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Education: Comparisons of Absolute vs. Relative Measures

(Draft: August 2001)

by

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Working Paper

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[COMMENTS WELCOME]

August 2001

Education: Relative and Absolute Measures

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Education – as acquired skills and knowledge, as a set of associations, acquaintances, and friends, or as a form of credentials – figures so prominently that it would be rare to find a discussion of most topics of social inquiry-- prestige, employment, fertility, income and poverty, divorce, political participation, or attitudes –that did not include mention of education. Most commonly, education is incorporated in such analyses either using a continuous measure, such as years of education, or ordered discrete categories, distinguishing those with a particular set of credentials with those without. These measures explicitly recognize that educational achievement is an ordered hierarchy, but discussions usually ignore that a given level of education can vary in *how high or low* it falls in the hierarchy depending on the age or period considered.

I Some Implications of Educational Expansion for Education-Based Comparisons

The importance of education may, to some extent, be marked by the substantial growth in the educational achievement during the 20th century. High school enrollment rates among teens aged 14-17, for example, climbed from about 10% in 1900 to 50% in 1930, 90% in 1960, and 96% in 2000. School enrollment rates for 20-21 year-olds, primarily reflecting post-secondary schooling, have also risen dramatically, growing from around 12% in 1947 to 44% in 2000. (Goldin and Katz, 1999, US Bureau of the Census, 2001) If this growth marks an increasing influence of education, it also creates some problems for analyses that seek to control for the effects of education. First, the rapid expansion of education, and the fact that formal education is, for most, undertaken early in life, creates a strong association between age and education that can confuse the separate effects of these factors. Secondly, if the effect of education is seen in terms of ranking individuals from high to low, the expansion of education means that the rank of any given level of education has declined over the course of the century.

Consider a 21 year-old with a high school diploma, but no more. In 1990, she shares the same educational credentials with just over a third (34.7%) of the adult population; 45% of adults have more schooling, and 20% have less education. The median age of adults who share her credentials is 40; somewhat counter-intuitively, the median age of adults with less education is even higher – 51 years – while those with “some college” are typically even younger, with a median age of 35. If we had to choose a single number to represent where, among all adults, she falls into the continuum of educational achievement, we would probably pick the rank in the very middle of those with an HS degree – at the 37th percentile.

In limiting ourselves to the adult population, we are implicitly recognizing that comparing the educations of some groups is inappropriate – a second grade education has a different meaning for an 8 year-old, a 38 year-old, and a 68 year-old. If we apply a similar logic, and rank this 21 year-old only among her peers¹, she would drop from the 37th percentile to the 31st, and more than half her peers would have more education. A sixty year old with the same education would rank at the 48th percentile, and only a third of her peers would have more years of schooling.

¹ In this case, those who were born in the same year. Depending on the role that education is presumed to play, peers might be limited to others in the same labor market area, or persons with the same sex or race.

Contrasting educational ranks across time, instead of across ages within a year, shows similar differences. In 1940, the earliest year in which education was recorded in the decennial censuses, a high school diploma placed one high in the educational hierarchy: only 10% of adults in that year had more education, and, on average, the holder of such a diploma ranked at the 81st percentile. Considering only peers, a diploma placed a 21 year-old in 1940 at the 71st percentile, and a 60 year-old at the 88th percentile.

In short, within a given year, controlling for age makes a substantial difference in the hierarchical ranking among one's peers of a given level of schooling and, whether controlling for age or not, the relative ranking of a credential over time can vary dramatically.

One final contrast is worth mentioning: the change in the ranking of a credential over time for a cohort of peers (e.g. among those who are 21 year-olds in 1940, 31 year-olds in 1950, 41 year-olds in 1960, etc.). If individuals all completed their education by age 18, and if there was no differential mortality by education, the rank of a degree wouldn't change over time. In fact, individuals do continue their formal educations over the course of their life, and the percentage who do so is increasing. For someone who turned 21 in 1940, 12 years of education would place them at the 71st percentile; 10 years later, if they obtained no further education, they would be at the 67th percentile. For 21 year-olds in 1960, a diploma places them at the 56th percentile; the continuing education of their peers would drop the rank of a high school diploma to the 51st percentile after a decade. For a 21 year-old in 1980, a high school education would locate them at the 39th percentile, falling to the 29th percentile after 10 years. For each of these cohorts, the relative rank represented by a given level of education, relative to others in their cohort, continues to decline moderately in subsequent decades as well.

Anecdotally, these examples suggest that the association of age and educational levels require attention to age effects when contrasting educational strata. They also suggest that, *if we are interested in the effects of education as a ranking mechanism*, treating a particular credential or level of education as equivalent regardless of the age of the people or period under examination is seriously flawed. The fashion in which the effects of education would be misstated are sketched out above: higher levels of education consistently increased over time, and will reflect lower relative rankings the more recent the period and the more youthful the age group under consideration. The following three sections will 1) flesh out the rank of selected educational levels and how they change by age and period; 2) identify a method to readjust educational levels to a common rank-based metric, and; 3) compare trends in selected characteristics -- household structure, marital status, employment, and income -- over time using both nominal and rank-based educational measures. Ultimately, the choice of what best represents the construct an analyst uses is driven by their theoretical conception of education. However, this last section provides the empirical basis for deciding whether alternate metrics for education would substantially change trends in characteristics by educational level in the latter half of the century.

II Age, Education, and Ranks of Educational Levels, 1940-1990

This section attempts to lay out in more detail *who* is included when contrasting persons with differing educational levels or following an educational category over time. Table 1 identifies the median age of adults at selected educational levels, and how the median ages of those groups have changed in the last half century. Although median age only indicates the central tendency, two points are clear: 1) In any given year, individuals in different educational groups are located at different points in their life cycle, and 2) particularly among those at the lower end of the educational scale, the same educational level is reflective of different point in the life cycle as well.

Table 1

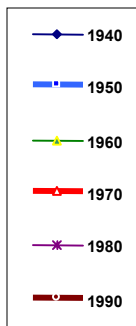
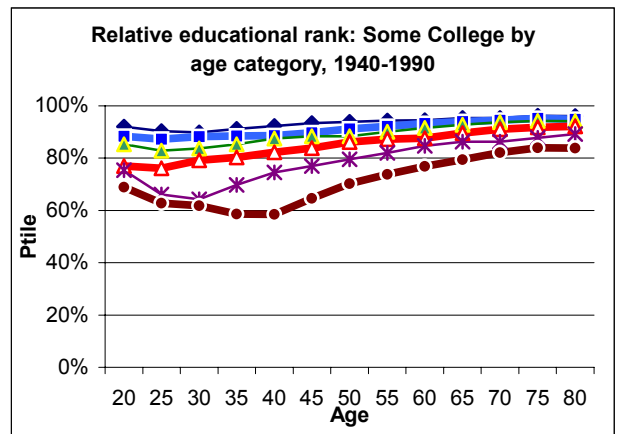
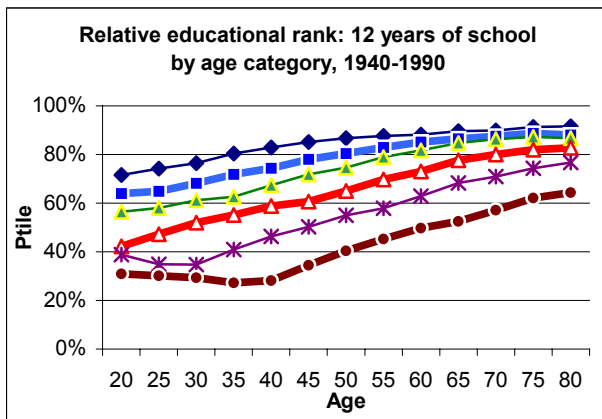
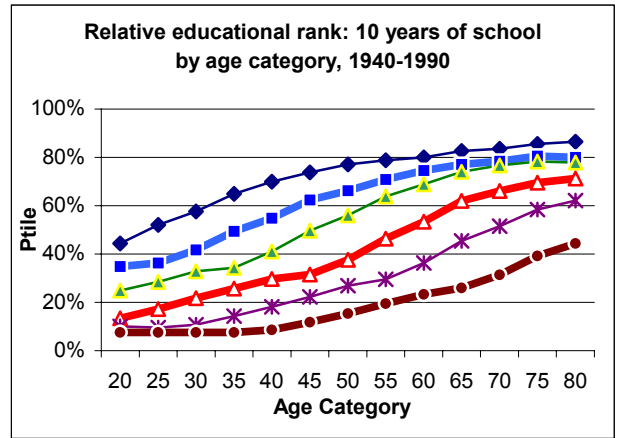
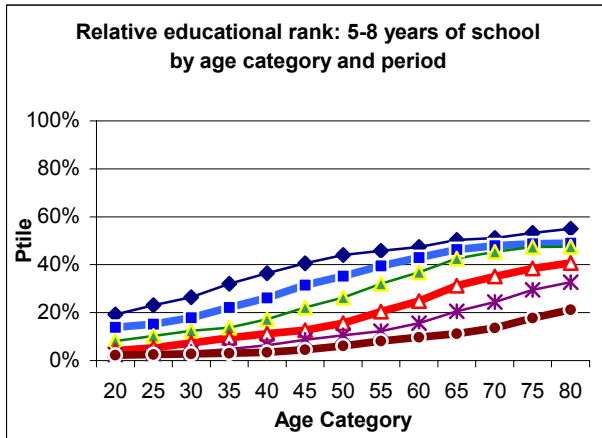
Census Year	Median Age			
	< HS Graduate	HS Graduate	Some College	4+ yrs College
1940	41	29	33	37
1950	44	32	34	39
1960	48	35	37	38
1970	50	36	32	39
1980	52	36	32	36
1990	51	40	35	39

At first blush, it may seem that controlling for age – limiting comparisons to those in the same age group – would address these problems. Because of the growth in education, though, even within the same age group an educational credential will place a person at different points in a hierarchy in different decades.

Figure 1 on the next page shows how the rank of 4 selected educational levels has differed by age between 1940 and 1990. In each year, individuals within an age group (e.g. 20-24, 25-29, 30-34, etc..) were ranked from high to low based on 9 educational categories. The average rank (from 1 to 100) for that educational level for that age in each year were calculated and plotted. The figures illustrate which educational levels have shifted the most in terms of their relative rank over time, what age groups are most affected by those changes, and in what years the rank for particular educational levels differ most by age group.

The *educational categories* that shift the greatest distance are the 9th, 10th, and 11th grades (grade 10 is displayed in Figure 1), which dropped about 60 points between 1940 and 1990 in the age groups from 35 to 60. In 1940, individuals in these age groups who had pursued their educations that far were ranked between the 60th and 80th percentiles – not in the top tier, but comfortably above average. By 1990, the same level of education placed them in the bottom quarter. The top of the educational hierarchy – those with a BA or more – shift much more modestly, dropping by about 6 points on average between 1940 and 1990. Those at the bottom also experience more modest shifts, declining by 2 points for those with no education, 8 point for those ending their educational careers in elementary school, and 25 points for those with 5-8 years of education.

Figure 1: Relative Rank for Selected Educational Levels, 1940-1990



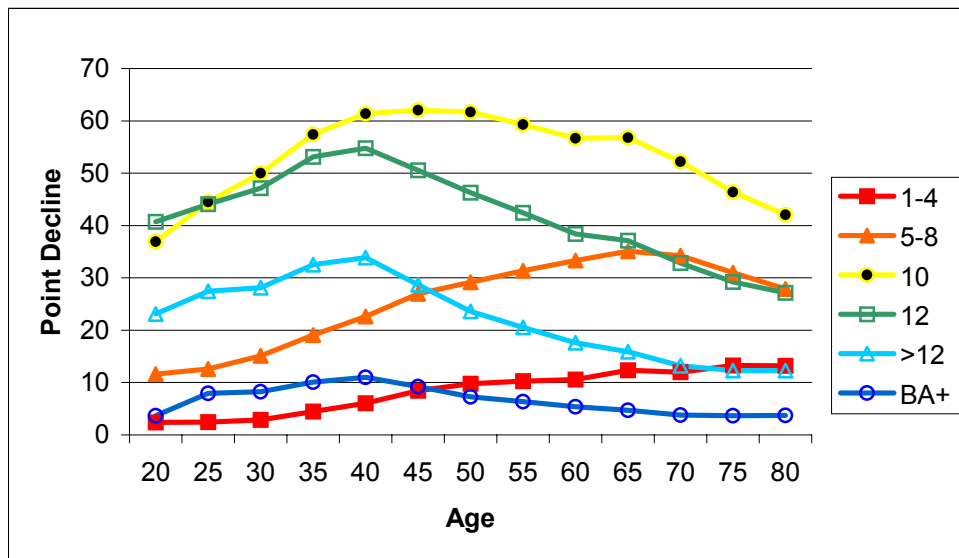
In each census year from 1940-1990, individuals from the Integrated Public Use Microdata Samples were grouped into 5 year age groups and ranked from most educated to least educated using 9 educational levels (no schooling, grades 1-4, grades 5-8, grades 9, 10, 11, and 12, some college, and 4 or more years of college). The rank of the person in the middle of each educational category was determined separately for each age group and year, and those ranks are plotted for each census year (the lines) by the age groups (on x axis).

For each line, the greater the difference between the first point and the last point, the more the rank of an educational level differs by age in that census year.

For each age group on the x axis, the greater the distance between the top line and the bottom line, the more the rank that educational level has declined between 1940 and 1990

Figure 2 provides more detail about the *age groups* most strongly affected by decline in educational rankings and the educational categories associated with the greatest age-specific declines between 1940 and 1990. The point decline is the simple difference between the age-specific ranking of the selected educational levels in 1940 and the ranking in 1990. It indicates that, while the *incomplete high school* level uniformly experiences the greatest declines, lower educational levels also drop substantially particularly among the older ages, and higher educational level drop significantly, particularly among the young.

Figure 2. Point decline in rank of selected educational levels between 1940 and 1990, by age group



III Adjusting Educational Levels to Reflect Changing Distributions.

In an analytic setting using continuous measures of education to adjust trends in the association between education and other characteristics (e.g. income, employment, or fertility), incorporating changes in the relative ranks for educational categories would be straightforward. When contrasting discrete groups (e.g. those with a college degree vs those with only an elementary school education), adjustments are less straightforward. In order to create discrete groups while maintaining fixed rankings, the most obvious approach is to break sample into education quintiles or deciles, as is common with measures like income.

Education, however, is a much “lumpier” measure than income -- some educational levels, like “high school diploma” in recent years or “5-8 years of schooling” at mid-century, are held by more than a third of the population. As a result, particular educational levels cannot be coded entirely into a particular percentile-based strata. An approach which relies on splitting and reweighting cases can be used instead, however. Educational classes which span strata are proportionally split among those strata.

For example, among 30-34 years-olds in 1990, individuals with a high school education span the range from the 48th percentile to the 78th percentile. To assign these cases to quintile strata, we can assume that any particular individual with a diploma is equally likely to fall into any of the percentiles from 48 to 78; they thus have a 0% chance of being in the lowest two quintiles, have a 40% chance of falling into the middle quintile, a 60% of falling into the next highest quintile, and a 0% chance of falling into the highest quintile. Each such individual, subsequently, can be split into two cases: one weighted at 40% of the original weight and assigned to the middle quintile, and one weighted at 60% of the original weight and assigned to the next highest strata.

Using the IPUMS samples from 1940 thru 1990, upper and lower percentile bounds for each of 9 educational levels were identified for individual in each single year of age classes in each of the decennial census years. Individuals under 18 were excluded from the sample. The upper and lower bounds in each year were then smoothed across adjacent age groups using a 4 year running average to decrease random variation in the location of the bounds. Based on the calculated upper and lower bounds, three percentile classes were established: a bottom quartile, a top quartile, and the intervening range from the 25th to the 75th percentile. Individuals in educational classes that did not completely lie within one of these strata were split into two cases, one for each of the strata that their credentials placed them in, and weights for the new cases adjusted to reflect the degree of overlap.

This method provides the ability to track trends in characteristics for the top and bottom of the educational hierarchy, defined in terms of their ranking relative to those of the same age in the same year. Figure 3, below, identifies the educational categories associated with each of these strata over time for selected age groups. The following section tracks trends in a number of characteristics using these strata and contrasts the results with those found using traditional educational categories.

IV Trends in Characteristics Using Alternate Educational Measures

Figures 4, 5, 6, and 7 contrast trends between 1940 and 1990 in marital status, household structure, labor force participation and occupation, and income using two measures of educational achievement. The first measure distinguishes between individuals with less than a high school education, from those who completed high school, obtained some post-secondary education, and completed a 4 year college degree. The second divides individuals into three groups as described above, ranked on their educational achievements relative to those born in the same year. Because the characteristics that we contrast by education, however measured, are strongly life-cycle related, both the trends and comparisons are restricted to selected age groups.

Marital Status

In the marital status figure, trends in the percent never-married among young adults (18-29), percent divorced among early middle aged-adults (30-44), and percent widowed among the elderly (65+), are shown. The general patterns of trends does not differ markedly by which educational metric is used. A couple of differences are worth noting,

however. Among the young, those who did not finish high school appear to have, since 1960, overtaken those with an HS degree or some college in terms of percent never married, and the gap in percent never-married to have narrowed in recent years. Using the relative rankings, the least educated trail those with more education in all years, and no secular trend in gap is apparent. Nor does percent never married increase monotonically with increasing educational credentials for this age group as a whole: those with some college are more likely to be never-married than either those with a BA+ or those with only an HS degree. This inconsistent association is due both to incomplete controls on age (since there is still an 11 year age range under consideration, during which both substantial changes in education and marital status occur) and staging of life course events (i.e. if getting married is seen as a sequel to completing one's education, those with a terminal HS degree and those with a terminal BA would be at higher risk for married than those in the process of completing a college degree). The former explanation would argue for using a relative ranking, while the latter would favor a credential oriented measure.

Virtually no differences between the two measures are found in % divorced among the next oldest age group, but differences appear again in rates of widowhood among the aged. The credential based measure suggests much larger gaps between the most and least educated, and little in the way of secular declines in widowhood for the least and most educated. The rank-based measure suggests a much narrower gap at mid-century, increasing over time, and showing substantial declines in widowhood among the upper-quartile of education. A reasonable story can be built around either set of trends, but the relative ranking seems more compelling. Those with a BA or more in this age group represent an elite: in 1940, only 2.5 % of this population had a BA, increasing gradually to 10% in 1990. The "flatness" of the trend seems to be more easily interpreted as a watering down of the eliteness, particularly in view of overall declines in widowhood over this time.

Household Structure

Marital status is only one of several vital events which drive household structure. The next set of tables looks at selected modes of household structure, comparing rates of single parenthood among the young, nuclear families among the early middle-aged, and "empty nests" among the older middle-aged.

The two educational measures provide much more similar stories for household structure than for marital status. Among young adults, both measures suggest a steadily declining likelihood of living in a single parent household as education increases in recent years, but little differentiation by education in earlier years. The *degree* to which the most and least educated diverge over time differs, but the patterns are consistent.

In the next age group, the two measures also provide a consistent story: the proportion of persons in households with two parents and children grew from slightly over 50 percent in 1940 to peaks in the 1970's, and declined through the next decades. The least educated were less likely than the better educated to live in such households, and little distinction exists between the moderately and well educated population. Declines appear larger for

the least educated when that group is identified as those without a diploma rather than as the bottom 25% of the educational tier, but the differences are relatively minor.

Among 45-64 year-olds, the percent living as married couples without children or other relatives grew fairly rapidly between 1940 and 1950, and continued to grow as a much reduced pace for all but the least educated through 1990. The pattern of change is the same, regardless of educational measure used, but the degree of differentiation by educational levels appears higher using the relative scale, rather than the credential scale. (This is because finer gradations in years of schooling at the “less than HS” level are incorporated into the relative scale, but folded together in the credential-based scale.)

Labor Force and Occupational Status

Rather than looking across different age groups, as in the previous comparisons, these comparisons focus on adult men age 30-44; this group is the most likely to be employed and to have completed their educations, and least affected by changes in retirement age. The three comparisons look at, respectively, the likelihood that a man will be in the labor force (working or looking for a job), unemployed (in the labor force, but not working), or employed in a “Professional I” (architects, professors, doctors, and similarly credentialed salaried professionals) occupation.

For all of the characteristics, the percent with a characteristic are consistently ordered by education and, for the first two, the trends over time are consistent using either educational measure. The degree by which labor force characteristics differ by education in recent years are more muted using the relative measure rather than the credential based, but the story is substantively the same.

For the last characteristic, the percent in a “Professional I” occupation, the credential measure suggests a decline in percent of men with a BA or more in these occupations over time, while the relative measure suggests that men in the upper educational quartile are increasing employed in such occupations. Both educational measures indicate that about 20% of the highly educated find employment in these occupations in recent years (in which about 25% of men in the age group have a BA or more); they differ in early years. In those early years, the upper quartile is more likely to include those with only “some college” or a high school degree (it is not until 1970 that the upper quartile does not include men who earned only an HS diploma), and the proportion of upper-quartile men in these professional occupations are much lower.

Both measures tell a story: the credential measure says that men who earn a BA are increasingly less likely to find or choose employment in a PI occupation; while the relative measure says that men are increasingly likely to be employed in a PI occupation if they are more educated than their peers.

Income

The last characteristic shown, income, is median value of the entire family’s income, converted to 1999 dollars using the CPI UX, and adjusted to reflect economies of scale

by dividing the result by the square root of the family's size. This adjusted family income is a measure of standard of living, and comparisons of the two educational measures are shown for three age groups.

Both educational measures provide consistent results in terms of trends, with a much smaller spread of income by education in 1940, fanning out from 1970 onward. Gains in standard of living are concentrated among the better educated, regardless of how that groups is defined. The credential based measure does tend to suggest slightly greater declines in the fortunes of the less educated, particularly among 30-44 year-olds, but agree in both trends and timing among the other age groups.

Summary/Conclusions

The intent of this memo was to address three questions: does it make a difference in our analyses whether we define education in relative or absolute terms? If it does make a difference, for whom, for what characteristics, and why do results differ? For those analyses in which differences are apparent, which measure is better?

The examples chosen to contrast the two measures were neither random nor representative: many characteristics for which no differences emerged are not shown. Those cases predominate, and (by-and-large) the answer to the first question is that differences tend to be relatively small. However, those cases in which the two measures differ help to highlight answer to the second question.

The assumption that the relative measure reflects education appropriately relies on there being a consistent association between more years of education and the characteristic being examined. In some cases, this simply isn't true. As the comparison of never married showed, the timing of life cycle events for individuals on different educational trajectories can lead to non-linear associations. The same comparison also showed, however, that the relatively broad age categories used can obscure real trends: finer age groupings show the linear association holds true for the older individuals in that broad age group. The remaining comparisons suggest that when differences emerge, they tend to be among the older groups who are highly educated or among the poorly educated early middle-aged groups. These are both groups in which an educational class moved to or from the extreme margins of the educational hierarchy.

Which measure is better? While largely a judgment call, the credential based categories have the advantage of being easily interpretable and explainable, and require no additional transformations of data. They also tend to be suggestive of causal mechanisms in many circumstances (e.g. the relevance of credentials in professional occupations, or the life cycle timing of demographic events). Circumstances in which the relative measures seem preferable are when the sorting effects of education seem distant and linkages to particular credentials are weak (e.g. widowhood among the aged) or when use of an absolute credential might imply greater marginalization than may be true (e.g. unemployment rates or income for those without a HS diploma). The latter concerns are probably equally well addressed simply by remaining cognizant of the changes brought on by the expansion of education during the century when interpreting education based analyses.

Figure 4. Marital Status by Education, Selected Ages, 1940-1990

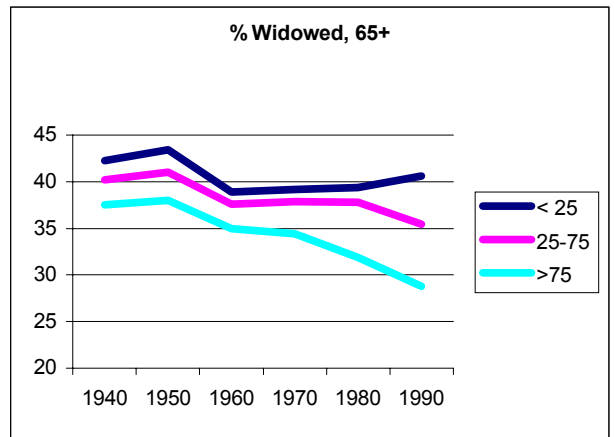
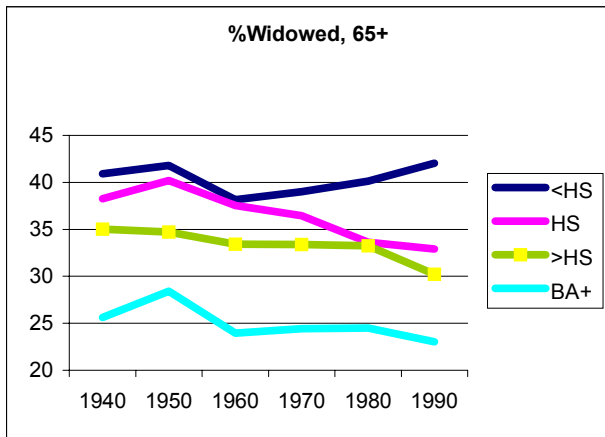
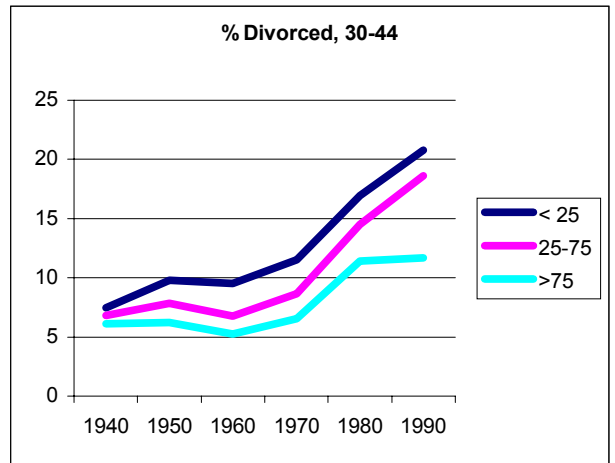
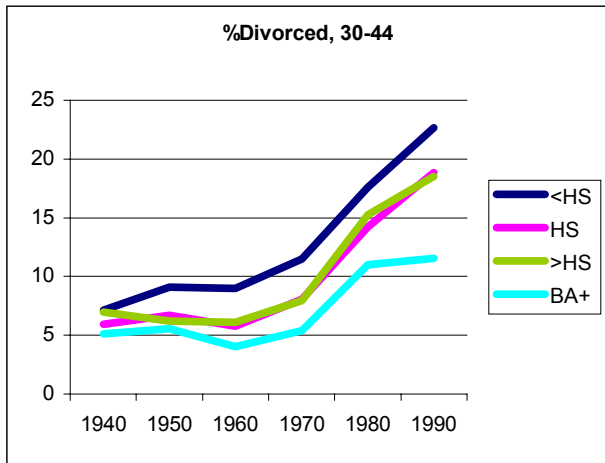
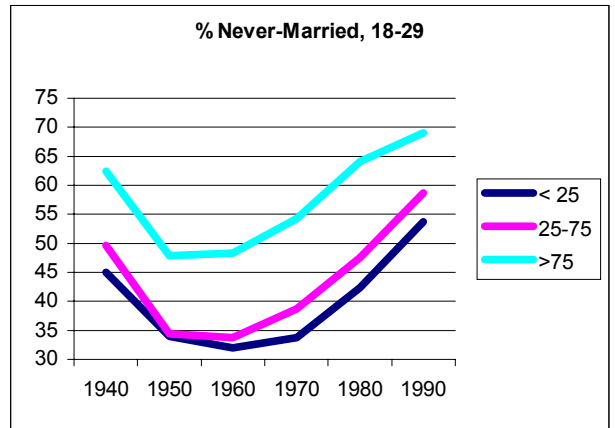
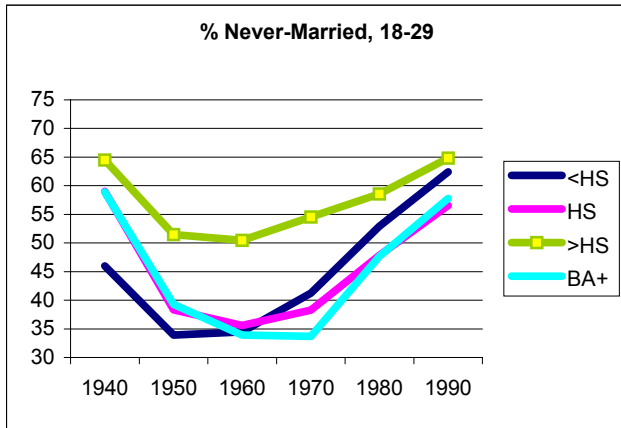


Figure 5. Household Type by Education, Selected Ages, 1940-1990

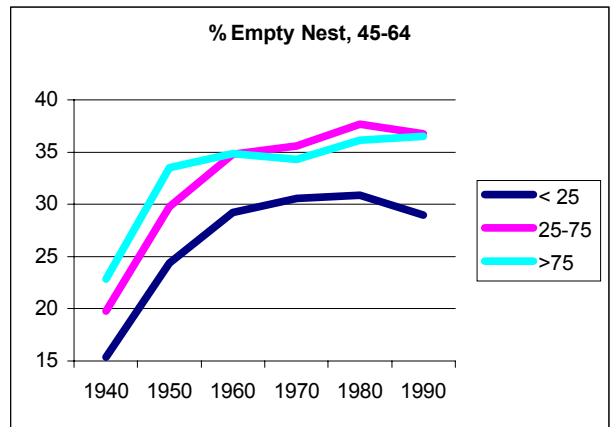
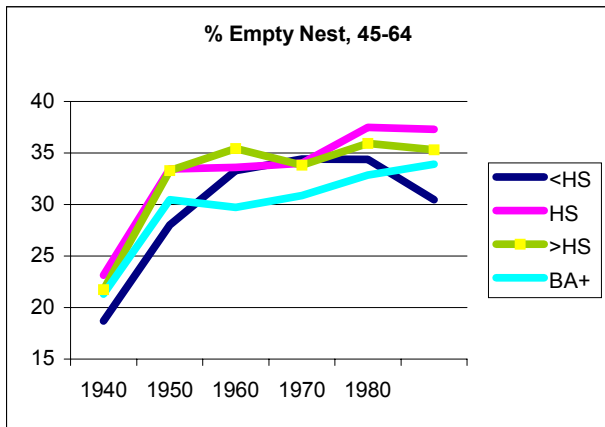
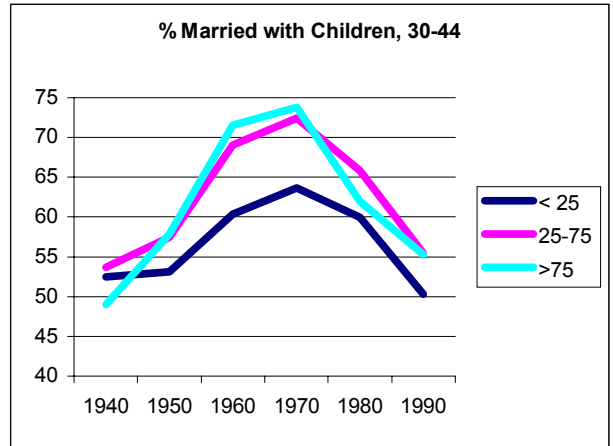
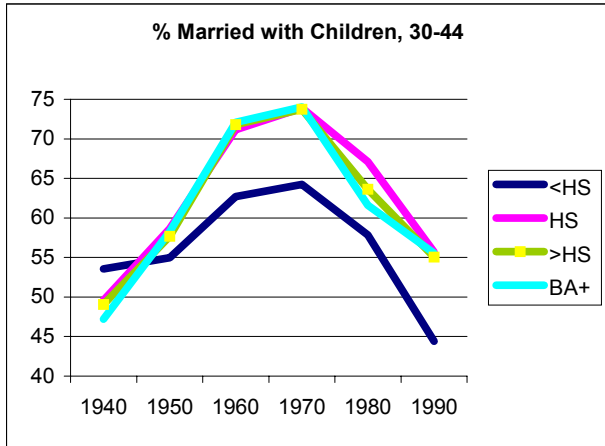
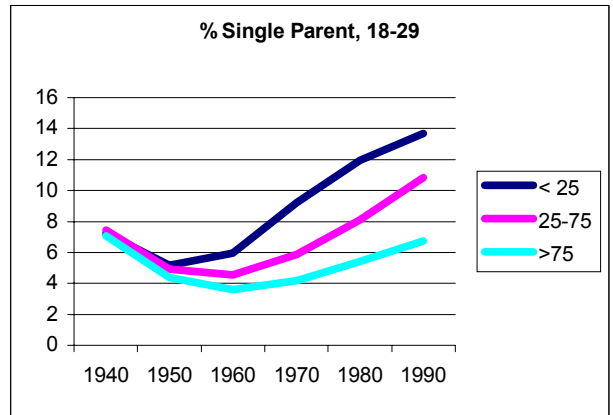
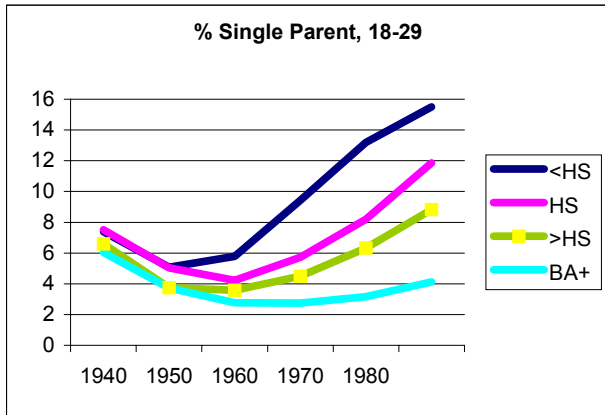


Figure 6. Labor Force and Occupational Status by Education, Selected Ages, 1940-1990

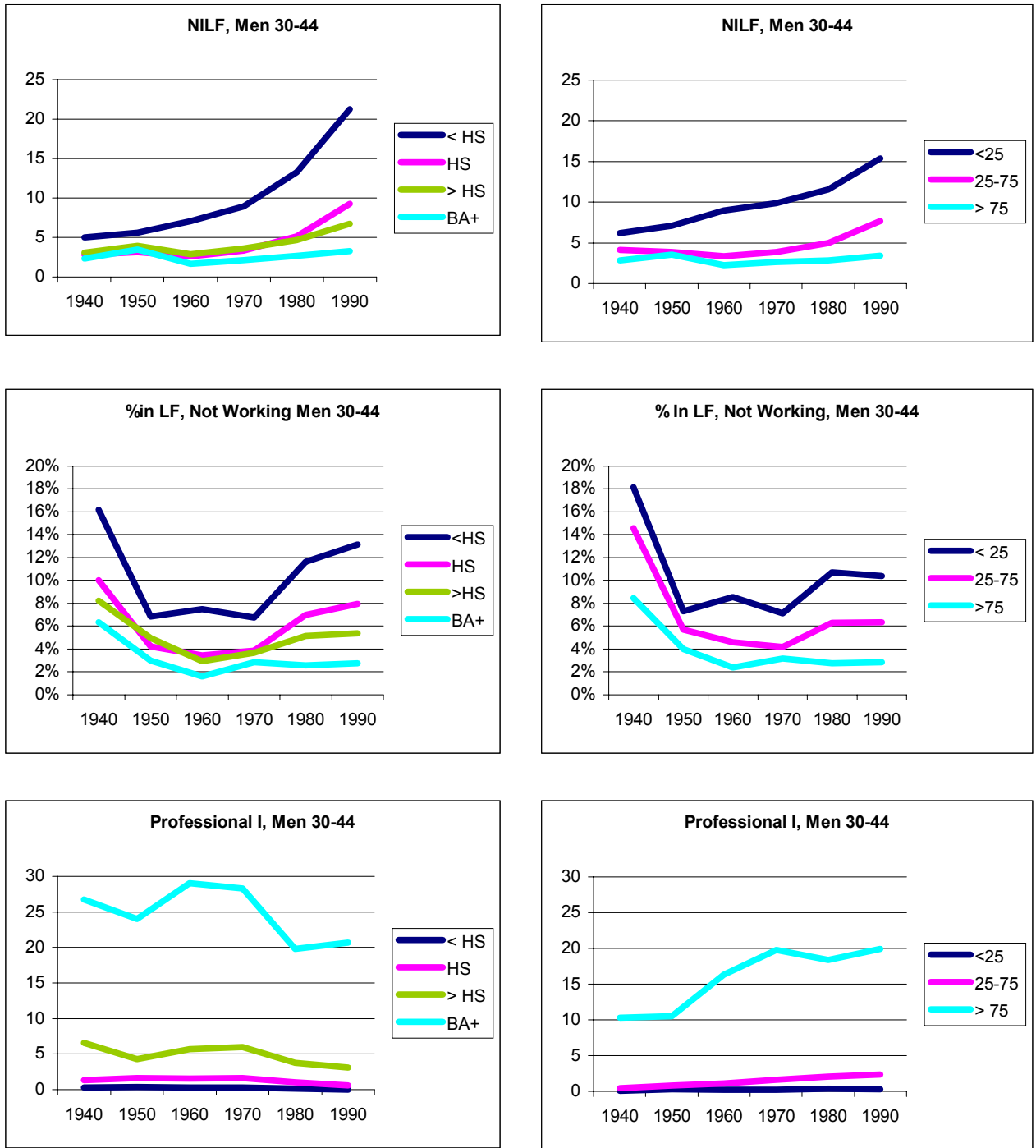


Figure 7. Median Adjusted Family Income by Education, Selected Ages, 1940-1990

