta\cdot(\bar{Y}(s)-\bar{Y}(s-1))\cdot(1-\delta^{59-s})/(1-\delta) \\ &\quad - \{\ \bar{Y}(s-2) - \delta\cdot(\bar{Y}(s-1)-\bar{Y}(s-2))\cdot(1-\delta^{59-(s-1)})/(1-\delta)\ \} \\ &\doteq [\bar{Y}(s-1)-\bar{Y}(s-2)] - \delta\cdot[\bar{Y}(s)-\bar{Y}(s-2)]/(1-\delta). \end{aligned}$$

This is more likely to happen the lower the discount factor δ.

Given that the incremental net cost $N^{\delta}[\bar{Y}]$ is weakly increasing in schooling s, Theorem 1 characterizes M_5 by stating that an agent with taste θ will keep attending school until the incremental net cost $N^{\delta}[\bar{Y}]$ exceeds her θ.

<u>Theorem 1</u>: Suppose that the incremental net cost function $N^{\delta}[\bar{Y}]$ is weakly increasing. Then

$$M_5^{\delta,\theta}[\bar{Y}] = \max \{5\} \cup \{\ s\ge 6 \mid N^{\delta}[\bar{Y}](s) \le \theta\ \}.$$

<u>Proof</u>: For notational ease, fix δ, θ, and $\bar{Y}$, and then define $N = N^{\delta}[\bar{Y}]$ and $U = U^{\delta,\theta}[\bar{Y}]$. Notice that

$$\begin{aligned} &U(s) - U(s-1) \\ &= \Sigma_{a=1}^{s}\delta^{a-1}\theta + \Sigma_{a=s+1}^{59}\delta^{a-1}\bar{Y}(s) \\ &\quad - [\ \Sigma_{a=1}^{s-1}\delta^{a-1}\theta + \Sigma_{a=s}^{59}\delta^{a-1}\bar{Y}(s-1)\ ] \\ &= \Sigma_{a=1}^{s-1}\delta^{a-1}\theta + \delta^{s-1}\theta + \Sigma_{a=s+1}^{59}\delta^{a-1}\bar{Y}(s) \\ &\quad - \Sigma_{a=1}^{s-1}\delta^{a-1}\theta - \delta^{s-1}\bar{Y}(s-1) - \Sigma_{a=s+1}^{59}\delta^{a-1}\bar{Y}(s-1) \\ &= \delta^{s-1}[\ \theta - Y(s-1) + \delta\cdot(Y(s)-Y(s-1))\cdot\Sigma_{a=1}^{59-s}\delta^{a-1}\ ] \\ &= \delta^{s-1}[\ \theta - Y(s-1) + \delta\cdot(Y(s)-Y(s-1))\cdot(1-\delta^{59-s})/(1-\delta)\ ] \\ &= \delta^{s-1}[\ \theta - N(s)\ ]. \end{aligned}$$

Hence, $U(s) \ge U(s-1)$ if and only if $\theta \ge N(s)$.

Define $s^* = M_5^{\delta,\theta}[\bar{Y}]$. Note that

$$s^* \in \{5\} \cup \{\ s \geq 6 \mid \theta \geq N(s)\ \} \tag{1}$$

for if $s^* \geq 6$, its optimality implies that $U(s^*) \geq U(s^*-1)$, and thus $\theta \geq N(s^*)$ by the preceding paragraph. Since s^* is (by the definitions of M_5 and U) the highest schooling that maximizes U, we have that $U(s^*+1) < U(s^*)$, and thus $\theta < N(s^*+1)$ by the preceding paragraph. Since N is weakly increasing by assumption, we then have that

$$(\forall s>s^*)\ \theta < N(s). \tag{2}$$

Equations (1) and (2) together imply that $s^* = \max \{5\} \cup \{\ s \geq 6 \mid \theta \geq N(s)\ \}$. ■

2.2. Simulation 1

Parameters: The model has three parameters: F, δ, and θ. The simulation has 100 persons, each of whom act according to the model. These persons share the same F and the same δ, but have different θ's.

I define each F(s) in $F = \langle F(s) \rangle_{s \in S}$ to be the lognormal cumulative distribution function with mean

$$E[F](s) = (1-\delta)\cdot(1-\delta^{59-s})^{-1}\cdot\Sigma_{a=s+1}^{59}\delta^{a-(s+1)}y(s,a-s)$$
$$\text{where } y(s,x) = 4.48\cdot(4.87 + .255s - .0029s^2 - .0043sx + .148x - .0018x^2),$$

and with standard deviation equal to one-half of this mean. The second term in the product defining y(s,x) is the earnings function estimated by Mincer (1974) and discussed in Willis ((1986), Table 10.5). The variable x denotes experience, which is identically equal to age (as measured by grade in school as opposed to year from birth) less schooling. Since Mincer's data was from the 1960 census, I multiplied his earnings function by 4.48, which is the purchasing power of a 1959 dollar in early 1991 dollars (U.S. Bureau of the Census (1990), Table 756; U.S. Council of Economic Advisers (1991), p. 23). E[F](s) itself is the present discounted value of lifetime earnings, expressed at an annual rate. In other words, the equation defining E[F](s) is equivalent to

$$\Sigma_{a=s+1}^{59}\delta^{a-(s+1)}E[F](s) = \Sigma_{a=s+1}^{59}\delta^{a-(s+1)}y(s,a-s).$$

The numerical values of E[F] appear in the second column of Table 1 (lagged one year).

All persons share the common discount factor $\delta = .85$. This discount rate can be regarded as modeling not only time preference but also financial constraints. A discount factor of .85 corresponds to a discount rate of .176. Since the rate of return to schooling is about 17 percent at $s = 8$ (as discussed by Willis (1986), p. 546), significantly lower discount rates result in no schooling choices near $s = 8$ and also violate Theorem 1's assumption.

The 100 persons differ only in their taste parameter θ. The 100 θ's are "log-beta-ly" distributed: the base-2 logarithms of a linear transformation of the 100 θ's are percentiles from a symmetric beta distribution (the remarks in the GAUSS procedure MAKETV give full details). I chose this distribution of θ's so that the resulting distribution of schooling choice would match the actual distribution of schooling in the 1988 U.S. labor force as closely as possible (U.S. Bureau of the Census (1990), Table 632).

Results: See Figure 1a in order to understand the definition of F. Schooling (s) is measured in grades on the horizontal axis, and income (y) is measured in $1000 units of annual income on the vertical axis. The expected-income function E[F] is the convex curve, and at each schooling s, the c.d.f. F(s) is depicted by stars representing quantiles. For example, F(15) is depicted by 10 stars corresponding to the 10 quantiles .05, .15, ... .95. Six of these 10 quantiles fall below the mean E[F](10) because the lognormal distribution is skewed.

s	$E[F](s-1)$ $-\{$	$E[F](s)-E[F](s-1)$ $\cdot$	$\delta(1-\delta^{59-s})/(1-\delta)$ $\} =$	$N^{\delta}\circ E[F](s)$
19	31.686	3.871	5.658	9.781
18	28.095	3.592	5.659	7.768
17	24.786	3.309	5.661	6.056
16	21.758	3.028	5.661	4.617
15	19.006	2.752	5.662	3.423
14	16.520	2.485	5.663	2.446
13	14.290	2.230	5.663	1.659
12	12.301	1.989	5.664	1.036
11	10.538	1.763	5.664	0.553
10	8.985	1.553	5.665	0.187
9	7.625	1.360	5.665	-0.081
8	6.440	1.185	5.665	-0.271
7	5.415	1.026	5.665	-0.396
6	4.531	0.883	5.666	-0.472

<u>Table 1</u>: Column 5 gives the true incremental net cost function $N^{\delta}\circ E[F]$ in Simulation 1's benchmark model. The middle three columns decompose this into forgone income (column 2) less the present discounted value of incremental future income (column 3 × column 4). Column 2 is simply Mincer's earnings function (lagged one year).

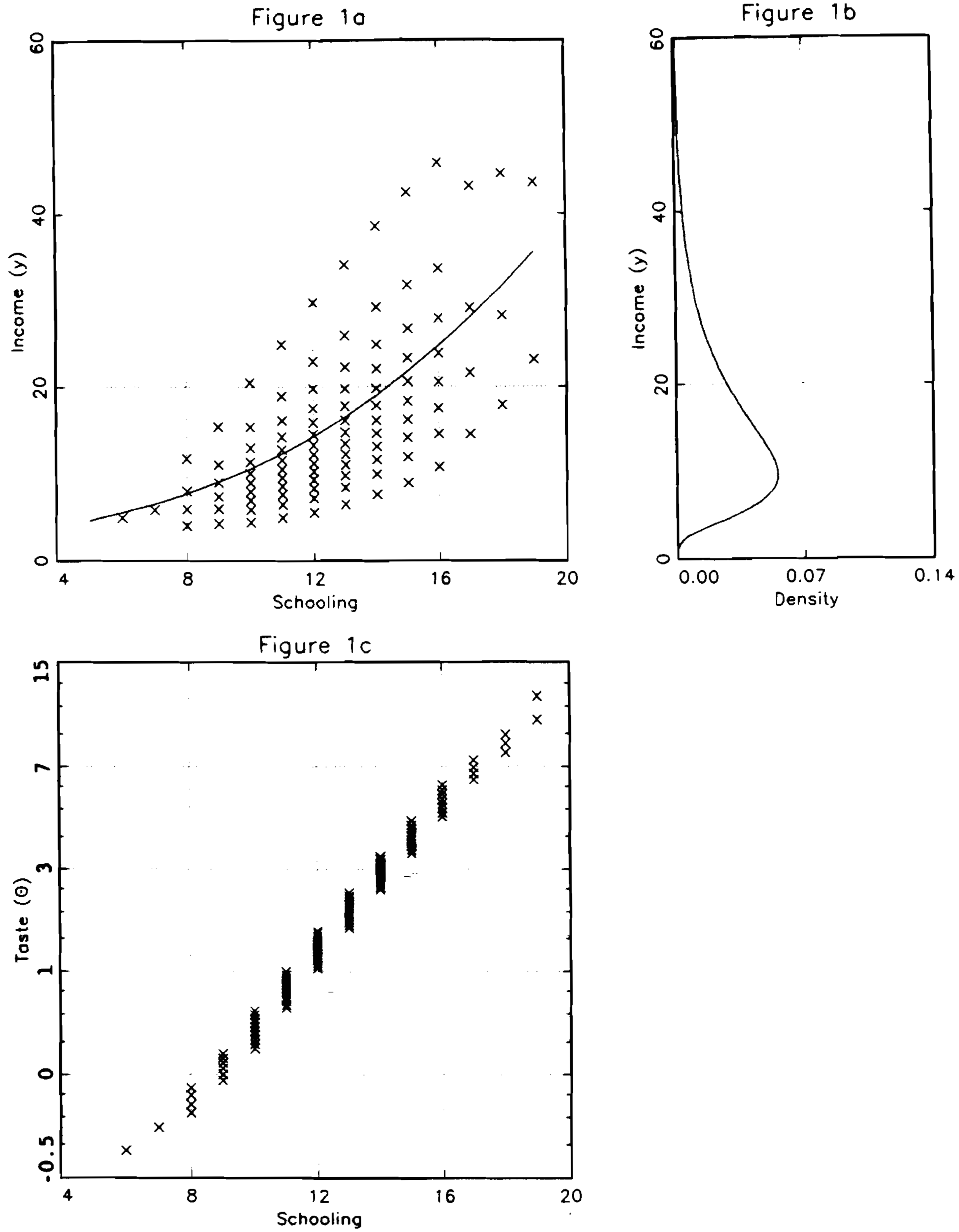

Figure 1: The large stars and solid curves depict Simulation 1's simulation of the benchmark model.

See Figure 1c in order to understand the distribution of taste θ among the hundred persons, and in order to understand their schooling choices. Schooling appears on the horizontal axis (just as in Figure 1a), and taste θ appears on the vertical axis. Each of the hundred stars represents one person's taste θ and schooling choice $s = M_5^{\delta,\theta} \circ E[F]$. Thus the stars are "log-beta-ly" distributed with respect to the vertical θ axis, and the variable s on the horizontal axis is a function (namely $s = M_5^{\delta,\theta} \circ E[F]$) of the variable θ on the vertical axis.

For example, person $\theta = 1.039$ chooses a high-school education ($s = 12$). This choice can be readily explained by Table 1's data and by Theorem 1's marginal characterization. The incremental net cost of her senior year in high school was 1.036 thousand dollars, which is the forgone income: 12.301 thousand dollars, less the present discounted value of incremental future income: $1.989 \cdot 5.664 = 11.265$ thousand dollars. Since this net cost of 1.036 was less than her taste for school $\theta = 1.039$, she chose to finish high school. But she quits after high school because the incremental net cost of her freshman year in college ($s = 13$) would be 1.659, which far exceeds her taste θ. Notice that the 14 net costs listed in Table 1 divide the clumps of stars in Figure 1c. It happens that no one's taste falls below the incremental net cost for sixth grade, and thus, no one drops out right after fifth grade.

Return to Figure 1a in order to understand the random income which the hundred persons receive. Consider person $\theta = 1.039$ as in the previous paragraph. Since she chose a high-school education ($s = 12$), her income (y) is lognormally distributed with mean $E[F](12) = 14.290$ (thousand dollars) and standard deviation $.5 \cdot E[F](12) = 7.145$. In fact, 14 of the 100 persons chose a high-school education, and their 14 random incomes are shown in Figure 1a as the 14 quantiles at $s = 12$. Similarly, the 12 quantiles at $s = 11$ represent the random incomes of the 12 persons who chose an eleventh-grade education. Just as Figure 1c, Figure 1a has 100 stars representing the 100 persons.

Then see Figure 1b for the income distribution among the hundred individuals. As in Figure 1a, income (y) is on the vertical axis. The income of each person θ has a density function equal to the derivative of the c.d.f. $F(M_5^{\delta,\theta} \circ E[F])$. The curve in Figure 1b is the average of these 100 density functions. Casually speaking, this curve is obtained by projecting all of Figure 1a's stars onto the vertical axis and letting them stack up when they overlap. The curve swells at low incomes (say $y \leq 20$) because the lognormal distribution is skewed, and because y is an average of lifetime income that weights entry-level wages heavily (recall that y is the present discounted value of lifetime income, expressed at an annual rate, with $\delta = .85$).

Finally, see Figure 1a to understand how a youth uses role models to learn about the random earnings function F. The hundred stars are a representative "sample" of role models from the labor force (though quantiles are obviously not an actual sample). For example, a youth could take the mean of the 14 stars at $s = 12$ in order to estimate E[F](12), which is the expected income of a high-school graduate. My model assumes asymptotic sampling, so that a youth learns the entire c.d.f. F(12) rather than just a 14-observation sample. In the extreme, I assume that she learns F(5) even though less than one percent of the labor force has a fifth-grade education (i.e., there are no stars at $s = 5$).

2.3. A Discussion of the Model's Assumptions

This section discusses the many implicit and explicit assumptions that my model employs in order to derive sharp statements about the effect of social isolation on schooling choice.

Schooling: My model measures schooling as years of attendance. This measure ignores school quality, student performance, and subject area. These three omissions clearly affect postschool income. Moreover, a student cannot simply choose her performance. Rather she chooses school effort and this leads to academic credentials and ultimately job opportunities in a stochastic fashion. This could be studied by reinterpreting the model's schooling variable as effort. The new model would then describe how role models provide information about the relationship between effort and income, and how underclass youth can be dissuaded from college by observing college dropouts. Yet both young people and empirical researchers have great difficulty observing the past effort of current workers.

Income: The model unambiguously measures income and utility (and later, loss) in thousands of dollars because a rather specialized partial equilibrium framework is implicitly assumed: schooling is inelastically supplied, labor (at each schooling) is inelastically demanded, and all other markets are simply ignored. Also ignored are possible effects from workplace discrimination, transportation costs (Kain (1968)), and the nonmarket benefits of education (Haveman and Wolfe (1984)). These last three deficiencies could be largely remedied by reinterpreting the model's income variable as discrimination-affected income plus nonmarket benefits less transportation costs.

Age: If young people observe not only the schooling and income, but also the age of each role model, they can learn expected income as a function of both schooling and age (given asymptotic sampling). Then they can aggregate across time to calculate the present discounted value of lifetime earnings at each schooling. This is a straightforward extension of the model, and Simulation 1 was calibrated in precisely this fashion (see Section 2.2).

Ability: By ability I mean a variable that is positively correlated with income at each schooling. My model assumes that at the time of her schooling decision, a youth has no information about her ability, either directly or through a correlation with taste θ. Thus (given asymptotic sampling) she has no interest in observing the abilities of role models. At the other extreme, a youth might know her own ability and observe the ability of every role model she encounters. This poses no conceptual difficulties (given asymptotic sampling): she would simply ignore all role models other than those having an ability identical (or very nearly identical) to her own (see Manski (1990)). Although matters would become far more subtle if a youth had partial knowledge of her own and others' abilities, I don't expect that these embellishments would fundamentally alter my conclusions.

Small Samples: If young people observe a finite sample of role models (in contrast to the model's assumption of asymptotic sampling) and if they are risk averse (in contrast to the model's assumption of risk-neutrality), one would conjecture a tendency to choose the schooling levels for which there are more role models. This conjecture complements my work: it concerns a lopsided distribution of the sample across schoolings rather than a biased sample at each schooling; and it is particularly relevant if concentrated poverty is the result of racial segregation (Massey (1990)) rather than selective outmigration (Wilson (1987)). Shen (1989) has made some progress in formalizing this conjecture within a Bayesian framework.

Miscellaneous: (a) Frequently, workers gain more schooling through on-the-job training or by returning to formal schools. My schooling variable is the first time to quit school, and the possibility of return is incorporated into the lifetime earnings expressed in F. (b) Although my model formally ignores the financial obstacles considered abstractly in Loury (1981) and Ljungqvist (1989) and concretely in Manski and Wise (1983), these omitted factors may be partially captured by varying δ and θ among individuals and over time. (c) Young people are assumed to adjust the current income of role models to account for the secular rise in income which will benefit them in the future.

3. Social Isolation

3.1. Theory

I model underclass social isolation by assuming that an underclass youth observes, for each schooling, a distribution of incomes that is truncated from above at α. This truncation models selective out-migration from an underclass neighborhood: everyone with income above α leaves the ghetto while everyone with an income at or below α remains in the ghetto and provides a role model for underclass youth. Section 7 notes that "neighborhood" (and hence "ghetto" = underclass neighborhood) need not be interpreted geographically.

Formally, define the truncation operator T: $\bar{\mathbb{R}}_{++} \times \mathbb{F}^S \to \mathbb{F}^S$ by

$$(\forall s)(\forall y)\ T^{\alpha}[F](s)(y) = \begin{cases} 1 & \text{if } y > \alpha \\ F(y)/F(\alpha) & \text{if } y \leq \alpha. \end{cases}$$

If $\alpha = +\infty$, the truncation operator is merely the identity function (i.e., there is no truncation). If $\alpha \in \mathbb{R}_{++} = (0,+\infty)$, each $T^{\alpha}[F](s)$ is the truncated c.d.f. generated by an asymptotic sample of the labor force with schooling s and income $y \leq \alpha$.

The focus of this paper is the effect of truncation on schooling choice. As a result of truncation, an underclass youth concludes that the relationship between schooling and income is given by the random function $T^{\alpha}[F]$ rather than F, and thus erroneously believes that the expected income function is $E \circ T^{\alpha}[F]$ rather than E[F]. This leads her to choose schooling equal to $M_5^{\delta,\theta} \circ E \circ T^{\alpha}[F]$ rather than $M_5^{\delta,\theta} \circ E[F]$. Wilson's conjecture is that truncation discourages education. This may be formalized as the statement

$$(\forall \delta,\theta,\alpha',\alpha)\quad \alpha' \leq \alpha \ \Rightarrow\ M_5^{\delta,\theta} \circ E \circ T^{\alpha'}[F] \leq M_5^{\delta,\theta} \circ E \circ T^{\alpha}[F] \qquad (3)$$

(where no truncation is denoted by $\alpha = +\infty$), together with compelling examples in which $M_5^{\delta,\theta} \circ E \circ T^{\alpha'}[F] < M_5^{\delta,\theta} \circ E \circ T^{\alpha}[F]$.

Although my calibrated simulations suggest that Wilson's conjecture stands at parameter values determined by empirical studies, the theoretical results in the remainder of this section show that conjecture (3) does not hold at all parameter values. In fact, Counterexample 1 will exhibit a mathematically reasonable set of parameter values for which truncation unambiguously encourages education. The two sources of this contrary result are systematically investigated beforehand.

Assume for the remainder of the section that the incremental net cost function $N^{\delta}\circ E\circ T^{\alpha}[F]$ defined in Section 2.1 is weakly increasing. This assumption is satisfied by Counterexample 1 and Simulations 1 and 2. Given this assumption, Theorem 1 implies that conjecture (3) is equivalent to the statement that for all δ and s,

$$N^{\delta}\circ E\circ T^{\alpha}[F](s) \equiv$$
$$E\circ T^{\alpha}[F](s-1) - \delta\cdot(\ E\circ T^{\alpha}[F](s)-E\circ T^{\alpha}[F](s-1)\ )\cdot(1-\delta^{59-s})/(1-\delta)$$

increases as α falls (i.e., as truncation becomes more severe). In other words, truncation discourages education if and only if it increases incremental net cost, where this cost was defined in Section 2.1 as forgone current income less the present discounted value of incremental future income.

As discussed in the Introduction, the heart of Wilson's very intuitive conjecture is that truncation (i.e., a decrease in α) flattens the regression of income on schooling. In other words, it decreases incremental future income and thereby increases incremental net cost. This intuition augers in favor of conjecture (3). Unfortunately, conjecture (3) often fails for one of two reasons.

First, truncation can very well steepen rather than flatten the regression of income on schooling. A simple and compelling example of this is provided in Counterexample 1. The gist of this counterexample is its choice of F, in which the densities of F(s) and F(s-1) coincide everywhere except for a relatively small region near the lower end of their common support. When truncation removes the upper end of their common support, it accentuates the difference in the lower end.

Second, truncation lowers the entire regression. Specifically, truncation unambiguously reduces forgone current income, which is the first term of incremental net cost. Therefore, incremental net cost increases only when the decrease in incremental future income is sufficiently large to outweigh the decrease in forgone current income. This is far from universally true in light of the previous paragraph's demonstration that incremental future income might even move in the wrong direction. Thus conjecture (3) is false without parametric restrictions.

Counterexample 1: Define $F \in \mathbf{F}$ by

$$F(s)(y) = \begin{cases} y/100 & \text{if } y \in [0,s) \\ (2y-s)/100 & \text{if } y \in [s,s+1) \\ (y+1)/100 & \text{if } y \in [s+1,99) \\ 1 & \text{if } y \geq 99. \end{cases}$$

Each F(s) describes a uniform distribution over [0,100] that has been altered by taking the probability mass over [99,100] and adding that mass to the mass already present at [s,s+1]. This F is extremely reasonable from a mathematical perspective. Each F(s) is continuous and its density is single-peaked. Moreover, $(\forall\ s \in \{6,7,\ldots 19\})$ F(s) first-order stochastically dominates F(s-1).

In order to simplify the algebra, restrict your attention to truncation cutoffs α in the interval [20,99]. Notice that $\alpha = 99$ is equivalent to $\alpha = +\infty$ (i.e., no truncation) since the support of every F(s) lies within [0,99]. Given this restriction on α, the incremental net cost function may be calculated straightforwardly:

$$\begin{aligned} & N^{\delta}\circ E\circ T^{\alpha}[F](s) \\ &= E\circ T^{\alpha}[F](s-1) - \delta\cdot(\ E\circ T^{\alpha}[F](s) - E\circ T^{\alpha}[F](s-1)\ )\cdot(1-\delta^{59-s})\cdot(1-\delta)^{-1} \\ &= (\alpha^2+2s-1)\cdot(2\alpha+2)^{-1} - \delta\cdot(\alpha+1)^{-1}\cdot(1-\delta^{59-s})\cdot(1-\delta)^{-1}. \end{aligned}$$

Incremental net cost unambiguously decreases as α decreases (that is, with more truncation). As must be the case, the first term (forgone income) falls as α falls (recall $s\leq 19\leq 20\leq\alpha$). And surprisingly, the second term moves in the same direction (that is, becomes more negative). This occurs because the incremental future income $(\alpha+1)^{-1}$ increases as α falls. That is, truncation amplifies the incremental future income resulting from an additional year of schooling. To verify this unexpected result, the reader may either (a) verify the above formula (which is no fun) or (b) consider

$$\begin{aligned} & E\circ T^{\alpha}[F](s) - E\circ T^{\alpha}[F](s-1) \\ &= \int_0^{\alpha} [\ 1 - F(s)(y)/F(s)(\alpha)\ ]\ dy \ - \ \int_0^{\alpha} [\ 1 - F(s-1)(y)/F(s-1)(\alpha)\ ]\ dy \\ &= \int_0^{\alpha} [\ 1 - F(s)(y)\cdot 100/(\alpha+1)\ ]\ dy \ - \ \int_0^{\alpha} [\ 1 - F(s-1)(y)\cdot 100/(\alpha+1)\ ]\ dy \\ &= 100/(\alpha+1) \int_0^{\alpha} [\ F(s-1)(y) - F(s)(y)\ ]\ dy \\ &= 100/(\alpha+1) \int_0^{20} [\ F(s-1)(y) - F(s)(y)\ ]\ dy. \end{aligned}$$

The second and fourth equalities hold because $\alpha \geq 20$ and because $(\forall y\geq 20)$ $F(s)(y) = F(s-1)(y) = (y+1)/100$; the rest is mundane algebra. The integral in the last line is constant with respect to α (it happens to equal 1/100), and thus incremental future income increases as α falls. Intuitively, this occurs because the original distributions were identical except for only 1/100 of the probability mass. As truncation increases (i.e., as α falls), the distributions come to differ over a greater portion of the probability mass. At the extreme where $\alpha = 20$, they differ over 1/21 of it.

3.2. Simulation 2

Parameters: Simulation 2 adds social isolation to Simulation 1 by truncating from above at the cutoff $\alpha = 16$ (thousand dollars). Formally, Simulation 2 lets $s = M_5^{\delta,\theta} \circ E \circ T^{16}[F]$ rather than $s = M_5^{\delta,\theta} \circ E[F]$.

Results: See Figure 2a and (for the moment) ignore the hundred stars. As in Figure 1a, E[F] is depicted by the convex curve. However, since underclass youth observe only role models below the horizontal line $y = 16$, they estimate E[F] by $E \circ T^{16}[F]$, which is the curve that asymptotically approaches the line $y = 16$. Note that the regression $E \circ T^{16}[F]$ is lower than E[F] (this is a theoretical necessity), and that the slope of $E \circ T^{16}[F]$ is shallower than that of E[F] (this results from the simulation's parameters and is not a theoretical necessity).

See Figure 2c. For each of the hundred θ's, the large star depicts schooling choice $s = M_5^{\delta,\theta} \circ E \circ T^{16}[F]$ under social isolation and the small star depicts schooling choice $s = M_5^{\delta,\theta} \circ E[F]$ in Simulation 1's benchmark model. As Wilson predicts, social isolation depresses schooling choice. For example, consider person $\theta = 1.039$, who chose $s = 12$ in Simulation 1's benchmark model. Social isolation causes her to drop out after eighth grade. Ninth grade is unattractive because she perceives its incremental net cost to be 1.906 (see Table 2), and this exceeds her taste $\theta = 1.039$.

By Theorem 1's marginal characterization, Table 2's incremental net cost function determines the steps in Simulation 2's schooling choice function. Hence the increase of Table 2's incremental net cost function relative to Table 1's is directly related to the decline of Simulation 2's schooling choice relative to Simulation 1's. It is not theoretically necessary that truncation increases incremental net costs. Rather, it is a specific feature of the simulations' parameters (see Tables 1 and 2) that (1) truncation decreases perceived incremental future income (e.g., from 1.360 to 0.932

s	$E\circ T^{16}[F](s-1)$	$-\{E\circ T^{16}[F](s)-E\circ T^{16}[F](s-1)$	$\cdot\delta(1-\delta^{59-s})/(1-\delta)\}=$	$N^{\delta}\circ E\circ T^{16}[F](s)$
19	12.951	0.218	5.658	11.719
18	12.694	0.257	5.659	11.242
17	12.390	0.304	5.661	10.671
16	12.030	0.361	5.661	9.987
15	11.601	0.429	5.662	9.171
14	11.091	0.509	5.663	8.207
13	10.490	0.601	5.663	7.088
12	9.791	0.699	5.664	5.830
11	8.995	0.797	5.664	4.483
10	8.115	0.879	5.665	3.135
9	7.184	0.932	5.665	1.906
8	6.243	0.941	5.665	0.911
7	5.338	0.905	5.665	0.211
6	4.506	0.832	5.666	-0.207

Table 2: Column 5 gives the perceived incremental net cost function $N^{\delta}\circ E\circ T^{16}[F]$ in Section 2's model of social isolation. The middle three columns decompose this into perceived forgone income (column 2) less the perceived present discounted value of future income (column 3 × column 4). Column 2 is the perceived earnings function (lagged one year).

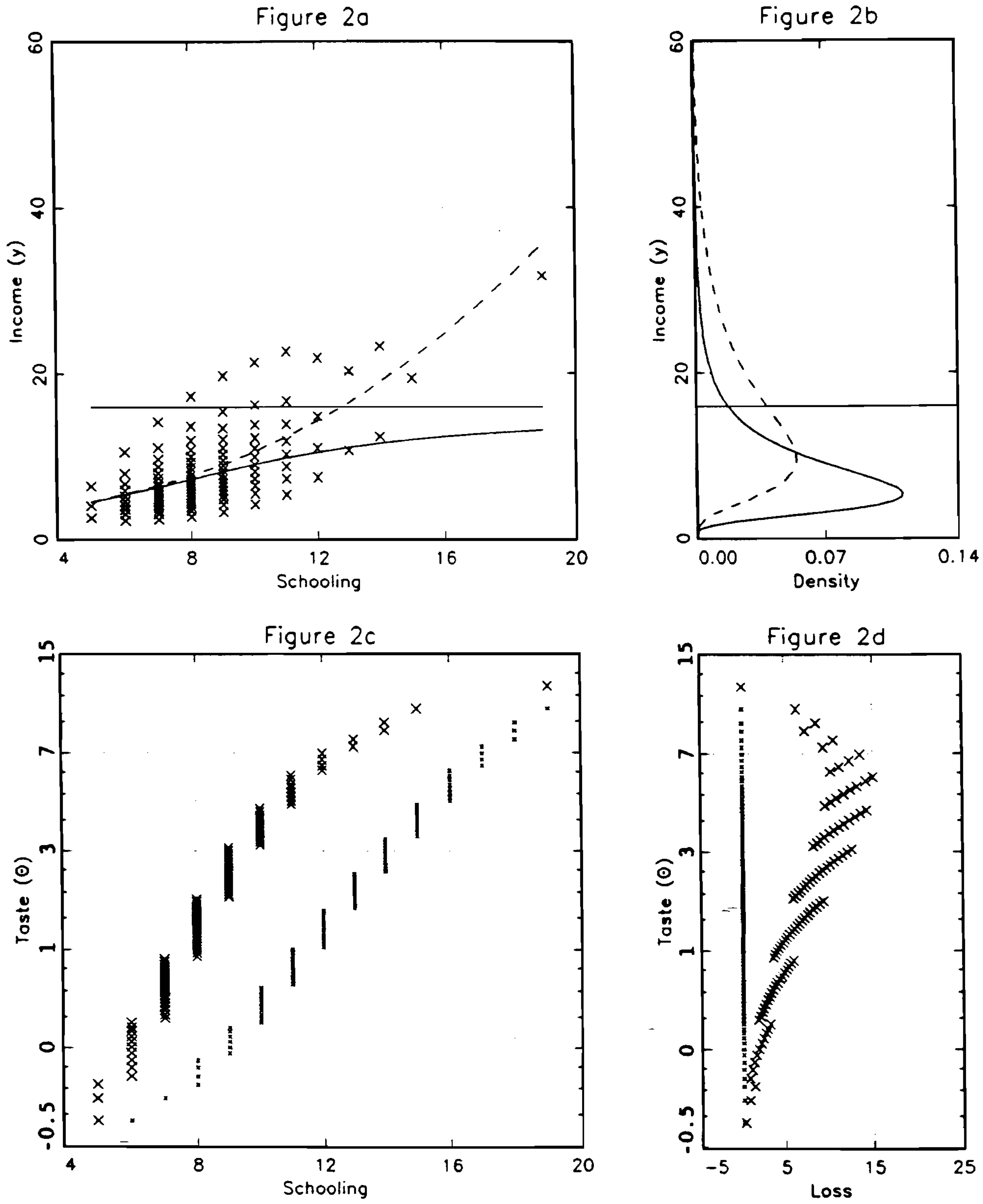

Figure 2: The large stars and solid curves depict Simulation 2's model of social isolation. The small stars and dotted curves recall Simulation 1's benchmark model.

thousand dollars in the case of ninth grade), and that (2) the present discounted value of this decrease (e.g., 5.665•(1.360-0.932) = 2.425) is greater than the decline in perceived forgone income (e.g., 7.625-7.184 = 0.441).

See Figure 2d for the losses borne by misinformed persons. As in Figure 2c, taste (θ) is on the vertical axis. Each star gives the loss of person θ, in thousands of dollars, as measured by

$$\delta^{-12}\cdot\{ U^{\delta,\theta}(M_5^{\delta,\theta}\circ E[F]) - U^{\delta,\theta}(M_5^{\delta,\theta}\circ E\circ T^{16}[F]) \}.$$

This may be interpreted as the amount of money that person θ would be willing to pay in order to be fully informed about E[F]. The factor δ^{-12} scales this amount to the dollars of a college freshman as opposed to those of a first grader. For example, person $\theta = 1.039$ loses about 4 thousand dollars. At the extremes, person $\theta = 5.809$ loses about 15 thousand dollars, and person $\theta = 11.801$ loses nothing because she happens to choose education efficiently even though she is poorly informed.

Return to Figure 2a. The hundred stars depict the chosen education and realized income of the hundred persons. Since only one person ($\theta = 11.801$) chose to complete three years of postgraduate education ($s = 19$), there is only one quantile (at about $y = 32$ thousand dollars) depicting the c.d.f. F(19). Nonetheless, asymptotic sampling enables the model's agents to estimate E[F](19) by $E\circ T^{16}[F](19)$, which is about 13 thousand dollars.

Finally, Figure 2b shows that social isolation has made Simulation 2's income distribution lower than that of Simulation 1's benchmark.

4. Changing Role Models

4.1. Theory

This section modifies the model of the previous section by letting the truncation cutoff α vary as an underclass youth moves through school. Her choice of education then becomes a sequential problem: She continues on in school if and only if the role models that she has observed up until that time suggest that some amount of further schooling is better than stopping immediately.

Informally, we might assume that α increases over time. This would model the notion that, as an underclass youth moves from grade school to high school to college and finally to graduate school, the social isolation of her underclass origins is gradually lifted. However, social isolation might well depress her schooling choice so much so that she drops out before observing these new role models.

Formally, let $\langle\alpha(t)\rangle_{t\in S} \in \mathbb{R}_+^S$ be a sequence of cutoffs. Then for $t \in \{6,7,..19\}$, define the <u>maximization operator</u> M_t: $(0,1)\times\mathbb{R}\times\mathbb{R}_+^S \rightarrow \{t,t+1,...19\}$ by

$$M_t^{\delta,\theta}[\bar{Y}] = \max\{ \operatorname{argmax}\{ U^{\delta,\theta}[\bar{Y}](s) \mid s \in \{t,t+1,...19\} \}\}.$$

The maximization operators $M_6, M_7, ...M_{19}$ defined here are virtually identical to the maximization operator M_5 defined in Section 2. The only difference is that M_t imposes the constraint $s \geq t$. This additional constraint is needed momentarily so that (for example) a college freshman can't observe a fresh set of role models and opt for a sixth-grade education. Finally, a student chooses to quit at time t if and only if

$$M_t^{\delta,\theta} \circ E \circ T^{\alpha(t)}[F] = t.$$

Thus the chosen level of education is

$$\min \{ t \mid M_t^{\delta,\theta} \circ E \circ T^{\alpha(t)}[F] = t \}.$$

(I assume the change in role models is completely unanticipated, and thus ignore the incentive to continue in school for the sake of gathering information (Manski and Wise (1983), p. 10).)

4.2. Simulation 3

Parameters: Simulation 3 alters Simulation 2 by assuming that an underclass youth's social isolation ends abruptly when she enters college and consequently observes a fresh set of role models. Formally, define $\langle\alpha(t)\rangle_{t\in S}$ by setting $\alpha(t) = 16$ if $t \leq 12$ and $\alpha(t) = +\infty$ if $t > 12$; and let schooling choice be $s = \min \{ t \mid M^{\delta,\theta}_{t} \circ E \circ T^{\alpha(t)}[F] = t \}$.

Results: Note that

$$\min \{ t \mid M^{\delta,\theta}_{t} \circ E \circ T^{\alpha(t)}[F] = t \}$$
$$= \begin{cases} M^{\delta,\theta}_{5} \circ E \circ T^{16}[F] & \text{if } M^{\delta,\theta}_{5} \circ E \circ T^{16}[F] \leq 12 \\ M^{\delta,\theta}_{13} \circ E[F] & \text{if } M^{\delta,\theta}_{5} \circ E \circ T^{16}[F] \geq 13. \end{cases}$$

Thus Simulation 3 is essentially an amalgamation of Simulations 1 and 2: Social isolation causes an underclass youth to choose too little schooling (as in Simulation 2) unless she chooses to begin college in spite of social isolation, in which case she chooses an efficient level of schooling (as in Simulation 1) on the basis of role models observed after entering college. This discontinuous change in information is reflected by the stark gap in the middle of Figure 3a, by the jumps at $\theta = 7.088$ in Figures 3c and 3d, and less visibly, by the slightly fatter tail in Figure 3b relative to Figure 2b.

This discontinuity divides underclass youth into two starkly different classes: school-loving underclass youth ($\theta > 7.088$) who are ultimately unaffected by the social isolation of their ghetto origins, and their comparatively school-averse peers ($\theta < 7.088$) who are severely harmed. This tendency to polarization is a strong implication of my model, and it accords well with the empirical fact that the income distribution of black men is becoming increasingly polarized (Murray (1984), p. 92, citing Kilson (1981); and Wilson (1987), p. 45, citing Levy (1986)).

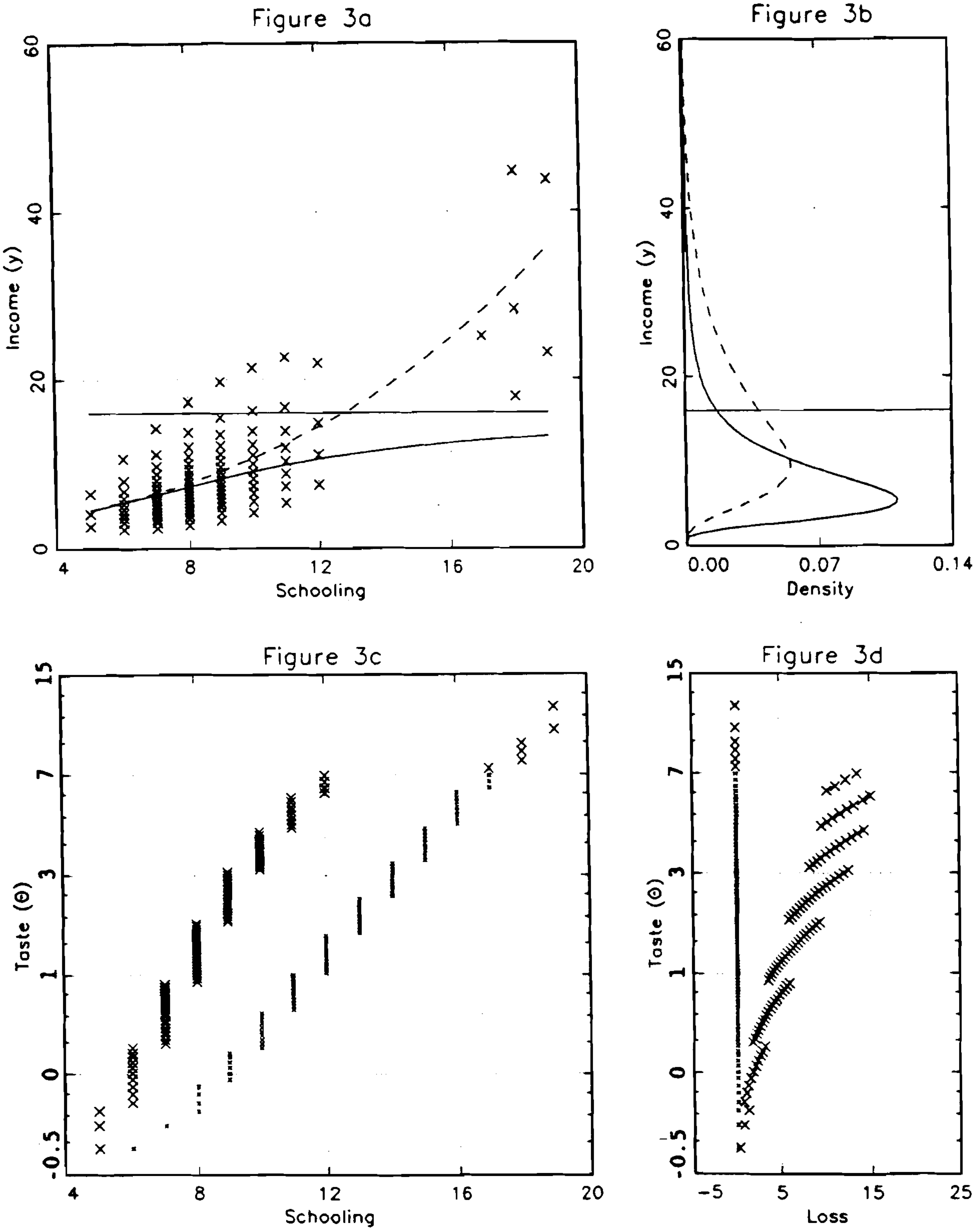

Figure 3: The large stars and solid curves depict Simulation 3's model of social isolation with changing role models. The small stars and dotted curves recall Simulation 1's benchmark model.

5. Welfare Effects

5.1. Theory

This section modifies the model of the previous section by assuming that an underclass youth observes, at each schooling, a distribution of income which is censored from below at the cutoff β. Censoring is very different from truncating. While truncation from below at β would result in a loss of all the probability mass below β, censoring from below at β means that all the probability mass below β is piled up at β. This censoring models a stylized welfare system in which everyone who has left school is guaranteed an income of at least β. It implies that an underclass youth will observe no role models with an income below β, and will observe an appreciable number of role models earning exactly β.

Formally, define the <u>censoring operator</u> C: $\mathbb{R}_+ \times \mathbb{F}^S \to \bar{\mathbb{F}}^S$ by

$$(\forall s)(\forall y) \quad C^\beta[G](s)(y) = \begin{cases} G(s)(y) & \text{if } y \geq \beta \\ 0 & \text{if } y < \beta. \end{cases}$$

If $\beta = 0$, the censoring operator is merely the identity function (i.e., there is no censoring). If $\beta > 0$, each $C^\beta[G](s)$ is the cumulative distribution function generated by censoring $G(s)$ from below at β.

This is the final component of my model, which may be stated in its entirety as follows. An underclass youth who is finishing grade t concludes that the relationship between schooling and income is $C^\beta \circ T^{\alpha(t)}[F]$, and thus believes that the expected income function is $E \circ C^\beta \circ T^{\alpha(t)}[F]$. Because she continues in school as long as her beliefs suggest that some amount of future schooling is desirable, her schooling choice is

$$\min \{ t \mid M_t \circ E \circ C^\beta \circ T^{\alpha(t)}[F] = t \}.$$

Changing role models may be eliminated from the model by setting every α_t

equal to some constant parameter α, in which case schooling choice is simply $M_5 \circ E \circ C^\beta \circ T^\alpha[F]$. Truncation can then be eliminated from the model by setting $\alpha = +\infty$, in which case schooling choice is simply $M_5 \circ E \circ C^\beta[F]$. This last specialization of the model considers welfare effects only.

Unfortunately, censoring tends to violate Theorem 1's assumption by making the expected income function very convex at low schoolings. As a result, we cannot generally employ Theorem 1's marginal characterization of schooling choice after censoring has taken place.

Fortunately, Theorem 2 shows that censoring has an unambiguous effect on schooling choice. [In contrast, truncation had an ambiguous effect.] The gist of Theorem 2's proof is that censoring unambiguously diminishes incremental future income [truncation had an ambiguous effect], and that censoring increases forgone income [truncation decreased it]. Theorem 2 may be applied either when G equals the true random function F (as in a model of welfare effects alone) or when G equals $T^\alpha[F]$ (as in a model that also includes social isolation). Theorem 2's assumption of first-order stochastic dominance is quite reasonable when applied to F. But it is not always satisfied when applied to $T^\alpha[F]$ because truncation doesn't necessarily preserve first-order stochastic dominance.

<u>Theorem 2</u>: Suppose that $(\forall\ s \in \{6,7,\ldots 19\})$ G(s) first-order stochastically dominates G(s-1). Then $(\forall \delta, \theta, \beta, \beta')$

$$\beta' \geq \beta \;\Rightarrow\; M_5^{\delta,\theta} \circ E \circ C^{\beta'}[G] \leq M_5^{\delta,\theta} \circ E \circ C^{\beta}[G].$$

<u>Proof</u>: Begin by noting that if $\beta' > \beta$ and if $G(s^A)$ first-order stochastically dominates $G(s^B)$, then

$$E \circ C^{\beta'}[G](s^A) - E \circ C^{\beta}[G](s^A)$$
$$= \{\ \beta' + \int_{\beta'}^{+\infty} (1-G(s^A)(y))\ dy\ \} - \{\ \beta + \int_{\beta}^{+\infty} (1-G(s^A)(y))\ dy\ \}$$

$$\begin{aligned}
&= \int_{\beta}^{\beta'} G(s^A)(y)\ dy \\
&\leq \int_{\beta}^{\beta'} G(s^B)(y)\ dy \\
&= \{\ \beta' + \int_{\beta'}^{+\infty} (1-G(s^B)(y))\ dy\ \} - \{\ \beta + \int_{\beta}^{+\infty} (1-G(s^B)(y))\ dy\ \} \\
&= E \circ C^{\beta'}[G](s^B) - E \circ C^{\beta}[G](s^B).
\end{aligned}$$

The inequality follows from stochastic dominance and the rest is algebra. This observation is equivalent to the statement that if $\beta' > \beta$ and if $G(s^A)$ first-order stochastically dominates $G(s^B)$, then

$$\begin{aligned}
&E \circ C^{\beta'}[G](s^A) - E \circ C^{\beta'}[G](s^B) \\
&\leq E \circ C^{\beta}[G](s^A) - E \circ C^{\beta}[G](s^B).
\end{aligned}$$

Intuitively, this says that increased censoring (i.e., β' rather than β) unambiguously diminishes incremental future income.

Now fix any δ, any θ, any $\beta' > \beta$, and define $s^* = M_5^{\delta,\theta} \circ E \circ C^{\beta}[G]$. Note that

$$\begin{aligned}
&(\forall s > s^*) \\
&\quad U^{\delta,\theta} \circ E \circ C^{\beta'}[G](s) - U^{\delta,\theta} \circ E \circ C^{\beta'}[G](s^*) \\
&= \Sigma_{a=s^*+1}^{s} \delta^{a-1} \{\ \theta - E \circ C^{\beta'}[G](s^*)\ \} + \Sigma_{a=s+1}^{59} \delta^{a-1} \{\ E \circ C^{\beta'}[G](s) - E \circ C^{\beta'}[G](s^*)\ \} \\
&\leq \Sigma_{a=s^*+1}^{s} \delta^{a-1} \{\ \theta - E \circ C^{\beta}[G](s^*)\ \} + \Sigma_{a=s+1}^{59} \delta^{a-1} \{\ E \circ C^{\beta'}[G](s) - E \circ C^{\beta'}[G](s^*)\ \} \\
&\leq \Sigma_{a=s^*+1}^{s} \delta^{a-1} \{\ \theta - E \circ C^{\beta}[G](s^*)\ \} + \Sigma_{a=s+1}^{59} \delta^{a-1} \{\ E \circ C^{\beta}[G](s) - E \circ C^{\beta}[G](s^*)\ \} \\
&= U^{\delta,\theta} \circ E \circ C^{\beta}[G](s) - U^{\delta,\theta} \circ E \circ C^{\beta}[G](s^*) \\
&< 0.
\end{aligned}$$

The first inequality follows from the fact that $E \circ C^{\beta'}[G](s^*) \geq E \circ C^{\beta}[G](s^*)$ (that is, censoring increases forgone income); the second inequality follows from the preceding paragraph (that is, censoring diminishes incremental future income since $F(s)$ first-order stochastically dominates $F(s^*)$); the final inequality follows from the definition of s^*; and the equalities are just algebra. Since the first line is the objective function evaluated at s less the objective function evaluated at s*, the entire result implies that

$$(\forall s>s^*)\ s \neq M_5^{\delta,\theta}\circ E\circ C^{\beta'}[G],$$

which by the definition of s* is equivalent to

$$M_5^{\delta,\theta}\circ E\circ C^{\beta'}[G] \leq M_5^{\delta,\theta}\circ E\circ C^{\beta}[G]. \qquad \blacksquare$$

Although an underclass youth is prudent to consider post- rather than pre-transfer income when making her individual decisions, welfare leads her to make decisions that are quite inefficient from the perspective of society as a whole. To be precise, let $s^* = M_5^{\delta,\theta}\circ E[F]$ be choice in the benchmark model with no distortions and let $s' = \min\{\ t \mid M_t^{\delta,\theta}\circ E\circ C^{\beta}\circ T^{\alpha(t)}[F] = t\ \}$ be choice with social isolation and welfare. Since the objective function is defined in a way that makes income and utility directly comparable, and under the assumption that the social and individual discount factor coincide, we may unambiguously calculate the loss to society as

$$\begin{aligned}
&U^{\delta,\theta}\circ E[F](s^*) - U^{\delta,\theta}\circ E[F](s') && (4)\\
&= [\ U^{\delta,\theta}\circ E[F](s^*) - U^{\delta,\theta}\circ E\circ C^{\beta}[F](s')\ ] + [\ U^{\delta,\theta}\circ E\circ C^{\beta}[F](s') - U^{\delta,\theta}\circ E[F](s')\ ]\\
&= [\ U^{\delta,\theta}\circ E[F](s^*) - U^{\delta,\theta}\circ E\circ C^{\beta}[F](s')\ ] + \Sigma_{a=s'+1}^{59}\delta^{a-1}[\ E\circ C^{\beta}[F](s')-E[F](s')\ ].
\end{aligned}$$

The first term is the loss to the individual, which can be negative given a sufficiently generous welfare program. The second term is the expected present discounted value of the government's welfare expenditures, which cannot be negative. Since the sum of the two terms cannot be negative (because s* is defined to be a maximizer of $U^{\delta,\theta}\circ E[F]$), the individual gains (if any) are overwhelmed by the government's expenditures.

The effect of social isolation on underclass schooling is not diminished by the effect of welfare. Rather, Simulations 4 and 5 demonstrate that the two mechanisms tend to depress schooling choice through distinct and reinforcing channels. In fact, I am tempted to conclude that the effects of social isolation and welfare are not only additive, but even superadditive. Essentially, social isolation destroys incentives through the loss of high-income role models while welfare destroys incentives by altering the experience of low-income role models. Distortions on one side make the distortions on the other side even more critical.

5.2. Simulation 4

Parameters: Simulation 4 specifies F, δ, and θ as in Section 1's benchmark model; it assumes no social isolation (i.e., $\alpha = +\infty$); and it studies the effects of a welfare program which censors income at the level $\beta = 4$. Formally, let $s = M_5^{\delta,\theta} \circ E \circ C^4[F]$.

Results: Theorem 2 tells us that welfare monotonically depresses schooling choice. Simulation 4 reveals that this effect can be quite severe: 26 percent of the simulation's hundred persons drop out after fifth grade, which is the model's lower bound on schooling choice (Figures 4a, 4c). This contrasts markedly with the benchmark model in which no one drops out this early (Figures 1a, 1c). Moreover, the cutoff level $\beta = 4$ is rather moderate. It lies everywhere below the true expected income function E[F].

While social isolation shifts all but the upper tail of the distribution of schooling choice (Simulation 3), welfare's main effect is to entrap the lower tail at $s = 5$. The most severely affected person is $\theta = 0.677$, who dropped out after fifth grade even though she should have chosen an eleventh-grade education. Her decision creates a loss of 11 thousand dollars (Figure 4d), as measured by equation (4). (Some other schooling choices that are not in the lower tail are also affected. For example, person $\theta = 1.036$ chooses $s = 11$ rather than $s = 12$ (Figure 4c), but her utility loss is insignificant (Figure 4d).)

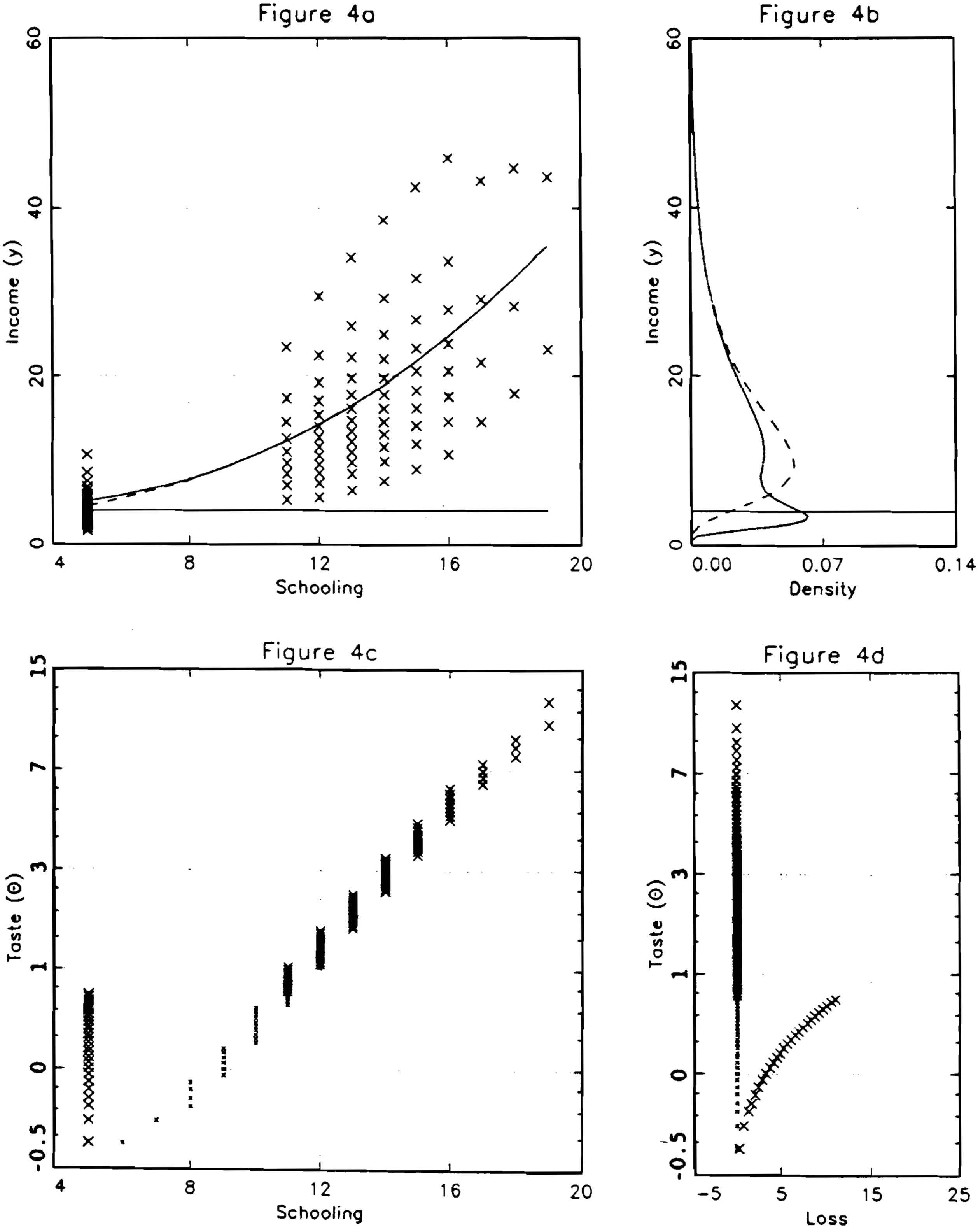

Figure 4: The large stars and solid curves depict Simulation 4's model of welfare effects. The small stars and dotted curves recall Simulation 1's benchmark model.

Mathematically speaking, entrapment at $s = 5$ is a consequence of the fact that the schooling choice problem has become nonconcave in the precise sense that Theorem 1's assumption has been violated. This effect is somewhat exaggerated in this simulation because the benchmark model is already rather close to nonconcavity because $E[F]$ is convex (and $E[F]$'s convexity ultimately stems from Mincer's regression of the logarithm of income on schooling).

Like Simulation 3's changing role models, Simulation 4's welfare programs divide underclass youth into two distinct groups: school-loving youth (i.e., $\theta > 0.677$) who are largely unaffected by the presence of welfare, and school-averse youth (i.e., $\theta \leq 0.667$) who are severely affected. This polarization is quite apparent in Figures 4a, 4c, and 4d, and also in the two-humped income distribution of Figure 4b.

5.3. Simulation 5

Parameters: Simulation 5 combines the social isolation of Simulation 3 with the welfare of Simulation 4. Formally, Simulation 5 assumes Simulation 1's specification of F, δ, and θ; Simulation 3's specification of $\langle\alpha(t)\rangle_{t=1}^{\infty}$ by $\alpha(t) = 16$ if $t \leq 12$ and $\alpha(t) = +\infty$ if $t > 13$; and Simulation 4's specification of $\beta = 4$. Thus schooling choice is $s = \min \{ t \mid M_t^{\delta,\theta} \circ E \circ C^4 \circ T^{\alpha(t)}[F] = t \}$.

Results: Simulation 5 demonstrates that social isolation and welfare are likely to depress schooling choice through distinct and reinforcing channels. This stems from the fact that social isolation squeezes the regression from above while welfare squeezes from below (see Figure 5a).

Recall that social isolation with changing role models shifts all but the upper tail of the schooling distribution (Simulation 3), while welfare entraps its lower tail (Simulation 4). By comparing Figures 5a,c,d with Figures 3a,c,d and 4a,c,d, it is quite apparent that both social isolation's shift as well as welfare's entrapment are completely present in Simulation 5. More-

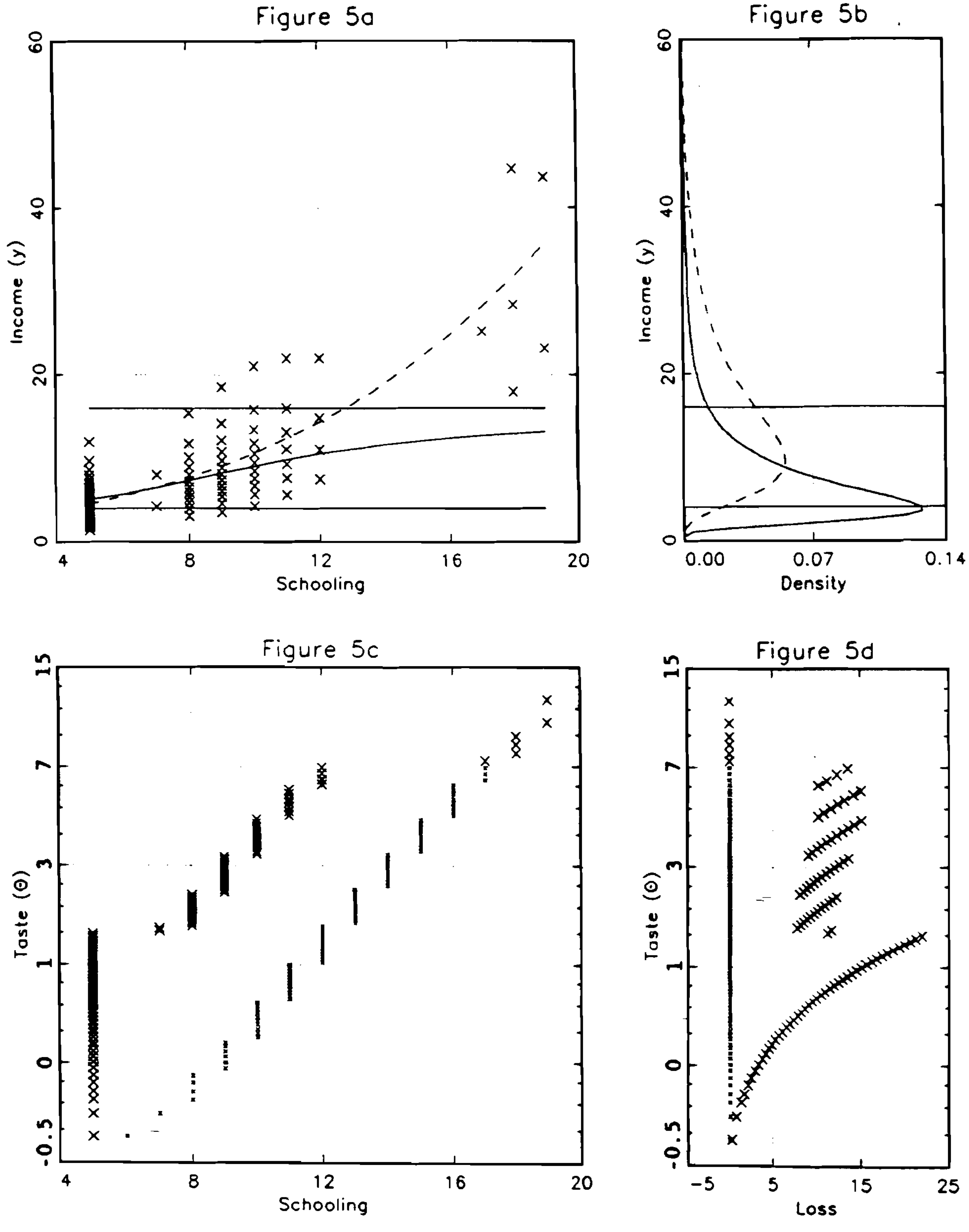

Figure 5: The large stars and solid curves depict Simulation 5's model of welfare and social isolation with changing role models. The small stars and dotted curves recall Simulation 1's benchmark model.

over, there is a reinforcing interaction: social isolation's shift enables welfare to entrap a larger tail. In particular, 45 percent of the hundred persons are entrapped by welfare in the social isolation of the ghetto (Simulation 5), even though only 26 percent would have been entrapped outside the ghetto (Simulation 4). The greatest loss is created by someone in this extra 19 percent: Person $\theta = 1.487$ should have chosen a high-school education, but instead dropped out after fifth grade and thereby created a loss of about 22 thousand dollars (Figure 5d), as measured by equation (4).

6. Further Simulations

Table 3 offers a number of simulations which tweak the parameters of Simulations 1, 3, 4, and 5. These additional simulations will help you gauge the validity of the conclusions I have drawn. Note how bad things get as the cutoffs α and β converge.

7. Empirical Comments

This section builds a bridge to related empirical work in order to demonstrate the empirical relevance of my theory and in order to suggest new avenues of empirical research.

By neighborhood, I mean the collection of role models from the labor force which a youth observes. Such a neighborhood is geographic (as in Hughes' (1989) careful definition) to the extent that residential proximity and social interaction are highly correlated. This correlation increases as stores, schools, and social institutions draw from smaller geographic areas. More generally, my neighborhoods could be regarded as nongeographic entities such as schools (as below), friendship networks, religious institutions, or groups maintaining an ethnic identity. As in a geographic neighborhood, social isolation occurs within a nongeographic neighborhood when there is

	Paramtrs		Frequency of Schooling Choice															Ave
	β	α	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1	0	+∞	0	1	1	4	6	10	12	14	13	12	10	8	4	3	2	12.7
	0	70	0	1	1	4	6	10	13	15	11	12	10	8	4	3	2	12.7
	0	60	0	1	1	4	6	11	14	16	8	12	10	8	4	3	2	12.6
	0	50	0	1	1	4	7	12	16	18	2	12	10	8	4	3	2	12.5
	0	45	0	1	1	4	8	13	18	18	0	10	10	8	4	3	2	12.4
	0	40	0	1	1	5	9	15	20	19	0	3	10	8	4	3	2	12.1
	0	35	0	1	1	6	12	18	21	18	0	0	6	8	4	3	2	11.7
	0	30	0	1	2	8	16	21	20	16	0	0	0	7	4	3	2	11.2
	0	25	0	1	5	13	21	21	17	11	0	0	0	2	4	3	2	10.6
	0	20	1	3	11	20	22	17	12	7	0	0	0	0	2	3	2	9.7
	0	18	1	6	15	22	20	15	9	6	0	0	0	0	1	3	2	9.3
3	0	16	3	10	18	21	18	12	8	4	0	0	0	0	1	3	2	9.0
	0	14	7	15	20	19	14	10	5	4	0	0	0	0	1	3	2	8.6
	0	12	15	18	19	16	11	7	4	3	0	0	0	0	2	3	2	8.2
	0	10	27	18	16	12	8	5	3	2	0	0	0	0	4	3	2	7.9
	2	+∞	1	0	1	4	6	10	12	14	13	12	10	8	4	3	2	12.7
	2	20	2	3	11	19	22	17	12	7	0	0	0	0	2	3	2	9.7
	2	16	5	9	18	21	17	12	8	4	0	0	0	0	1	3	2	8.9
	2	12	18	16	19	15	11	7	4	3	0	0	0	0	2	3	2	8.1
4	4	+∞	26	0	0	0	0	0	9	13	13	12	10	8	4	3	2	11.6
	4	20	38	0	0	6	16	15	11	7	0	0	0	0	2	3	2	8.6
5	4	16	45	0	2	12	13	11	7	4	0	0	0	0	1	3	2	8.0
	4	12	55	2	7	9	8	5	4	3	0	0	0	0	2	3	2	7.4
	6	+∞	64	0	0	0	0	0	0	0	0	10	9	8	4	3	2	8.8
	6	20	75	0	0	0	0	6	7	6	0	0	0	0	1	3	2	7.0
	6	16	79	0	0	0	3	5	5	3	0	0	0	0	0	3	2	6.6
	6	12	84	0	0	1	3	2	2	2	0	0	0	0	1	3	2	6.3
	8	+∞	84	0	0	0	0	0	0	0	0	0	0	7	5	2	2	6.9
	8	20	91	0	0	0	0	0	2	2	0	0	0	0	1	2	2	5.9
	8	16	93	0	0	0	0	0	2	1	0	0	0	0	0	2	2	5.7
	8	12	95	0	0	0	0	0	1	0	0	0	0	0	0	2	2	5.6

Table 3: The frequency of schooling choice s = min { t | $M_t^{\delta,\theta} \circ E \circ C \circ T^{\alpha(t)}[F] = t$ } over the 100 θ's discussed in Simulations 1 through 5. F and δ are fixed in Simulations 1 through 5, $\langle \alpha(t) \rangle_{t \in S}$ is defined by $\alpha(t) = \alpha$ if $t \leq 12$ and $\alpha(t) = +\infty$ if $t > 13$, and α and β are varied parametrically in each line. Simulations 1, 3, 4, and 5 are marked in the left column.

selective out-migration by high-income role models (or equivalently, selective in-migration by low-income role models).

The theory predicts that socially isolated neighborhoods (i.e., ghettos) engender inefficient schooling choices. This prediction is only tenuously related to the statement that mean neighborhood income depresses schooling choice. First, there is the theoretical possibility that social isolation increases schooling choice (Counterexample 1). This concern is somewhat ameliorated by calibrated simulations which confirm the expected effect (Simulation 2).

Second, and more importantly, the theory clarifies that schooling choice is inefficient when a youth's perception of the earnings function is distorted by an unrepresentative neighborhood, and the representativeness of a neighborhood need not have anything to do with its mean income. For example, suppose that there are three neighborhoods: a lower-class neighborhood truncated from above at an income of 16 thousand dollars (as in Simulation 2); a middle-class neighborhood that is perfectly representative of the labor market; and an upper-class neighborhood truncated from below at an income of 40 thousand dollars (this can be simulated by the GAUSS procedure ECTL). In this example, the graph of schooling choice as a function of mean neighborhood income would be an upside-down U. Thus a linear regression of schooling choice on neighborhood income could very well be flat or even downward sloping (when one controls for parental income). This observation accords very well with Jencks and Mayer's ((1990), pages 123-125, and 177) suggestion that empirical researchers be concerned with nonlinear relationships.

Given these weighty caveats, I turn to linear regressions of schooling choice on mean neighborhood income and socioeconomic status, and draw heavily from Jencks and Mayer's (1990) excellent survey. Datcher (1982) and Corcoran et al. (1987) study geographic neighborhoods and provide evidence in support of the theory. For example, Datcher finds that a $1000 increase in mean neighborhood income (measured in 1970 dollars) increases schooling by about one-tenth of a year (the estimate is .087 (with a standard error of .061) for blacks, and .103 (.035) for whites). This is roughly the magnitude predicted by the means in Table 3, if one takes α to be about twice mean neighborhood income.

On the other hand, many researchers, including Meyer (1970) and Jencks et al. (1972), have regressed a youth's schooling choice on the mean socioeconomic status of families with children in her school. The consensus of these studies supports the theory by finding that schooling is positively correlated with mean school socioeconomic status when one controls for mean school test scores (Jencks and Mayer (1990), pages 127-130 and Jencks et al. (1972), pages 151-153).

Perhaps future empirical work will regress schooling choice on a better measure of social isolation, and simulate the model with more finely calibrated parameters.

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