Sociology Working Papers

Paper Number 2010-05

Maximally Maintained Inequality and Effectively Maintained Inequality in Education: Operationalizing the Expansion-Inequality Relationship

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Abstract

The hypotheses of Maximally Maintained Inequality (MMI) and Effectively Maintained Inequality (EMI) predict that differences in the quantity and quality of education obtained by members of different socioeconomic groups are unlikely to be ameliorated simply by expanding educational opportunity. A large number of studies have set out to test these predictions, but the results of this body of work cannot be considered conclusive because the main concepts of interest – expansion, quantitative inequality, and qualitative inequality – have not always been operationalized appropriately. This paper illustrates how inappropriate operationalizations can generate misleading findings and discusses how best to operationalize the MMI and EMI hypotheses for empirical testing.

Maximally Maintained Inequality and Effectively Maintained Inequality in Education: Operationalizing the Expansion-Inequality Relationship

1. Introduction

The idea that educational expansion serves to increase equality of educational opportunity has a long pedigree in sociology. Proponents of modernization theory in particular expected to see social inequalities in educational participation and attainment decline as industrial societies expanded their education systems on the road to becoming education-based meritocracies (Parsons 1970; Treiman 1970; and Bell 1973). Much of the early research evidence, however, showed educational inequalities to be surprisingly persistent in the face of the expansion of schooling at the elementary and secondary levels (Featherman and Hauser 1978; Halsey, Heath and Ridge 1980), prompting sociologists to begin re-theorizing the relationship between expansion and inequality. Two of the most influential of these new lines of thought, known as the hypothesis of Maximally Maintained Inequality (MMI) (Raftery and Hout 1993) and the hypothesis of Effectively Maintained Inequality (EMI) (Lucas 2001, 2009), contend that expansion in and of itself is unlikely to reduce educational inequalities simply because those from more advantaged socioeconomic backgrounds are better placed than others to take up the new educational opportunities that expansion affords (MMI) and to secure for themselves a qualitatively better kind of education at any given level (EMI). In other words, quantitative inequalities in enrollment rates will be "maximally maintained" in the face of expansion, diminishing only once the enrollment rate for the most socioeconomically advantaged group reaches saturation point, while qualitative inequalities of access to more prestigious programs and institutions will be "effectively maintained", and may even increase once quantitative inequalities in enrollment begin to decline.[1]

The predictions of the MMI hypothesis and, to a lesser extent, the EMI hypothesis, have been explored empirically for a large number of countries to date (see especially Shavit and Blossfeld 1993, and Erikson and Jonsson 1996, regarding MMI in secondary education; and see especially Shavit et al. 2007a regarding both MMI and EMI in higher education). The findings of these studies have been somewhat inconclusive, however, at least in relation to the MMI hypothesis where the prediction of persistent quantitative inequality in the face of expansion short of saturation has been found to hold for many but by no means all countries, and for certain countries in some studies but not others (Breen 2005; Breen et al. 2009). In relation to secondary education, empirical support for the MMI hypothesis has been reported for the United States (Hout, Raftery and Bell 1993), England and Wales, (Kerckhoff and Trott 1993), Ireland (Raftery and Hout 1993), Scotland (Gamoran 1996), West Germany (Blossfeld 1993), Italy (Cobalti and Schizzerotto 1993), Switzerland (Buchmann and Charles 1993), Poland (Heyns and Biatecki 1993), Hungary (Szelényi and Aschaffenburg 1993), Czechoslovakia (Matějů 1993), Russia (Gerber and Hout 1995; Gerber 2000), Israel (Shavit 1993), Taiwan (Tsai and Chiu 1993), and Japan (Treiman and Yamaguchi 1993; Ishida 1994). However, empirical findings at odds with the MMI hypothesis have also been reported for

[1] According to Lucas, inequality is "effectively maintained" if the analyst finds "consequential effects of social background on qualitative placement" (Lucas 2001: 1652). By "consequential" Lucas means that the qualitative type of education that a person would be predicted to be most likely to enrol in would be different depending on their social origin (Lucas 2001: 1679-70; Lucas 2009: 490-93). Different social origins need not predict different qualitative placements for social origins to be considered "consequential", however. Instead it could be that different social origins predict the same qualitative placement but with markedly different probabilities.

Sweden (Jonsson 1993; Erikson and Jonsson 1996), the Netherlands (De Graaf and Ganzeboom 1993) and France (Vallet 2004), and in replication studies for the United States (Kuo and Hauser 1995), Germany (Jonsson, Mills and Müller 1996) and Italy (Shavit and Westerbeek 1998).

Tests of the MMI hypothesis focusing on higher education have yielded similarly ambiguous results. For some countries, the predictions of the MMI hypothesis appear to hold, including for the United States (Roska et al. 2007), Ireland (O'Connell et al. 2006), France (Givord and Goux 2007), Germany (Mayer et al. 2007), Sweden (Jonsson and Erikson 2007), the Netherlands (Rijken et al. 2007), Switzerland (Buchmann et al. 2007), the Czech Republic (Matějů et al. 2007), Russia (Gerber 2007), Japan (Ishida 2007), and South Korea (Park 2007). For other countries, however, including Great Britain (Cheung and Egerton 2007), Italy (Shavit and Westerbeek 1998), Australia (Marks and McMillan 2007), Israel (Shavit et al 2007b), and Taiwan (Tsai and Shavit 2007), inequalities in higher education enrollment appear to have declined prior to saturation of the enrollment rate for those from higher socioeconomic backgrounds.

Because of its more recent vintage, fewer tests of the EMI hypothesis have been carried out to date and, perhaps also because the hypothesis is relatively new, all such studies have reported findings consistent with the prediction that qualitative inequalities are substantial and tend to persist despite expansion. Cross-sectional evidence has been presented in support of the EMI hypothesis for a number of countries, including for the United States where, under conditions of practically universal participation and therefore negligible quantitative inequality in secondary education, qualitative inequality has been shown to be substantial as evidenced by the predomination of those from more advantaged socioeconomic backgrounds in the more prestigious college-preparatory high school tracks (Lucas 2001).

Studies employing over time data have yielded similarly supportive results in relation to EMI in higher education. Despite decades of educational expansion at the tertiary level, those from more advantaged socioeconomic backgrounds have been shown to have maintained their monopoly over access to more prestigious higher education institutions and programs in a range of countries, including in the United States (Roska et al. 2007), Great Britain (Cheung and Egerton 2007), Ireland (O'Connell et al. 2006), France (Givord and Goux 2007), Germany (Mayer et al. 2007), the Netherlands (Rijken et al. 2007), Sweden (Jonsson and Erikson 2007), Switzerland (Buchmann et al. 2007), Russia (Gerber 2007), Israel (Shavit et al. 2007b), Japan (Ishida 2007), South Korea (Park 2007) and Taiwan (Tsai and Shavit 2007).

The large number of studies just cited attests to the wealth of research evidence that has been generated to date in connection with the MMI and EMI hypotheses. And yet, whether or not educational expansion serves to reduce educational inequality of a quantitative or of a qualitative kind remains an open question. The reason for this is simply that the key concepts of interest in this research field have not always been operationalized appropriately. In fact, as this paper will argue, the common practice in this field of research of operationalizing expansion using birth cohort categories, of operationalizing quantitative inequality using the educational transitions model put forward by Mare (1980, 1981), and of operationalizing qualitative inequality using models for polychotomous dependent variables such as those advocated by Lucas (2001) and by Breen and Jonsson (2000), all run the risk of producing misleading findings. In fact, these approaches to operationalizing expansion and inequality may even result in the MMI and EMI hypotheses not being rejected despite being false, or being rejected despite being true. This paper presents a series of hypothetical scenarios to help illustrate why this is the case and offers some suggestions as to how the MMI and EMI hypotheses could be more adequately operationalized for empirical testing.

2. Operationalizing educational expansion

Most studies that have set out to test the predictions of the MMI and EMI hypotheses have operationalized the main independent variable of interest, educational expansion, using a categorical measure of time as a proxy for expansion. A typical strategy has been to use cross-sectional data to create a set of pseudo birth cohort categories, distinguishing, for example, between those born in successive decades (e.g. born in 1950-59, 1960-69, 1970-79, and so on). The corresponding analytical strategy has then been to compare the average degree of inequality in successive birth cohort categories as a test of the prediction that inequality persists despite expansion. Because the process of educational expansion is sometimes discontinuous, not every birth cohort category distinguished by the analyst will necessarily represent a period of expansion.[2] However, between the first and the last category distinguished, some degree of expansion will typically have taken place.

[2] For example, in only two of the fifteen national case studies reported in Shavit et al. (2007) did every one of the cohorts distinguished reach the age of 18 at a time when the higher education sector was expanding in the country concerned.

A categorical birth cohort measure may be the most appropriate means of capturing change over time, most obviously if a small sample size makes it unfeasible to employ a more fine-grained measure of time such as an interval-level (i.e. continuous) measure of birth year. However, it is important to bear in mind that one shortcoming of a categorical measure of birth cohort is that trends over time *within* each category are inevitably obscured. This poses no problem if the categories that have been distinguished, despite their comparative crudity, tell the same story about the expansion-inequality relationship as would an interval-level measure. Unfortunately, however, this is not always the case; in fact, an analysis employing a categorical birth cohort measure may well yield results that wrongly suggest that inequality does not decline with expansion, or that wrongly suggest that it does.

Figure 1 helps to illustrate how birth cohort categories, in contrast to a continuous measure of birth year, can paint a misleading picture of the expansion-inequality relationship. The nine graphs in Figure 1 illustrate the different ways in which the extent of inequality could change across the span of years covered by two consecutive birth cohort categories. The x-axis for each graph measures the passage of time in years, with vertical lines used to mark the boundaries between adjacent birth cohort categories, while the y-axis measures the extent of inequality. For the purposes of illustration, members of at least one (but not necessarily both) of the two birth cohort categories are assumed to have come of age during a period of educational expansion. A further simplifying assumption is that by the end of the entire time span under consideration the enrollment rate of the most advantaged class has not yet reached saturation point.

[Figure 1 about here]

To begin with the three graphs in the first row (graphs 1A, 1B and 1C), all three of the scenarios depicted are ones in which both a categorical birth cohort measure and a continuous measure of birth year would lead to the same conclusion: namely that inequality had increased over time. In all three scenarios, the average level of inequality is clearly greater for the second birth cohort category than for the first, and for successive categories the trend is one of continually increasing (1A), increasing then stable (1B) or stable then increasing (1C) inequality. In the case of scenarios 1A, 1B, and 1C, then, both a categorical and a continuous measure would produce results consistent with the predictions of the MMI and EMI hypotheses that inequality does not decline with expansion.

The three graphs in the second row (graphs 2A, 2B and 2C), in contrast, include two scenarios in which the use of birth cohort categories could suggest a *different* conclusion than the use of a continuous measure of birth year. In the case of scenario 2A, the average level of inequality is clearly the same for the second birth cohort category as for the first, and within both birth cohort categories the trend is clearly one of stability: as such, both a categorical and a continuous measure would suggest the conclusion of persistent inequality in the face of expansion. In the case of scenarios 2B and 2C, however, while a categorical measure would also suggest the conclusion of persistent inequality, by virtue of the fact that the average level of inequality is the same for both birth cohort categories, a continuous measure of birth year would show that inequality had in fact declined and then increased (2B) or had increased and then declined (2C). Assuming that the birth cohort category associated with declining inequality was also one characterized by expansion, then a continuous measure of birth year, unlike a categorical measure, would indicate that the hypothesis of persistent inequality despite expansion should be rejected. In the case of scenarios 2B and 2C, then, an analysis employing birth cohort categories would be likely to lead the analyst to fail to reject the MMI and EMI hypotheses, even though, as a more fine-grained measure of birth year reveals, their prediction of persistent inequality is in fact incorrect.

The final three graphs in the third row (graphs 3A, 3B and 3C) are the mirror image of those in the first row, but unlike the first row they include two scenarios in which a categorical birth cohort measure and a continuous birth year measure could suggest different conclusions regarding the expansion-inequality relationship. In the case of scenario 3A, the average level of inequality is clearly lower in the second birth cohort category than the first, and within both categories there is a clear trend of declining inequality: as such, both a categorical and a continuous measure would suggest that the hypothesis of persistent inequality in the face of expansion should be rejected. In the case of scenarios 3B and 3C, however, while the use of birth cohort categories would also suggest that the hypothesis of persistent inequality should be rejected, since the average level of inequality is evidently lower for the second birth cohort category than for the first, an analysis employing a continuous measure of birth year would show that the pattern was one of declining then stable inequality (3B) or of stable then declining inequality (3C). Assuming that the birth cohort category associated with declining inequality was also associated with expansion, then an analysis using a continuous measure of birth year would reach the same conclusion as an analysis employing birth cohort categories: namely that the hypothesis of persistent inequality despite expansion should be rejected. If, however, the birth cohort category associated with declining inequality was not also one characterized by expansion – that is, if expansion was confined to the birth cohort category for which inequality remained steady – then a continuous measure of birth year, in contrast to a categorical measure of birth cohort, would lead to the conclusion the hypothesis of persistent inequality should *not* be rejected. Importantly, while an analysis employing a categorical birth cohort measure can detect a decline in inequality over time such as that illustrated in scenarios 3B and 3C, a categorical birth cohort measure cannot be used to identify whether that decline occurred within the first category, the second category, or both. As such, in the case of scenarios 3B and 3C, if the birth cohort category associated with declining inequality was not also characterized by expansion, then the results of an analysis employing birth cohort categories might lead the analyst to reject the MMI and EMI hypotheses even though the empirical evidence in fact supports their prediction of persistent inequality in the face of expansion.

As the discussion above has illustrated, the use of birth cohort categories rather than a continuous measure of birth year can generate a highly misleading picture of the expansion-inequality relationship. A birth cohort category approach permits a between-category comparison of average levels of inequality, but because it is blind to within-category trends it may lead the analyst to fail to reject the MMI and EMI hypotheses despite their predictions of persistent inequality in the face of expansion being false, or to reject these hypotheses despite their predictions being true. Operationalizing expansion using a continuous measure of birth year, in contrast, makes it possible to identify trends that would escape the notice of an analyst relying on a crude aggregation of birth years. A continuous measure of birth year, moreover, offers the opportunity to explore non-linear specifications of the expansion-inequality relationship using quadratic terms, smoothing splines or other semi- or non-parametric techniques (for an example, see Boliver forthcoming). Of course, continuous measures tend to require larger sample sizes than categorical measures if the analyst hopes to avoid simply modeling error in the data. Happily it seems that the vast majority of previous tests of the MMI and EMI hypotheses have utilized datasets with sample sizes that are likely to be more than adequate for the task.[3]

3. Operationalizing quantitative inequality

The central concern of the MMI hypothesis is with quantitative inequality in education; that is, with socioeconomic group differences in the chances of enrollment in education at a given educational level. Most tests of the MMI hypothesis to date have operationalized the dependent variable of interest, quantitative inequality, following Mare's educational transitions model (Mare 1980, 1981). The Mare model was originally put forward as an alternative to the linear regression approach to modeling quantitative educational inequality which involved estimating social group differences in the total number of years schooling completed (see, for example, Duncan 1965, 1967; Hauser and Featherman 1976) or in the probability of continuing in education from one grade level to the next (see, for example, Boudon 1974). In place of these linear regression models, Mare advocated the use of binary logit models to estimate quantitative inequality as measured by social inequalities in the odds of making successive educational transitions.

[3] Of course the exact sample size required depends on a whole host of factors, but to give some indication of the adequacy of the available data, 7 of the 13 studies reported in Shavit and Blossfeld (1993) drew on samples in excess of 5,000 cases, as did 11 of the 15 studies reported in Shavit et al (2007).

As Mare and others have argued, there are several reasons for preferring binary logit to linear regression models when estimating quantitative educational inequality. One reason is that the use of a series of dichotomous variables to capture enrollment versus non-enrollment in progressively higher levels of education, rather than the use of a single continuous variable representing highest educational level reached, makes it possible to focus the analysis on educational levels that are of particular theoretical or substantive interest.[4] A more important reason, however, is that the use of a logistic rather than a linear regression function to estimate the odds rather than the probability of enrollment in education at a given level is better suited to an exploration of how quantitative inequality changes over time because the parameter estimates it produces are not sensitive to changes over time in the marginal distribution of educational attainment.

A further feature of the Mare model – and one that goes beyond being simply a feature of the binary logit model – is that the odds of enrollment in education at successive levels are estimated conditional on completion of the previous level, rather than irrespective of continuation in education up until the transition point of interest. This distinctive feature of the Mare model also arguably offers an advantage over its alternative in that it avoids confounding inequality in the educational transition of interest with inequalities in prior transitions.

[4] For the same reason, binary logit models are also preferable to models for a polychotomous categorical dependent variable, including the log-linear models and ordered logit models used by Breen et al. (2009).

The opposite case can also be made, however: that restricting the analysis to the sub-sample of individuals who are eligible to make the transition of interest by virtue of having survived the previous transition rests on the assumption that earlier continuation decisions are made myopically, without consideration for later ones. As other have argued, this assumption is ultimately an untenable one (see especially Cameron and Heckman 2008). A rather more plausible assumption is that continuation decisions made at earlier transition points are typically made with subsequent transitions in mind; decisions about whether or not to complete the upper grades of secondary school, for example, are likely to be made at least partly in light of intentions regarding subsequent college attendance.

The logic of this argument can be extended to the dynamic, over time case in that the propensities of populations to make earlier transitions can be expected to change over time in response to changing perceptions regarding the possibility of making later ones. The proportion of people deciding to complete the upper grades of secondary school, for example, might well be expected to increase as the expansion of higher education increases opportunities for college attendance. By the same token, expansion has the potential to reduce quantitative inequality at a given educational level not only by altering social group differences in propensities to enroll in education at that level, but also by changing propensities for eligibility for enrollment. Given this, it is far from clear that it would be desirable to model quantitative educational inequality conditioned on eligibility for enrollment at the level of interest. In fact, such a strategy would run the risk of generating results that wrongly suggest that quantitative inequality declines with expansion, or that wrongly suggest that it doesn't.

Figure 2 helps to illustrate how conditioning on eligibility for enrollment might generate a misleading picture of change over time in the extent of quantitative inequality. The thirteen graphs in Figure 2 illustrate the different ways in which enrollment inequality (solid lines) and enrollment eligibility inequality (broken lines) may change over a given period of time. In each graph, the slope of the solid line indicates the direction of change over time in the extent of enrollment inequality *irrespective of eligibility*. The direction of change over time in the extent of inequality *conditional on eligibility*, in contrast, is indicated by the slope of the solid line in relation to that of the broken line.

[Figure 2 about here]

The five graphs in the first row of Figure 2 all illustrate scenarios in which enrollment inequality irrespective of eligibility can be seen to have increased over time. Likewise, the first three graphs in the first row (graphs 1A, 1B and 1C) also illustrate scenarios in which enrollment inequality conditional on eligibility can be seen to have increased over time; this is evident from the widening gap between the solid lines in these three scenarios and the broken lines representing stable (1A), only modestly increasing (1B) and declining (1C) inequality in enrollment eligibility. In the case of scenarios 1A, 1B and 1C, then, enrollment inequality would be found to have increased over time no matter whether the analysis conditioned on eligibility for enrollment or not. In contrast, the last two graphs in the first row (graphs 1D and 1E) illustrate scenarios in which different conclusions would be reached regarding enrollment inequality depending on whether or not the analysis conditioned on eligibility. In these scenarios, conditioning on eligibility makes enrollment inequality appear stable over time (1D) or in decline (1E), but only because eligibility inequality increased to an extent equal to (1D) or greater than (1E) the increase in enrollment inequality irrespective of eligibility. Importantly, in the specific case of scenario 1E, the results of an analysis that conditioned on eligibility would wrongly suggest that the MMI hypothesis of persistent inequality in the face of expansion be rejected.

The logic of the argument just set out in relation to first row of graphs in Figure 2 also applies to those in the second row. All five of the graphs in row two depict scenarios in which enrollment inequality irrespective of eligibility can be seen to have declined over time. The first three graphs in the second row (graphs 2A, 2B and 2C) also depict scenarios in which enrollment inequality can be seen to have declined over time after conditioning on eligibility, as is shown by the narrowing gap between the solid lines in these three scenarios and the broken lines representing stable (2A), only modestly declining (2B), and increasing (2C) inequality in enrollment eligibility. In contrast, in the last two graphs in the second row (graphs 2D and 2E), enrollment inequality appears stable over time (2D) or on the increase (2E) after conditioning on eligibility, but only because eligibility inequality decreased to an extent equal to (2D) or greater than (2E) the decrease in enrollment inequality irrespective of eligibility. An important consequence of this is that, in the case of scenarios 2D and 2E, conditioning on eligibility would likely lead to the MMI hypothesis of persistent inequality being accepted despite its being false.

Turning finally to row three of Figure 2, the first graph in this row (graph 3A) illustrates a scenario in which an examination of changes in enrollment inequality would lead to the conclusion that inequality had remained stable over time regardless of whether the analysis conditioned on eligibility or not. The last two graphs in the third row (graphs 3B and 3C), in contrast, illustrate scenarios in which an analysis that conditioned on eligibility would suggest that enrollment inequality had increased (3B) or had declined (3C) over time – in both cases simply because eligibility inequality declined (3B) or had increased (3C). Importantly, in the specific case of scenario 3C, conditioning on eligibility would likely result in the MMI hypothesis of persistent inequality being rejected despite its being true.

As the discussion above has illustrated, studies that follow the Mare model in estimating quantitative educational inequality conditional on eligibility for enrollment run the risk of generating highly misleading findings. Because conditioning on eligibility removes ineligibles from the denominator of the enrollment measure, change over time in the extent of enrollment inequality may be misrepresented as a result of its being confounded with change over time in the extent of inequality in eligibility for enrollment at that level. This is a problem if we suspect that expanding education at a given level not only encourages already-eligible individuals to enroll at that level but also encourages people who would otherwise have remained ineligible for enrollment at that level to become eligible.

A solution to this problem of confounding is to operationalize quantitative inequality as enrollment in education at the level of interest relative to non-enrollment *irrespective of eligibility*; that is, to employ a series of *unconditional* binary logit models in place of the series of conditional binary logit models advocated by Mare. Unconditional binary logit models make it possible to obtain estimates of change in the extent of inequality at a given level of education that are unaffected by change occurring simultaneously at lower educational levels. That is not to say that there is no place for models that condition on eligibility; indeed, conditional models are needed to understand how (as opposed to establish whether) inequality increased, declined or persisted over time.

4. Operationalizing qualitative inequality

The central concern of the EMI hypothesis is with qualitative inequality in education; that is, with socioeconomic group differences in the likelihood of enrollment in more as opposed to less prestigious educational options at, or nominally at, the same educational level. Lucas (2001), for example, in his analysis of qualitative inequality in the US high school system, distinguishes between taking college-preparatory math classes, taking non-college math classes, and taking no math classes in high school, in addition to the option of dropping out of high school altogether. Similarly, Breen and Jonsson (2000), in their analysis of qualitative inequality in upper secondary education in Sweden, distinguish between the academic and the vocational path, in addition to the option of non-continuation. As both Lucas and Breen and Jonsson argue, it is important to distinguish such quantitatively similar but qualitatively different kinds of education, not only because different kinds of education are likely to be subject to different degrees of inequality, but also because they are likely to differ in their impact on subsequent educational trajectories

Lucas employs an ordered probit model to estimate the cumulative probability of enrollment in progressively higher status upper secondary educational programs. Somewhat differently, Breen and Jonsson employ a multinomial logit model to estimate the odds of enrollment in the higher status academic option and in the lower status vocational alternative expressed relative to the reference category of non-enrollment. The ordered probit model advocated by Lucas have not been widely adopted in this research field; Breen and Jonsson's multinomial logit approach, on the other hand, has been commonly employed in studies concerned with qualitative inequality.[5]

In developing the case for a multinomial logit approach to analyzing qualitative inequality, Breen and Jonsson argue that such models are preferable to a binary model for a dichotomous dependent variable because the latter would require combining enrollment in the lower status educational option with non-enrollment to form a single reference category. This, Breen and Jonsson argue, would amount to inappropriately treating these two outcomes as though they were equivalents, and would tend to produce lower estimates of the extent of inequality in the higher status educational option due to its being confounded with the commonly lower extent of inequality in the lower status alternative.

Although estimates of the extent of inequality in the higher status educational option are indeed likely to be smaller when the reference category includes the lower status alternative together with non-enrollment, it is nevertheless questionable whether it really would be preferable to employ a multinomial logit model instead of a set of binary logit models, thereby restricting the reference category to non-enrollment alone. On the contrary, a compelling case can be made for not modeling the dependent variable using a multinomial

[5] For example, 5 out of the 12 studies reported in Shavit et al (2007) that explored qualitative inequality made use of multinomial logit models.

logit on the grounds that to do so would be likely to violate a key assumption of this model, known as the independence of irrelevant alternatives (IIA) (Arrow 1951). Under the IIA assumption, propensities for enrollment in the higher status type of education as opposed to non-enrollment should be unaffected by (independent of) the availability or otherwise of the lower status alternative (the irrelevant alternative). It is easy to see that this is not a plausible assumption in this case; on the contrary, the availability of the lower status alternative may well reduce propensities towards non-enrollment for some, and may well serve as a diversion away from the higher status option for others. As a result, the extent of inequality in enrollment in the higher status option relative to non-enrollment may well be substantially altered by the existence of opportunities to enroll in the lower status alternative, suggesting that inequality in higher status enrollment would be more appropriately estimated with reference to lower status enrollment and non-enrollment combined.

The potential violation of the IIA assumption is good grounds for choosing to operationalize qualitative inequality using a set of binary logit models rather than a single multinomial logit one, not least when the concern is with change in the extent of qualitative inequality over time. Indeed, the use of a multinomial logit model will inevitably confound change in the extent of inequality in the higher status option with change in the extent of inequality in the lower status alternative because the extent of inequality in the reference category of non-enrollment is a function of that in the higher and lower status educational options combined. As such, using a multinomial logit model and restricting the reference category to non-enrollment alone runs the risk of generating highly misleading results regarding change in the extent of qualitative inequality. In fact, such a strategy runs the risk of producing findings that wrongly suggest that qualitative inequality declines over time, or that wrongly suggest that it doesn't.

Figure 3 helps to illustrate how restricting the reference category to non-enrollment may generate a misleading picture of change over time in the extent of qualitative inequality. The thirteen graphs in Figure 3 are similar to those in Figure 2 except that they contain three trend lines rather than two. These illustrate the different ways in which inequality in the higher status educational option (solid lines), inequality in the lower status alternative (broken lines), and inequality in non-enrollment (dotted lines) may change over a given period of time.[6] In each graph, the slope of the solid line indicates the direction of change over time in the extent of higher status enrollment inequality when the reference category refers to lower status enrollment and non-enrollment combined. In contrast, the direction of change over time in the extent of higher status enrollment inequality relative to non-enrollment alone is indicated by the slope of the solid line in relation to that of the dotted line.

[Figure 3 about here]

The five graphs in the first row of Figure 3 all illustrate scenarios in which higher status enrollment inequality can be seen to have increased over time. The first three graphs in the first row (graphs 1A, 1B and 1C) also illustrate scenarios in which higher status enrollment inequality expressed in contrast to inequality in non-enrollment can be seen to have increased over time; this is evident from the widening gap between the solid lines in these three

[6] For simplicity's sake, the extent of non-enrollment inequality is calculated on the basis that higher status and lower status enrollment contribute 50:50 to total enrollment over the course of the entire time span under consideration.

scenarios and the dotted lines representing only modestly increasing (1A and 1B) and stable (1C) inequality in non-enrollment. In the case of scenarios 1A, 1B and 1C, then, higher status enrollment inequality would be found to have increased over time no matter whether the reference category of the dependent variable referred to non-enrollment alone or lower status enrollment and non-enrollment combined. In contrast, the last two graphs in the first row (graphs 1D and 1E) illustrate scenarios in which different conclusions would be reached regarding enrollment inequality depending on the nature of the reference category. In these scenarios, restricting the reference category to non-enrollment makes higher status enrollment inequality appear stable over time (1D) or in decline (1E), but only because lower status enrollment inequality increased to an equivalent (1D) or greater (1E) extent. Importantly, in the specific case of scenario 1E, the results of an analysis that restricted the reference category to non-enrollment would wrongly suggest that the EMI hypothesis of persistent qualitative inequality should be rejected.

A similar logic to the argument just set out in relation to first row of graphs in Figure 3 can also be applied to those in the second row. All five of the graphs in row two depict scenarios in which higher status enrollment inequality can be seen to have declined over time. The first three graphs in the second row (graphs 2A, 2B and 2C) also depict scenarios in which higher status enrollment inequality measured against non-enrollment as the reference category can be seen to have declined over time, as is shown by the narrowing gap between the solid lines in these three scenarios and the dotted lines representing more modestly declining (2A and 2B) and stable (2C) inequality in non-enrollment. In contrast, in the last two graphs in the second row (graphs 2D and 2E), higher status enrollment inequality appears stable over time (2D) or on the increase (2E) when measured in reference to non-enrollment, but only because non-enrollment inequality decreased to an equivalent (2D) or greater (2E) extent. An important consequence of this is that, in the case of scenarios 2D and 2E, restricting the reference category to non-enrollment would likely lead to the EMI hypothesis of persistent qualitative inequality being accepted despite its being false.

Turning finally to row three of Figure 3, the first graph in this row (graph 3A) illustrates a scenario in which an examination of changes in higher status enrollment inequality would lead to the conclusion that qualitative inequality had remained stable over time regardless of the reference category used. The last two graphs in the third row (graphs 3B and 3C), in contrast, illustrate scenarios in which the use of non-enrollment alone as the reference category would suggest that higher status enrollment inequality had increased (3B) or had declined (3C) over time – in both cases simply because non-enrollment inequality had declined (3B) or had increased (3C). Importantly, in the specific case of scenario 3C, restricting the reference category to non-enrollment would likely result in the EMI hypothesis of persistent qualitative inequality being rejected despite its being true.

As the discussion in this section has illustrated, the multinomial logit model advocated by Breen and Jonsson and commonly used in studies of qualitative inequality may generate a misleading picture of change in the extent of qualitative inequality over time. Because a multinomial logit model involves restricting the reference category to non-enrollment alone, change in the extent of inequality in the higher status option may be misrepresented as a result of its being confounded with change in the extent of inequality in the lower status alternative.

The problem of confounding illustrated in this section potentially applies whenever the reference category does not encompass all of the alternatives to the option being considered. Of course, an analyst employing a multinomial logit model can check whether the IIA assumption is met. If it is not met, then clearly the analyst will need to decide on an alternative modeling strategy. If it is met, then the problem of confounding discussed above may well still apply, even if it only affects the magnitude rather than the direction of the coefficients the model produces. One solution to the potential problem of confounding would be to estimate a multinomial probit or ordered probit model, as Lucas advocates. Another would be to employ a series of binary logit models in place of a single multinomial lgit model, each contrasting one qualitative option with all other qualitative options and non-enrollment combined.

5. Conclusion

The hypotheses of Maximally Maintained Inequality and of Effectively Maintained Inequality predict that neither quantitative nor qualitative educational inequalities between socioeconomic groups can be expected to decline merely as a result of educational expansion. But whether or not these predictions hold empirically has yet to be established because few prior studies have operationalized their central concepts appropriately. As this paper has demonstrated, the standard approach of operationalizing expansion using a categorical rather than a continuous measure of birth cohort, the convention of operationalizing quantitative inequality using the Mare model of educational transitions, and the common practice of operationalizing qualitative inequality using a multinomial logit model, all run the risk of producing misleading findings, potentially resulting in the MMI and EMI hypotheses not being rejected despite being false, or being rejected despite being true.

As the hypothetical examples in this paper have illustrated, operationalizing expansion using birth cohort categories is problematic because of the blindness of such an approach to changes in inequality that occurs within cohorts as opposed to between them. Operationalizing quantitative inequality following the Mare model of educational transitions is problematic too, because conditioning on eligibility confounds changes in the extent of enrollment inequality with changes in the extent of inequality in enrollment eligibility. Operationalizing qualitative inequality using a multinomial logit model is likewise problematic, because confining the reference category to non-enrollment alone confounds change in the extent of inequality in the higher status option with change in the extent of inequality in the lower status alternative. These problems can easily be avoided, however, simply by operationalizing these concepts differently. Indeed, by using an interval-level measure of time to represent expansion, by measuring quantitative inequality as enrollment in education at the level of interest without conditioning on eligibility, and by measuring qualitative inequality as enrollment in each educational option relative to enrollment in all other options and non-enrollment combined; the predictions of the MMI and EMI hypotheses that quantitative and qualitative educational inequalities persist in the face of expansion can be put to a more definitive test.

References

Arrow, Kenneth. 1963. "Social Choice and Individual Values." 2nd edition. New York: John Wiley and Sons Inc.

Bell, Daniel. 1973. "The Coming of Post-Industrial Society." New York: Basic Books Inc.

Blossfeld, Hans-Peter. 1993. "Changes in Educational Opportunities in the Federal Republic of Germany: A Longitudinal Study of Cohorts Born Between 1916 and 1965." Pp. 51-74 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

Boliver, Vikki. Forthcoming. "Expansion, Differentiation and the Persistence of Social Class Inequalities in British Higher Education" in *Higher Education* Netherlands: Springer.

Boudon, Raymond. 1974. "Education, Opportunity and Social Inequality." New York: Wiley.

Breen, Richard. 2005. "Why Did Class Inequalities in Educational Attainment Remain Unchanged over Much of the Twentieth Century?" in A. F. Heath *et al* (eds.), "Understanding Social Change: Proceedings of the British Academy", pp. 55-72. Oxford: Oxford University Press.

Breen, Richard, and Jan O. Jonsson. 2000. "Analyzing Educational Careers: A Multinomial Transition Model." *American Journal of Sociology* 65(5): 754-772.

Breen, Richard, Ruud Luijkx, Walter Müller and Reinhard Pollak. 2009. "Non-Persistent Inequality in Educational Attainment: Evidence from Eight European Countries." *American Journal of Sociology,* 114(5): 1475-1521.

Buchmann, Marlis, and Maria Charles with Stefan Sacchi. 1993. "The Lifelong Shadow: Social Origins and Educational Opportunity in Switzerland." Pp. 177-192 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

Buchmann, Marlis, Stefan Sacchi, Marjus Lamprecht and Hanspeter Stamm. 2007. "Switzerland: Tertiary Education Expansion and Social Inequality." Pp.321-350 in "Stratification in Higher Education: A Comparative Study." Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Cameron, Stephen V., and James, J. Heckmann. 1998. "Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males." *The Journal of Political Economy*. 106(2): 262-333.

Cheung, Sin Yi, and Muriel Egerton. 2007. "Great Britain: Higher Education Expansion and Reform – Changing Educational Inequalities." Pp.195-219 in "Stratification in Higher

Education: A Comparative Study." Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Cobalti, Antonio, and Antonio Schizzerotto. 1993. "Inequality of Educational Opportunity in Italy." Pp. 155-176 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

De Graaf, Paul M., and Harry B.G. Ganzeboom. 1993. "Family Background and Educational Attainment in the Netherlands for the 1891-1960 Birth Cohorts." Pp. 75-100 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

Duncan, Beverly. 1965. "Family Factors and School Dropout: 1920-1960." Ann Arbor, University of Michigan Cooperative, Research Project No. 2258, U.S. Office of Education.

Duncan, Beverly. 1967. "Education and Social Background." *American Journal of Sociology*. 72: 363-372.

Erikson, Robert, and Jan O. Jonsson. 1996. "Can Education be Equalized? The Swedish Case in Comparative Perspective." Boulder CO.: Westview Press.

Featherman, David L., and Robert M. Hauser. 1978. "Opportunity and Change." New York: Academic Press.

Gamoran, Adam. 1996. "Curriculum standardization and equality of opportunity in Scottish secondary education: 1984-90." *Sociology of Education*, 69: 1-21

Gerber, Theodore P., and Michael Hout 1995. "Educational Stratification in Russia During the Soviet Period." *American Journal of Sociology*, 101: 611-660.

Gerber, Theodore P. 2000. "Educational Stratification in Contemporary Russia: Stability and Change." *Sociology of Education*, 73: 219-246.

Gerber, Theodore, P. 2007. "Russia: Stratification in Postsecondary Education Since the Second World War." Pp. 294-320 in "Stratification in Higher Education: A Comparative Study." Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Givord, Pauline, and Dominique Goux. 2007. "France: Mass and Class – Persisting Inequalities in Postsecondary Education." Pp.220-239 in "Stratification in Higher Education: A Comparative Study." Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Halsey, A.H., Anthony Heath, and John M. Ridge. 1980. "Origins and Destinations." Oxford: Clarendon Press.

Hauser, Robert M., and David L. Featherman. 1976. “Equality of Schooling: Trends and Prospects.” *Sociology of Education*, 49: 99-120.

Heyns, Barbara, and Ireneusz Biatecki. 1993. “Educational Inequalities in Postwar Poland.” Pp.303-336 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. “Persistent Inequality: Changing Educational Attainment in Thirteen Countries.” Boulder CO.: Westview Press.

Hout, Michael, Adrian E. Raftery and Eleanor O. Bell. 1993. “Making the Grade: Educational Stratification in the United States: 1925-1989.” Pp.25-50 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. “Persistent Inequality: Changing Educational Attainment in Thirteen Countries.” Boulder CO.: Westview Press.

Ishida, Hiroshi. 1994. “Social Mobility in Contemporary Japan.” Stanford CA: Stanford University Press.

Ishida, Hiroshi. 2007. “Japan: Educational Expansion and Inequality in Access to Higher Education.” Pp.63-86 in “Stratification in Higher Education: A Comparative Study.” Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Jonsson, Jan O. 1993. “Persisting Inequalities in Sweden.” Pp.101-132 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. “Persistent Inequality: Changing Educational Attainment in Thirteen Countries.” Boulder CO.: Westview Press.

Jonsson, Jan O., Colin Mills and Walter Müller. 1996. “A Half Century of Increasing Educational Openness? Social Class, Gender and Educational Attainment in Sweden, Germany and Britain.” Pp. 183-206 in “Can Education be Equalized? The Swedish Case in Comparative Perspective.” Edited by Erikson, Robert, and Jan O. Jonsson. Boulder CO.: Westview Press.

Jonsson, Jan O., and Robert Erikson. 2007. “Sweden: Why Educational Expansion Is Not Such a Great Strategy for Equality – Theory and Evidence.” Pp.113-130 in “Stratification in Higher Education: A Comparative Study.” Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Kerckhoff, Alan C., and Jerry M. Trott. 1993. “Educational Attainment in a Changing Educational System: The Case of England and Wales.” Pp.133-154 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. “Persistent Inequality: Changing Educational Attainment in Thirteen Countries.” Boulder CO.: Westview Press.

Kuo, Hsiang-Hui and Robert M. Hauser. 1995. “Trends in family effects on the foundation of blacks and white brothers.” *Sociology of Education*, 68(2): 136–160.

Lucas, Samuel R. 2001. “Effectively Maintained Inequality: Education Transitions, Track Mobility, and Social Background Effects.” *American Journal of Sociology*, 106: 1642-1690

Lucas, Samuel R. 2009. “Stratification Theory, Socioeconomic Background, and Educational Attainment: A Formal Analysis.” *Rationality and Society.* 21: 459-511.

Mare, Robert. D. 1980. “Social Background and School Continuation Decisions.” *Journal of the American Statistical Association*. 75: 295-305.

Mare, Robert D. 1981. “Change and Stability in Educational Stratification.” *American Sociological Review. 46: 72-87.*

Marks, Gary N., and Julie McMillan. 2007. “Australia: Changes in Socioeconomic Inequalities in University Participation.” Pp. 351-373 in “Stratification in Higher Education: A Comparative Study.*”* Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Mayer, Karl Ulrich, Walter Müller and Reinhard Pollak. 2007. “Germany: Institutional Change and Inequalities of Access in Higher Education.” Pp. 240-265 in “Stratification in Higher Education: A Comparative Study.*”* Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Matějů, Petr. 1993. “Who Won and Who Lost in a Socialist Redistribution in Czechoslovakia.” Pp. 251-272 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. “Persistent Inequality: Changing Educational Attainment in Thirteen Countries.” Boulder CO.: Westview Press.

Matějů, Petr, Blanka Řeháková, and Natalie Simonová. 2007. “The Czech Republic: Structural Growth of Inequality of Access to Higher Education.” Pp.374-399 in “Stratification in Higher Education: A Comparative Study.*”* Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Mayer, Karl Ulrich, Walter Müller and Reinhard Pollak. 2007. “Germany: Institutional Change and Inequalities of Access in Higher Education.” Pp.240-265 in “Stratification in Higher Education: A Comparative Study.*”* Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

O’Connell, Philip J., Selina McCoy and David Clancy. 2006. “Who Went to College? Socio-Economic Inequality in Entry to Higher Education in the Republic of Ireland in 2004.” *Higher Education Quarterly*. 60(4): 312-332.

Park, Hyunjoon. 2007. “South Korea: Educational Expansion and Inequality of Opportunity for Higher Education.” Pp.87-112 in “Stratification in Higher Education: A Comparative Study.*”* Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Parsons, Talcott. 1970. "Equality and Inequality in Modern Society, or Social Stratification Revisited." In E.O. Laumann (Ed.) "Social Stratification: Research and Theory for the 1970s." Indianapolis: Bobbs-Merrill.

Raftery, Adrian E., and Michael Hout. 1993. "Maximally Maintained Inequality: Expansion, Reform, and Opportunity in Irish Education, 1921-75." *Sociology of Education*, 66, pp.41-62.

Rijken, Susanne, Ineke Maas, and Harry B. G. Ganzeboom. 2007. "The Netherlands: Access to Higher Education – Institutional Arrangements and Inequality of Opportunity." Pp.266-294 in "Stratification in Higher Education: A Comparative Study." Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Roksa, Josipa, Eric Grodsky, Richard Arum, and Adam Gamoran, A. 2007. "United States: Changes in Higher Education and Social Stratification." Pp. 165-194 in "Stratification in Higher Education: A Comparative Study." Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Shavit, Yossi. 1993. "From Peasantry to Proleteriat: Changes in the Educational Stratification of Arabs in Israel." Pp.337-350 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

Shavit, Yossi, and Karin Westerbeek. 1998. "Educational Stratification in Italy: Reforms, Expansion, and Equality of Opportunity." *European Sociological Review*, 14(1): 33-47.

Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

Shavit, Yossi, Richard Arum, and Adam Gamoran, with Gila Menahem. 2007a. "Stratification in Higher Education: A Comparative Study." Stanford, C.A.: Stanford University Press.

Shavit, Yossi, Hanna Ayalon, Svetlana Chachashvili-Bolotin and Gila Menahem. 2007b. "Israel: Diversification, Expansion and Inequality in Higher Education." Pp.39-62 in "Stratification in Higher Education: A Comparative Study." Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Szelényi, Szonja, and Karen Aschaffenburg. 1993. "Inequalities in Educational Opportunity in Hungary." Pp.273-302 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

Treiman, Donald J. 1970. "Industrialization and Social Stratification." In E.O. Laumann (Ed.) "Social Stratification: Research and Theory for the 1970s." Indianapolis: Bobbs-Merrill.

Treiman, Donald J., and Kazuo Yamaguchi. 1993. "Trends in Educational Attainment in Japan." Pp.229-250 in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

Tsai, Shu-Ling, and Hei-Yuan Chiu. 1993. "Changes in Educational Stratification in Taiwan." Pp.193-228 in in Shavit, Yossi, and Hans-Peter Blossfeld. 1993. "Persistent Inequality: Changing Educational Attainment in Thirteen Countries." Boulder CO.: Westview Press.

Tsai, Shu-Ling and Yossi Shavit. 2007. "Taiwan: Higher Education – Expansion and Equality of Educational Opportunity." Pp.140-164 in "Stratification in Higher Education: A Comparative Study." Edited by Yossi Shavit, Richard Arum, and Adam Gamoran, with Gila Menahem. Stanford, C.A.: Stanford University Press.

Vallet, Louis-André. 2004. "The Dynamics of Inequality of Educational Opportunity in France: Change in the Association Between Social Background and Education in Thirteen Five-Year Birth Cohorts (1908-1972)." Paper prepared for the meeting of the ISA Research Committee on Social Stratification and Mobility, 6-8 May, 2004, Neuchâtel.

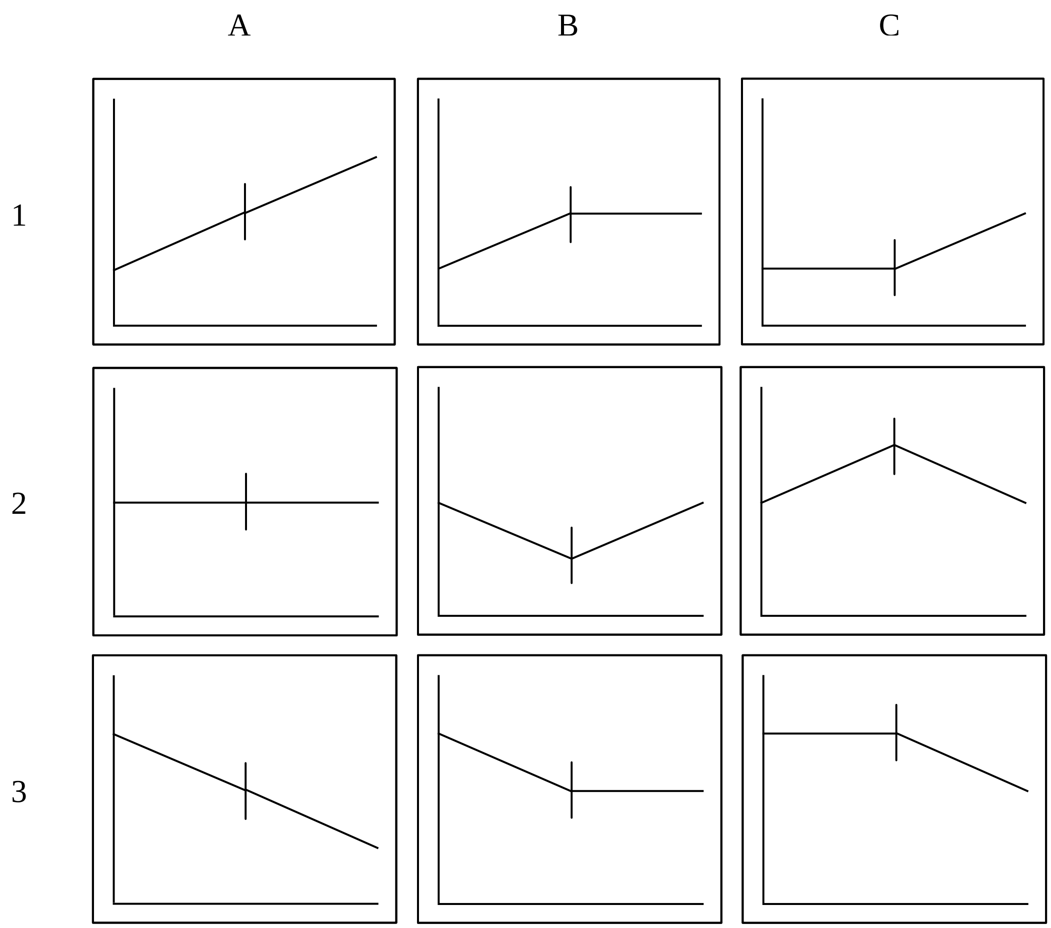

FIG. 1. – Change over time (x-axis) in the extent of inequality (y-axis)
for two adjacent birth cohorts

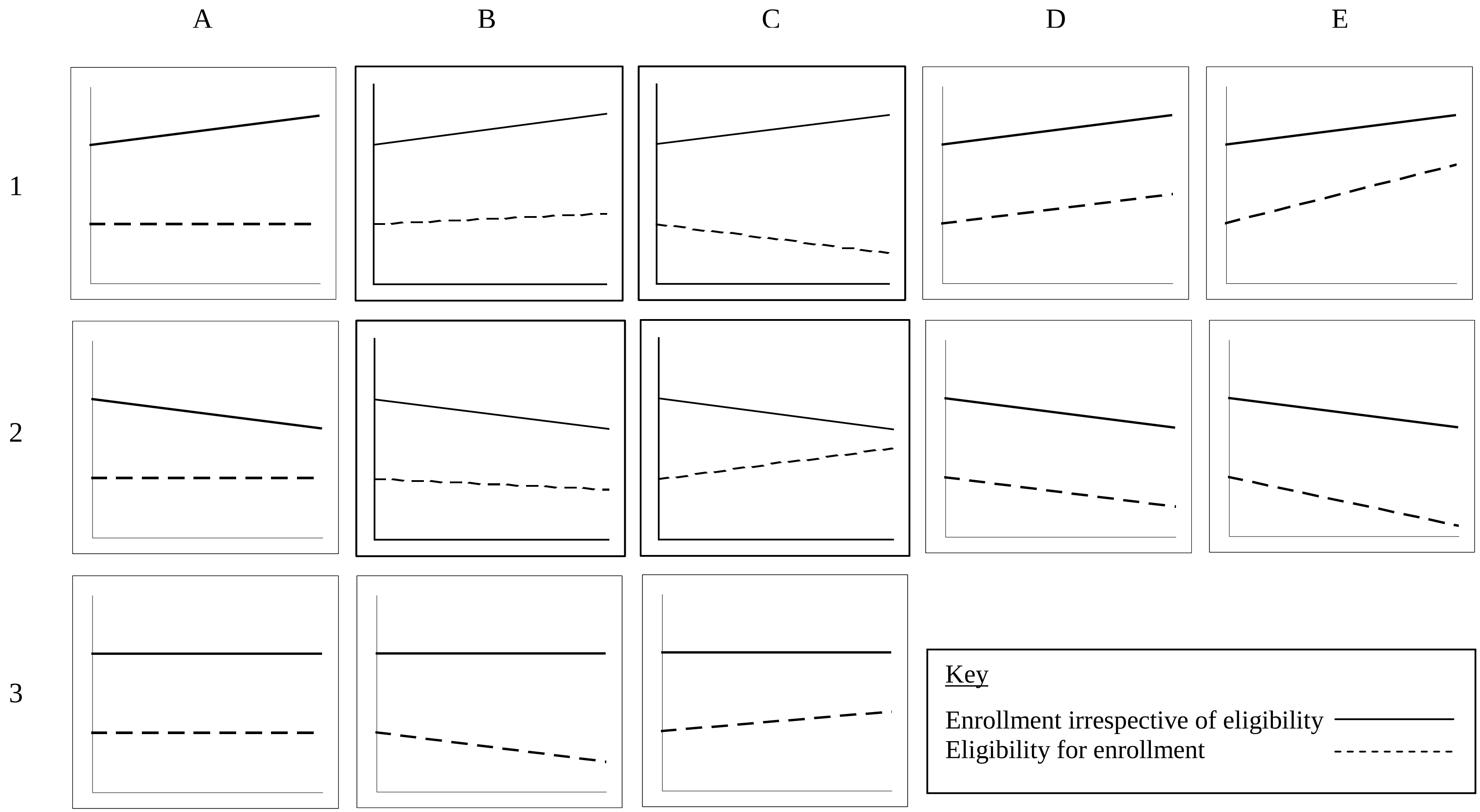

FIG. 2. – Change over time (x) in the extent of inequality (y) in enrollment irrespective of eligibility and in eligibility for enrollment

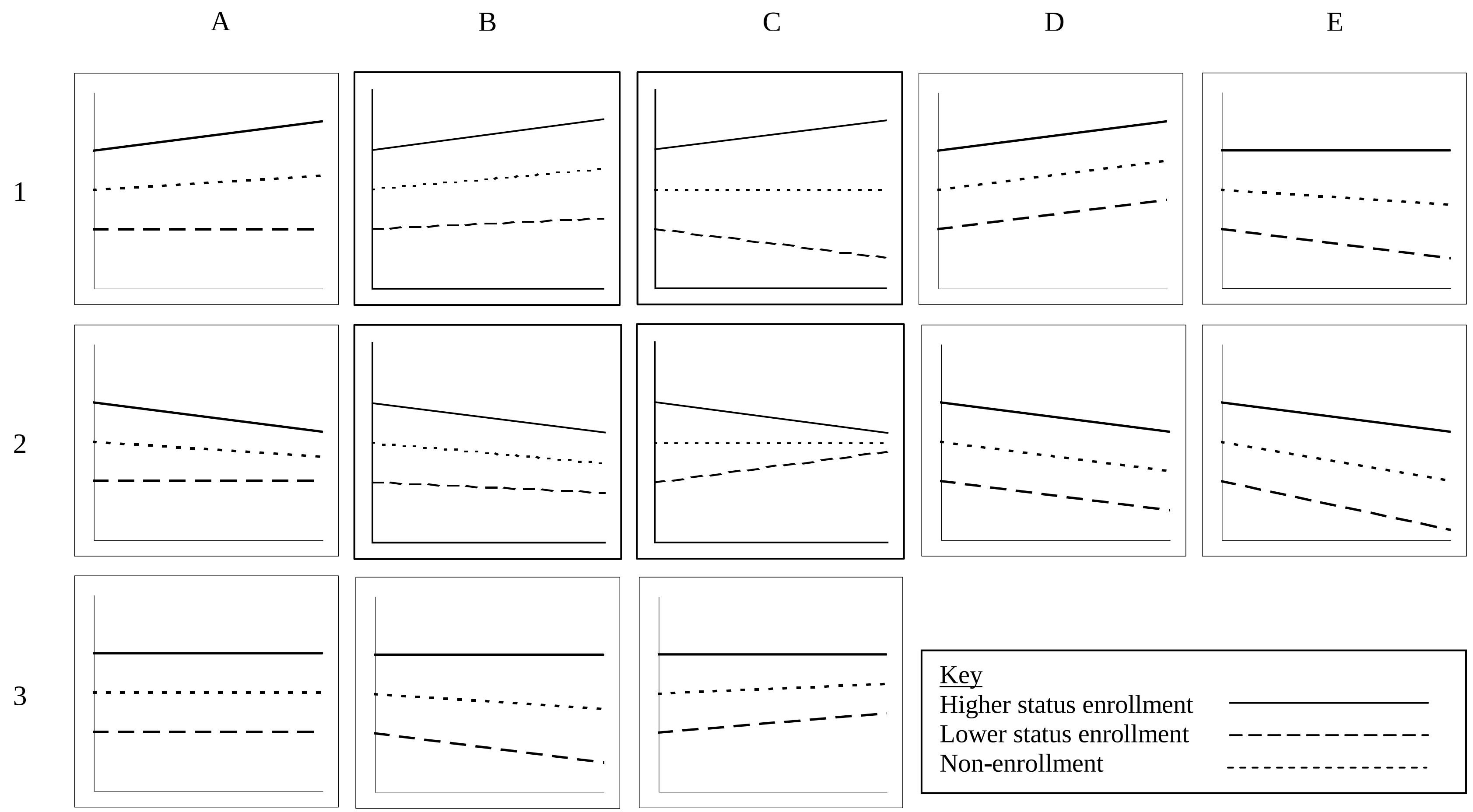

FIG. 3. – Change over time (x) in the extent of inequality (y) in higher status enrollment, lower status enrollment and non-enrollment