Work in progress - do not quote

Assortative Mating and Inequality

Draft of extended abstract for kind consideration for the 2018 conference for Swedish economists.

NOTE: Highly incomplete draft!

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We analyze mating patterns, their changes, and their consequences for both current and future inequality using continuous and time-consistent measures of productive abilities. Contrary to related work based on data on educational attainment, we find that the mating market has become more selective along both the extensive and intensive margin for recent cohorts. The contribution of this increase to overall household inequality in productive abilities is small, however. Our estimates show that productive abilities are transmitted to the same extent from mothers and fathers. Parental abilities are found to be substitutes rather than complements in the production of child abilities, which tends to mute the impact of assortative mating on the ability distribution among children.

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1 Introduction

The decisions if and with whom to mate are arguably among the most important consumption and investment decisions that an individual makes. The patterns of family formation that emerge from these decisions are non-random and generally display a substantial degree of positive assortative mating, which has implications for the between household inequality in economic, intellectual, and cultural resource availability.[1] Through the intergenerational transmission of resources, abilities, and attitudes, mating patterns also affect inequalities in future generations.[2] In this study, we describe how men and women sort in the mating market with respect to productive abilities and how this has evolved over forty Swedish cohorts with completed fertility. We analyze the implications of these sorting patterns for inequality within the mating generations, as well for future generations by estimating actual intergenerational linkages. Most studies that precede our work base their analysis on indicators of educational attainment.[3] Describing trends in educational assortative mating in this way is sensitive to the precise definition of educational groups and to changes in the underlying distributions of educational attainment (Gihleb and Lang, 2016). By construction, such measures also do not capture within-group sorting. Our analysis builds on encompassing measures of productive abilities that are continuous and consistent over time, and thus avoids these shortcomings.

[1] Pearson (1903) documented a positive correlation in physical attributes between spouses. Assortative mating has since been documented for a wide range of traits and characteristics, among them personality and social attitudes (Eaves et al, 1999), risk and trust attitudes (Dohmen et al, 2012), IQ (Keller et al, 2013), and genomes (Robinson et al, 2017). Assortative mating in social attributes such as education is particularly strong: Björklund (1992) found the correlation in years of schooling among Swedish couples to be 0.68 in 1981, and Blossfeld and Timm (2003) report similar levels for a range of developed countries. Nakosteen et al (2004) report spousal correlations in log earnings between 0.15-0.2 both pre and post marriage for Swedish couples married in the mid 1990's. While still positive, these correlations are reduced substantially after residualizing earnings by educational attainment. Recent work by Frémeaux and Lefranc (2017) find correlations between French spouses ranging from 0.3 to 0.6 for various socio-economic attributes.

[2] Becker and Tomes (1979, 1986) present a theory of the intergenerational transmission of income. Black and Devereux (2011) and Corack (2013) survey of the literature of intergenerational transmissions. Much of the empirical research on social mobility has focused on the role of fathers, but Beller (2009) and Grönqvist et al (2017) show that mothers also matter. Kremer (1997), Fernandez and Rogerson (2001), and Bowels and Gintis (2002) discuss the role of assortative mating for inequality over generations. Chadwick and Solon (2002) and Ermisch et al (2006) show that assortative mating is an important determinant of intergenerational income persistence for the US, UK, and Germany.

[3] An increase in the proportion of US couples sharing the same level of educational attainment (educational homogamy) has been well documented (e.g. Mare, 1991; Pencavel, 1998; Schwartz and Mare, 2005; Schwartz, 2015). Conley et al (2016) find an increased correlation in educational attainment between US spouses born 1920-1955, but no increase in the correlation for genotypes linked to educational attainment. Mare (2016) show that educational homogamy decreased among young US couples until the mid-1950's and increased thereafter. Henz and Jonsson (2003) document broadly similar patterns for Sweden. Eika et al (2017) find increases in educational homogamy, but only minor changes in educational assortative mating over the last decades in Denmark, Norway, Germany, the UK, and the US. They also show that these changes have contributed little to changes in household income inequality. Breen and Salazar (2010, 2011), Greenwood et al (2014), Gihleb and Lang (2016), and Hryskho et al (2017) reach a similar conclusions using different datasets, time-periods, and methodological approaches. Breen and Andersen (2012) report that changes in the distributions of educational attainment can explain their result that educational assortative mating contributed to income inequality between, but not within cohorts, in Denmark 1987-2006.

Broad social developments give reasons to hypothesize that the mating market has become more selective and that assortative mating has increased.[4] As stressed by Greenwood et al (2005), advancements in household technologies have reduced the time needed for domestic chores, thereby freeing up time for market work, leisure, and investment in children. Stephenson and Wolfers (2007) argue that this is likely to result in less within-household specialization and a greater propensity to form households based on preferences for household public goods. Since such preferences are likely to overlap more among individuals with similar traits and characteristics, increased assortative mating is a likely outcome. Increased income inequality, as well as improved labor market opportunities for women, can have similar effects on the selectivity of the mating market, since it increases the relative payoff of mating on traits and characteristics related to market productivity.[5] These notions are formalized in Chiappori et al (2017), where the household public good is modelled as the wellbeing of children. Within this framework, both improvements in household technology and increased income inequality will result in a higher degree of assortative mating. According to standard economic theory on intergenerational income inequality, increased assortative mating generates higher inequality in the following generation (Becker and Tomes, 1979, 1986). The persistence in income inequality across multiple generations is higher than predicted by this theory, however, and models where latent factors are transmitted from parents to children fit the data better (Clark and Cummins, 2015; Braun and Stuhler, 2017).[6] Such latent factors models are also close to the spirit of our approach.

Specifically, we address the following questions within a unified empirical framework: i) To what extent do men and women mate with respect to their productive abilities? ii) Have mating patterns with respect to productive abilities changed over time? iii) What

[4] In the standard economic framework, assortative mating arise when spousal characteristics are complements rather than substitutes for the joint utility of spouses (e.g. Becker, 1993: Lam, 1988; Browning et al, 2013).

[5] The impact of income inequality on assortative mating is modelled by Fernandez et al, (2005) while Greenwood et al (2016) considers this jointly with progress in household technology. GENERAL REFECENCE to increase in income inequality. SOME SWEDISH NUMBERS. Goldin (2014) and Blau and Kahn (2017) survey the changes in labor market opportunities for women. Changes in various in-group biases due to modernization, geographic mobility, and in search technology are some other plausible factors that could affect mating patterns (Kalmijn, 1998; Blossfeld, 2009; Schwartz, 2013). Greenwood et al (2017) provide an extensive economic analysis of how different economic, social, and technological changes affect the marriage market.

[6] Studies of multiple generations typically find that inequality in income and educational attainment is substantially more persistent across generations than predicted by the Becker-Tomes model. See Lindahl et al. (2015) and Hällsten and Pfeffer (2017) for evidence from Sweden, and Solon (2017) for a survey of the larger literature. Evidence provided by Braun and Stuhler (2017) show that theories based on the transmission of latent income generating factors better explain these findings than theories where, for example, grandparents have a direct impact on child income (Mare, 2011).

are the consequences of mating patterns for household inequality? iv) What are the consequences of mating patterns for the distribution of productive abilities in the next generation? We do this by using two different encompassing measures of "earnings ability". For cohorts born 1951-1970, earnings ability is based on a combined measure of cognitive and non-cognitive abilities from the compulsory Swedish military enlistment. Since only males underwent the enlistment, we apply the IV-approach presented in Grönqvist et al (2017) and use enlistment tests of brothers to derive ability measures for both genders while simultaneously correcting for measurement error. For cohorts born 1930-1970, we use a similar approach but then use brotherly earnings to derive earnings ability. For the cohorts that overlap, the two approaches yield similar results. The measures we derive are continuous and comparable over time, across men and women, and generations. We thereby avoid the problem that mating patterns such as assortative mating are often studied using measures of educational attainment that are categorical and sensitive to potentially gender-specific changes in the underlying ability distributions.[7] The measures we employ are also unlikely to be endogenous to mating decisions or mating considerations.[8]

Among men, we find that the likelihood of mating (the extensive margin) is increasing sharply in earnings ability, but just up until 0.5 standard deviations above the mean. As ability increases above this level, the mating probability is unchanged. Among women, the mating probability is almost flat throughout the ability distributions. Among couples who mate (the intensive margin), we find a high degree of assortative mating that persists – albeit somewhat muted – after residualizing on educational attainment. The sorting that occurs within educational categories is thus non-trivial and studies that rely on educational attainment to measure assortative mating do not capture this component. When analyzing cohort trends, we find that the mating market became less selective both

[7] Our measures of productive ability are in spirit close to the measures of predicted earnings used by Gihleb and Lang (2016) and Gonalons-Pons and Schwartz (2017). While more detailed than standard measures of educational attainment, such measures still rely heavily on categorical data.

[8] That labor-supply decisions and the marriage market interactions are closely related is central in models of the marriage market (e.g. Becker, 1993; Browning et al, 2013). Using actual income or earnings to measure the degree of assortative mating is therefore questionable. Raaum et al (2007) show that the relation between labor-supply decisions and assortative mating differs substantially between countries, mainly due to differing behavior among women. That the relation may also differ over time is supported by Gonalons-Pons and Schwartz (2017) who find an increased correlation in actual earnings between US spouses US between 1970 and 2013, while the correlation in predicted earnings remained constant. Bredemeister and Juessen (2013) attribute changes in female hours worked across their husbands' wage distribution in the US to changes in assortative mating. Relatedly, Pestel (2017) find differing time-trends in the relation between assortative mating and labor-supply between East and West Germany since reunification.

with respect to the extensive and the intensive margin among cohorts born up until 1955. This trend is reversed for later born cohorts. Without making claims regarding causality, this pattern follows that of cohort-level income inequality closely.

We next compare actual patterns of household inequality in earnings ability to those of two simulated scenarios; random sorting and perfect assortative mating. The observed household ability distribution turns out to be close to that generated by perfect sorting; moving from observed patterns to perfect assortative mating would increase the Gini measure of inequality from 0.25 to 0.26. Under random sorting, the Gini is 0.19. Given this exercise, it is hardly surprising that the observed trends in assortative mating have only had a minor impact on the household distribution of earnings ability across cohorts.

Our measure of earnings ability is strongly related to actual earnings and more so for men than for women, most likely due to differences in labor supply. Throughout the ability distribution, men's actual earnings are higher if their spouse has a high earnings potential. On the other hand, women have a higher return to their ability if they have a low-productive spouse. The combined impact of these labor supply responses is that assortative mating matters for actual earnings inequality more than predicted by household inequality in earnings ability.

Intergenerational transmission of abilities implies that the degree of assortative mating affects the distribution of abilities in the following generation. Kremer (1997) shows that this impact is unlikely to be substantial, but his result depends on whether parental abilities are complements or substitutes, as well as the fertility rates along the parental ability distributions.[9] Our estimates show that earnings abilities are transmitted to the same extent from mothers and fathers,[10] and to both boys and girls. We further find that parental abilities are substitutes rather than complements in the production of child abilities, which tends to mute the impact of assortative mating on the ability distribution among children. Combining the estimates of ability transmission with actual patterns of fertility rates, we find that the ability distribution in the child generation is **more/less** dispersed compared to the parental generation. When parental abilities have a mean of zero and a standard deviation of one, the mean is X and the standard deviation Y in the

[9] These aspects are discussed by Fernandez et al (200X) who argue that birth rates are higher among less able parents and that parental abilities are complements [CHECK!].
[10] This is in line with Grönqvist et al (2017), where we study the intergenerational transmission of cognitive and non-cognitive abilities.

child generation. The low fertility rates of less able men accounts for the change in the mean. Simulating the ability distribution for the next generation under random parental sorting results in a mean of Y and a standard deviation of X. Perfect assortative mating gives a mean of X and standard deviation of Y. In the simulations behind these results, we assume that the current ability-specific fertility rates also apply in the hypothetical scenarios. Thus our findings are broadly consistent with Kremer (1997); increased assortative mating has a minor impact on the dispersion of abilities in following generations.

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2 Conceptual framework and data

We study how earnings potential or productive ability, X^*, affects outcomes, Y, that could either be fertility or the productive ability of the spouse. The relation between productive ability and earnings are given by the following:

$$w_{it} = X_{it}^{*}\beta_t + u_{it},$$

While the relation between productive ability and the outcome of interest is given by the following:

$$Y_{it} = X_{it}^{*}\beta_t\gamma_t + \varepsilon_{it}$$

In the case of assortative mating, the outcome of interest is the productive ability of the spouse, which is then given by:

$$\rho_{AM} = \frac{cov(X_{it}^{*s}\beta_t, X_{it}^{*}\beta_t)}{\sqrt{V(X_{it}^{*s}\beta_t)V(X_{it}^{*}\beta_t)}} = \frac{cov(X_{it}^{*s}, X_{it}^{*})}{\sqrt{V(X_{it}^{*s})V(X_{it}^{*})}}$$

Measures of productive ability are likely to suffer from measurement error, which gives rise to attenuation bias, which can be substantial. In order to correct for measurement error, we use ability measures of brothers as an instrument. This relies on the assumption that individuals do not directly mate on brother-in-law's abilities. This assumption is not innocent, but in Grönqvist et al (2017) we give evidence supporting the exclusion restriction.

Some of our ability measures are available only for men and we thus need to derive measures also for women. Again, we build on our previous work (Grönqvist et al, 2017) and generate measures of women's ability using their brothers. An hypothetical first-stage relation is then given by the following (*w* stands for women and *b* for brother):

$$\hat{X}_{it}^{w} = X_{it}^{wb}\hat{\lambda}_{t}^{w}$$

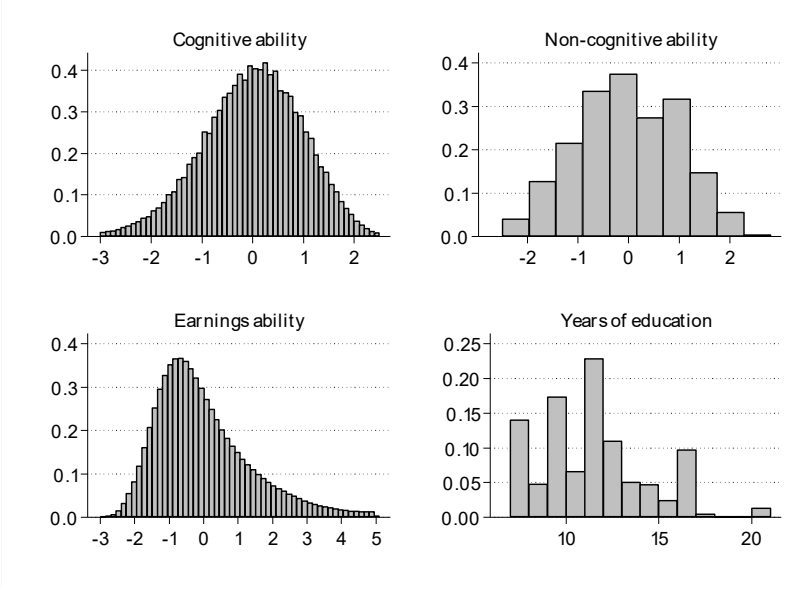
The problem here is of course, that we do not observe abilities for women. Rather, we use the first-stage relation for brothers and use auxiliary data to correct for the somewhat lower correlation in abilities between siblings of different gender. This relies on the assumption that these alternative ability measures are equally good proxies for observed abilities for men and women. Mathematically, we do the following to derive these measures:

$$\hat{X}_{it}^{w} = X_{it}^{wb}\hat{\lambda}_{t}^{m}\frac{\hat{\lambda}_{t}^{w}}{\hat{\lambda}_{t}^{m}} = X_{it}^{wb}\hat{\lambda}_{t}^{m}\frac{\hat{\tilde{\lambda}}_{t}^{w}}{\hat{\tilde{\lambda}}_{t}^{m}}$$

The observed ability correlation between brothers is given by $\hat{\lambda}$, while the correlations in auxiliary abilities are given by $\hat{\tilde{\lambda}}$ for sisters-brothers and $\hat{\tilde{\lambda}}$ for brothers-brothers.

In order to order derive encompassing measures of productive abilities, we use to two different approaches. The first is based on military enlistment data that contains measures of cognitive and non-cognitive abilities. These measures are available for essentially all Swedish men who turned 18 up until the late 1990s. The evaluation of cognitive ability consisted of tests of the conscript's logical, verbal, and spatial abilities, as well as a test of technical comprehension. The measure of non-cognitive abilities is based on a standardized psychological evaluation aimed at determining the conscripts' capacity to fulfill the requirements of military duty and armed combat. Central to this are the abilities to cope with stress and to contribute to group cohesion. The evaluation was performed by a certified psychologist who conducted a structured interview with the conscript. As shown in Lindqvist and Vestman (2011), both the cognitive and non-cognitive tests are strongly related to future labor market outcomes.

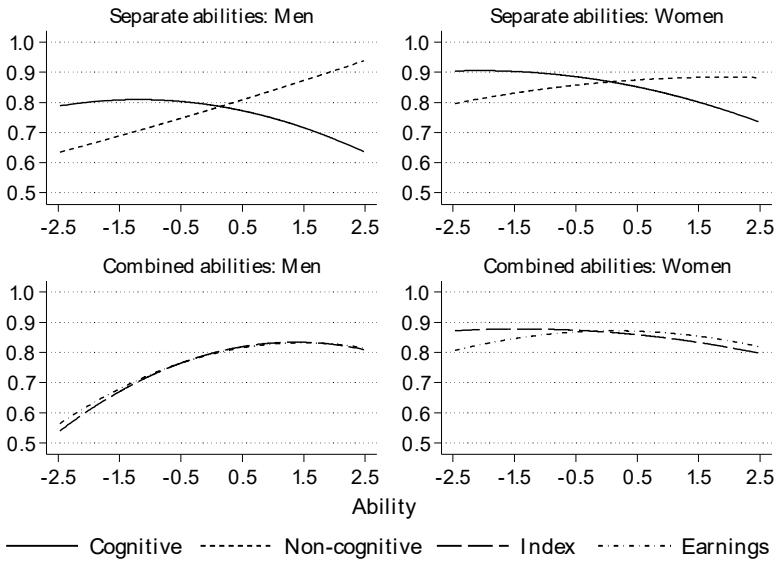
As a second approach, we use actual earnings for brothers as an instrument for earnings. This measure captures all earnings determinants that are shared by brothers. For women, we use the earnings of their brothers and adjust the first-stage relation between brothers according to the procedure discussed above. The below graphs show the distributions of the different ability measures.



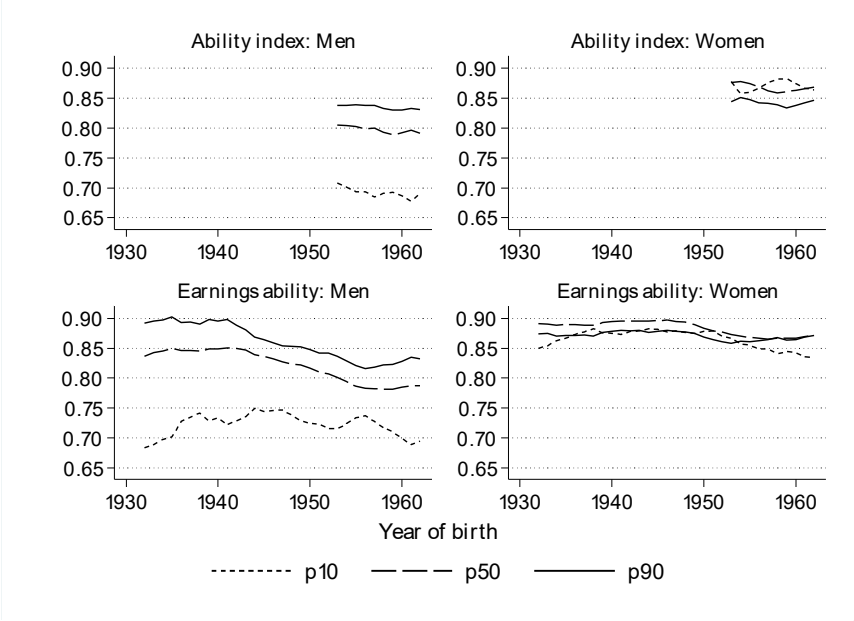
3 Results

3.1 The extenstive margin

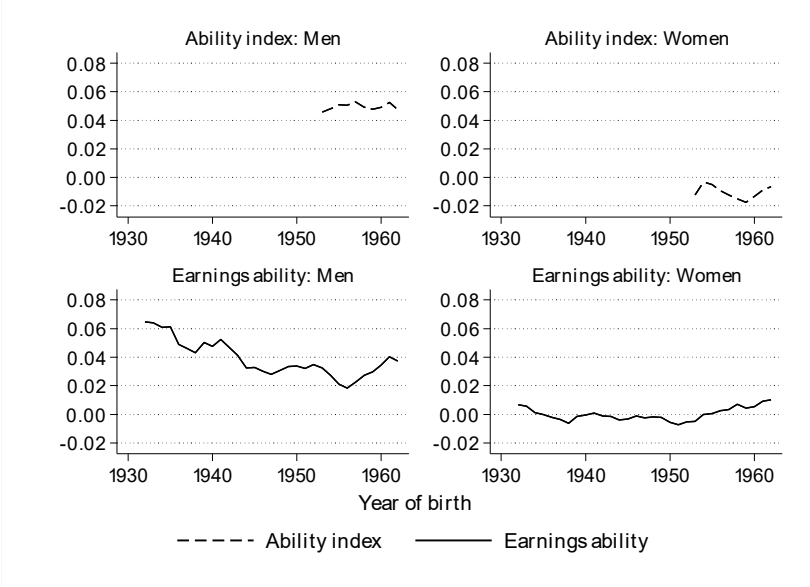
The below graphs document the probability of having at least one child by age for the cohorts born 1951-1964. Most relevant are the graphs for combined abilities, which shows the relation for the combined cognitive and non-cognitive ability index (long dashes) and the earnings measure based on brotherly earnings (short dashes).



In the next figure, we document trends along the extensive fertility margin for individuals in different positions in the ability distributions according to the different ability measures. By using brothers' earnings, we can extend the time period to cohorts born as early as 1932.

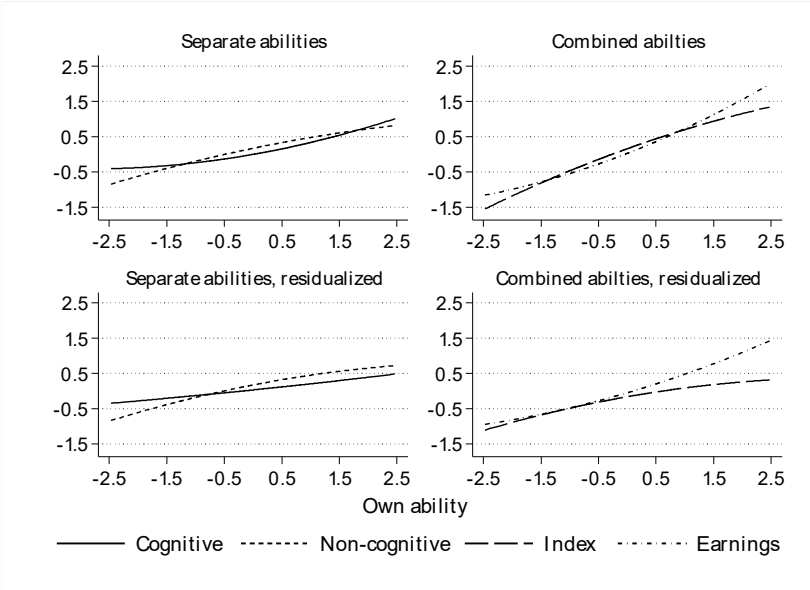


Another way of getting at the selectivity is to study trends in the average ability among those who have at least one child:

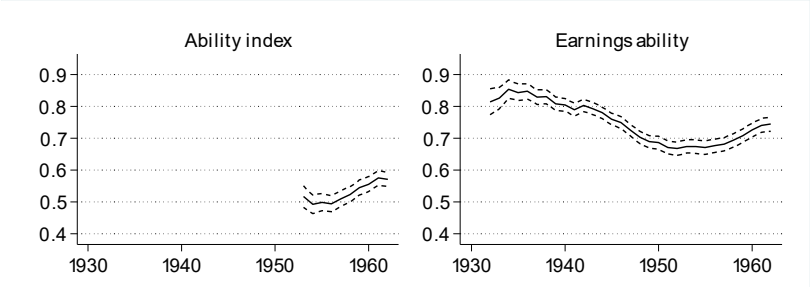


3.2 The intensive margin (assortative mating)

The below figure shows the relation between spousal abilities according to the different measures among cohorts born 1951-1964. In the lower panel, the ability measures are residualized for educational attainment.

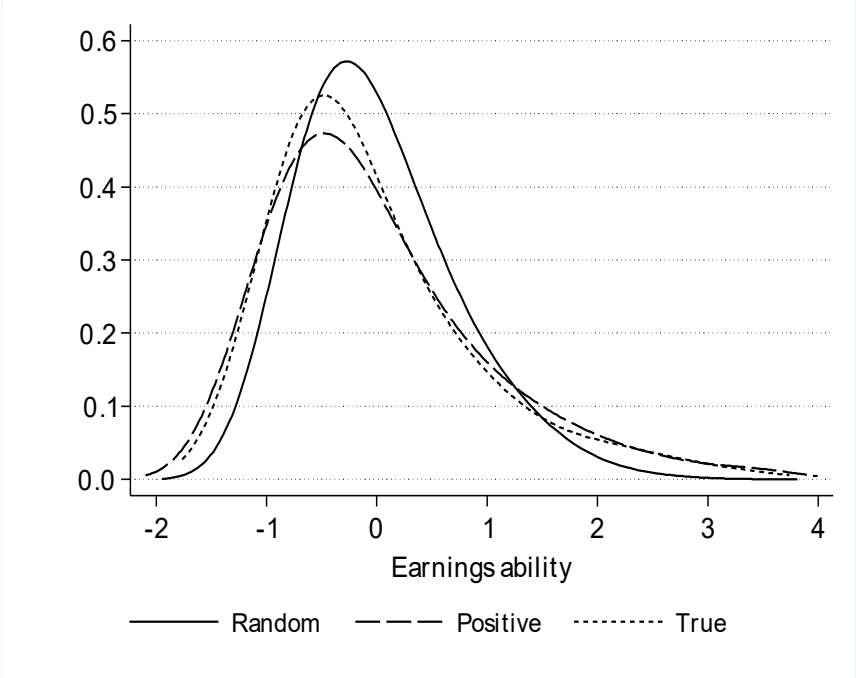


The following figure displays trends in assortative mating according to the different ability measures.

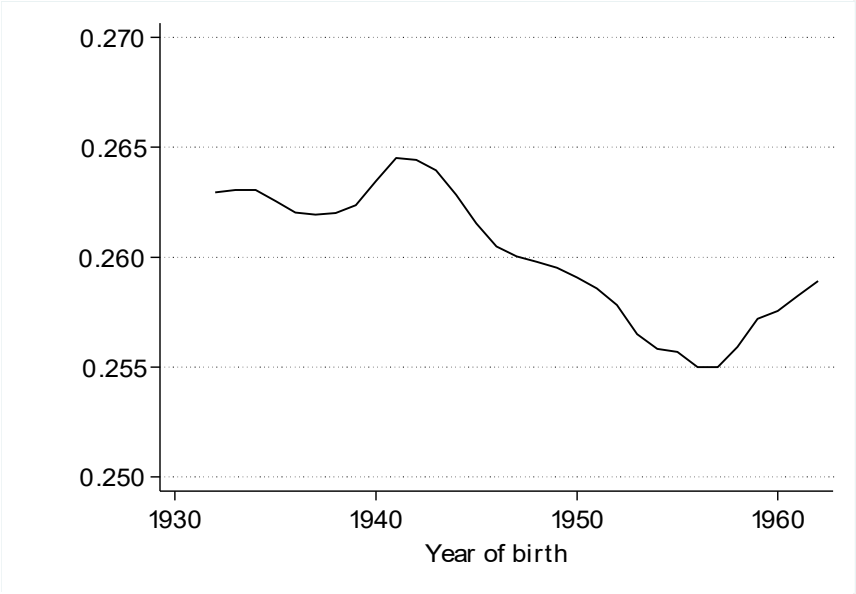


3.3 Household inequality in earnings ability

We derive household inequality in earnings ability under different scenarios: random sorting, actual sorting, and perfect assortative mating. We then see that actual sorting is close to perfect positive assortative mating.



As for trends in household inequality, we derive the Gini coefficient for the different cohorts. While it is clear that there is a trend towards less sorting up until cohorts born in the mid 1950's and that sorting increases thereafter, the impact on the Gini is small.



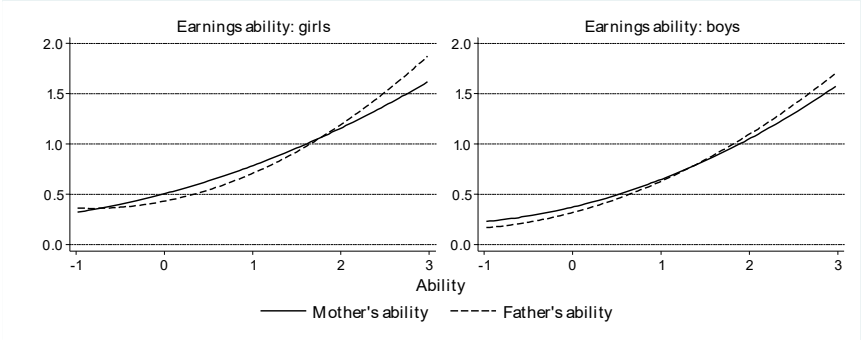
3.4 Earnings and earnings ability

The relation between actual earnings and own earnings ability.

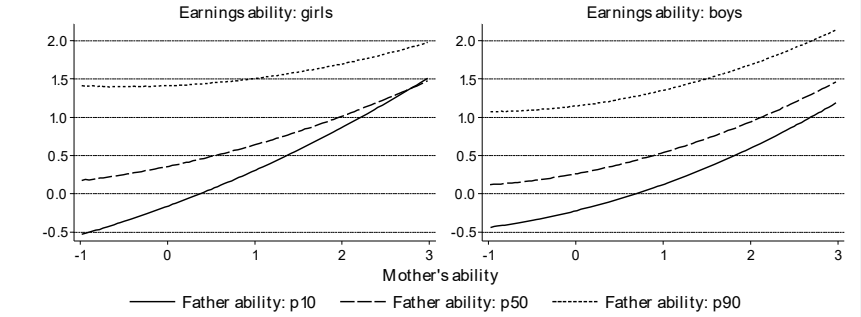
The interaction between own earnings ability and spousal earnings ability.

3.5 The transmission of earnings ability to children

The direct relation between maternal and paternal earnings ability and the earnings ability among children.



The below figure shows that parental abilities are substitutes rather than complements in the transmission of abilities to children



Since we are interested in overall productive abilities, we combine cognitive and non-cognitive abilities to a combined measure based on their weight in a Mincer-type earnings regression.

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