Educational assortative mating – a micro-educational approach

Stefan B. Andrade* and Jens-Peter Thomsen**

*Senior Researcher, MA, PhD, The Danish Center for Social Science Research (VIVE),
Herluf Trolles Gade 11, DK-1052 Copenhagen, sba@vive.dk

** Corresponding author. Senior Researcher, MA, PhD, The Danish Center for Social
Science Research (VIVE), Herluf Trolles Gade 11, DK-1052 Copenhagen, jpt@vive.dk

THIS PAPER IS PUBLISHED IN:

BRITISH JOURNAL OF SOCIOLOGY, online first, November 8, 2018.

Link: <https://doi.org/10.1111/1468-4446.12488>

THIS IS A POST-PRINT (FINAL DRAFT POST-REFEREEING) VERSION.

Abstract

This article presents a new way of analysing educational assortative mating patterns, using a detailed ‘micro-educational’ classification capturing both hierarchical and horizontal forms of educational differentiation. Taking advantage of rich Danish population data, we apply log-linear models that include four ways of measuring educational homogamy patterns: (a) by returns to education, (b) by macro-education (five aggregated levels), (c) by field of study (16 categories), and (d) by a disaggregated micro-educational classification, combining levels and fields of study (54 groups). Our results show declines in educational homogamy from 1984 to 2013, but the odds ratios of being educationally homogamous at the university college and university levels remain of substantial magnitude, by both the macro- and micro-educational measures. The micro-educational classification outperforms all other measures in explaining the associations in the homogamy tables. The income measure (‘returns to education’) does a particularly poor job of explaining homogamy patterns from 1984 to 2013.

Introduction

Research on educational assortative mating patterns is important for the study of social inequality. Family formation patterns are key to uncovering mechanisms that generate inequality, both intra-generationally, when individuals with similar resources tend to cluster together and form new families, and inter-generationally, when parents transmit resources to their children (Blossfeld and Timm 2003; Musick and Mare 2004). This article presents a new way of analysing educational assortative mating patterns inspired by the micro-class approach known from social stratification research (Grusky and Sørensen 1998). The main argument of the micro-class approach is that large aggregated classifications of class may cover up important differences in occupational socialization and identity formation at the disaggregated level (Weeden and Grusky 2005). Using population data on 35-year-old Danish women born 1984 to 2013, we apply a highly disaggregated ‘micro-educational’ classification to account for both vertical differences (educational levels) and horizontal differences (fields of study within educational levels) in a systematic way (Andrade and Thomsen 2017). We argue that the expansion and diversification of education warrants an approach to educational assortative mating that accounts for mating patterns in much more detail, as aggregated classifications – such as level of education – may cover up significant mating patterns.

In addition to the massive educational expansion, the increasing differentials in returns to education make convincing cases for examining the importance of educational assortative mating in a much more disaggregated way than has previously been applied. First, to meet the demands of an increasingly knowledge-based society, modern education systems have massively expanded and diversified. Today, education is the primary transmitter of social privilege, and education influences both partner preferences and the transmission of resources from one generation to the next (Blossfeld 2009; Schwartz and Mare 2005). The rise of women in education is a major factor in this process. In many Western countries, labour market

participation for women almost equals that of men, and females are increasingly better educated than their male counterparts (DiPrete and Buckmann 2013). Moreover, Sweeney and Cancian (2004) have suggested that the changes in labour market participation for women have led to the growing importance of their socioeconomic status in the marriage market.

Education functions as an easily recognizable proxy for a number of individual characteristics, such as norms, values, abilities, earnings and lifestyle (Blossfeld 2009; Bourdieu 1986, 1987; Kalmijn 1998). Therefore, it is perhaps the most important signal or – as Kalmijn (1994, p. 427) has called it – ‘badge’ for people seeking a partner. Schwartz (2013) has found that couples meeting in educational institutions are far more likely to be educationally homogamous than people meeting in other social contexts. Skyt-Nielsen and Svarer (2009), analysing a sample of about 3,000 Danish couples, have found that a little under half of the educational homogamy processes in Denmark can be explained by couples having graduated from the same educational institutions. Nevertheless, most studies on educational assortative mating have used aggregated measures of education, neglecting the specific norms, values and cultures associated with specific educational programmes (see, e.g. Bourdieu and Passeron 1979; Reay, David and Ball 2005; Mullen 2010; Stuber 2011; Thomsen 2012; Thomsen et al. 2013 for studies on cultures in educational programmes).

Second, several studies have reported growing heterogeneity in returns on education not only *between* but also *within* educational levels (Goldin and Katz 2010; Hällsten 2010; Hout 2012). Increasing heterogeneity in returns within educational levels may lead to changing mating patterns, which can be captured more fully by detailed micro-educational groupings that distinguish between particular types of education at each educational level. We suggest that such patterns are also visible in Denmark, as the mean income gap between the lowest and highest educational level has grown and as returns to the higher educational levels have become more heterogeneous between 1984 and 2013 (see Appendix C and D).

Third, we argue that the micro-educational approach, by differentiating between detailed fields of studies within educational levels, enables us to identify patterns that are not simply linked to cognitive skills/intelligence (Plomin and Deary 2015), but to cultural and occupational preferences (Farkas 2003). As other studies show, field of study is not only associated with future labour market outcomes such as earnings but also related to the development of individuals' consumption patterns and socio-political orientation (Reeves and Vries 2016; Stubager 2008; Van de Werfhorst and de Graaf 2004). These associations between field of study and normative traits remain strong even after controlling for selection into the educational programs (van de Werfhorst and Kraaykamp 2001).

Denmark offers a good case for examining the role of micro-education in assortative mating patterns. The Danish welfare state is characterized by generous economic redistribution, comprehensive social benefits and a tuition-free education system, with the state providing students with monthly grants, regardless of parental income. As in most other Western countries, the Danish education system has expanded vastly since the 1960s and the educational level for both men and women has increased rapidly. Because Danish children experience fewer constraints in succeeding in the education system relative to children from other advanced industrial countries (OECD 2014), Denmark is well suited for examining the role of education in mating patterns.

In addition, Denmark witnessed a substantial diversification in types of programmes offered at the university level, from 189 in 1984–89 to 607 in 2008–13 (see Appendix E). Moreover, Statistics Denmark offers rich administrative data with detailed micro-level information, enabling us to, among other things, distinguish between specific educational programmes.

Background and hypotheses

Research on the drivers of assortative mating patterns is particularly important in times of growing economic inequality. Some researchers have argued that assortative mating patterns might be linked to income inequality between households (e.g., Blossfeld 2009). In a comparative literature review, Schwartz (2013) reported higher odds ratios of educational assortative mating in countries with greater income inequality and differences in returns to education. Torche (2010) found close associations between income inequality and educational assortative mating in Latin American countries, and the findings of several US studies have suggested that assortative mating is linked to economic inequality (Mare 2016; Schwartz and Mare 2005). The evidence remains inconclusive, however, as Breen and Salazar (2011) found no impact of increasing educational assortative mating on inequality in the US from the late 1970s to the early 2000s. Furthermore, studies on Denmark and the United Kingdom have reported little, if any, growth in earnings inequality due to educational assortative mating patterns (Breen and Andersen 2012; Breen and Salazar 2010).

Although increasing economic inequality can also be observed in Denmark, income inequality and differentials in returns to education are less pronounced than in, for example, UK or the US (OECD 2015). In addition, Kalmijn (1994) concluded that people in the US are more likely to marry according to cultural status (education) than economic status (wages), even though economic status homogamy increased at the expense of cultural status homogamy from 1970 to 1980 – a period marked by rising income inequality (for similar conclusions in other countries, see Smits, Ultee and Lammers 1998). Compared to non-Scandinavian countries, the Danish redistributive welfare state has lower levels of economic inequality and provides free education, government grants, and high levels of social benefits. In so far as educational homogamy constitutes a way of securing resources for couples and families, the more egalitarian conditions in Denmark lead us to expect that people in Denmark across the

period observed match on signals of cultural status more than economic status (see also Jæger and Holm 2007). In other words, we assume Danish couples will be more likely to match on education as a signal of cultural characteristics than on education as a signal of (future) economic characteristics. As a result, we test the following hypothesis:

Hypothesis 1: Matching on micro-education will explain more of the associations in the homogamy tables than will matching on income.

Educational expansion in contemporary societies has been followed by a steadily increasing number of differentiated and specialized types of education. Therefore, many researchers have argued for new approaches to studying how social groups reproduce their privileges – approaches in which education is classified not only hierarchically by level but also horizontally by field of study (Davies and Guppy 1997; Jackson et al. 2008; Lucas 2001; Raftery and Hout 1993; van de Werfhorst and Luijkx 2010). However, the field-of-study approach has been largely absent in homogamy studies. Along with educational differentiation, the increased division and specialization of labour have changed the occupational structure in modern societies. Weeden and Grusky (2005) reported that occupational groups can be characterized by distinctive patterns of socialization (and processes of social closure), resulting in great disparities in intergenerational transmissions of resources. These distinct socialization patterns may reasonably be present in educational programmes leading to specific occupations (e.g., Mullen 2010; Stuber 2011; Thomsen et al. 2013), but the patterns have been neglected in assortative mating studies, which have relied on highly aggregated measures of education.

We investigate whether educational assortative mating is linked not only to levels of education but also to specific types of education – or micro-educational classifications. As individuals increasingly reach the upper educational levels, we expect educational assortative mating within qualitatively different types of education to become increasingly pronounced. Previously, having any college degree would send a clear signal to future partners about cultural

characteristics and economic prospects. However, as college education has become increasingly common, the signalling effect of such an education may be reduced, possibly leading individuals to sort on specific types of education in their search for a partner. Lucas (2001) coined the phrase ‘effectively maintained inequality’ to refer to the processes by which privileged groups seek out educational advantages within a given level of education, once it has become common to reach that level. We apply this logic in our educational assortative mating context, leading us to expect that people will match on any college degree when a college degree is uncommon, but as possessing a college degree becomes more and more common, people will increasingly match on specific types of college degrees. Thus, we develop a two-part hypothesis regarding the importance of new forms of educational differentiation in assortative mating:

Hypothesis 2a: At higher educational levels, propensities for matching on micro-education will increase across the period investigated.

In addition, as research on the social closure of professional classes has found education to be an important element of closure processes (Bol and Weeden 2015; Jonsson et al. 2009; Weeden 2002), we expect individuals in prestigious college programmes – namely, those leading to professional occupations, such as medicine, law and architecture – to be particularly likely to be educationally homogamous:

Hypothesis 2b: Relative to other micro-educations, those leading to prestigious professions are constantly highly educationally homogamous.

The next section provides a description of the data and presents in detail the analytical approach for testing the hypotheses.

Method

Data and Measurement

We use high quality administrative data from Statistics Denmark on the population of 35-year-old Danish women born between 1984 and 2013 ($n = 1,089,521$). Danish administrative data include information from governmental records on all citizens, for example, information on gender, date of birth, parents, place of residence, educational attainment, income, tax. Data are linked together by a unique personal identification number and because data come from governmental records, there is no attrition bias.

We use an approach similar to Mare (2016) and focus on the age group of newlyweds. Our decision to focus on 35-year-old women is based on the fact that Danish women with the highest educational achievement complete their education relatively late, and because the average age of newlywed women increased between 1984 and 2013.¹ From administrative data registers, we draw data on education, income and household formation.

Education: We use detailed information on the individual's highest educational degree.² We classify education in three different ways. The first is *vertical*, as five hierarchical levels based on the International Standard Classification of Education (ISCED): compulsory schooling, high school, vocational education and training (VET), university college, and university. The second is *horizontal*, based on the ISCED classification of field of study, and the third is *multidimensional*, as 54 disaggregated micro-educations combining vertical levels and horizontal fields of study.

Income: To examine the extent to which returns to education can explain the assortative mating patterns, we include in our models a measure of average net earnings. We construct our income measure to reflect the future average income for members of each micro-education group when they are between ages 44 and 46. This measure enables us to distinguish between the cultural signals (the micro-education obtained) and economic signals

(the average income for the micro-education obtained, measured at age 44–46) of each micro-education. From the administrative tax registers on the Danish population of 44–46 year-olds ($N = 6,755,679$), we merge annual wage data with detailed information on educational status, calculate the inflation-adjusted three-year average wage net income for each micro-education, and rank the educations as percentiles from 0 to 100 in the wage income distribution. We then construct a dummy of being homogamous by returns to education if the individual mates with a partner who has an income within the same decile of that individual's education.³

Households: We distinguish two types of households, – namely, single households and households with either a cohabiting or married couple.⁴ We include single households in our analysis because research suggests that increases in single households exacerbate inequality – especially if the rise in single households is primarily among those with lower educational attainment (Western et al. 2008). In our analysis, we thus include ‘single’ (or no partner) as an additional category for the variable measuring partner's education.

Table I shows how the five educational levels, the different fields of study, and the micro-educations (levels by field) are related. As the first column in Table I shows, the Danish education system comprises five levels. The basic educational level (level 1) is compulsory schooling (ages 6 to 15). Adolescents can continue to a three-year college-preparatory high school (level 2) or a vocational education and training course preparing them for skilled work in a specific trade (level 3). Those who choose a college-preparatory high school can later continue to either a university college (level 4) comprising mainly applied programmes, such as nursing and elementary school teaching, or enrol in a university (level 5) offering a range of traditional liberal arts and science programmes. Whereas a university college degree follows the completion of a two-year programme or a longer three- to four-year programme, university courses are commonly five-year programmes (three years for a bachelor's degree plus two years for a master's degree). University college and university programmes in

Denmark are subject-specific; in other words, prospective higher education students apply to a particular field of study, such as sociology, engineering or biology.⁵

[TABLE I ABOUT HERE]

The second column in Table I displays the formal taxonomy of the micro-educational classification. Excluding the first two educational levels (compulsory schooling and college preparatory high school), where differentiating by field of study does not apply, the three upper educational levels are divided into identical fields of study. As some micro-educations may in reality have very few or even no students, the number of actual micro-educations used in our later models is smaller than the number of formal classifications shown in Table I (see Appendix B for all micro-educations). We single out numerically large programmes leading to major professional occupations (i.e., medicine, law, engineering and architecture) and semi-professional occupations (i.e., nursing, elementary school teaching, and early care and education programmes).⁶

Analytical approach

Propensities for being educationally homogamous have been associated with choosing culturally similar partners (same level of schooling) or with choosing partners with financially lucrative prospects (returns to education) (Blossfeld and Timm 2003). We extend this line of research by using log-linear models known from social mobility research (see Powers and Xie 2008). The main purpose of log-linear modelling is to measure the association between two variables (in this case the relationship between couples' education) under various statistical assumptions. By including different layers in the log-linear model, we are able to determine

how much different measures of educational homogamy contribute to explaining the patterns of assortative mating in Denmark.⁷

Our model includes four layers capturing different patterns of educational homogamy: people mate on the basis of signals about (a) income status, (b) educational level, (c) field of study, and (d) specific (micro-) education (for similar approaches, see Andrade and Thomsen 2017; Jonsson et al. 2009). Since the parameters are layered on one another, they capture net effects; that is, any effect of the micro-educational parameter (micro-educational assortative mating) will be an effect that persists above and beyond the effects of the other parameters.

The *economic layer* measures the tendency for people to mate on the basis of signals about income status. To keep the interpretation of the layer as simple as possible, we use a dummy variable measuring whether couples are homogamous by returns to education or not (as detailed earlier in this section). The three other layers capturing education as a categorical measure are illustrated in Figure I. The *macro-educational layer* (subfigure I in Figure I) classifies education into five hierarchal levels: elementary school, high school, VET, university college, and university; the *horizontal educational layer* is represented by the ISCED classification of field of study (sub-figure II); and our *micro-educational layer* combines both levels and fields of study into 54 micro-educations (sub-figure III).

[FIGURE I ABOUT HERE]

Our log-linear model can be written as follows:

$$\log(m_{ijk}) = \alpha + \beta_i + \gamma_j + \tau_k + \delta_{ij}^A + \delta_{ij}^B + \delta_{ij}^C + \delta_{ij}^D + \beta_i \times \tau_k + \gamma_j \times \tau_k + \delta_{ij}^A \times \tau_k + \delta_{ij}^B \times \tau_k + \delta_{ij}^C \times \tau_k + \delta_{ij}^D \times \tau_k \quad (1),$$

(1)

where i indexes the micro-education of the woman, j indexes the micro-education of the partner, k indexes time, m_{ijk} refers to the logarithm of the expected frequency in the ijk^{th} cell, and α is the main effect. β_i and γ_j refer to row and column marginal effects, respectively, τ_k refers to the time parameter. δ_{ij}^A refers to matching on returns to education, and δ_{ij}^B , δ_{ij}^C , and δ_{ij}^D refer to the aggregated, hierarchical educational levels, horizontal levels (field of education); and disaggregated (micro-educational) effects, respectively. We examine both time-constant and time-varying educational assortative mating patterns (with and without interactions with the time parameter).

Results

Descriptive results

We begin our analysis with descriptive statistics. Table II and Appendix B list the trends in educational attainment and mating patterns among 35-year-old women and men in the earliest and latest periods. These tables provide an overview of homogamy probabilities and show that women and men can be very unevenly dispersed among educational levels and micro-educations. In Appendix B, we show the homogamy percentages for each micro-education, separately for women and men. The uneven dispersion of men and women in each micro-education is reflected in the homogamy rates. While women with a police officer training education, having an abundance of potential partners with the same micro-education, have a homogamy rate of 38 per cent in the latest period, only 5.6 per cent of men with the same micro-education are homogamous. In the engineering programme, another male-dominated education, 11 per cent of all men are homogamous, as opposed to 31 per cent of the women. At the other extreme, male nurses, a very rare sight in the nursing programme, have a homogamy rate of 32.3 per cent in the latest period, compared to only 1.4 per cent for women. Men with a medical degree are 29 per cent homogamous, while women are 22.7 per cent homogamous.

Moving to Table II, the upper part of the table shows how the educational expansion in Denmark has led to a substantial rise in educational attainment, in particular for women. While in 1984–89, 36.8 per cent of 35-year-old women have compulsory schooling as their highest level of education, by 2008–13, this percentage drops to only 13.8 per cent. In the same period, the percentage of 35-year-old women with a university degree quadruples from 4 per cent to 17.2 per cent. For 35-year-old men, the skills increase is more modest: In the latest period close to one in five of 35-year-old men (18.6 per cent) have compulsory schooling as their highest level of education.

[TABLE II ABOUT HERE]

Table II also shows a decrease in overall assortative mating for 35-year-old women from the earliest to the latest time period. At the macro-educational and micro-educational levels, assortative mating rates go down within the university and university college groups for women, while the rates increase for men at the micro-educational university level. Looking at singles, low-skilled women and men are more likely to remain single in the latest period than in the earliest period. In the latest period, 26.2 per cent of 35-year-old women and 41.2 per cent of 35-year-old men with only compulsory schooling are single. For manually skilled women and men (i.e. those with a VET diploma), we also see substantial rises in singlehood. The figures for single women indicate the importance of including singles in the log-linear models: The rise in single women with low levels of education may reduce educational homogamy, as declines in suitable men can lead low-educated women not to marry or to marry higher-skilled men (Schwartz and Mare 2005). In other words, excluding singles from the log-linear models may lead to bias in the homogamy estimates. Table II also serves as a reminder of the need for margin-insensitive models when analysing educational assortative mating in times of educational expansion. For example, only 4 per cent of all 35-year-old women have a university

degree in the first period, making it more likely for them to marry an equally educated partner in the first rather than the last period, in which 17.2 per cent of all women have a university degree.

Log-linear model results

We now turn to our hypothesis on trends in educational homogamy. We begin by assessing the fits of our log-linear models, as reported in Table III. Because these log-linear models are margin-insensitive cross-tabulations of women and their partners, they produce results that take both the distribution of women and men within each micro-education into account.⁶ Table III depicts the fits for different models comprising our four layers: macro-education, field of study, micro-education, and returns to education. We report several fit measures. The index of dissimilarity (D) reports the percentage of cases needed for changing cells to make the fitted distribution identical to the actual distribution (the lower the percentage reported, the better the model fit). The Bayesian Information Criterion (BIC) takes the number of parameters into account (loss of degrees of freedom), and lower values indicate a better model fit. The deviance measure (G^2) provides information on the discrepancy between the observed and fitted values. Similar to the BIC measure, smaller values of G^2 indicate a better model fit. Finally, we include a column reporting the difference in deviance (ΔG^2) between our main models (1.1, 2.1 and 3.1) and the models where we include or exclude layers, providing an easy overview of how much we are penalized for excluding particular layers (or how much we gain by including layers).

The first five models demonstrate how much each layer adds to the explanation of educational assortative mating patterns in Denmark. The first model (1.1) is the baseline model including only the education of the individual and her partner along with time. Adding the vertical macro-educational layer (model 1.2) results in a large model fit improvement. This improvement is much higher than when we add the horizontal layer measuring assortative mating by field of

study (model 1.3). However, when we include the multidimensional micro-educational layer (model 1.4), we obtain an even better model fit than we did by adding the macro-educational layer. Moreover, Table III shows that compared to the macro- and micro-educational layers, the economic layer (model 1.5), which captures returns to education, does a rather poor job of explaining the assortative mating association in Denmark.

[TABLE III ABOUT HERE]

In the next five models (models 2.1–2.5) we assess the net effects of each layer. We start by including all layers (2.1) and investigate the decline in model fits when one layer is excluded. Again, the model search demonstrates a strong case for including the micro-educational layer (2.4) when examining educational assortative mating: excluding the micro-educational layer results in the worst model fit. Excluding the macro-layer (2.2) is also costly, whereas excluding the economic layer (2.5) only results in a marginally poorer fit. The last five models in Table III (models 3.1–3.5) introduce time variability. By the deviance measure, the model with the best fit is model 3.1, the full, time-varying model including all layers.

In sum, the changes in educational homogamy patterns are reflected in all parameters included in our models, with the micro-educational layer improving the model fit the most. The model fits show a strong case for including our micro-educational parameter when examining educational assortative mating patterns. Importantly, the layer capturing returns to education does not do a very good job of explaining the association in the assortative mating tables. This means that matching on cultural characteristics (e.g. on micro-education) better explains the assortative mating patterns than matching on returns to education.⁸ In the remainder of the paper, we employ the full model 3.1 to investigate the odds ratios of being educationally homogamous by our four different layers.

Odds ratios of educational homogamy

Table IV presents the exponentiated net effect estimates of assortative mating (odds ratios) from model 3.1 in Table III. Overall, the macro- and micro-educational layers show declining tendencies to be educationally homogamous in Denmark. Macro-educational homogamy at the university level is reduced across the period from an odds ratio of 8.3 to 5.5. In comparison, the decline for averaged micro-educational homogamy at the university level – that is, the averaged propensities for teaming up with a partner with the same type of micro-education – is reduced by half (from 9.6 to 4.8). Despite these reductions, the odds ratios for both macro- and micro-educational homogamy are substantial, especially when we consider that these are net effects – that is, effects that persist above and beyond the effects of the other layers.

[TABLE IV ABOUT HERE]

The field-of-study layer captures the propensity for seeking out a partner within the same educational field, but at a different educational level, such as when doctors marry nurses or when sociologists marry social workers. Compared to the macro- and micro-educational layers, the horizontal field of study layer has smaller, but non-trivial odds ratios of 2 to 3 across the period.

Most notably, relative to the odds ratios of the other parameters, we find small and negligible odds ratios for having a partner whose education leads to an income within the same income decile. In other words, when we control for all the other ways of explaining the associations in the homogamy table, men are just as likely to form a union with a partner with an education leading to an income differing from their own as they are to form a union with a partner with an education leading to a similar income. Even in a time-varying model including only the

returns-to-education parameter, the odds ratios of forming a union by returns to education remain small (1.9 to 2.4; not shown).

In contrast to the economic parameter, the odds ratios of being educationally homogamous at the college and university levels – even though they diminish across the period – are of substantial magnitude, by both the macro- and micro-educational parameters. However, as the propensities for being micro-educationally homogamous are level averages in Table IV, they may cover up substantial differences in the odds ratios of being micro-educationally homogamous within levels. Therefore, in the last part of our analysis, we investigate micro-educational assortative mating at the university college and university levels (Table V). Educational credentials are important elements in the social closure processes of professional groups, particularly when education grants the holder the exclusive right to practise that particular profession. For this reason, we expected individuals with micro-educations leading to prestigious professions to have been constantly highly educationally homogamous relative to other micro-educations.

[TABLE V ABOUT HERE]

Table V depicts the odds ratios of being micro-educationally homogamous at the university and university college levels (see Appendix A for all estimates). Large and expanding programmes, like the humanities and social sciences, display decreasing homogamy odds ratios across the period (from 5.4 to 2.2 for the humanities; 5.8 to 3.4 for the social sciences). However, architecture and medicine – some highly sought-after programmes granting licences that allow entry into prestigious or lucrative professional occupations – show high and increasing odds ratios of being micro-educationally homogamous (architecture degrees from 13.8 to 31.7; medical degrees from 11 to 15.1). The homogamy odds ratios for those with a law

degree – a degree with a more varied occupational profile than architecture and medicine – decrease from 12.1 to 7.9.

At the university college level, we find mixed patterns of homogamy for the professional and semi-professional micro-educations. Those with a degree in journalism maintain a high, and even slightly increasing, propensity for partnering with one another – from an odds ratio of 17.8 in 1984–89 to about 21.9 in 2008–13. In contrast, compulsory school teachers, representing a traditionally large and educationally homogenous micro-education, have decreasing odds of partnering with one another relative to mating elsewhere, from about 9.4 to 5.6 across the same period.

Looking at the individual field-of-study homogamy odds ratios (see Appendix A) – that is, the propensity to form a union with someone educated within the same field as oneself – we notice that homogamy varies by field and that agriculture, health and teaching display substantial odds ratios of field-of-study homogamy across the period. This happens when, for example, a nurse forms a union with a doctor or when a compulsory school teacher partners with a person with a master's degree in teaching.

Discussion

In this paper, we have presented a new micro-educational approach to analysing educational assortative mating patterns. Whereas previous research has tended to rely on a single aggregated measure of education, we have analysed educational homogamy using four different measures – (1) returns to education (earnings), (2) categorical aggregated (5 levels), (3) horizontal (field of study by 16 categories), and (4) our disaggregated micro-educational classification (in 54 categories) – capturing both hierarchical and horizontal forms of educational differentiation. We have applied these measures in log-linear models using high-quality administrative data for the population of 35-yearold Danish women.

Our first hypothesis was motivated by studies arguing that couples tend to unite on the basis of either culture or characteristics – that is, either by type and length of education or by expected returns to education (Blossfeld and Timm 2003). In so far as educational homogamy is a way of securing economic resources, the relatively more egalitarian conditions in Denmark has led us to hypothesize that matching on type of education would better explain the associations in the homogamy tables than matching on income. We have found convincing support for this hypothesis: Our model search has shown that matching on education (micro- as well as macro-education) explains much more of the associations in the homogamy tables than matching on income does. This result is in line with a previous Danish study by Nielsen and Svarer (2009), finding income to have a negligible effect on educational homogamy.

In addition, across the period observed, the odds ratios of 35-year-olds matching on returns are much lower – and negligible – compared to the odds ratios for macro- and micro-educational homogamy, even though these latter odds ratios diminish across the period. Studying trends in US marriage patterns in cohorts preceding ours, Kalmijn (1994) found declines in the tendency to form unions by cultural similarities, in favour of economic similarities, in times of rising economic inequality. In Denmark, income inequality also increased during the period under investigation, albeit on a much more modest scale than in the US (OECD 2015). However, in contrast to Kalmijn (1994), we have not found similar tendencies in Denmark.

We argue that the importance of education over income for assortative mating must be viewed against the backdrop of the Danish redistributive welfare state. This argument is in line with studies finding that cultural capital as a family asset is much more important than economic capital for Danish children's future success in the labour market (Jæger and Holm 2007, see also Bourdieu 2001). Researchers have suggested that Scandinavian welfare states provide generous childcare services that affect women's labour market entry and, consequently, marital

choices (Blossfeld 2009; Esping-Andersen 2009). From an economic perspective, these childcare services may make it less important for Danish women to seek high-income partners who can provide economic security and cover expenses for childcare and higher education.

However, we have not found support for our second hypothesis, that micro-educational assortative mating increased at the university college and university levels across the period under study. We expected that a university college or university degree would present an increasingly weak signal for people seeking a partner, as these degrees have become increasingly common. In short, we anticipated that matching would be aimed more at similar types of education, resulting in higher propensities for micro-educational assortative mating. Yet our log-linear models have shown that propensities for matching on micro-education decreases in tandem with propensities for matching on macro-education.

Our results stand in contrast to existing explanations of assortative mating trends. The ‘modernization thesis’, for example, implies a rise in assortative mating as people increasingly sort on achieved (meritocratic), over ascribed characteristics (e.g., Kalmijn 1991). A related thesis posits that declining gender inequality in both education and the labour market increases assortative mating, as women are freer to choose their partner and as the symmetry of men’s and women’s preferences increases (e.g. Schwartz and Mare 2005: 623). In addition, as earnings differentiation by education increases, the social distance between people may increase concomitantly, leading to strengthened propensities for educational homogamy (Schwartz 2013: 455). As a modern society, with declining gender inequality and increasing economic inequality, these hypotheses could all apply to Denmark, but we nevertheless see decreasing odds ratios of being educationally homogamous.

Why, then, do we observe these patterns? One possible explanation could be found in the structuring effect of educational institutions. Mare (1991) has proposed that assortative mating will increase if the time gap between graduation and marriage decreases, as people will then be

more likely to meet at educational institutions. In fact, we do observe an increase in the period between the average graduation age and the average age of newlywed women.⁹ This could imply that people increasingly meet outside of educational institutions, leading to decreases in educational homogamy.

A second explanation concerns the rise of women in education (DiPrete and Buchmann 2013). Schwartz and Mare (2005: 624) have suggested that declines in economically suitable men may force low-educated women not to marry or to marry men who have attained a different educational level, and this may, in principle, result in a reduction in educational homogamy. We do, in fact, observe substantial rises in the percentages of single unskilled and manually skilled women across the period, and this may lead to less educational homogamy. McLanahan (2004: 619) has argued that the increasingly difficult labour market conditions for low-skilled men has made them less attractive for lowskilled women, while welfare benefits at the same time has made it more manageable for women and mothers to remain single (see also Esping-Andersen 2009). In addition, we offer a third possible explanation for the decrease in educational homogamy: When micro-educations expand rapidly, it may lead to diminishing returns (and to increasing unemployment rates) and render these micro-educations less exclusive and prestigious. The humanities programmes are a case in point. At the university level, these programmes expanded rapidly from 70 programmes in 1984–89 to 186 programmes in 2008–13 (see Appendix E). At the same time, the humanities programmes have gone from being positioned at the 90th income percentile to the 70th income percentile in the income hierarchy for women and from the 97th to the 77th income percentile for men (see Appendix D). This example may help to explain that while a university degree may present an increasingly weak signal, it may not necessarily lead people to match on the same micro-education, as posited in our second hypothesis, but to seek out a partner with another micro-education.

It could also be the case that higher propensities for micro-educational assortative mating hold true only for some micro-educations. In fact, whereas aggregated measures of educational homogamy show declines in homogamy ratios at all levels, our disaggregated, micro-educational classification reveals that the sought-after micro-educations of architecture and medicine display high and increasing odds ratios of being educationally homogamous. These results from our log-linear models confirm our third hypothesis, that individuals with a micro-education leading to a prestigious profession are highly homogamous across the period, relative to other micro-educations. At both the university college and university levels, we find large odds ratios of being educationally homogamous within the highly profession-oriented programmes. These findings suggest that professions with a particularly strong professional identity, like medicine and architecture (Thomsen et al. 2013), are more likely to be homogamous. However, we may also interpret these findings with reference to social closure theory (Grusky and Sørensen 1998) and argue that privileged social groups will attempt to secure their position by different means, including family formation.

We have found that educational assortative mating has been decreasing in Denmark, although the odds ratios for micro-educational assortative mating in the latest time period remain substantially high – and just as high as odds ratios for macro-educational assortative mating. This could suggest that we are moving toward a more open society in terms of educational union formation, even though Danes are still much more likely to mate with equally educated partners than they are to search elsewhere. The assortative mating trends found in this paper at the macro-educational level stand in contrast to what has been found in UK and the US, where studies applying similar models have found stable mating patterns by social class, or increases in educational assortative mating since the 1960s (Mare 1991, 2016; Mills and Henz 2017; Schwartz and Mare 2005). These differential patterns point to the importance of taking country-specific structural differences into account – such as differentials in economic redistribution,

returns to education, education, and the labour market participation of women and men – as well as more intangible cultural differences.

That UK, the US and Denmark display different trends in educational assortative mating, despite the increase in income inequality in all countries (albeit less so in Denmark), suggests that educational assortative mating patterns may not be driven only by the incentive to find a financially lucrative partner in times of rising economic inequality, as suggested by Mare (2016). In short, there is much need for comparative work on educational assortative mating patterns and the mechanisms underlying disparate mating patterns across welfare regimes. We encourage researchers to conduct comparative investigations into patterns of not only how educational assortative mating varies but also how it varies with income inequality.

Notes

1. The mean graduation age for master's students in Denmark was 29 years in 2013. The average age of newly-wed women increased from 26 to 33 from 1984 to 2013. We have run our models with several alternative age groups (40, 45, 28–33, 26–59) and they all roughly display the same pattern as the models included in this paper
2. In Denmark, most individuals will have reached their final educational level by age 30.
3. We apply several alternative income measures as robustness checks; see endnote 8.
4. As Danish women very often form couples without being married (30 per cent of 35-year-old women in two-adult households were not married in 2013), we do not distinguish between married and unmarried couples (Statistic Denmark's online stat tool, statistikbanken.dk).
5. In Denmark, more than 80 per cent of those with a bachelor's degree from a university continue to pursue a master's degree. There are no higher education tuition fees in Denmark, and a universal government grant system entitles all students above age 18 to monthly grants for the stipulated time of their study
6. In our micro-education classification, we do not distinguish between similar micro-educations from different educational institutions, such as old and new universities. In our data, information on institutional affiliation is missing for over half of the population in earlier cohorts. Moreover, as Denmark does not hold genuine elite university institutions, social selection is primarily into particular programmes, rather than into particular institutions (Thomsen et al. 2010). Therefore, we do not view this data limitation as having major implications for our findings.
7. Log-linear models are aggregated couple-level analysis (i.e., cross-tabulations of couples' education). As the odds ratios produced by the log-linear models are insensitive to the marginal distributions of men and women across micro-educations, the table of association between men and women can be switched without coefficients changing, in other words homogamy

coefficients will be the same whether we present results for women + partners, or for men + partners. Small but negligible differences may appear from the fact that the singles distribution for men and women may differ, and from the fact that we match 35-year-old women with partners regardless of their age. We have run models for men as well and the results are virtually identical to models for women.

8. To validate our approach of measuring the propensity for choosing a partner with a similar income, we estimate not only models in which we divide people's wage income into alternative, larger groups (quartiles and quintiles) but also models in which we allow no upper bound for mating on income (i.e., mating with a partner with an equal or higher income). We have also tried to include gender-specific income measures capturing income proximity between women and men, as well as measures where there are no upper bounds for the partner (both as relative and actual net income). The overall results of using these measures (available on request) do not differ from the conclusions we have reached by using the measure applied in the paper.

9. The average age of newly-wed women increased from 26 to 33 from 1984 to 2013, whereas the median age of master graduates decreased slightly from 29 to 28 during the same period.

Bibliography

- Andrade, S.B. and Thomsen, J.-P.** 2017 'Micro-Educational Reproduction', *Social Forces* 96(2): 717–50.
- Blossfeld, H.-P.** 2009 'Educational Assortative Marriage in Comparative Perspective', *Annual Review of Sociology* 35: 513–30.
- Blossfeld, H.-P. and Timm, A.** 2003 *Who Marries Whom? Educational Systems as Marriage Markets in Modern Societies*, Dordrecht: Kluwer Academic.
- Bol, T. and Weeden, K.A.** 2015 'Occupational Closure and Wage Inequality in Germany and the United Kingdom', *European Sociological Review* 31(3): 354–69.
- Bourdieu, P.** 1986 *Distinction: A Social Critique of the Judgement of Taste*, New York: Routledge.
- Bourdieu, P.** 1987 'What Makes a Social Class? On the Theoretical and Practical Existence of Groups', *Berkeley Journal of Sociology* 32.
- Bourdieu, P.** 2001 'The Forms of Capital' in A.H. Halsey, H. Lauder, P.Brown and A.S.Wells (eds) *Education: Culture, Economy, and Society*, Oxford: Oxford University Press.
- Bourdieu, P. and Passeron, J.-C.** 1979 *The Inheritors: French Students and their Relation to Culture*, Chicago: University of Chicago Press.
- Breen, R. and Andersen, S.H.** 2012 'Educational Assortative Mating and Income Inequality in Denmark', *Demography* 49(3): 867–87.
- Breen, R. and Salazar, L.** 2010 'Has Increased Women's Educational Attainment Led to Greater Earnings Inequality in the UK? A Multivariate Decomposition Analysis', *European Sociological Review* 26(2): 143–58.
- Breen, R. and Salazar, L.** 2011 'Educational Assortative Mating and Earnings Inequality in the United States', *American Journal of Sociology* 117(3): 808–43.

- Davies, S. and Guppy, N.** 1997 'Fields of Study, College Selectivity, and Student Inequalities in Higher Education', *Social Forces* 75(4): 1417–38.
- DiPrete, T.A. and Buchman, C.** 2013 *The Rise of Women: The Growing Gender Gap in Education and What It Means for American Schools*, New York: Russell Sage Foundation.
- Esping-Andersen, G.** 2009 *Incomplete Revolution: Adapting Welfare States to Women's New Roles*, Cambridge: Polity Press.
- Farkas, G.** 2003 'Cognitive Skills and Noncognitive Traits and Behaviors in Stratification Processes', *Annual Review of Sociology* 29(1): 541–62.
- Goldin, C.D. and Katz, L.F.** 2010 *The Race between Education and Technology*, Cambridge, MA: Harvard University Press.
- Grusky, D.B. and Sørensen, J.B.** 1998 'Can Class Analysis Be Salvaged?', *American Journal of Sociology* 103(5): 1187–234.
- Hällsten, M.** 2010 'The Structure of Educational Decision-Making and Consequences for Inequality: A Swedish Test Case', *American Journal of Sociology* 116(3): 806–54.
- Hout, M.** 2012 'Social and Economic Returns to College Education in the United States', *Annual Review of Sociology* 38: 379–400.
- Jackson, M., Ruud, L., Pollak, R., Vallet, L.-A. and van der Werfhorst, H.** 2008 'Educational Fields of Study and the Intergenerational Mobility Process in Comparative Perspective', *International Journal of Comparative Sociology* 49(4– 5): 369–88.
- Jæger, M.M. and Holm, A.** 2007 'Does Parents' Economic, Cultural, and Social Capital Explain the Social Class Effect on Educational Attainment in the Scandinavian Mobility Regime?', *Social Science Research* 36(2): 719–44.
- Jonsson, J.O., Grusky, D.B., Di Carlo, M., Pollak, R. and Brinton, M.C.** 2009 'Microclass Mobility: Social Reproduction in Four Countries', *American Journal of Sociology* 114(4): 977–1036.

- Kalmijn, M.** 1991 'Status Homogamy in the United States', *American Journal of Sociology* 97(2): 496–523.
- Kalmijn, M.** 1994 'Assortative Mating by Cultural and Economic Occupational Status', *American Journal of Sociology* 100(2): 422–52.
- Kalmijn, M.** 1998 'Intermarriage and Homogamy: Causes, Patterns, Trends', *Annual Review of Sociology* 24(1): 395–421.
- Lucas, S.R.** 2001 'Effectively Maintained Inequality: Education Transitions, Track Mobility, and Social Background Effects', *American Journal of Sociology* 106(6): 1642–90.
- Mare, R.D.** 1991 'Five Decades of Educational Assortative Mating', *American Sociological Review* 56(1): 15–32.
- Mare, R.D.** 2016. 'Educational Homogamy in Two Gilded Ages', *Annals of the American Academy of Political and Social Science* 663(1): 117–39.
- McLanahan, S.** 2004 'Diverging Destinies: How Children Are Faring under the Second Demographic Transition', *Demography* 41(4): 607–27.
- Mills, C. and Henz, U.** 2017 'Social Class Origin and Assortative Mating in Britain, 1949–2010', *Sociology*.
- Mullen, A.L.** 2010 *Degrees of Inequality*, Baltimore, MD: Johns Hopkins University Press.
- Musick, K. and Mare, R.D.** 2004 'Family Structure, Intergenerational Mobility, and the Reproduction of Poverty: Evidence for Increasing Polarization?', *Demography* 41(4): 629–48.
- Nielsen, H.S. and Svarer, M.** 2009, 'Educational Homogamy: How Much is Opportunities?', *Journal of Human Resources* 44(4): 1066–86.
- OECD.** 2014 *Education at a Glance*. Paris: OECD Publishing.
- OECD.** 2015 *In it Together: Why Less Inequality Benefits All*, Paris: OECD Publishing.

- Plomin, R. and Deary, I.J.** 2015 ‘Genetics and Intelligence Differences: Five Special Findings’, *Molecular Psychiatry* 20(1): 98–108.
- Powers, D. and Xie, Y.** 2008 *Statistical Methods for Categorical Data Analysis*, Bingley: Emerald Group.
- Raftery, A.E. and Hout, M.** ‘Maximally Maintained Inequality: Expansion, Reform, and Opportunity in Irish Education, 1921–75’, *Sociology of Education* 66(1): 41–62.
- Reay, D., David, M.E. and Ball, S.J.** 2005 *Degrees of Choice: Social Class, Race and Gender in Higher Education*, Stokeon-Trent: Trentham Books.
- Reeves, A. and Vries, R.** 2016 ‘The Social Gradient in Cultural Consumption and the Information-processing Hypothesis’, *Sociological Review* 64(3): 550–74.
- Schwartz, C.R.** 2013 ‘Trends and Variation in Assortative Mating: Causes and Consequences’, *Annual Review of Sociology* 39: 451–70.
- Schwartz, C.R. and Mare, R.D.** 2005 ‘Trends in Educational Assortative Mating from 1940 to 2003’, *Demography* 42(4): 621–46.
- Skyt-Nielsen, H. and Svarer, M.** 2009 ‘Educational Homogamy: How Much Is Opportunities?’, *Journal of Human Resources* 44: 1066–86.
- Smits, J., Ultee, W. and Lammers, J.** 1998 ‘Educational Homogamy in 65 Countries: An Explanation of Differences in Openness Using CountryLevel Explanatory Variables’, *American Sociological Review* 63(2): 264–85.
- Stubager, R.** 2008 ‘Education Effects on Authoritarian-Libertarian Values: A Question of Socialization’, *The British Journal of Sociology* 59(2): 327–50.
- Stuber, J.M.** 2011 *Inside the College Gates: How Class and Culture Matter in Higher Education*, Lanham, MD: Lexington Books.
- Sweeney, M.M. and Cancian, M.** 2004 ‘The Changing Importance of White Women’s Economic Prospects for Assortative Mating’, *Journal of Marriage and Family* 66(4): 1015–28.

- Thomsen, J.P.** 2012 'Exploring the Heterogeneity of Class in Higher Education: Social and Cultural Differentiation in Danish University Programmes', *British Journal of Sociology of Education* 33(4): 565–85.
- Thomsen, J.-P., Bertilsson, E., Dalberg, T., Hedman, J. and Helland, H.** 2010 'Higher Education Participation in the Nordic Countries 1985–2010—A Comparative Perspective', *European Sociological Review* 33(1): 98–111.
- Thomsen, J.P., Munk, M.D., EibergMadsen, M. and Hansen, G.I.** 2013 'The Educational Strategies of Danish University Students from Professional and Working-Class Backgrounds', *Comparative Education Review* 57(3): 457–80.
- Torche, F.** 2010 'Educational Assortative Mating and Economic Inequality: A Comparative Analysis of Three Latin American Countries', *Demography* 47(2): 481–502.
- Van de Werfhorst, H.G. and de Graaf, N.D.** 2004 'The Sources of Political Orientations in Post-industrial Society: Social Class and Education Revisited', *British Journal of Sociology* 55(2): 211–35.
- Van de Werfhorst, H.G. and Kraaykamp, G.** 2001 'Four Field-related Educational Resources and their Impact on Labor, Consumption, and Sociopolitical Orientation', *Sociology of Education* 74(4): 296–317.
- Van de Werfhorst, H.G. and Luijkx, R.** 2010 'Educational Field of Study and Social Mobility: Disaggregating Social Origin and Education', *Sociology* 44(4): 695–715.
- Weeden, K.B.** 2002 'Why Do Some Occupations Pay More than Others? Social Closure and Earnings Inequality in the United States', *American Journal of Sociology* 108(1): 55–101.
- Weeden, K.B. and Grusky, D.B.** 2005 'The Case for a New Class Map', *American Journal of Sociology* 111(1): 141–212.
- Western, B., Bloome, D. and Percheski, C.** 2008 'Inequality among American Families with Children, 1975 to 2005', *American Sociological Review* 73(6): 903–20.

Table I: *The Micro-Educational Classification*

Educational level	Micro-educational classification (levels combined with ISCED fields)
Level 1: Compulsory school (ISCED level 1+2)	Compulsory school
Level 2: High school (ISCED level 3)	High school (applied) High school (general)
	ISCED narrow fields:
	A Agriculture, forestry and fishery (veterinary singled out at level 5)
	B Architecture and building (architecture singled out at level 5)
Level 3: Vocational education and training (VET) (ISCED level 4)	C Business and administration
	D Computing
	E Creative arts
	F Engineering and engineering trades
	G Health (nursing singled out at level 4 and medicine singled out at level 5)
	H Humanities
	I Journalism and information
Level 4: University college (ISCED level 5+6)	J Law
	K Life science
	L Manufacturing and processing
	M Mathematics and statistics
	N Personal services
	O Physics
Level 5: University (ISCED level 7+8)	P Security services (police officer training at level 4)
	Q Social science/social services (social work and early care at level 4)
	R Teacher training and education science (compulsory school teaching at level 4)
	S Transport services

Note: Table I depicts the principle in classifying micro-educations. Each of the three upper educational levels consists of 19 fields. Each field has been assigned a letter for identification. Some micro-educations may not exist in reality or may have very small cell counts (for example, there are no law programs at level 4 in Denmark).

Table II: Absolute Rates of Assortative Mating

	35-year-old women		35-year-old men	
	1984-1989 (n=207,937)	2008-2013 (n=204,448)	1984-1989 (n=219,644)	2008-2013 (n=205,735)
Educational attainment^a				
Compulsory school	36.8	13.8	25.7	18.6
High school	3.2	6.4	4.5	6.7
Vocational education and training	35.3	38.4	50.0	47.4
University college	20.8	24.2	11.8	11.5
University	4.0	17.2	7.9	15.9
Assortative mating^b				
Macro-educational assortative mating				
Overall	41.4	37.8	35.9	34.5
Compulsory school	36.0	29.2	43.6	19.9
High school	9.1	8.2	8.4	8.1
Vocational education and training	57.2	54.2	35.3	39.5
University college	27.6	20.9	42.1	39.2
University	48.1	42.6	20.6	44.3
Micro-educational assortative mating				
Overall	13.2	11.5	9.9	11.4
Vocational education and training	12.8	12.4	7.8	9.1
University college	12.4	8.2	19.6	15.7
University	20.6	14.0	8.9	14.9
Singles^c				
Overall	10.0	17.1	18.4	25.6
Compulsory school	9.4	26.2	25.9	41.2
High school	20.1	22.7	29.2	33.2
Vocational education and training	6.9	14.7	14.5	22.1
University college	12.8	13.8	14.5	17.5
University	19.0	17.8	17.7	20.6

Note: Only the earliest and latest period shown for brevity.

^a Column percentages. ^b Assortative mating row percentages, e.g. 41.4 per cent of all 35-year-old women were macro-educationally homogamous in the earliest time period. Micro-educational assortative mating is only possible at the three upper educational levels. ^c Singles are row percentages, e.g. 10.0 per cent of all 35-year-old women were single in the earliest time period.

Table III: Goodness of Fit of Log Linear Models

Models	35-year-old women (n = 1,089,521)				
	<i>df</i>	D	BIC	G ²	ΔG ²
1. Baseline					
<i>1.1 Baseline</i> I + P + T	14,738	24.6	425,906.1	567,475.7	
<i>1.2 Adding the macro layer</i> I + P + T + A	14,733	21.1	249,392.8	390,914.4	+176,561.3
<i>1.3 Adding the field of study layer</i> I + P + T + F	14,722	24.4	420,143.9	561,559.8	+5,915.9
<i>1.4 Adding the micro-education layer</i> I + P + T + B	18,310	21.0	219,304.3	360,355.2	+207,120.5
<i>1.5 Adding the economic layer</i> I + P + T + R	14,737	24.5	352,409.6	493,969.7	+73,506.0
2. Time invariance					
<i>2.1 Full model (common social fluidity)</i> I + P + T + A + F + B + R	14,663	18.7	149,196.4	290,045.6	
<i>2.2 Excluding macro layer</i> I + P + T + B + F + R	14,667	20.7	208,495.7	349,383.3	-59,337.7
<i>2.3 Excluding field of study layer</i> I + P + T + A + B + R	14,679	19.1	160,992.0	301,994.9	-11,949.3
<i>2.4 Excluding micro-education layer</i> I + P + T + A + F + R	14,716	20.7	223,044.8	364,403.1	-74,357.5
<i>2.5 Excluding income layer</i> I + P + T + A + F + B	14,664	18.7	149,923.6	290,782.4	-736.8
3. Time variability					
<i>3.1 Full model (complete variability)</i> I + P + T + A × T + B × T + F × T + R × T	13,935	11.8	10,743.7	144,599.9	
<i>3.2 Time constant macro layer</i> I + P + T + A + B × T + F × T + R × T	13,951	11.9	11,548.8	145,558.7	-958.8
<i>3.3 Time constant field of study layer</i> I + P + T + A × T + B × T + F + R × T	13,999	11.8	10,664.2	145,153.2	-553.3
<i>3.4 Time constant micro-education layer</i> I + P + T + A × T + B + F × T + R × T	14,147	12.1	10,449.2	146,341.9	-1,742.0
<i>3.5 Time constant income layer</i> I + P + T + A × T + B × T + F × T + R	13,939	11.8	11,444.6	145,339.2	-739.3

Note: I = Micro-education of individual; P = Micro-education of partner; T = Time; A = Macro-education layer; B = Micro-education layer; F = Field of study; R = Returns to education. *df*=Degrees of freedom; D=Index of Dissimilarity; BIC=Bayesian Information Criterion; G²=Deviance; Δ G²= Deterioration in model fit.

Table IV: Homogamy Coefficients (Odds Ratios)

Layers	35-year-old women (n = 1,089,521)				
	1984- 1989	1990- 1995	1996- 2001	2002- 2007	2008- 2013
Macro-educational homogamy					
Compulsory school	2.3	2.0	1.9	1.9	2.0
High school	1.9	1.5	1.1	(0.9)	(1.0)
Vocational education and training	1.3	1.2	1.5	1.6	1.5
University college	2.3	2.5	2.1	1.8	1.7
University	8.3	7.6	6.3	6.1	5.5
Field homogamy	2.7	2.7	2.3	2.2	2.0
Economic homogamy	1.0	1.0	1.2	1.2	1.3
Micro-educational homogamy within each macro-educational level					
Compulsory school	-	-	-	-	-
High school	-	-	-	-	-
Vocational education and training	1.7	1.8	1.7	1.6	1.7
University college	9.0	8.1	6.7	5.9	5.1
University	9.6	10.2	7.6	5.6	4.8

Note: For the purpose of presentation, the table is based on a modified version of the full model (3.1), with fields aggregated into a dummy variable of marrying within the field or not, and micro-educational assortative mating is aggregated into a dummy within each macro-educational level (being micro-educational homogamous or not). Odds Ratios in parentheses are insignificant at the 5 per cent level (two-tailed tests).

Table V: *Homogamy Coefficients for Selected Micro-Educations at University and University College Level (Odds Ratios)*

	35-year-old women (n = 1,089,521)				
Micro-Educations at university level	1984- 1988	1989- 1993	1999- 2003	2004- 2008	2009- 2013
5B Architecture	13.8	23.2	37.5	33.8	31.7
5C Business and administration	6.1	4.7	3.2	2.9	2.8
5E Creative arts	9.0	11.5	10.4	8.3	5.8
5F Engineering and engineering trades	14.7	11.4	7.4	7.3	6.9
5G Health	30.7	31.1	18.4	12.9	12.0
5G Medicine	11.0	13.1	17.7	14.5	15.1
5H Humanities	5.4	4.9	4.2	3.0	2.2
5J Law	12.1	12.9	9.3	8.4	7.9
5Q Social science	5.8	5.4	4.3	3.5	3.4
Micro-Educations at university college level					
4C Business and administration	14.6	6.9	3.8	3.3	4.8
4G Health	11.9	12.8	10.6	9.0	9.1
4G Nurse	12.7	10.8	10.4	8.7	7.8
4I Journalism and information	17.8	19.4	28.0	32.7	21.9
4Q Social work and early care	7	5.8	4.4	3.6	3.1
4R Compulsory school teaching	9.4	8.4	6.5	6.7	5.6

Note: Only largest micro-educations shown. Only significant estimates (5 per cent level) and estimates with cells of at least N=30 shown. See appendix A for all estimates.

Figure I: *The Three Categorical Layers of assortative Mating Patterns. Two-Dimensional Matrix of Woman (IP) and Partners' Micro-Education.*

Note: Levels are denoted 1-5, fields are a-e. First sub-figure shows aggregated (macro-educational) assortative mating (grey squares denoting the five hierarchical educational levels). Second sub-figure shows assortative mating by field (squares denote field homogamy across educational levels and net of micro-educational homogamy, e.g. 4c+5c, but not 4c+4c). Third sub-figure shows micro-educational homogamy (diagonal squares). For ease of interpretation, we show the principle in classification by fields (a-e), not the actual number of fields used in our analysis.

Appendix A: Homogamy Coefficients for Micro-Educations at Vocational Educational and Training Level, University College level, University level, and for Fields (Odds Ratios). 35-year-old Women.

35-year-old women (n = 1,089,521)					
	1984- 1989	1990- 1995	1996- 2001	2002- 2007	2008- 2013
Vocational Educational and Training Level					
3A Agriculture, forestry and fishery	12.7	14.1	9.0	8.7	8.1
3B Architecture and building	1.7	1.6	1.3	1.8	2.0
3C Business and administration	1.7	1.7	1.6	1.4	1.4
3D Computing	-	16.8	10.7	6.4	4.7
3E Creative arts	4.4	9.5	11.6	9.1	5.9
3F Engineering and engineering trades	-	1.1	-	1.1	1.3
3G Health	3.7	4.4	3.1	2.2	2.3
3L Manufacturing and processing	1.8	3.6	2.9	2.9	2.7
3N Personal services	1.7	2.9	2.9	2.8	2.6
3P Security services	-	78.0	69.5	48.5	43.4
3S Transport services	-	26.0	13.7	12.3	-
University College level					
4B Architecture and building	21.6	17.8	14.9	10.7	8.4
4C Business and administration	14.6	6.9	3.8	3.3	4.8
4E Creative arts	-	-	107.2	76.9	43.0
4F Engineering and engineering trades	-	9.6	6.3	6.6	4.9
4G Health	11.9	12.8	10.6	9.0	9.1
4G Nurse	12.7	10.8	10.4	8.7	7.8
4I Journalism and information	17.8	19.4	28.0	32.7	21.9
4P Police officer training	-	39.3	53.7	37	38.5
4Q Social work and early care	7	5.8	4.4	3.6	3.1
4R Compulsory school teaching	9.4	8.4	6.5	6.7	5.6
University level					
5A Agriculture, forestry and fishery	-	33.0	38.9	34.4	28.6
5A Veterinary	65.4	47.0	50.1	50.1	38.1
5B Architecture	13.8	23.2	37.5	33.8	31.7
5C Business and administration	6.1	4.7	3.2	2.9	2.8
5D Computing	-	-	48.2	13.0	7.5
5E Creative arts	9.0	11.5	10.4	8.3	5.8
5F Engineering and engineering trades	14.7	11.4	7.4	7.3	6.9
5G Health	30.7	31.1	18.4	12.9	12.0
5G Medicine	11.0	13.1	17.7	14.5	15.1
5H Humanities	5.4	4.9	4.2	3.0	2.2
5J Law	12.1	12.9	9.3	8.4	7.9
5K Life science	33.2	25.5	21.3	15.2	12.1
5M Mathematics and statistics	-	-	25.5	18.0	14.6
5O Physics	-	12.0	9.1	6.9	8.1
5Q Social science	5.8	5.4	4.3	3.5	3.4
Field-of-study					
A Agriculture, forestry, fishery	-	5.4	4.7	5.8	4.3
B Architecture and building	1.4	1.9	1.7	1.6	1.2
C Business and administration	1.5	1.7	1.8	2.0	2.1
D/M Computing, mathematics, statistics	5.5	4.2	3.9	2.9	2.6
E Creative arts	2.8	3.2	3.2	3.8	2.7
F Engineering and engineering trades	2.8	2.4	1.9	1.8	1.6
G Health	4.5	4.7	4.0	3.0	2.5
H Humanities	4.1	3.1	3.6	-	-
Q Social science/social service	2.4	2.1	1.9	1.5	1.4
R Teaching	10.0	6.6	-	5.9	4.7

Note: Only significant estimates shown (5 per cent level) and estimates with cells of at least N=30.

Appendix B: Detailed Frequencies for Micro-Educations for 35-year-old Women, 1984-1989 and 2008-13.

Micro-educations	Women				Men			
	1984-1989 (n=207,937)		2008-2013 (n=204,448)		1984-1989 (n=219,644)		2008-2013 (n=205,735)	
	N	Per cent homo- gamous	N	Per cent homo- gamous	N	Per cent homo- gamous	N	Per cent homo- gamous
1 Compulsory school	76,236	36.0	27,913	29.2	56,519	43.2	38,173	19.7
2 High school, applied	4,167	7.3	7,724	5.9	7,001	6.6	9,567	5.4
2 High school, general	2,326	3.9	5,340	5.3	2,899	3.8	4,168	4.9
3A Agriculture, forestry and fishery	365	23.6	2,284	23.4	6,070	2.1	6,133	9.0
3B Architecture and building	745	17.4	1,498	17.4	21,024	0.8	13,921	1.6
3C Business and administration	44,772	17.2	40,805	16.8	23,534	28.8	23,480	26.8
3D Computing	220	7.7	635	10.2	578	4.2	4,054	1.5
3E Creative arts	971	8.7	1,424	6.4	3,716	1.9	1,624	4.7
3F Engineering and engineering trades	4,590	20.8	3,633	25.9	43,234	2.1	34,136	2.1
3G Health	13,577	1.2	15,294	1.3	922	16.5	1,108	17.6
3H Humanities	1,636	0.4	119	0.0	163	3.1	-	-
3L Manufacturing and processing	1,809	6.0	3,219	10.2	5,468	1.3	5,901	5.2
3N Personal services	4,662	2.7	7,996	4.8	3,220	5.2	3,224	10.7
3P Security services	-	-	348	20.4	536	3.5	904	6.6
3Q Social science/social service	-	-	938	0.4	-	-	256	2.0
3S Transport services	140	12.1	284	8.1	1,410	1.8	2,679	0.9
4B Architecture and building	111	36.0	527	17.8	2,632	1.3	2,602	3.7
4C Business and administration	184	18.5	2,115	8.8	1,552	2.1	2,616	6.5
4E Creative arts	143	9.8	363	10.2	234	3.8	373	10.7
4F Engineering and engineering trades	107	27.1	587	14.7	3,068	1.0	3,366	2.2
4G Health	6,597	2.7	5,525	4.5	680	27.1	1,012	23.8
4G Nurse	7,903	1.4	9,356	1.4	438	33.3	339	32.2
4H Humanities	1,021	0.8	246	0.8	149	6.0	-	-
4I Journalism and information	1,265	9.7	800	12.3	980	12.2	808	12.1
4M Mathematics and statistics	-	-	-	-	-	-	380	2.1
4P Police officer training	-	-	321	38.0	2,333	1.2	1,674	5.6
4Q Social work and early care	14,588	10.3	18,158	7.1	3,690	38.8	4,094	28.3
4R Compulsory school teaching	11,398	29.3	11,434	15.3	8,445	35.8	5,070	31.9
4S Transport services	-	-	-	-	1,625	0.1	1,269	0.6
5A Agriculture, forestry and fishery	-	-	333	14.1	321	8.4	386	14.5
5A Veterinary	161	24.8	552	8.7	269	17.1	201	24.9
5B Architecture	328	26.5	772	19.8	1,088	7.2	658	20.5
5C Business and administration	275	18.9	4,355	20.0	1,983	2.8	6,719	12.7
5D Computing	-	-	449	12.2	-	-	1,564	3.2
5E Creative arts	820	8.9	3,360	11.0	664	10.2	1,935	17.8
5F Engineering and engineering trades	184	35.9	1,360	31.0	2,162	3.0	4,224	11.0
5G Health	983	18.9	1,685	6.8	698	25.5	542	20.8
5G Medicine	1,068	30.9	2,600	22.7	2,401	12.7	1,969	29
5H Humanities	2,213	18.8	8,266	10.0	2,270	15.8	3,833	19.9
5I Journalism and information	-	-	327	8.0	-	-	200	17.0
5J Law	710	24.2	2,563	16.1	1,340	11.8	2,150	17.5
5K Life science	235	24.7	934	7.8	648	7.4	637	15.1
5L Manufacturing and processing	-	-	287	3.8	-	-	-	-
5M Mathematics and statistics	-	-	484	14.0	414	3.4	857	7.1
5N Personal services	-	-	218	10.1	-	-	341	7.9
5O Physics	121	15.7	711	10.7	668	2.5	1,290	5.7
5P Security services	-	-	-	-	259	0.4	542	1.7
5Q Social science	799	18.3	4,650	14.9	1,882	5.4	3,966	17.5
5R Teacher training and education science	110	9.1	1,135	2.8	131	5.3	473	6.8

Note: Only cells with N>100 shown.

Appendix C: *Increase in Average Returns to Education at the Macro-Level for Men and Women between 1984-1989 and 2008-2013*

Note: Three-year averaged net earnings for 44-46-year-old women and men, separate for each macro-educational level. Lines show increase in average net earnings from the earliest to the latest period.

Appendix D: Variation in returns to education 1984-2013 for each micro-education

Note: Three-year averaged net earnings for 44-46-year-old women and men, for each micro-education. The boxplot to the left show variations in returns to micro-educations for the university college (4) and university level (5). The figure to the right shows changes in returns (as changes in income percentiles) for each micro-education for the earliest and latest period (1984-89 to 2008-13; only those with N>100 shown).

Appendix E: *Increase in numbers of unique programs offered within each micro-education, 1984-2013*