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Effectively Maintained Inequality: Education Transitions, Track Mobility, and Social Background Effects[1]

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This article proposes a general explanation for social background-related inequality. Educational attainment research indicates that the later an education transition, the lower the social background effect. While some suggest life course changes in the parent-child relationship or between-family competition explain this pattern, others contend the result is a statistical artifact, and that the analytic strategy presupposes agents are irrationally myopic. This article addresses these criticisms by framing educational transitions in terms of students' movement through the stratified curriculum. Students select their stratum, one of which is dropping out. To make these choices, they consider their most recent salient performance. Using time-varying performance measures to predict students' track placement/school continuation sustains the validity of the educational transitions approach and suggests substantively important social background effects even for nearly universal transitions. Results are consistent with the general perspective termed effectively maintained inequality.

Two distinct literatures have developed to examine students' movement through secondary school. One strain of research uses ethnography and statistical analysis to focus on students' placement in the stratified curriculum or, in other words, students' track location. This literature treats track location both as a determinant of important factors such as achieve-

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ment (e.g., Gamoran and Mare 1989), college entry (e.g., Rosenbaum 1980), and political efficacy (e.g., Paulsen 1991), and as an outcome in its own right (e.g., Rehberg and Rosenthal 1978; Hallinan 1992).

A second line of inquiry has viewed educational attainment as a process of completing a sequence of transitions. In this line of research, henceforth termed the educational transitions tradition, students in any given grade either continue on to the next grade or level of schooling or end their formal education. Thus, educational attainment is analyzed as the cumulation of a sequence of yes/no decisions (e.g., Mare 1980; Shavit and Blossfeld 1993). By treating educational attainment in this manner, analysts have sought to discern the transition points where social background effects are largest, and they have apparently shown a nearly universal pattern, whereby effects of social background appear lower for later educational transitions than for earlier ones. However, as analysts have attempted to explain this common pattern, the entire enterprise of educational transitions analysis has come to be questioned; indeed, some researchers now call for the abandonment of educational transitions research (e.g., Cameron and Heckman 1998).

This division between the tracking literature, on the one hand, and the educational transitions literature, on the other, is unfortunate for at least four reasons. First, tracking research provides important findings that can justify continuing to study educational attainment as a sequence of transitions. Recent research suggests that educational transitions analyses are based on untenable behavioral assumptions, but findings from research on tracking imply at least some of those assumptions are actually appropriate.

Second, a problem in the treatment of dropouts in the tracking literature is resolved by adopting an educational transitions perspective. The tracking literature sees each grade as composed of a set of stratified positions, and students' location in the stratification system in a given year has potentially important implications for social and psychological development. For this reason, tracking researchers are interested in the determinants of track location and track mobility. When studying these processes, track researchers have usually deleted dropouts from the analysis (e.g., Rosenbaum 1976; Hallinan 1996). When viewed through the lens of the education transitions tradition, however, deleting dropouts from the analysis is problematic. Instead, given the logic of educational transitions, research on track mobility can treat dropout as an important absorbing state or destination in the track structure.

Third, an inconsistency in the educational transitions literature's treatment of the stratified curriculum can be resolved by elaborating the destinations students may reach. The educational transitions literature focuses on the accumulation of an additional year of formal education;

educational attainment is of interest because of its well-documented implications for social, political, and economic behavior. While the educational transitions literature has often considered students as existing in a stratified curriculum *prior* to making a transition, and thus has not ignored the insights of tracking research, it has not seen the destination as *also* composed of stratified curricular positions. Thus, the treatment of origins and destinations in the educational transitions literature is often not consistent (e.g., Lucas 1996). This inconsistency is consequential, because treating origins and destinations consistently will facilitate investigation of two important explanations for the commonly found pattern of waning social background effects across transitions: the life course perspective (LCP) and maximally maintained inequality (MMI).

Fourth, when we consider educational transitions through a stratified curriculum, it becomes feasible to estimate the effects of social background both on making a transition and on reaching particular locations in the stratified curriculum. Obtaining both estimates will make it possible to investigate whether results support a comprehensive explanation for both school continuation and in-school processes of tracking. As school continuation and track placement are two parts of the same process—accumulating resources to enter the world of adults—a comprehensive explanation may be appropriate.

These two literatures separately have provided important insights into the workings of schools and society. However, each literature has been pursued largely in isolation from the other. This article seeks to bring the two together. With respect to educational transitions, the article treats both in-school origins and in-school destinations as stratified, the better to estimate direct effects of social background and thus allow comparative assessment of LCP and MMI. With respect to track mobility, this article makes dropping out a part of the process of allocating students to positions in school, the better to estimate the effects of factors of interest. And with respect to their convergence, the article seeks to address rising doubt as to the value of educational transitions analyses and to offer a comprehensive explanation of both facets of educational attainment, an explanation I term effectively maintained inequality.

To pursue these aims, I first describe the logic and results of educational transitions research. I then relate two theories devised to explain the common pattern of results educational transitions analysts have found. I then shift attention to tracking research, detailing changes in tracking that encourage the convergence of these research traditions. This convergence facilitates development of a comprehensive explanation for social background effects on school continuation and track placement. I propose effectively maintained inequality as one such comprehensive explanation. After outlining this explanation, I return to educational transitions research, presenting several existing criticisms of educational transitions research and suggesting responses to them. Afterward, the particular methods used in this analysis are described, and the results and conclusions of the research are presented. Thus, to begin this effort, it is important to relate the logic and results of educational transitions research.

EDUCATIONAL TRANSITIONS RESEARCH: LOGIC AND RESULTS

The educational transitions literature flows from the long-held interest in whether the effect of social background on educational attainment differs over time or across societies. One way to investigate educational attainment is to regress years of school completed on a set of explanatory variables. However, ordinary least squares (OLS) coefficients reflect not only the level of association but also the variance of educational attainment. Because the variance of educational attainment has changed over time given the expansion of educational systems, comparisons of OLS coefficients across different cohorts or countries will not reveal whether the structural parameters governing the process of educational attainment differ.

To obtain estimates that can be compared across cohorts, Mare (1980), following on the work of Fienberg and Mason (1978), proposed that analysts treat education as a series of transitions or school continuation decisions. Mare reasoned that total years of school completed is the result of a series of decisions to stop or continue schooling. If each year students have the option of continuing or ending their formal education, each decision to stop or continue is a binary variable, scored one for students who continue on and zero for students who elect to stop. Figure 1 details

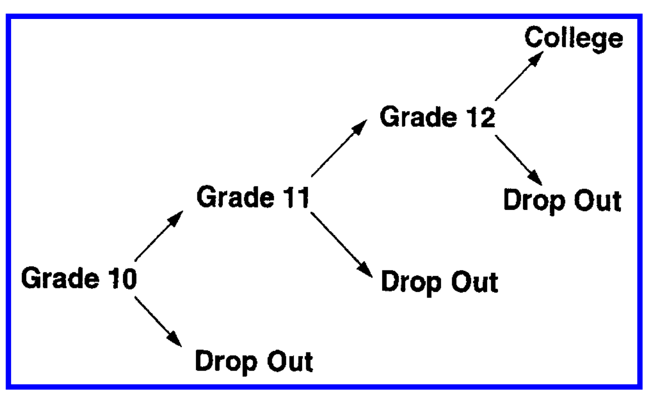

FIG. 1.—Perspective of traditional education transitions analyses

the process of educational attainment as seen through the lens of the educational transitions tradition.

Using Mare's approach, analysts have investigated whether logit coefficients for social background change across transitions, and within a given transition whether the coefficients change across cohorts, in at least 18 countries (e.g., Garnier and Raffalovich 1984; Kerckhoff and Trott 1993; Treiman and Yamaguchi 1993; Shavit 1993; Szelényi and Aschaffenburg 1993; Raftery and Hout 1993). In nearly every cohort in country after country, researchers have found logit coefficients to decline across transitions.

EXISTING EXPLANATIONS OF THE WANING COEFFICIENTS PATTERN

The vast majority of educational transitions analyses have found logit coefficients for social background to decline across transitions (e.g., Mare 1980; Shavit and Blossfeld 1993). Two major explanations of this finding have been constructed.[2]

Life Course Changes

Müller and Karle (1993) speculate that a life course perspective (LCP) could explain the waning coefficients pattern. They suggest that changes in the relationship between children and their parents may be at the root of the pattern. Allegedly, parental characteristics decline in value because students, who are older at each transition, are also less dependent economically and socially on their parents with each transition. If students are less dependent on their parents for later transitions, then social background should be less important for determining who receives additional schooling.

Maximally Maintained Inequality

Raftery and Hout offer a second explanation (Raftery and Hout 1993; Hout, Raftery, and Bell 1993). These authors argue that the pattern of background effects across cohorts can be explained by a theory of maximally maintained inequality (MMI), which has four tenets.

First, *ceteris paribus*, expansion of secondary and higher education will reflect increased demand generated by two typically glacial forces: (1)

[2] Mare (1980) originally proposed that selective attrition might explain the waning coefficients pattern, but recent research has led analysts to doubt this explanation is sufficient (e.g., Mare 1993; Shavit and Blossfeld 1993; Lucas 1996).

population increase and (2) social origins upgrading. Second, if enrollment rises *faster* than demand (where demand is the amount of schooling expected on the basis of population level and social class background composition), then lower-class persons obtain more schooling. Even so, the social class effect remains the same. Third, if completion of a given level of education becomes universal for upper-class persons, then the effect of social background on *that* transition declines over time, but only if educational expansion cannot be maintained otherwise (hence the name of the theory). And fourth, falling effects of social background can reverse to become rising effects of social background. If public support for education is reduced, social class effects will increase (Hout et al. 1993).

MMI was devised to explain cross-cohort variation in social background effects. Yet, MMI is potentially relevant to understanding the pattern of background effects across transitions. Most important in this context is the fourth precept of MMI, which states that when public support for a particular level of education changes, the impact of social background on completion of that transition will also change. Notably, if support for making a particular transition declines, then social background will become more important for making that transition. Given sufficient change in the support for a particular transition, MMI suggests that social background may actually become more important for later transitions than it is for earlier ones. This is the key difference between MMI and LCP; LCP emphasizes that as children age they become more and more independent of parents, whereas MMI implies that adolescents' independence itself depends on the sociopolitical context and the resulting social support for particular levels of education.

Educational transitions research has furthered our understanding of educational stratification. However, research on tracking has also been concerned with stratification issues and thus is potentially relevant for educational transitions research. Therefore, consideration of tracking research is in order.

TRACKING RESEARCH AND IMPLICATIONS FOR EDUCATIONAL TRANSITIONS

MMI and LCP were devised to explain the results of educational transitions analyses. Educational transitions research highlights the cumulative nature of the process of educational attainment. Although researchers have at times referenced qualitative differences in schooling to make sense of educational transitions results, the qualitative differences these interpretations highlight are collinear with the level of schooling. This is the result of the strategy of educational transitions analyses, which, as figure

1 suggests, suppresses within-level differences in schooling.[3] Thus, in educational transitions research, it is impossible to assess the role of social background on qualitative dimensions of schooling that are not collinear with the level of schooling.

This is a limitation of educational transitions analysis, because qualitative differences in schooling are an important feature of educational systems in their own right, and many of those qualitative differences are not collinear with the level of study. One such qualitative feature is curricular tracks. Educational systems are often composed of explicit or implicit curricular strata or tracks. Such tracks are not collinear with the level of schooling. The strategy of educational transitions analysis, therefore, may systematically miss or greatly deemphasize processes of in-school stratification. If qualitative differences in students' experience are an important pathway through which social background affects educational transitions, de-emphasizing processes of in-school stratification may lead one to mischaracterize the pattern of social background effects on educational attainment.

Change and Stability in Tracking in the United States

In order for the treatment of tracking to matter for educational transitions research, two conditions must be met. First, track location must be an important part of the process of educational transitions, and second, social background must be a determinant of track location.

With respect to the first condition, it is important to distinguish more recent cohorts from earlier ones. At the inception of the educational transition tradition, it may have been sufficient to ignore track location in analyzing the cumulation of years of schooling for American cohorts. However, considering the way tracking has come to work in the United States raises questions as to whether suppressing the complexities of tracking is still warranted. These questions arise because the in-school stratification system—the track system—is more complex than formerly believed. Indeed, as I have noted elsewhere, the simple view of how schools work implicit in many theories of the school-economy relation is based

[3] Buchmann and Charles's (1993) analysis of educational transitions in Switzerland is an exception. Notably, they included qualitative dimensions in their analysis and failed to replicate the waning logit coefficients pattern. Yet, the sample sizes are small (approximately 500 for each sex/cohort studied, and each sex/cohort combination is analyzed separately), the response rate of the study is low (45%), and the data were collected long after the modal person would complete high school, allowing dropouts to possibly obtain enough later schooling to endanger accurate estimation of the effect of parental status characteristics. For these reasons, the implications of the results remain unclear.

on an outdated understanding of how schools track students in the United States (Lucas 1999). The difference between the old understanding and the new reality is best reflected in research on track mobility.

Historically tracking researchers found low levels of track mobility and a greater incidence of downward mobility than upward mobility. This finding was explained by a theory of tournament track mobility. Tournament track mobility (Rosenbaum 1976) explained students' extremely low mobility chances by highlighting the ideational and institutional supports for tracking. Ideationally, mobility might call into question the legitimacy of earlier placements and thus was subtly discouraged. Institutionally, school personnel appeared to hold overwhelming power to assign students to tracks, and evidence suggests they wielded this power on a regular basis (e.g., Cicourel and Kitsuse 1963). In such a world, it would be sufficient to treat track location as an independent variable in educational transitions analyses and ignore the track destinations of students, because mobility was so rare that one could regard students in disparate tracks as following unalterably separate paths.

Recent analyses, however, have been unable to replicate earlier findings concerning track mobility. Indeed, more recent research finds a high incidence of mobility, and none find upward mobility to be rare (e.g., Wilson and Rossman 1993; Hallinan 1996; Lucas 1999; Lucas and Good 2001). As analysts have looked closer, they have come to explain this new set of findings by pointing to an unremarked revolution in how schools track students (Lucas 1999). Evidence suggests that schools no longer formally assign students to overarching tracks that determine their course-taking (e.g., Carey, Farris, and Carpenter 1994; Hayes 1990). Now tracking is activated in many *separate, yearly, subject-specific* decisions rather than in *one global* assignment to a track at one pivotal point in a career (e.g., Moore and Davenport 1988).

The above suggests that tracking has become a possibly important part of the process of educational transitions. Students are not allocated to one track that governs their schooling for multiple years. Instead, students encounter many separate decision points that implicitly allocate them to different curricula. In order for changes in tracking to matter for educational transitions research, however, social background must matter for students' track placement. Are these decisions made under conditions that might allow social background to matter for placement? Evidence suggests that students make enrollment decisions with comparatively less counselor input than previously, as counselors have retreated from the proactive role they formerly played (e.g., Rosenbaum, Miller, and Krei 1996). The retreat of the counselors ushers in an environment of ostensible student choice; in this environment, researchers continue to find social background to matter in track placement (e.g., Garet and DeLany 1988; Hallinan 1992).

Sociologists have identified two ways that social background appears to matter. Middle-class parents appear to be proactive both as individuals and as a class, maintaining tracking in general and securing for their children the best positions within the track structure of the school (e.g., Useem 1992; Wells and Serna 1996). Class conflict around schools' decisions to track or not track is well-documented, as socioeconomically advantaged parents often work to maintain tracking in the schools (e.g., Wells and Oakes 1996; Wells and Serna 1996).

Social background also affects individual placements. Socioeconomically advantaged parents can secure advantaged places for their child, not only because they may use a wide array of resources in a given instance, but perhaps more important, they have personal experiences that make it more likely they will be able to recognize the pivotal "given instance" to which they may *want* to bring those resources to bear. They know which decision points involve high stakes and which can be ignored safely. Having been to college themselves, they can help their children navigate the high school curricular structure in ways that make subsequent college entry a real possibility.

Socioeconomically disadvantaged parents may certainly cheer their children on in their efforts to reach college. But socioeconomically advantaged parents may not only cheer, but also coach, their children in their efforts to reach college. The difference between cheering and coaching is information as to what matters for college. Given the retreat of the former school gatekeepers, as evidenced by existing research, and the episodic nature of track decisions, students whose parents lack such knowledge are on their own. This environment, with many more decision points, unclear signs for the uninitiated, and continued effects of social background, has two important implications for how we may study educational attainment.

Implications of Tracking Research for Educational Transitions Research

The first implication of tracking research is that we need to change our focus from the yes/no decision of educational transitions research to decisions about a more varied set of options. Students make decisions yearly as to which structural path they will follow—drop out; stay in school in college preparatory courses in academic subjects such as math, English, foreign language, science, and social studies; stay in school in noncollege preparatory courses in academic subjects; or stay in school but avoid academic subjects. Thus, this new state of affairs means both that the

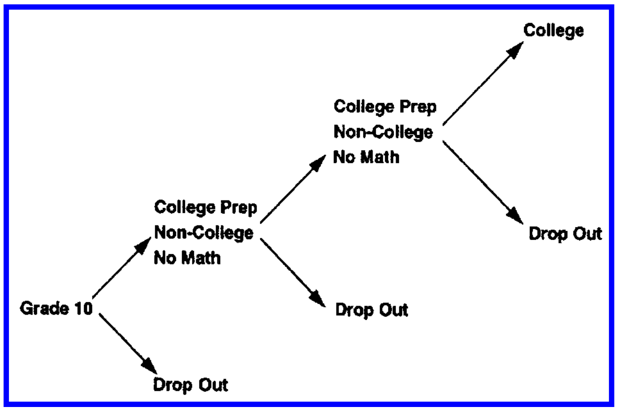

FIG. 2.—Education transitions with stratified destinations

vision of educational transitions evident in figure 1 is no longer sufficient *and* that educational attainment is produced through a sequence of transitions. This suggests it is potentially useful for the tracking and educational transitions literatures to converge. When these literatures converge, the vision of the process of educational transitions is as illustrated in figure 2. In figure 2, dropping out becomes one of a small subset of potential locations to which students may move, and students who decide to continue also decide within which curriculum they will continue. Seen in this way, the distinction between the educational transitions literature, on the one hand, which treats school as a sequence of transitions, and the track mobility literature, on the other hand, which sees students as moving through a stratified curriculum, dissolves.

Second, the unremarked revolution heightened the potential importance of student performance for students' placement in the stratified curriculum. The consistent finding from the recent research is that there is far more mobility in the recent period than previously observed. Students routinely obtain updated information as to their performance in school in the form of grades; these grades are obtained in particular curricular positions. Students and others can use this updated information—this time-varying covariate—to aid in placements for the following academic year. This is possible because placements for the following year are not completely determined by prior placement, as seemed to be the case prior to the change in school practice. Thus, time-varying covariates are a routinized and potentially consequential feature of the educational career. Analysts, therefore, may use such information to aid their study of the determinants of educational transitions.

EFFECTIVELY MAINTAINED INEQUALITY

The joint study of educational transitions and track mobility raises the possibility of providing a comprehensive explanation of the role of social background in educational attainment. I propose that a theory of *effectively maintained inequality* (EMI) may illuminate both processes of school continuation and track mobility.

Effectively maintained inequality posits that socioeconomically advantaged actors secure for themselves and their children some degree of advantage wherever advantages are commonly possible. On the one hand, if quantitative differences are common, the socioeconomically advantaged will obtain quantitative advantage; on the other hand, if qualitative differences are common the socioeconomically advantaged will obtain qualitative advantage.

EMI

For educational attainment, the above claims could be true in one of at least two ways. It may be that as long as a particular level of schooling is not universal (e.g., high school completion throughout the first half of the 20th century in the United States), the socioeconomically advantaged use their advantages to secure that level of schooling. Once that level of schooling becomes nearly universal, however, the socioeconomically advantaged seek out whatever qualitative differences there are *at that level* and use their advantages to secure quantitatively similar but qualitatively better education.

The above suggests that the focus of activity may change over time as qualitative differences supplant quantitative differences in importance. Alternatively, it is possible that even when quantitative differences are common, qualitative differences are also important; if so, I posit that the socioeconomically advantaged will use their socioeconomic advantages to secure both quantitatively and qualitatively better outcomes.

Unfortunately, it is not possible to adjudicate between these two possibilities in the current analysis, because we lack detailed data on the track placements of earlier cohorts. However, it is possible to determine whether in one cohort studied we find consequential effects of social background on qualitative placements, even where quantitative differences are virtually nil. Finding such a pattern of effects will provide evidence consistent with effectively maintained inequality; the central implication of EMI for educational attainment is that for nearly universal levels of schooling, background will affect differences in kind.

EMI, MMI, and LCP

EMI and LCP are not mutually exclusive, but they do highlight different processes. LCP emphasizes the relationship between children and their parents, and how that relationship changes over time as children mature. Owing to changes in the parent-child relationship, parental status characteristics are expected to wane in importance over time. EMI is agnostic with respect to whether this causal story explains the waning logit coefficient pattern. The pace at which persons' own status characteristics replace their parents' status characteristics is both an empirical question whose answer may depend on the outcome under study and an issue in need of theoretical reflection beyond the scope of this analysis. However, EMI implies that for as long as parents' status characteristics *are* students' status characteristics, the children of the socioeconomically advantaged will be allocated to quantitatively and qualitatively advantaged positions on that basis. Further, EMI implies that once parents' status characteristics are truly replaced by children's own status characteristics, the adult children's own status characteristics will serve the same purpose parents' status characteristics served in the past.

EMI and MMI are somewhat more divergent. Both highlight class competition between families, but MMI suggests competition will be nil for any level of education that is universal. In contrast, EMI implies that for levels of education that are universal, competition will occur around the *type* of education attained. Thus, for some levels, MMI implies the maximum amount of background-related inequality is virtually zero, whereas EMI implies that for those very same levels inequality will not only be nonzero but also nontrivial, that is, the background-related inequality will be consequential. However, MMI and EMI do not disagree about every aspect of schooling, for both perspectives would predict social background effects to be nontrivial at levels of education that are not universal.

EVALUATING EDUCATIONAL TRANSITIONS RESEARCH: CRITIQUES AND RESPONSE

MMI and LCP were crafted to make sense of the waning coefficients pattern educational transitions researchers have found. I have suggested that bringing tracking and educational transitions research together is appropriate, given changes in tracking, and useful, given the possibility of developing a comprehensive explanation of school continuation and track mobility.

However, several analysts have suggested that the waning coefficients pattern of educational transitions research may be a statistical artifact.

The arguments concerning this issue have raised doubt as to whether researchers should continue to study educational attainment in this manner. Thus, in order to continue to conduct educational transitions research, even educational transitions research informed by research on tracking, a response to the critiques is required.

Improper Functional Form and Untenable Behavioral Assumptions

Cameron and Heckman's (1998) criticisms of educational transitions research culminate in their declaring that the near universal finding of declining logit coefficients should be ignored. They argue that the finding is an artifact of ad hoc decisions regarding the functional form of the model. They reach this conclusion by contending that the functional form for the model makes it possible to obtain estimates, but absent time-varying covariates, it is impossible to assess whether effects of social background vary across transitions. They show that the logistic regression model with transition-specific coefficients can be identified when the values of at least one covariate vary across transitions, but they maintain that time-varying covariates are not usually available.

The lack of time-varying covariates is important because if covariates do not vary across transitions, then one must assume a distribution for the error term in order to identify the model with transition-specific parameters. Further, if there are no time-varying covariates, the only factor inducing differences on the dependent variable across transitions is the error term. Cameron and Heckman argue that under these conditions the sequential decision-making process underlying the educational transitions logit model implies students assume that their current school experience perfectly predicts their future school experience, and thus students act only on contemporaneous conditions. Cameron and Heckman regard this as an untenable assumption of student myopia.[4] In response, they offer what they regard as a rational choice perspective in which persons know their endowments, know the costs of investments (including foregone earnings), and know the payoffs that attend certain levels of education. Using

[4] Cameron and Heckman argue that under the sequential model with time-invariant covariates, the error term (ε) is the only person-specific factor varying over transitions. The person-specific, across transition distribution of ε is a martingale; the most important implication of this is that $E(\varepsilon_t) = \varepsilon_{t-1}$, i.e., if ε is a martingale, then persons use their most immediate experience to decide on their next move, ignoring experiences earlier than $t - 1$. Because the sequential decision-making model with time-invariant regressors implies that persons make decisions sequentially, and the only factor inducing variation is a martingale in this situation, Cameron and Heckman contend that the model implies myopic agents.

this information, persons obtain just enough schooling to maximize net benefits.[5]

Cameron and Heckman propose a statistical model that reflects their preferred behavioral assumptions, an ordered discrete choice model with multiplicative heteroskedasticity. The dependent variable for their analysis appears to be years of school completed, but the discrete choice model relaxes the assumption of equal intervals between years. Were one to assume that the error was normally distributed and homoskedastic, their model would become the ordered probit model, with years of schooling as the dependent variable. Thus, essentially Cameron and Heckman are calling for a return to years of school completed as the focus of analysis and suggesting that a different functional form will resolve the problems that attend using OLS regression. They allow for heteroskedastic errors to allow for differences they do not observe; they assert that a major portion of the unobserved heterogeneity reflects differences in ability.

On the basis of estimates derived from their preferred model, Cameron and Heckman argue against expanding financial support for college. They contend that such support entices students from the bottom of the distribution of their unobserved variable to continue schooling. Given their assertion that the unobserved variable is ability, they suggest that though those induced to continue schooling with increases in financial aid are more productive than they would otherwise be, the productivity gains to their continued education fall short of the productivity gains typically observed for college entrants. Thus, they contend, financial aid for college should not be expanded.

In sum, Cameron and Heckman reject the educational transitions literature. They essentially argue that without time-varying covariates one cannot identify the education transitions model with transition-specific parameters independent of the assumption for the distribution of the error term. But solving the identification dilemma by assuming a distribution for the error term leaves the error term to induce all over-time variation in the dependent variable. This implies that as soon as the error term pushes a person below the school continuation threshold, the person falls

[5] I have attempted to use the term Cameron and Heckman use—rational choice—without joining the debate about the meaning of the term. Suffice it to say, their reasons for assuming that students use a particular kind of information in a particular way are clear, but I see no analytic justification for labeling use of that information in that particular way as rational. The assumption is what it is, regardless of whether one judges behavior that matches the assumption as rational or not. And, as an unsubstantiated assumption, it is as subject to Manski's (1993) cogent criticism of social scientific presumptions about how students form expectations, as are any of the analyses Cameron and Heckman critique. Thus, in this article, I will attempt to defend the behavioral assumption that underlies the model used but will offer no judgment as to the rationality of the behavior.

out of school, even if a later error term would have been such that they would have accrued substantial gains upon continuing. Cameron and Heckman argue that this is a restatement of myopia, and thus the behavioral theory behind the sequential decision-making model requires myopic agents. Thus, they reject the sequential decision-making model and the educational transitions literature. (See appendix B for a more technical explication of their position as well as my response).

However, although Cameron and Heckman argue that the sequential decision-making model creates the assumption of myopia, in actuality, the sequential decision-making model *in concert with* the lack of time-varying covariates creates the assumption of myopia; the presence of both features is necessary in order to force the error term to take the decisive role in creating over-time variation in a student's decision of whether to stop or continue schooling. Cameron and Heckman decide to retain the idea that observed characteristics are stable over time and change the functional form of the model to jettison the implication of myopia. But their response seems arbitrary in the face of research on tracking showing that students' structural locations change, implying that their performance—a key piece of information—can also in principle change over time.

Cameron and Heckman call for researchers to use statistical models that reflect defensible behavioral models and processes. A response consistent with their counsel would be to retain the sequential decision-making behavioral model and add theoretically defensible time-varying covariates to the statistical model. That is the approach taken here, because evidence shows that the process of educational attainment in the United States occurs in a stratified curriculum that requires sequential decision making. Once time-varying covariates are allowed, the educational transitions model with transition-specific parameters is identified without recourse to an assumption for the distribution of the errors. Once it is identified, person-specific variance in the dependent variable over time is not driven only by the error term. Once the error term does not drive the variance in Y, the claim of myopia is not sustained.

The observations above are sufficient to support the work that follows. However, several other important observations concerning the existing critiques of the educational transitions approach need to be made for at least two reasons. First, these observations will suggest further dangers analysts must avoid should they seek to conduct educational transitions research specifically. Second, some of the critiques actually violate generally good research practice and thus may have created much confusion.

Myopia

Despite the discomfort of some with the prospect of myopic decision making, all students pursue options as the sequence of opportunities unfolds. All students select from among immediately visible options whose long-term implications they cannot accurately estimate and perhaps would not know how to begin to evaluate (Manski 1993). The extent to which decisions are myopic is likely dependent on the resources a student has to gather pertinent information. All students have records of their performance in courses by which to judge the appropriateness of continued study at different levels. However, socioeconomically advantaged students have college-experienced parents, and students in college track courses have teachers pointing them to college with time-tested strategies of success. Other students lack these resources. Access to knowledgeable parents and teachers makes savvy and strategic forward-looking behavior more likely, while lack of access to these resources diminishes its likelihood.

Thus tracking research, and a line of reasoning consistent with it, suggests that students—even socioeconomically advantaged students—make decisions both sequentially, as Mare contends, and potentially myopically, as Cameron and Heckman deny (Powell, Farrar, and Cohen 1985). However, myopia is likely to be a differentially allocated feature of students' educational decision making. If one considers the process of schooling, one may adopt modeling strategies that make it unnecessary to assume myopia in the modeling process. However, myopia may be present even if it is not assumed; indeed, known and commonly measured social factors such as parents' education and students' track location are associated with the extent to which students are exposed to persons who can dispel the myopic elements of their decision making. Thus the social background coefficients from a sequential decision model may reflect in part the element of myopia. Similarly, the social background coefficients from an ordered probit model of years of school completed with heteroskedastic errors may reflect in part the element of myopia.

Appropriate Parameters to Estimate

One criticism of educational transitions analysis is that the waning logit coefficients pattern is the result of a particular parameterization of the relationship between social background and educational attainment. The case for the logit coefficient as an appropriate index of the relationship between social background and attainment is based on the claim that logit coefficients are not contaminated in the same way as OLS coefficients are. However, De Graaf and Ganzeboom (1993) note that although OLS coefficients are an amalgam of different processes, including socioeconomic upgrading of parents' characteristics and expansions in educational systems, they remain descriptively accurate for the entire cohort, whereas logit coefficients for later transitions do not. Mare (1993) agrees but maintains that logit coefficients are more structural than OLS coefficients, because logit coefficients reflect the way that educational attainment actually occurs, namely, through an unfolding sequence of decisions.

Clearly, different summaries of nonlinear relationships can lead to different substantive conclusions (e.g., Long 1997). However, as Long suggests, the fundamental focus of many analyses is the probability of a discrete outcome. Advances in computing have facilitated determining how changes in independent variables are associated with changes in the probabilities of an outcome. As probabilities are the fundamental focus of many analyses, analysts may want to make probabilities the fundamental focus of presentation. Indeed, in order to assess EMI, it will be necessary to focus on how probalities differ for students with different social background characteristics, rather than on coefficients from the model.

Appropriate Dependent Variables to Study

When Cameron and Heckman resurrect years of schooling as the dependent variable of interest for investigation of educational attainment, they alter the functional form of the model to avoid estimating OLS coefficients; they also inadvertently suppress potentially important qualitative differences in schooling even more than education transitions analyses do. Although they allow the scaling distances between years of schooling to differ, this forces all qualitative differences to be translated into the unidimensional scale of years of school completed. This translation may obscure more than it reveals, because persons who obtain the same number of years of schooling, but do so in different types of programs, will be assigned the same value on the dependent variable. This may lead some persons to be misclassified, in that a proper translation of their educational attainment into years of schooling would put them higher or lower on the scale than their nominal years in school actually does. Because of these difficulties, even with the altered functional form, Cameron and Heckman lose the ability to investigate whether social background matters, not only for how much education a person receives, but also what kind of education a person receives. As the research discussed above suggests, however, this is an important question that is directly related to the concerns, if not the common analysis, of educational transitions researchers.

The existence of the stratified curriculum certainly suggests that a return to years of school completed may mask important pathways through which social background has its effects. Yet, adding qualitative dimensions to educational transitions analyses may complicate cross-national comparison. A central motivation for the development of the educational transitions tradition was the desire to conduct cross-national comparative analysis, and thus this limitation is an important one. Many qualitative characteristics may be country-specific, and even for those that are common across nations (e.g., the existence of stratified curricula), the actual categories and the meaning of the categories may differ markedly from country to country. Balancing the desire to make cross-national comparisons, on the one hand, with the aim of accurately capturing important country-specific features, on the other, is of course a challenge. Most likely, approaches that de-emphasize qualitative dimensions can aid in estimating the total effect of social background on the amount of educational attainment; these analyses may be most directly comparable across nations. This seems to be the strategy followed to great effect by Shavit, Blossfeld, and colleagues. However, to discern the mechanisms producing the pattern of social background effects, it is likely we will need to attend to the nuances of particular educational systems.[6]

Unobserved Heterogeneity

An additional criticism of educational transitions research contends that unobserved heterogeneity may make the waning coefficients pattern an incorrect representation of students' experience (e.g., Mare 1993). In some analyses, omitted variables must be correlated with independent variables included in the model in order to bias results, but in other analyses, including education transitions research, biases arise even if the omitted variable is not correlated with the included independent variables (Vaupel and Yashin 1985).

Analysts have long been concerned with unobserved heterogeneity. A big improvement is to use data that would allow one to directly measure the factors that are typically unobserved, if measurement is possible. Using good data is a helpful response because unobserved heterogeneity is an omitted variable problem. However, any finite set of regressors leaves a vast untapped reservoir of additional variables with the potential to create bias by their omission. Hence, although this strategy may be useful, it cannot dismiss the possibility that findings are driven by unobserved heterogeneity.

Thus, even when good data are available, some unobserved heterogeneity may remain, in which case one may adopt one of the many prom-

[6] I am thankful to an anonymous reviewer for drawing my attention to these implications.

ising statistical tools analysts have devised to account for unobserved heterogeneity when indicators for the potentially biasing variables are lacking. Such methods include the use of sibling models (e.g., Mare 1993; Mare and Chang 1998), parametric mixture distributions (e.g., Manton, Stallard, and Vaupel 1981), nonparametric mixture distributions (e.g., Heckman and Singer 1982), and a general nonparametric latent variable approach (Vermunt 1997). Each of these approaches is promising, but each has limitations as well. Limitations for the different approaches include variously the possibility that one may overcorrect for unobserved heterogeneity and thus produce results biased in the opposite direction, the necessity of assuming that unobserved heterogeneity is independent of included covariates, and sensitivity to the functional form assumed for the time-dependence or mixture distribution (e.g., Griliches 1977, 1979; Yamaguchi 1991).

However, taken together, these methods have an important use, for with these methods, it would be possible and advisable to calculate bounds on the parameters of interest, as Manski (1995) proposes. The calculation of bounds and detailed investigation of the sensitivity of results to different assumptions about unobserved heterogeneity is an effort worth conducting, but the purpose of this article is different. Here I seek to complete an essential precursor to such a project, for before assessing the sensitivity of results to a variety of different assumptions concerning unobserved heterogeneity, it is important to determine whether the framework under investigation has promise sufficient to justify deeper investigation.

The strategy I adopt in this article, therefore, is to include a lengthy, theoretically defensible set of covariates (e.g., Gamoran and Mare 1989). As I later describe, I will attempt to use a healthy set of time-varying and time-invariant covariates, given the possibilities and limitations of the data, the data collection strategy, and sociological theory. I admit this approach cannot remove the possibility of unobserved heterogeneity, but because it is grounded in the current state of sociological knowledge, as we learn more over time, the specification can be adjusted explicitly. Further, should the findings prove sociologically interesting, the baseline established by this investigation can and should be probed with detailed analysis, using a variety of specifications for unobserved heterogeneity, to determine the sensitivity of results to different assumptions.

Still, it should be noted that statistical developments may soon ease the treatment of unobserved heterogeneity. As these advances cumulate, it is extremely important that analysts refrain from making inferences beyond what such techniques allow. It is important to remember that the unobserved heterogeneity claim is an arguably admirable admission of ignorance. It means we do not know what induces the observed variance. Despite this obvious point, analysts often strain to attribute some positive content to the unobserved component. A case in point is the Cameron and Heckman (1998) analysis. The analysis asserts that unobserved (by the analyst) heterogeneity is largely ability, and policy prescriptions are then based on this assertion. By definition, however, unobserved heterogeneity could be any of a number of factors, and the relative weight of those factors cannot be established and remain unobserved heterogeneity. Under these conditions, analysts should refrain from making policy prescriptions that depend on identifying the content behind unobserved heterogeneity.

Data Selection and Handling

Although the discussion of unobserved heterogeneity touched on the selection of data, additional issues make data selection an important concern for educational transitions research. The elegance and, consequentially, apparent simplicity of educational transitions analysis belies the high data requirements for effective research. Both Cameron and Heckman (1998), implicitly, and Mare (1993), explicitly, call for analysts to attend closely to the data requirements of such modeling, which depend in part on the theories one seeks to assess. If the data requirements for a theory are not met, the theory cannot be evaluated. For example, in order to assess the key claim of LCP, one must use data that does not allow persons decades to complete their schooling. Otherwise, the LCP explanation is true but trivial; educational and other life pursuits of older persons are virtually *always* made in the context of weakened power of parental status characteristics relative to the power of those characteristics when the child was not yet an adult. But the life-course explanation of Müller and Karle is not trivial; it has sociological punch owing to its potential to explain why disadvantaged youngsters continue their schooling in such numbers that the logit coefficients for social background decline across transitions. In order to assess this claim, analysts either need to restrict their analysis to relatively young potential students, or use information on the timing of educational transitions in their analysis. Unfortunately, many educational transitions analyses have used samples of the general adult population that lack information on the timing of educational transitions. Thus, they do not meet the data requirements for assessing LCP and can provide no evidence with respect to the validity of the LCP claim.

Again, Cameron and Heckman illustrate how problems ensue when data are not matched to the research question. Cameron and Heckman conclude that widening financial aid availability is unwise because it induces low-ability students to continue schooling. Setting aside the earlier observation that assertions concerning the content of unobserved heterogeneity are by definition problematic, Cameron and Heckman cannot speak to policy generally because of several other errors in data analysis.

First, they restrict their analysis to white males, thus preventing their analysis from reflecting parameters of the process generally considered. This should reduce one's faith in the general applicability of the policy prescription they offer, although on the basis of their analysis, one might infer that one should restrict the financial aid available to white males.

However, Cameron and Heckman also delete all cases missing on any variable, a tactic that necessitated removal of approximately one-third of the white males. This approach to missing data substantially lowers the likelihood that their analysis can generalize even to the population of white males.[7]

An additional data problem is that the bulk of their analysis is based on Occupational Changes in a Generation (OCG) data. Thus, Cameron and Heckman study educational transitions for persons who may have completed their education at any time within a window spanning several decades. Given that OCG respondents' reports may summarize educational experiences that occurred decades after leaving their parents' household, the Cameron and Heckman analysis is insufficiently precise to address the policy issue of the role of financial liquidity in constraining college entrance. That is not to say that the finding would not be replicated with better data, but it is to say that the Cameron and Heckman analysis fails to address the question.[8]

The Cameron and Heckman analysis is unable to address their research question; this is unfortunate because they raise an intriguing possibility. In general, then, analysts need attend to the theoretical and substantive claims they seek to address and assure that the methods and data are sufficient to address them.

[7] For analogous analyses led astray in part by problematic treatment of missing data, see Herrnstein and Murray 1994; for a correction, see Fischer et al. 1996, and for a discussion of strategies for handling missing data and the implications of failures to effectively treat missing data, see Little and Rubin 1987.

[8] However, if we ignore both the deletion of nonwhites and women and the mistreatment of missing data, the data may be appropriate to assess their explanation. This is so because it is likely that, all else equal, a person who has several decades of adulthood in which to make further investments in education will make those decisions based on more reflection and knowledge than will a youth who has little experience with the world of work. A 45-year-old person considering their own educational investments will probably more closely approximate the nonmyopic agent than will the 17-year-old student of the American high school. The implication of this observation, however, is that the Cameron and Heckman analysis cannot comparatively assess their theory and others, because they inadvertently used data that is biased in favor of their explanation.

Evaluating Educational Transitions Research: Brief Summary of Key Responses

The foregoing discussion has offered several observations on the conduct of education transitions research. Analysts have raised many questions about education transitions analyses, but three are most prominent: (1) how can one account for unobserved heterogeneity, (2) how can one identify transition-specific effects without making an ad hoc assumption, and (3) how can one select appropriate parameters to index social relations?

Unobserved heterogeneity is an escapable possibility in every analysis. In the education transitions approach, it is certainly more difficult to protect against because an omitted variable may bias results even when that variable is not associated with included independent variables. In this situation, there are four possible responses. One response is to stop conducting education transitions research. However, our knowledge of tracking suggests that sequential decision making produces educational attainment. Were we to halt education transitions research, our statistical model, rather than our knowledge of social processes, would be driving our investigatory strategy. Our knowledge of social processes suggests that the educational transitions framework, or something very much like it, is needed, and thus efforts to address the unobserved heterogeneity problem seem worthwhile.

In that vein, a second response is to attempt to account for unobserved heterogeneity using one of the methods developed for missing data analysis. A third approach is to attempt to account for unobserved heterogeneity by including a lengthy, theoretically defensible set of covariates. Neither approach offers certainty that one has successfully removed unobserved heterogeneity, for both may miss important heterogeneity.

A fourth approach is to use a variety of methods, either separately or together, to establish bounds on parameters and to investigate the sensitivity of findings to assumptions concerning unobserved heterogeneity. In the present case, drawing on existing theories and within the limits of the available data, I use the third approach. Should the findings prove of sociological interest, detailed investigation of unobserved heterogeneity using a variety of specifications would be in order.

To avoid ad hoc identifying assumptions, findings from tracking research should be considered. These findings not only affirm that students follow a sequential decision-making process as they navigate schools, but also reveal a higher incidence of track mobility than previously existed. This suggests the potential importance of the time-varying covariate of performance. Because time-varying covariates identify the education transitions model with transition-specific parameters, one need only invoke the substantively defensible assumption that grades matter, and use measures consistent with this assumption, to identify the model.

Different summaries of nonlinear relations may lead to different conclusions. Given this observation, one response is to highlight the fundamental unit of measure underlying the analysis, which for education transitions analysis is the probability of obtaining particular categorical outcomes.

These three questions have been raised, and responses to them have been offered. Although the first and third questions and responses are important, the foundational basis of the analysis concerns the second, the fusing of educational transitions and tracking research. It is that fusion that highlights the time-varying covariate of performance, facilitates the comparative assessment of existing explanations of school continuation (see below), and allows investigation of a comprehensive explanation for both school continuation and track location. The following pages describe the methods used to address the questions this fusion brings to the fore, relate the results of the analysis, and close with concluding remarks.

ANALYSIS PLAN

The prime aim of the analysis is to assess effectively maintained inequality. Before doing so, however, it is possible and useful to evaluate LCP and MMI comparatively, for several reasons. First, MMI and LCP are existing explanations for this subject area. Thus, I would be remiss to ignore them at this juncture. Second, MMI and LCP have not been studied in an analysis that fuses tracking and educational transitions. Yet, as I will note below, it is just this kind of analysis that is needed to comparatively assess MMI and LCP. Third, the same model that produces the information needed to evaluate EMI also produces the information needed to comparatively assess MMI and LCP. Thus, it will not be necessary to estimate multiple models to consider the different explanations. Yet, because assessing the different explanations entails perusing different types of parameters (from the same model), it will be most effective to proceed by first comparing MMI and LCP and then turning to consideration of EMI. For these reasons, therefore, I will spend some time investigating MMI and LCP, even as the bulk of the analysis is focused on considering the evidence for and against effectively maintained inequality.

Conditions for Comparing MMI and LCP

LCP and MMI do not have mutually exclusive implications for the total effect of social background under all circumstances. However, they do imply potentially different patterns of *direct* effects under certain conditions. LCP implies that the direct effect of social background declines across transitions, for it is the direct effect that captures parents' contemporaneous role in students' successful completion of a particular transition. Whatever that role, LCP implies it is lower for later transitions than for earlier ones. In contrast, MMI implies that direct effects will be responsive to shocks to the system, rising or falling depending upon the changing structure of social support for different stages of education. If so, it is possible for direct effects on later transitions to exceed the direct effects for earlier ones, if the shock to the relevant transition(s) is strong enough.

Still, under general conditions, it is not necessarily possible to differentiate between LCP and MMI explanations. However, Reagan-era policy change increased the financial costs of attending college for early 1980s cohorts (e.g., Evangelauf 1987). Of course, the Reagan-era policy change may not have been sufficient to raise the effect of social background on college entry above the effect of background on high school graduation. But many elements made up the Reagan-era reforms. The 1981–82 academic year marked the start of a period of sharply rising tuitions. In addition, that year saw the introduction of decreases in the availability of grants, increases in the interest rate for Guaranteed Student Loans (GSLs; from 7% to 9%), and the inception of a 10% surcharge on GSLs (points). The magnitude of these changes certainly suggest that the era provides a chance to discern a greater effect of social background on college entry than on earlier transitions. Thus, although the analysis cannot provide the proverbial "crucial experiment" that will adjudicate forever between MMI and LCP, the conditions of the Reagan era do seem to provide an opportunity to assess them comparatively.

However, in order to estimate the direct effect of social background, it is important to account for the role of social background in allocating students to different locations in the stratified curriculum in earlier years. Otherwise, indirect effects of social background that work through prior placement will be inadvertently included in estimates of the direct effect of social background. In order to compare LCP and MMI, therefore, it is necessary to study school continuation and students' track mobility simultaneously, for doing so facilitates proper estimation of the direct effects of social background.

The Sample

The investigation uses the 1980 sophomores from High School and Beyond (HS&B). Analyzing these data is particularly advantageous for pursuing our concerns, for these data include the variables necessary to estimate direct effects of social background and, owing to the period of data collection, these data allow one to consider the transition to college for a cohort that encountered both higher tuitions and a public policy environment that had just become decidedly less generous with financial aid (e.g., Evangelauf 1987). Note that the legislative changes mentioned above were all passed after January 1981 and took effect for the 1981–82 academic year. Thus, one advantage of using this sample is that not only did support decline, but also the decline was decidedly abrupt. Moreover, by using only the 1980, 1982, and 1986 waves, this analysis is constructed so that it is plausible to regard social background effects as indexing the relevance of parental characteristics for youths' educational attainment. Further, these data include information on the curricular tracks students followed, as well as the grades they obtained. Taken together, these features are essential for comparing LCP and MMI.

HS&B used a complex sample design. Thus, standard errors are adjusted using a design effect of 2.4, which reflects a slight upward adjustment from the design effect of 2.19 estimated by Sebring et al. (1987). Moreover, weights were constructed to account for nonresponse; I use weights in the analysis.

Methods

Appendix A describes the measurement of social background, measured achievement, and performance, and table 1 provides descriptive statistics for these variables. It is necessary to use at least one time-varying covariate in this analysis. The measures of performance—grades—are time-varying covariates obtained from students' transcripts. HS&B also contains several other time-varying measures, including standardized measures of achievement in the form of tenth and twelfth grade tests, measures of student behavior such as cutting class, and measures of student experience with the disciplinary authorities of the school such as suspension. Each of these indicators, however, has some problems. First, students did not have access to their HS&B test scores, and thus neither their scores nor changes in the scores could have informed their decision making. Moreover, some argue that achievement tests actually measure stable ability. To give this position the benefit of the doubt, I use only the tenth grade test scores and thus treat standardized measured achievement as constant over time.

The indicators of class cutting, suspensions, and other involvement with disciplinary authorities are only partially time varying, because they were recorded during the two survey years (grades 10 and 12) but not in grade 11. Thus, to include these variables as time-varying covariates is to specify different lag structures for different academic years, which might differ-

TABLE 1
Descriptive Statistics

Variable and Value	Proportions/Means in Each Sample		
	Grade 11	Grade 12	College
Fathers education:			
< High school graduate	.218	.207	.202
High school graduate	.289	.291	.291
Some college	.204	.209	.212
College graduate or more	.203	.209	.214
Missing	.087	.084	.081
Mother's education:			
< High school graduate	.182	.171	.162
High school graduate	.409	.414	.419
Some college	.220	.223	.226
College graduate or more	.135	.139	.141
Missing	.055	.054	.052
Father's occupation:			
Mean	38.968	39.317	39.518
SD	17.703	17.764	17.807
Proportion missing	.084	.083	.079
Family earnings:			
Mean	25,697.376	25,957.542	26,157.868
SD	21,262.278	21,655.499	21,961.580
Proportion missing	.081	.061	.047
Farm background:			
Yes	.046	.047	.047
Missing	.084	.083	.079
Siblings:			
Mean	2.889	2.852	2.822
SD	1.631	1.610	1.596
Proportion missing	.127	.131	.135
"Broken" family:			
Yes	.385	.372	.360
Missing	.132	.099	.074
Male	.485	.483	.482
Black	.097	.095	.095
Latino/a	.117	.114	.112
Math 1:			
Mean	15.105	15.267	15.406
SD	5.269	5.286	5.292
Proportion missing	.162	.148	.140
Math 2:			
Mean	4.519	4.560	4.597
SD	1.901	1.925	1.937
Proportion missing	.166	.153	.144
Science:			
Mean	11.335	11.415	11.486
SD	3.289	3.297	3.294
Proportion missing	.167	.153	.145

TABLE 1 (*Continued*)

Variable and Value	Proportions/Means in Each Sample		
	Grade 11	Grade 12	College
Writing:			
Mean	10.819	10.910	10.998
SD	3.465	3.460	3.437
Proportion missing	.175	.161	.153
Civics:			
Mean	6.031	6.066	6.099
SD	1.833	1.843	1.846
Proportion missing	.181	.167	.158
Reading:			
Mean	9.457	9.538	9.619
SD	3.543	1.925	3.581
Proportion missing	.160	.146	.139
Vocabulary:			
Mean	11.333	11.420	11.509
SD	3.888	3.896	3.899
Proportion missing	.161	.147	.139
No course last year	.145	.310	.470
College prep last year	.529	.385	.270
Last math grade:			
Mean	2.110	2.142	2.209
SD	1.139	1.030	1.112
Proportion missing	.007	.006	.005
Incomplete previous time	.001	.003	.003
Audited course previous time	.001	.000	.001
Sample size	10,292.000	9,709.000	9,268.000

Note.—Proportions of mutually exclusive categories (e.g., father's education) may not sum to 1 due to rounding.

entially bias coefficients for the different transitions. Further, analysts have yet to settle whether cutting class, involvement with disciplinary school authorities, and other correlates of delinquency are causes or consequences of track placement (e.g., Wiatrowski et al. 1982; Berends 1994). Indeterminance about causal direction problematizes the inclusion of these variables in this analysis.

Students' destinations are the dependent variable for the analysis. Because changes have made tracking a subject-specific phenomenon, it is necessary to select a subject for study. The ideal subject to study would be central to the curriculum, on the one hand, but would allow students some freedom to be allocated to any of the logically possible categories (including not taking a course in the subject), on the other. Mathematics and English are the two central subjects in American high schools. However, in comparison to English, math allows more freedom of placement, because it is not required every year in most schools. For the HS&B

cohort, the modal requirement for English was four years, while the modal requirement for math was two. Thus, mathematics is the subject of study in this analysis. For this reason also, I use mathematics grades, because these grades are probably most salient for math course-taking. As test scores in other subjects are controlled, ability in other domains is allowed to influence mathematics course-taking.

I have analyzed students' movement from grade 10 to grade 11, from grade 11 to grade 12, and from grade 12 to college. In moving to grade 11 and grade 12, students have the possibility of moving to any one of four destinations. In each transition, a student may drop out (coded 0), in which case the student is not considered for later transitions (which is the common treatment of dropouts in educational transitions analyses).[9] Or they may remain in school and take a college preparatory mathematics course (coded 3), remain in school and take a noncollege preparatory math course (coded 2), or remain in school and take *no* math course (coded 1). Thus, the destination variable is an ordered categorical variable with four categories—drop out, no math, noncollege math, or college preparatory math.

The ordered probit model:

$$P(y_i = 0) = \Phi(\mu_1 - \beta'X),$$

$$P(y_i = 1) = \Phi(\mu_2 - \beta'X) - \Phi(\mu_1 - \beta'X),$$

$$P(y_i = 2) = \Phi(\mu_3 - \beta'X) - \Phi(\mu_2 - \beta'X),$$

$$P(y_i = 3) = 1 - \Phi(\mu_3 - \beta'X),$$

where Φ signifies the normal cumulative distribution function (CDF), μ's represent thresholds, X represents a matrix of explanatory variables, and β represents a vector of estimated parameters linking variables to the outcome, is appropriate for analyzing just such an ordered categorical variable. Essentially, the model posits that an interval-level latent variable with a standard normal distribution underlies the observed categorical variable. The thresholds carve the latent variable into the appropriate number of categories.

The high school destinations have four categories, but the last destination, college entry, has only two categories—either the student did not enter college (coded "0") or the student did enter college (coded "1"). In

[9] This is not the same as deleting dropouts from the overall analysis. Former tenth graders who drop out in eleventh grade are deleted from the analysis of movement to twelfth grade; similar treatment occurs for later dropouts and transitions. This approach provides estimates of the correlates of dropping out. Were dropouts deleted from the analysis completely this would not be possible.

reality, colleges are stratified. Yet there is no consensus as to how one should measure the stratification of collegiate institutions. Thus, college entry is coded as a dichotomous variable.

The ordered probit model in this analysis is estimated as

$$P(y_{it} = 0) = \Phi(\mu_1 - \beta_t' X_{it}),$$

$$P(y_{it} = 1) = \Phi(\mu_2 - \beta_t' X_{it}) - \Phi(\mu_1 - \beta_t' X_{it}),$$

$$P(y_{it} = 2) = \Phi(\mu_3 - \beta_t' X_{it}) - \Phi(\mu_2 - \beta_t' X_{it}),$$

$$P(y_{it} = 3) = 1 - \Phi(\mu_3 - \beta_t' X_{it}),$$

for i individuals across t transitions. Note that this means that the thresholds for all transitions are the same, but the effects of characteristics as well as some of the characteristics themselves are allowed to vary over time. Note that parameters for each outcome, including college entry, are estimated simultaneously, even though college entry has but two possibilities. This is addressed, however, by treating the college entry outcome as right-censored. College entry is censored because I know whether or not a student entered college, but if a student did enter college, I do not know where their institution falls in the distribution of collegiate institutions. Thus, all that can be done for college entry is to distinguish between those who enter college and those who do not.

Also note that each year students who continue in school reach a destination in the stratified curriculum. This destination is a particular track location and serves as the track origin for the students' next transition. Thus, for each year, I constructed two dichotomous variables to capture the effects of track location on students' likelihood of making the next transition—one variable scored 1 for students who did not take math and zero for others, and one variable scored 1 for students who enrolled in college preparatory math and zero for others. Thus, the omitted category is students who took noncollege prep math (because dropouts are not at risk of entering a grade above the grade they never entered). Note that this implies two types of time-varying covariates are included: (1) students' performance and (2) students' track location the previous year.

Parameters

Above, I described the debate concerning which parameters one should use to assess the relation between social background and school continuation. Because the fundamental dependent variable in the analysis is students' probability of reaching particular destinations in the stratified educational system, I focus on how the predicted probability is associated with differences in social background.

Indeed, predicted probabilities, not regression-type coefficients, are required in order to assess EMI, because effectively maintained inequality contends that the advantages that accrue to the socioeconomically well-placed are sufficient to secure for them desired outcomes. The dependent variable of this analysis is composed of a small set of discrete ordered locations; a student experiences a particular outcome if the student exceeds the threshold dividing that outcome from the one just below it. Given this image, social background becomes effective if it can move people over thresholds.

Regression-type coefficients by themselves cannot reveal whether social background moves people over thresholds. Thus, a good question to ask is, What kind of evidence *would* allow us to assess whether empirical findings are consistent with a process of effectively maintained inequality? One kind of evidence would be whether the effect of social background is such that we would predict a different outcome for a person at the low end of the social background continuum than one at the high end. A common decision rule for predicting discrete outcomes is to predict the outcome that has the largest predicted probability. Thus, in order to evaluate whether the effect of social background works to effectively maintain inequality, we need see whether its effect on the predicted probability is such that our best prediction will change simply on the basis of differences in social background. Surely, it would be possible to find some values of covariates for which this is true, but some protection from a search for such values is to use theoretically interesting values and investigate whether the prediction would change for such focal students. Thus, predicted probabilities are the focus of the analysis.

However, because MMI and LCP were devised with respect to logit coefficients (which differ from probit coefficients by a fairly constant multiple), it will be useful to briefly consider the findings one would reach on the basis of ordered probit coefficients. By comparing the results obtained by the focus on coefficients to those obtained by considering differences in probabilities, it will be possible to determine whether the preference for one or the other explanation is consistent given two different ways of indexing effects of social background on school continuation.

RESULTS

MMI, LCP, and the Ordered Probit Coefficients

Table 2 contains the ordered probit (OP) coefficients for a model predicting students' educational transitions. The coefficient for broken family rises in absolute value then falls, while the coefficient for farm background rises in absolute value across the three transitions. Further, the coefficient

TABLE 2

ORDERED PROBIT COEFFICIENTS AND t-VALUES FOR MODELS PREDICTING SCHOOL CONTINUATION AND TRACK LOCATION

	Grade 11	Grade 12	College
Constant	.264	.424	−3.042
	(5.356)	(8.256)	(−32.942)
Father's education	.092	.059	.160
	(11.857)	(5.581)	(10.278)
Mother's education	.063	.037	.164
	(7.934)	(3.717)	(9.938)
Father's occupation	.004	.002	.003
	(8.624)	(3.516)	(2.812)
Family earnings in $10,000s	.021	.005	.043
	(6.016)	(1.762)	(8.104)
Farm background	−.015	−.070	.076
	(−.359)	(−1.566)	(1.019)
Number of siblings	−.037	−.015	−.041
	(−9.955)	(−3.196)	(−4.814)
"Broken" family	−.121	−.149	−.099
	(−6.873)	(−7.395)	(−3.677)
Male	.091	.131	.055
	(6.694)	(7.514)	(1.810)
Black	.324	.402	.290
	(15.313)	(9.391)	(4.350)
Latino/a	.097	.141	.064
	(4.766)	(4.659)	(1.318)
Math 1	.022	.013	.026
	(8.773)	(4.159)	(5.937)
Math 2	.027	.025	.022
	(4.131)	(3.602)	(2.024)
Science	−.007	−.002	.003
	(−1.571)	(−.377)	(.434)
Writing	.011	.006	.017
	(2.727)	(1.477)	(2.507)
Civics	.008	.014	.056
	(1.415)	(2.140)	(6.127)
Reading	.011	.015	.012
	(2.825)	(3.539)	(1.855)
Vocabulary	.002	−.002	.031
	(.645)	(−.456)	(5.162)
No course last year	−.065	−.232	−.115
	(−3.427)	(−10.620)	(−3.390)
College prep last year	.643	.604	.543
	(42.083)	(30.716)	(15.626)
Last performance grade	.217	.185	.138
	(40.866)	(25.047)	(10.061)
Audit previous time	.225	−1.738	.000
	(.607)	(−.017)	(.000)
Incomplete previous time	−.316	−.680	.111
	(−1.112)	(−4.315)	(.338)

for father's occupation declines from grade 11 to grade 12 and rises thereafter, but the coefficient on college entry does not exceed the coefficient for grade 11. These complexities occur, however, amid a more general story. OP coefficients for parents' education, family earnings, and siblings are higher for college entry than for the other transitions. Indeed, OP coefficients for these four indicators of social background decline between grade 11 and grade 12, and rise for college. These last four indicators of social background suggest that an equalization is reversed; such a reversal provides more support for MMI than for LCP.

MMI, LCP, and School Continuation Probabilities

To broaden the assessment of the effects of social background on students' school continuation, I graph the predicted probabilities of school continuation by earnings holding all remaining interval-level factors except previous mathematics grade constant at their means; I hold previous mathematics grade constant at a B to signify a capable but not outstanding performance. Ordinal- and nominal-level indicators are held constant such that the graph represents white females from intact nonfarm families who were taking noncollege prep mathematics the previous year. For such middling white female students of middling family backgrounds, the effects of earnings are nearly linear throughout so that one may compare the effects of earnings on different outcomes by comparing the difference between the predicted probability for students from extremely poor families and the predicted probability for students from wealthy families (see fig. 3). Owing to the near certain probability of school continuation for such eleventh and twelfth graders, the effects of earnings appear trivial, approximately one percentage point difference for eleventh grade, and smaller for twelfth grade.

However, the difference between poverty and wealth is associated with a difference of approximately 20 percentage points in the likelihood of entering college, certainly a substantively nontrivial difference. This finding suggests that the effects of earnings are higher for college entry than for high school continuation, which is the same inference we drew above on the basis of the OP coefficients. And, as above, the evidence favors MMI over LCP.

Table 3 presents differences between the predicted probability of reaching a particular outcome for the most disadvantaged and most advantaged students for each of five social background variables, holding all other variables constant as above. Because the underlying dependent variable in this analysis is the probability of reaching a particular track destination in a given year, the numbers that appear in the "diff" columns, which reflect the difference between the probability for the most advantaged

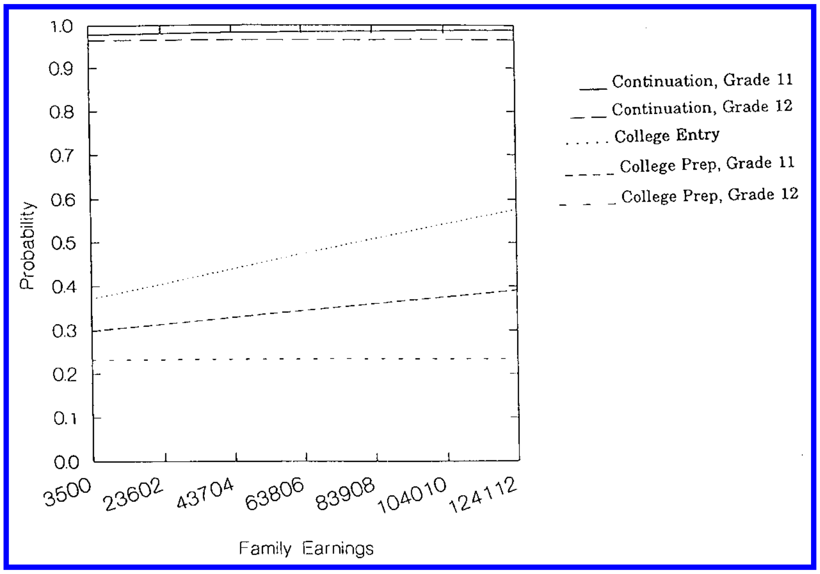

FIG. 3.—Selected destinations and earnings

and most disadvantaged students, can reveal the effects of social background for particular parts of the educational transitions process. When one peruses the table, a common pattern is evident—the effect of social background is far larger for college entry than for high school continuation.

For example, the difference in the probability of college entry for those with fathers who did not complete high school and those with fathers who completed college or more is 0.185 points. In contrast, the same social locations differ by only 0.013 points in the probability of continuing in school to grade 11 or grade 12.

Thus, when we consider the pattern of effects of social background on school continuation probabilities, we find that social background matters more for college entry than for high school completion. This finding is consistent with MMI.

One caveat, however, is that I have not determined whether the pattern of social background effects on the probabilities of college entry were different for older cohorts, and thus cannot say whether Reagan-era policy change lies behind my results. But it is apparent that the pattern of effects on school continuation probabilities are more consistent with MMI than with LCP, because LCP implies that social background effects on college entry will be lower than social background effects on high school graduation. I do not find this to be true when I consider probabilities of school

TABLE 3

Predicted Probabilities for Selected Variables for Disadvantaged (Low) and Advantaged (High) Students

	School Continuation									College Prep Enrollment					
	Grade 11			Grade 12			College Entry			Grade 11			Grade 12		
	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff
Broken family	.974	.981	.007	.953	.966	.013	.371	.409	.038	.274	.315	.041	.192	.235	.043
Father's education	.973	.986	.013	.959	.972	.013	.322	.507	.185	.269	.368	.099	.210	.264	.054
Mother's education	.976	.985	.009	.962	.970	.008	.326	.516	.190	.286	.353	.067	.220	.254	.034
Father's occupation	.977	.987	.010	.963	.972	.009	.384	.459	.075	.288	.372	.084	.223	.261	.038
Number siblings	.975	.985	.010	.962	.969	.007	.360	.455	.095	.276	.353	.077	.220	.248	.028

Note.—In this table, disadvantaged students (low) are females having, variously, nonintact families, a mother/father who did not graduate from high school, a father at the lowest value in the SEI scale, *or* with six or more siblings. In contrast, advantaged students (high) are females having, variously, intact families, a mother/father who completed college or more education, a father at the highest value in the SEI scale, *or* no siblings.

continuation, which mirrors the conclusion reached after perusal of the OP coefficients. Thus, the preference for MMI over LCP does not depend on whether OP coefficients or probabilities are considered.

Effectively Maintained Inequality

The key question to ask to assess effectively maintained inequality is whether one's prediction of a student's destination will change on the basis of social background. Consider figure 3 again, which illustrates how the probability of college entry differs as family income differs for middling female students who are in the noncollege track, from an intact nonfarm family, and with mean values on other social background factors. The results in figure 3 show that the difference in the predicted probability of college entry is enough to move us from predicting that our focal student would *not* enter college to predicting that the student *would* enter college, because the predicted probability of college entry for the poor student is below 50%, while the analogous estimate for the wealthy student is above 50%.

Of course, estimating the probability of a given outcome by itself will not help in other cases, a fact well-illustrated by the bottom of figure 3. Figure 3 also shows predicted probabilities for college track location, conditional on prior track location and all other variables in the model, for grades 11 and 12. The difference between poverty and wealth is associated with a difference of nine points in the probability of enrolling in college prep math in eleventh grade. This effect is less than half as large as the effect of earnings on college entry but substantially larger than the effect of earnings on school continuation. Similarly, results in table 3 show that the effects of social background on college prep entry approach and may sometimes even surpass those for college entry (e.g., the effect of broken family status on college prep entry exceeds the effect of broken family status on entering college itself). These results allow us to assess whether social background effects are higher for college prep assignment or college entry, but they do not provide the kind of evidence needed to evaluate effectively maintained inequality, primarily because in order to assess EMI, one must calculate probabilities for all discrete outcomes. When there are more than two discrete possibilities, one must determine which outcome has the largest predicted probability. Although none of these probabilities may exceed 50%, the largest still identifies our best categorical guess.

Table 4 lists estimated probabilities of experiencing each of the four outcomes in grade 11 for our focal students when they have extreme values

TABLE 4
PREDICTED PROBABILITIES FOR ELEVENTH GRADE DESTINATIONS FOR DISADVANTAGED AND ADVANTAGED STUDENTS

	Dropout	No Course	Non–College Prep	College Prep
Family earnings:				
Disadvantaged[a] ...	.022	.343	.336	.299
Advantaged	.012	.264	.334	.391
Father's education:				
Disadvantaged[a] ...	.027	.371	.333	.269
Advantaged	.014	.283	.336	.368
Mother's education:				
Disadvantaged[a] ...	.024	.355	.335	.286
Advantaged	.015	.295	.337	.353
Father's occupation:				
Disadvantaged[a] ...	.023	.353	.335	.288
Advantaged	.013	.279	.336	.372
Broken family:				
Disadvantaged[a] ...	.026	.367	.333	.274
Advantaged	.019	.328	.337	.315
Number of siblings:				
Disadvantaged[a] ...	.025	.365	.334	.276
Advantaged	.015	.294	.337	.353
Socioeconomically:				
Disadvantaged[b] ...	.064	.496	.287	.153
Advantaged	.012	.272	.335	.381

[a] Disadvantaged students are females having, variously, nonintact families, a mother/father who did not graduate from high school, a father at the lowest value in the SEl scale, *or* with six or more siblings. In contrast, advantaged students (high) are females having, variously, intact families, a mother/father who completed college or more education, a father at the highest value in the SEI scale, *or* no siblings.

[b] Disadvantaged students are females from families with both parents and six children, a mother and father who did not graduate from high school, a father whose occupation is approximately that of a forging machine operator, and whose family income is approximately $14,936 (in 1980 dollars). Advantaged students are females from intact families with two children, parents who have some college, a father whose occupation is approximately that of a general public administrator, and whose family income is approximately $36,267 (in 1980 dollars).

on each separate indicator of socioeconomic background taken in turn.[10] Note that this means that a prediction of college prep track entry is also a prediction of upward mobility, while a prediction of noncollege prep course-taking is a prediction of stability. If one would predict the student does not take a course in the subject, one predicts downward track mobility.

In every case, altering the students' socioeconomic status would change the prediction for their destination. In most cases, the prediction change is so large that social background appears to send students in opposite

[10] When comparisons concern parents education, family background, earnings, or number of siblings, they refer to persons from intact nonfarm families.

directions. For example, if a student's father did not complete high school, then we would predict that the student would not take math in grade 11 and thus would be downwardly mobile. In contrast, if a student's father completed college, then we would predict that the student would take college prep math in grade 11, and thus would be upwardly mobile. This "diverging trajectories" pattern holds for all of the social background factors considered and is extreme for five of the six indicators.

Note, however, that the predictions above assume that social background factors are statistically independent of each other. The last two lines of table 4 relax this assumption, presenting predicted probabilities for focal students from intact families who are one standard deviation below (and above) the mean in father's education, mother's education, father's occupation, and number of siblings, and one-half standard deviation below (and above) mean family income.[11] This comparison, which reflects some degree of association between these indicators of social background, show that we would predict the disadvantaged student would take no course. Indeed, the predicted probability for the "no course" category for the disadvantaged student approaches 50%. Yet, our prediction for the socioeconomically advantaged student is again very different; we would expect this student to rise from noncollege prep math to enter the college preparatory track.

The stark contrast between socioeconomically disadvantaged and advantaged students is consistent with effectively maintained inequality and is a far cry from the suggestion that social background effects decline to zero when a level of education becomes universal. Instead, it suggests that when a level of education is universal, social background may matter for qualitative dimensions of education that are relevant at that level of education and that have implications for students' chances of making later transitions.

CONCLUDING REMARKS

When students move from grade to grade, they also move from one stratified curriculum to another. The factors that determine whether they continue schooling also determine where in the stratified curriculum that schooling will occur. Students' location in the stratified curriculum has

[11] Given the values on the variables we can flesh out the illustration. The disadvantaged student is a female from an intact family of six children, whose parents dropped out of high school, whose father's occupation is a forging machine operator, with a family income of $14,936 (in 1980 dollars). The advantaged student has one sibling, parents who have some college, a father who is a general public administrator, and whose family income is $36,267 (in 1980 dollars).

implications for their likelihood of making additional transitions, and thus their location in the stratified curriculum is an integral part of the process of educational attainment. The observations above serve to connect two distinct literatures—research on educational transitions and analyses of track mobility. Their convergence addresses issues raised in a provocative critique of the educational transitions tradition by supporting the sequential decision-making model, highlighting the theoretical importance of the time-varying covariates of track location and performance, and invalidating the suggestion that the sequential model of educational attainment requires a behavioral assumption of myopia. Thus, the foregoing analysis has investigated students' movements through the stratified curriculum. Although I present and discuss ordered probit coefficients to connect the findings to previous work, the argument that findings may be sensitive to the functional form of the model led me to assess existing theories using the effects of social background on the probabilities of school continuation as well. Finally, I evaluated whether the role of social background on the probability of reaching particular destinations was consistent with effectively maintained inequality. Because the analysis produced evidence consistent with this alternate explanation, it appears that the convergence of the tracking and education transitions treatments is not only statistically useful but also sociologically intriguing.

When we consider the life course explanation and the theory of maximally maintained inequality, we find that the pattern of background effects is most consistent with the maximally maintained inequality explanation. Key social background factors rise in importance as students attempt to enter college in comparison to their effects on previous transitions, just as MMI should predict for Reagan-era cohorts. Although few would deny that as children mature their dependence declines, and thus the life course perspective remains useful, the evidence suggests that declining dependence on parents does not explain the pattern of social background effects on educational transitions.

However, owing to the simultaneous treatment of school continuation and track placement, I found important social background effects operating even before the college entry transition, and thus the findings contradict a key implicit tenet of MMI. While MMI suggests that background-related inequality will go to zero when a level of education is nearly universal, EMI states that at that very level social background will allocate students to different types of education that have different implications for educational attainment. The evidence presented here is most consistent with the EMI claim.

The idea of effectively maintained inequality is not only that advantaged social background is associated with increased chances of better placements, but also that the increases are consequential for theoretically focal students. Given that school strata are discrete locations, effectively maintained inequality suggests that social background works efficaciously if we would alter our prediction of students' destinations simply on the basis of differences in social background. In other words, if social background can move an otherwise "average" student over a threshold, then social background effectively maintains inequality. When we considered the predictions we would make on the basis of the model results, we found that social background advantages consistently serve to "move" children (or our predictions for them) from disadvantageous discrete locations to advantageous ones. Thus, even though the increment for social background effects may be small, we observed it to be effective.

These findings have important implications for how to understand the provision of educational opportunity and the process of educational attainment. The findings lend credence to the postulation that even though high school completion is nearly universal, high school remains an important site of competition in which social background matters. Maximally maintained inequality implied that when a level of education is universal, socioeconomically related contestation (i.e., class conflict) would center on higher levels of education. Other research contradicts this vision, pointing to intense class conflict around the maintenance of tracking (e.g., Wells and Serna 1996). The findings here might help us understand this class conflict.

We find that in high school social background appears to matter for the kind of education received rather than for high school completion. Clearly, however, social background cannot allocate persons to qualitatively better or worse positions if all positions are equal. Thus, class conflict may occur at the high school level as different actors attempt not only to obtain advantageous positions for their children, but also to secure or dismantle the stratified curriculum.

Indeed, contrary to the MMI implication, universality of access may be largely irrelevant to the intensity of class conflict, as the focus of conflict may simply change once access is universal. Further, the results of this analysis, which show that social background continues to matter even in the presence of universal access, gives reason to speculate that the simple extension of universal access to institutions is unlikely to undo the effective power of social resources indexed by common indicators of social background, at least in the United States. This speculation, if true, would greatly complicate efforts to ameliorate the inheritance of social disadvantage, although it of course has no implications either way for the desirability of such efforts.

One may speculate further as to whether the idea of effectively maintained inequality has applicability to other educational situations or to even broader arenas. It is easy to suggest at least one other place one might search for the operation of effectively maintained inequality. As one example, consider that the proportion of a cohort that enters preschool is increasing. It would be illuminating to ascertain whether the effect of social background on *whether* the child enters preschool declines as the proportion of the cohort entering preschool increases, while the effect of social background on the features of the child's preschool was maintained, increased, or became consequential for otherwise average children. If so, this would be consistent with effectively maintained inequality.

That said, there is ample additional research to do even on students' high school experiences and educational attainment. Will we find similar patterns if additional subjects are studied? Would similar patterns be observed for additional cohorts? Would other qualitative dimensions of education in the United States, and studies of other nation's systems of education, reveal similar patterns of effects? Would models with more regressors, or different treatments for unmeasured heterogeneity, reveal similar patterns of effects? Thus, although the research presented here provides support for effectively maintained inequality, more work is needed to assess the robustness and generalizability of this claim even in the realm of social stratification and education.

Even as we acknowledge the importance of the questions above and more, we can also imagine the mechanisms behind effectively maintained inequality working in many different arenas, areas as important as health care (e.g., the role of social background shifting from allocating scarce organs to persons to allocating leading surgeons to perform the surgery), as well as the relatively trivial (e.g., the role of social background shifting from allocating personal transportation to allocating the type of vehicle for personal transportation). However, at this juncture, it should suffice to say that when we investigate both school continuation and track mobility, we find consequential effects of social background in each year studied. This suggests that the effects of social background occur in at least two ways: (1) they determine who completes a level of education if completion of that level is not nearly universal, and (2) they determine the kind of education persons will receive within levels of education that are nearly universal. Either way, social background advantages seem to work to effectively and continuously secure for the children of advantage advantaged locations of their own.

APPENDIX A

Independent Variables

All variables are recoded to the midpoint for missing cases, and a control for missing on each category of variable is used (owing to high collinearity on the missing indicators within each category)

Social Background

Father's occupation.—Students' responses to a 17 category question were recoded to the 1980 SEI score of the mean of the illustrative occupations in the questionnaire using Stevens and Cho's (1985) updated occupational scores for the total labor force. Students' 1980 responses were taken unless the responses were missing, in which case, the 1982 response was taken. Homemakers and military were coded as missing given that there is no SEI code for those pursuits.

Mother's education and father's education.—Students' responses to a 10-category question were recoded into the following ordered levels: 1 = less than high school graduate; 2 = high school graduate; 3 = some college only; and 4 = college degree or more.

Farm background.—Mother or father was a farmer (1) or not (0).

Male.—Students' self-report of sex was used.

Family income.—Students were asked twice in the base year and twice in the follow-up to report family income. Base-year data are used unless missing; follow-up data are used if the base year is missing. Responses are coded to the midpoint of categories; the unbounded upper category is coded using the Pareto transformation for an unbounded category.

Number of siblings.—Students were asked to report on the number of siblings in 1980; as herein used, the codes are 0 = none, 1 = 1 sibling, and so on, up to 6 = 6 or more siblings.

"Broken" family.—Students' report of whether in 1980 or 1982 the student lived with both mother and father (0) or not (1).

Race/Ethnicity

The omitted category for two dichotomous race/ethnicity indicators is non-black, non-Latino/a (approximately 95% of the omitted category are white). *Black* indicates students' self-report of black or not. *Latino/a* indicates students' self-report of Latin ancestry.

Measured Achievement

Tenth grade tests in vocabulary (range 0–21), reading (0–19), math 1 (0–28), math 2 (0–10), science (0–20), writing (0–17), and civics (0–10) capture measured achievement.

Academic Performance

Last performance grade.—Grade in last math class taken, ranges from 0.0 (F) to 4.3 (A+).

Audit.—Student audited last math course taken.

Incomplete.—Student given an incomplete in the last math course taken.

APPENDIX B

Each year students encounter an opportunity to either continue their schooling or elect to stop. Thus, educational attainment is the cumulation of a sequence of decisions. For an individual student, then:

$$Y_{is} = \sum_{t=1}^{T} Y_{it},$$

where i refers to the individual student, t refers to transitions, and s refers to the sum of the transitions. Educational transitions analyses do not model Y_{is} but, instead, typically model several Y_{it}'s using logistic regression techniques. The full set of transitions is implied below:

$$\text{Prob}(y_1 = 1) = \frac{e^{(X'\beta_1)}}{(1 + e^{(X'\beta_1)})} + \epsilon_1,$$

$$\text{Prob}(y_2 = 1 \mid y_1 = 1) = \frac{e^{(X'\beta_2)}}{(1 + e^{(X'\beta_2)})} + \epsilon_2,$$

$$\text{Prob}(y_3 = 1 \mid y_2 = 1) = \frac{e^{(X'\beta_3)}}{(1 + e^{(X'\beta_3)})} + \epsilon_{3,}$$

. . . .
. . . .
. . . .

$$\text{Prob}(y_{15} = 1 \mid y_{14} = 1) = \frac{e^{(X'\beta_{15})}}{(1 + e^{(X'\beta_{15})})} + \epsilon_{15},$$

$$\text{Prob}(y_{16} = 1 \mid y_{15} = 1) = \frac{e^{(X'\beta_{16})}}{(1 + e^{(X'\beta_{16})})} + \epsilon_{16},$$

$$\text{Prob}(y_{17} = 1 \mid y_{16} = 1) = \frac{e^{(X'\beta_{17})}}{(1 + e^{(X'\beta_{17})})} + \epsilon_{17}.$$

The key portion of the Cameron and Heckman critique can be demonstrated as follows; consider the logistic regression equations below:

$$\log_e\left(\frac{p_{i1}}{1 - p_{i1}}\right) = \sum_{1}^{K} \beta_{1k}\mathrm{X}_{ik} + \epsilon_{i1} \quad \epsilon_1 \sim L(0,\pi^2/3), \tag{B1}$$

$$\log_e\left(\frac{p_{i2}}{1 - p_{i2}}\right) = \sum_{1}^{K} \beta_{2k}\mathrm{X}_{ik} + \epsilon_{i2} \quad \epsilon_2 \sim L(0,\pi^2/3), \tag{B2}$$

$$\log_e\left(\frac{p_{i3}}{1 - p_{i3}}\right) = \sum_{1}^{K} \beta_{3k}\mathrm{X}_{ik} + \epsilon_{i3} \quad \epsilon_3 \sim L(0,\pi^2/3), \tag{B3}$$

or, in general:

$$\log_e\left(\frac{p_{it}}{1 - p_{it}}\right) = \sum_{k=1}^{K} \beta_{tk}\mathrm{X}_{ik} + \epsilon_{it} \qquad \epsilon_t \sim L(0,\pi^2/3),$$

where p_{it} refers to the probability of person i making transition t, β_{tk} is the association between variable X_k and the probability of making transition t, and ϵ_{it} is a person-specific, transition-specific error term.

Consider equations B1 through B3 from the point of view of a single student; suppress until further notice the assumption for the distribution of the error term. Assume, for illustration purposes, that the student completes the first two transitions but not the third. Thus, for this student, there is clearly variation in the dependent variable.[12]

The question Cameron and Heckman ask is what, according to equations B1–B3, induces the variation? The β's and ϵ's are unknowns estimated from the data, and for any given student, the value of X_k does not vary across transitions. In this situation, an infinite number of estimates for the β's satisfy the constraints imposed by the data. Therefore, the equations are not identified.

To obtain identification, researchers assume a distribution for the error term. This identifies the logit model. However, recall the single student. The assumption for the error term essentially implies a value for the error term for this student for each transition. This error term can, in principle, vary across transitions for the individual student. What this implies, how-

[12] Of course, the probability of making transitions varies for any student across transitions, because the (un)conditional population proportion making transitions may vary, and the best estimate of a student's probability of completing a transition is the (un)conditional population proportion making the transition. However, this illustration may be facilitated, and certainly is not hindered, by assuming variation in the student's decisions across transitions.

ever, is that the only right-hand side element that varies independently across equations is the error term. Thus, when the X_k do not vary for a person across transitions, the assumption for ϵ identifies all estimated differences between the β's. Cameron and Heckman correctly note that changing the assumption for the error term may change the findings.

This problem has an obvious solution: introduce a time-varying covariate. The foregoing analysis followed just this strategy. Requirements that the time-varying covariate must meet are not stringent. Consider equations B4–B6:

$$\log_e\left(\frac{p_{i1}}{1-p_{i1}}\right) = \sum_1^K \beta_{1k}X_{ik} + \gamma_1 Z_{i1} + \epsilon_{i1} \quad \epsilon_1 \sim L(0,\pi^2/3), \tag{B4}$$

$$\log_e\left(\frac{p_{i2}}{1-p_{i2}}\right) = \sum_1^K \beta_{2k}X_{ik} + \gamma_2 Z_{i2} + \epsilon_{i2} \quad \epsilon_2 \sim L(0,\pi^2/3), \tag{B5}$$

$$\log_e\left(\frac{p_{i3}}{1-p_{i3}}\right) = \sum_1^K \beta_{3k}X_{ik} + \gamma_3 Z_{i3} + \epsilon_{i3} \quad \epsilon_3 \sim L(0,\pi^2/3), \tag{B6}$$

where Z_1, Z_2, and Z_3 are time-specific realizations of Z. To simplify the presentation, assume they are centered on their means. Because the Z variables vary across transitions, two factors potentially create variation in a student's decisions across transitions: Z and ϵ. Now, assume, the following relationships:

$$Z_{i2} = \lambda_1 Z_{i1} + \delta_1,$$

$$Z_{i3} = \lambda_2 Z_{i2} + \delta_2,$$

where δ_1 and δ_2 are errors from regression equations with the standard assumptions of regression. δ_1 and δ_2 imply that the regression equation does not perfectly predict the dependent variable. The relationships above transform equations B4–B6 as follows:

$$\log_e\left(\frac{p_{i1}}{1-p_{i1}}\right) = \sum_1^K \beta_{1k}X_{ik} + \gamma_1 Z_{i1} + \epsilon_{i1} \qquad \epsilon_1 \sim L(0,\pi^2/3),$$

$$\log_e\left(\frac{p_{i2}}{1-p_{i2}}\right) = \sum_1^K \beta_{2k}X_{ik} + \gamma_2(\lambda_1 Z_{i1} + \delta_1) + \epsilon_{i2} \qquad \epsilon_2 \sim L(0,\pi^2/3),$$

$$\log_e\left(\frac{p_{i3}}{1-p_{i3}}\right) = \sum_1^K \beta_{3k}X_{ik} + \gamma_3(\lambda_2\lambda_1 Z_{i1} + \delta_2 + \lambda_2\delta_1) + \epsilon_{i3}\, \epsilon_3 \sim L(0,\pi^2/3).$$

Rearranging terms produces the following three equations:

$$\log_e\left(\frac{p_{i1}}{1-p_{i1}}\right) = \sum_{1}^{K}\beta_{1k}\mathbf{X}_{ik} + \gamma_1\mathbf{Z}_{i1} + \epsilon_{i1} \qquad \epsilon_1 \sim L(0,\pi^2/3), \quad \text{(B7)}$$

$$\log_e\left(\frac{p_{i2}}{1-p_{i2}}\right) = \sum_{1}^{K}\beta_{2k}\mathbf{X}_{ik} + \gamma_2\lambda_1\mathbf{Z}_{i1} + \gamma_2\delta_1 + \epsilon_{i2}$$

$$\epsilon_2 \sim L(0,\pi^2/3), \quad \text{(B8)}$$

$$\log_e\left(\frac{p_{i3}}{1-p_{i3}}\right) = \sum_{1}^{K}\beta_{3k}\mathbf{X}_{ik} + \gamma_3\lambda_2\lambda_1\mathbf{Z}_{i1} + \gamma_3(\delta_2 + \lambda_2\delta_1) + \epsilon_{i3}$$

$$\epsilon_3 \sim L(0,\pi^2/3), \quad \text{(B9)}$$

Note that for identifying the β's in the sequence of logistic regression equations (equations B7–B9), what we require is a variable that varies across transitions independently. Even if there is a relationship between the time-varying covariate over time, the δs—the portion of $\mathbf{Z}_t$ that is independent of $\mathbf{Z}_{t-u}$ (where u is a positive integer)—satisfy that requirement. This implies that as long as one can find a single time-varying covariate whose cross-time correlation is not perfect, one can identify differences between the β's by including that variable as a time-varying covariate.

Nothing is changed by assuming that some of the variables in X also determine $\mathbf{Z}_t$, for unless the X variables in concert with the lagged values of Z perfectly determine $\mathbf{Z}_t$, there is still some independent variation in $\mathbf{Z}_t$. It is that independent variation—not to say measurement error in $\mathbf{Z}_t$—that provides the leverage needed to identify the differences in the βs across transitions.

Once the differences in the βs are identified in this manner, Cameron and Heckman's claim that the education transitions model assumes myopia no longer holds. This claim depends upon the error term being the only right-hand side determinant that varies independently across transitions. However, because time-varying covariates also vary at least somewhat independently across transitions, introducing time-varying covariates makes the claim about myopia inaccurate.

The nonidentification of the differences in the βs, and the description of why this is so, is the major contribution of the Cameron and Heckman article. However, introducing time-varying covariates solves that problem.

In the foregoing analysis, two types of time-varying variables were used: (1) measures of student performance and (2) previous track location. Evidence certainly supports the contention that track location is not perfectly correlated over time (e.g., Lucas 1999). For theoretical reasons, the foregoing analysis highlighted the role of tracking, but surely there are likely other time-varying covariates that can serve to identify the standard logistic regression education transitions model. This still leaves the issue of unobserved heterogeneity, about which many analysts have written. Analysts may continue to work on this problem, because the identification issues Cameron and Heckman raise can be resolved by making theoretically defensible assumptions concerning time-varying covariates. Hence, given appropriate data, it is still too early to reject the education transitions logistic regression approach.

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