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ABSTRACT

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This paper reports evidence on the strong tendency of the college educated to match with partners who graduated in the same field of study – a dimension of assortative matching that has been overlooked thus far. We employ Labor Force Survey data covering most EU countries to measure the extent of field-of-study homogamy in prevailing married and cohabiting couples within several years of college graduation. We find that field-of-study homogamy increases almost immediately after graduation to reach very high levels, especially for spouses working in the same industry, and that it varies dramatically across countries. Graduates in Social Sciences display a particularly strong tendency towards homogamy and also have the highest matching theory-implied match gains from homogamous matches.

JEL Classification: I23, J13, J16

Keywords: field-of-study homogamy, college graduates, marriage and cohabitation

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1 Introduction

Positive assortative mating is a central feature of marriage markets and the subject of much research in evolutionary psychology, economics, sociology, and demography.[1] *Educational homogamy*—the tendency to match based on one's level of education—has received particular attention in the literature since it affects household inequality (Fernández, et al., 2005; Schwartz, 2013; Greenwood et al., 2014) and marriage returns to education (Goldin, 1997; Chiappori, et al., 2009).[2] Educational homogamy has increased since the 1970s (Siow, 2015) and is particularly strong among college graduates (Schwartz and Mare, 2005). A related, smaller body of work focuses on the tendency to match within occupations (Kalmijn, 1994; Mansour and McKinnish, 2014; McClendon et al., 2014).

The burgeoning literature on assortative matching has thus far ignored one potentially important dimension: matching on the field of study. This is again particularly relevant for college educated, for whom differences in (causal) wage returns across fields of study can be as large as the college wage premium (Hastings et al., 2014; Kirkebøen et al., 2014; Altonji et al., 2015, in press), and where field-of-study choices have been linked to fertility (e.g., van Bavel, 2010). If college graduates tend to match into couples within their field of study, the large differences across these fields in both earnings and in the availability of family-friendly careers could lead to sizeable consequences for household inequality and family formation.

In this paper, we provide the first available systematic evidence on the extent to which college graduates of each gender match into marriage/cohabitation couples across fields of study. We do so for most EU countries, using the European Labor Force Surveys, which since 2003 distinguishes eight broad fields of study for each respondent. The cross-sectional data allow us to document *field-of-study homogamy* (hereafter FSH) trends for couples in

[1] Schwartz (2013) provides a recent survey of the sociology and demography literature. Belot and Francesconi (2013) offer an extensive set of references to the theoretical work in economics on search and matching as well as to the evolutionary psychology literature studying assortative mating preferences.

[2] The rising marriage return to college for women (Ge, 2011; Chiappori et al., 2015) may help to explain why women now represent the majority of college graduates across the developed world (Becker, et al., 2010).

prevailing marriages/cohabitations. Specifically, we observe the entire post-college evolution of FSH for graduation cohorts starting in 2003; for earlier graduation cohorts, we map FSH patterns of prevailing marriages/cohabitations from 2003 to 2013. We focus on the 80% of couples involving a college graduate in which both partners are college-educated. Our analysis is based on country-wide groups of graduates in the same field of study and therefore asks about the combined channels of meeting potential partners in a study program and in marriage market-wide social and workplace networks linked to one's field of study.

Using measures that are 'marginal-free' (i.e., independent of supply structure), we uncover a staggering extent of FSH among couples formed by college graduates in the 24 EU countries we study, particularly among couples employed in the same industry. There is even a significant extent of FSH in matches formed by a college graduate and a high-school graduate. College fields of study differ significantly in their FSH patterns: Match log odds ratios across pairs of fields—the 'forces of attraction'—are particularly high for graduates in Agriculture and are low for graduates in Social Sciences who are thus relatively compatible with graduates from other fields. Log-linear-model-based decompositions of EU-wide matching patterns imply that FSH among college graduates grows rapidly after graduation and then plateaus, with little evidence pointing to EU-wide survey-year trends in FSH.

We also consider the interplay of FSH with the gender composition of fields of study. First, we demonstrate the direct relationship of FSH to the stark cross-field differences in meeting opportunities implied by the uneven representation of women across college fields of study. Next, we show how countries differ in their use of the FSH potential implied by the supply structure of graduates as reflected by the field marginal distributions of formed matches. Finally, we employ the Choo and Siow (2006) matching model, which incorporates cross-field substitution effects, to interpret the observed matching patterns. The model implies that graduates in Social Sciences, who display the highest degree of homogamy based on 'marginal-free' measures, also generate the highest matching gains from homogamous matches after accounting for supply structure.

2 Data

Our analysis is based on the EU Labour Force Survey (LFS), which provides information on college graduates and their marriage/cohabitation status in 24 EU countries.[3] We employ the 2014 release of the EU LFS covering reference years 2003 to 2013, when information on field of study is available in the data, and focus on individuals with ISCED education levels 5 and 6 who graduated between the ages of 20 and 44. We restrict our attention to matching outcomes of the 360,072 female and 321,069 male college graduates from 252 country-reference year LFS samples who graduated between 1993 and 2013. For each such college graduate we observe the year of graduation, education level, and field-of-study of their partner, if they have one.[4]

We study couples sharing the same household. The EU LFS data record the presence of "spouses or cohabiting partners in the same household" and we refer to such couples as 'marriage/cohabitation' matches. The inclusion of cohabiting couples in the analysis of FSH is motivated by the growing importance of cohabitation (see, e.g., Choo and Siow, 2006, or Schwartz, 2010). Next, we use a separate LFS question about the marital status of respondents to divide these couples into either married or cohabiting. In total, we observe 128,040 marriage/cohabitation couples formed by two college graduates, of which 95,497 (75%) are married.[5] There are an additional 58,412 marriage/cohabitation couples in our data formed by a college graduate and a less educated partner; in 32,593 of these it is the woman who holds a college degree. Hence, of the college graduates of either gender

[3]The focus on graduates, dictated by the data we use, reflects gender differences in both initial choices of field of study and in completion rates (Alon and Gelbgiser, 2011).

[4]The share of sampled individuals with missing education level or field generally does not exceed 5% in any of the country-year data cells. The Data Appendix provides details on our data sources.

[5]Under 5% of college graduates who report being married do not share their household with their spouse. We count them as single. We also omit from the analysis those couples where a college graduate who fulfils our sample criteria is matched to another college graduate who graduated before 1993 or graduated outside of the 20-44 age range. Including this group in the data does not affect the measured aggregate level of FSH.

in marriage/cohabitation couples in our recent EU data, about 80% are in 'college-college' pairs, corresponding to the high degree of educational homogamy explored extensively in the existing literature. Our analysis of FSH focuses on these college-college couples. We classify them as homogamous or not depending on whether both partners graduated from the same broad field of study. The LFS data recognize eight fields of study—Education, Humanities, Social Sciences, Science, Engineering, Agriculture, Health, and Services.[6]

The data cover the complete post-college matching pattern for cohorts of graduates from 2003 onward. For earlier graduation cohorts, we observe prevailing matching outcomes as of several years after graduation. It is possible that some of the couples we observe were formed prior to their choice of field of study in college. To a degree, this could correspond to same-field-of-study matching preferences. However, it could also be that randomly formed pre-college matches lead to both partners choosing the same field of study. In the absence of longitudinal information, we cannot disentangle these mechanisms.

The Data Appendix Table shows for each country and gender the number of sampled college graduates in the data together with the number of college-college matches, the number of matches formed by a college graduate and by a less educated partner, and the number of unmatched. Sample sizes vary widely across countries; we employ LFS sampling weights (corresponding to the female in each couple) in all of our analysis.

Ours appears to be the first available European panel on marriage/cohabitation patterns of college graduates by field of study, but it shares similar features with datasets employed in recent analyses of matching markets. Similar to Chiappori et al. (2014), we rely on cross-sectional surveys (the US CPS in their case, the EU LFS in ours) to study bidimensional matching in the marriage market when census data do not cover one of the important matching dimensions (smoking in their case, field of study in ours). Our analysis is based

[6]In Bičáková and Jurajda (2014) we use UNESCO population statistics on the gender structure of graduates by field of study to show that the LFS coding of fields of study is consistent with administrative data: The correlation of the UNESCO population shares of women in each graduation year-country-field cell with those measured with sampling error in the EU LFS is 0.97.

on country-wide groups of graduates in the same field of study. In this regard, our approach is similar to that of McClendon et al. (2014), who rely on US-wide measures of occupation-specific education levels to contrast marriage market outcomes across occupations that differ in their share of college graduates. Finally, similar to Schwartz and Mare (2005), who study educational homogamy, we map matching patterns in prevailing matches (as opposed to doing so for newlyweds). As argued in detail in Schwartz and Mare (2005), prevailing matches are relevant for analyzing household-level inequality and for considering child environments.[7]

3 Measuring Field-of-Study Homogamy

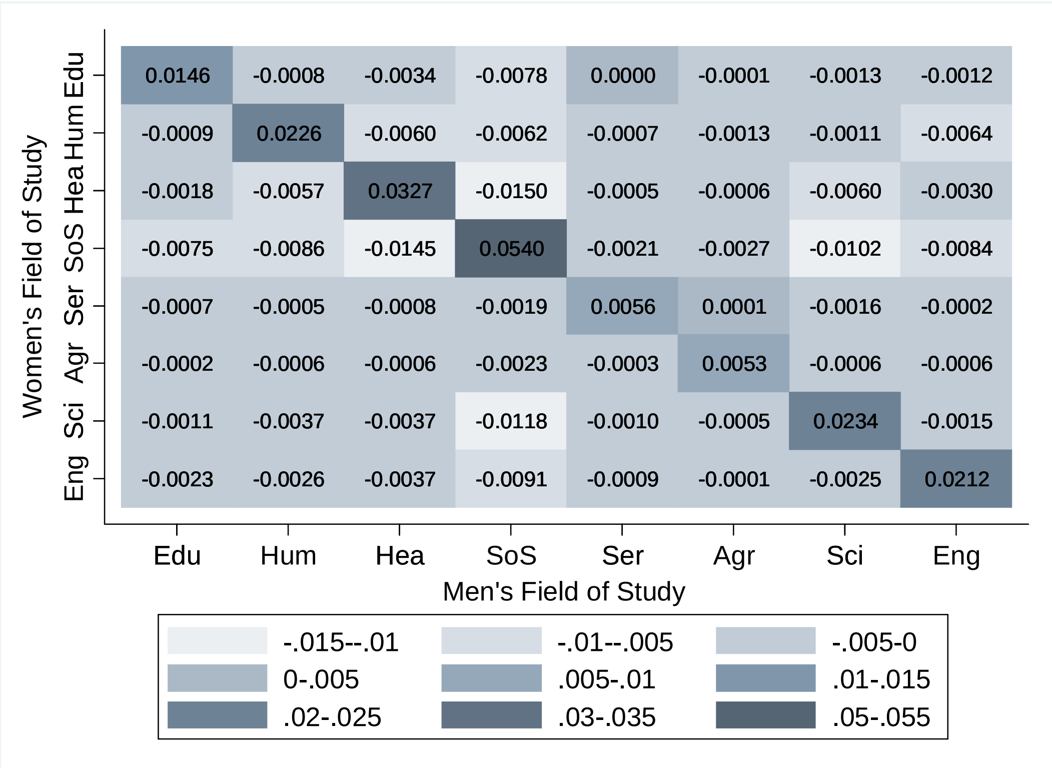
3.1 Overall Extent of FSH

We begin our analysis by mapping the field-of-study structure of matches formed between two college graduates at the EU level. 36.4% of the 128,040 marriage/cohabitation couples formed by two college graduates in our LFS sample are homogamous, i.e., formed by graduates from the same field of study. Since it is not clear to what extent this high share is driven by assortative mating on the field of study and to what extent it corresponds to the field-of-study composition of men and women (field marginal distributions), we contrast the pattern of matches against the natural benchmark of random (independent) matching in Figure 1, which offers a visualization of EU-wide FSH. The figure shows a field-by-field (8x8) matrix of match types; men's fields of study correspond to columns of the match matrix, women's to rows. The elements of the match matrix give the difference between two match distributions: the share of all matches of a given match type minus the benchmark share predicted under the assumption of independent matching using the marginal distributions of formed matches across fields of study. The counterfactual assumption (the benchmark comparison) is thus that fields of study play no role in match formation.

[7] Prevailing matches reflect the structure of newlyweds combined with separation and re-match patterns. Schwartz and Mare (2012) and Schwartz and Han (2014) study marriage separations by educational homogamy. We know of no work on separations and FSH.

Figure 1: College-to-College Match Distribution against the Benchmark of Independent Matching; All EU-LFS Couples Observed from 2003 to 2013.

Note: Weighted by LFS sample weights. Fields of study: Education (Edu), Humanities (Hum), Social Sciences (SoS), Science (Sci), Engineering (Eng), Agriculture (Agr), Health (Hea), and Services (Ser).



More formally, let μ_{ij} denote the match frequency of couples formed from men of type i and women of type j, where $i, j = 1, ..., K$ corresponds to fields-of-study groups so that $K = 8$ in our case. Let $T = \sum_{i=1}^{K} \sum_{j=1}^{K} \mu_{ij} = \sum_{i=1}^{K} \mu_{i\cdot} = \sum_{j=1}^{K} \mu_{\cdot j}$ denote the total number of formed matches. The 'marginal-free' match counts then equal $\overline{\mu}_{ij} = \mu_{ij}/T - \left(\mu_{i\cdot}\mu_{\cdot j}/T^2\right)$.[8]

The shading of the match matrix elements in Figure 1, which corresponds to the size of

[8] Throughout the paper, we present EU-wide matching statistics aggregated from country-specific matching markets. For example, the EU-wide $\overline{\mu}_{ij}$ values presented in Figure 1 correspond to averages of country-specific values weighted by country total match counts. We also calculated all of the presented matching statistics based on the EU-wide sample of matches and the results were practically identical.

each cell (the EU-wide $\overline{\mu}_{ij}$ value), clearly shows strong FSH on the diagonal of the match matrix, with weaker FSH among graduates in Services and Agriculture and particularly high degree of FSH in Social Sciences and also in Health. The least likely matches, relative to the benchmark of random matching, are to be found between graduates in Health and Social Sciences.

A natural summary of the extent of FSH across the entire matching market is provided by the ratio of the actual share of homogamous matches and the share of homogamous matches one would expect under the random matching assumption (employed as a benchmark in Figure 1). The ratio of the two diagonal shares, a 'marginal-free' homogamy measure, allows us to compare the extent of FSH across broad groups of graduates. The index, denoted H, expresses FSH in percentage points, with 0 corresponding to no tendency towards FSH:[9]

$$H = 100 * \left(\frac{\sum_{i=1}^{K} \mu_{ii}/T}{\sum_{i=1}^{K} (\mu_{i \cdot} \mu_{\cdot i}/T^2)} - 1 \right). \tag{1}$$

The EU-wide H value corresponding to Figure 1 is 98.8% with a boot-strapped 95% confidence interval of 96.2 to 101.4. Hence, in our EU-LFS data, a randomly picked couple is almost twice as likely to be homogamous than would be predicted from matched marginals under random matching.

To shed light on whether FSH is a phenomena affecting only 'college-college' matches, we calculate the H index value corresponding to marriage/cohabitation couples formed by a college graduate and a high-school graduate who reports his or her field of study in the EU LFS. There are 58,412 marriage/cohabitation couples in our data between a college graduate and a less educated partner; in 85% (49,716) of these couples, the partner of the college graduate is a high-school graduate who reports a field of study.[10] The value of H for the

[9] One could alternatively measure the marginal-free 'global' extent of FSH using the ratio of the geometric means of diagonal and off-diagonal matches. However, such measure, which in a 2x2 case closely resembles the 'local' log odds ratios, is sensitive to the distribution of matches among the off-diagonal match cells, which makes it less attractive.

[10] The other high-school graduates matched to a college graduate attended general secondary programs with no specific field of study.

'high school-college' couples with field of study reported is 25.6% (25.8%) for the 27,664 (22,052) couples where the college graduate is a woman (man).[11] That we find significant FSH in couples formed between high school graduates and college graduates is perhaps surprising given the likely differences in field-of-study content and given the potential field-of-study coding differences between secondary and tertiary education programs. This finding underscores the strong tendency towards FSH uncovered above for 'college-college' couples. Given the smaller sample size and the measurement difficulties involved in capturing FSH among high-school graduates, we focus the rest of our analysis on 'college-college' couples.

Our next question is whether FSH among 'college-college' couples corresponds primarily to married couples, which represent 75% of our 128,040 marriage/cohabitation matches. The answer is clearly no. The H value corresponding to the 95,497 married couples is 100.3% while the H based on the 32,543 cohabiting couples is almost identical at 98.7%. The match matrices corresponding to Figure 1 are almost identical for these two groups: The correlation of the 64 $\overline{\mu}_{ij}$ values across the two matrices is 0.99. The similarity of FSH for married and cohabiting couples motivates the joint analysis of both couple types in the rest of our analysis.

Finally, do homogamous and non-homogamous couples (formed by two college graduates) differ in their age—a basic match characteristic? While the mean age (by gender) of members of homogamous couples is indistinguishable from that of non-homogamous couples, members of homogamous couples are somewhat closer in age and also in terms of graduation year than members of non-homogamous couples. The average gap between partners in year of graduation is 3.4 for non-homogamous couples and only 2.6 for homogamous couples (the comparison is similar when based on the age gap within couples). Further, the share of homogamous couples who have graduated from college in the same year is higher, at 25%, compared to the corresponding share of non-homogamous couples, which stands at 14%.[12]

[11] Both of these measures are statistically significantly above 0 based on bootstrapped standard errors of 3.45 and 2.90 for women and men, respectively.

[12] Of the 128,040 marriage/cohabitation couples in our data composed of two college graduates, 97% graduated from college within 10 years of each other. The value of H for the 3% of couples in our sample who

This could correspond to couple formation being driven by social networks related to college studies, an issue we return to in Section 3.3.

3.2 Field-Specific FSH

How does the degree of positive assortative matching vary across pairs of fields of study? We answer this question using the local log odds ratios of match counts for pairs of fields, $\ln\left(\frac{\mu_{ii}\mu_{jj}}{\mu_{ij}\mu_{ji}}\right)$, which represent a standard measure of positive assortative matching and are often interpreted as 'forces of attraction' in the demography and sociology literature. These building blocks of log-linear models (estimated in the next section) are invariant to changes in marginal distributions (are 'marginal-free') and they also correspond to the degree of complementarity of marital output within the matching model of Choo and Siow (2006) (hereafter, the CS model), which empirically implements Becker's (1973) transferable utility model of a friction-less competitive marriage market. The CS model thus provides a behavioral justification for measuring the local log odds ratios.[13]

The 28 local log odds ratios corresponding to all pairwise comparisons of our eight fields of study are (sorted and) presented in Table 1. All of the values are much above 0, statistically significantly so (with p values below 0.001 based on bootstrapped standard errors), implying strong positive assortative matching. Within the CS model, the sum of matching outputs from homogamous matches exceeds the sum of matching outputs from mixed-field matches in all pairwise field comparisons. The minimum 'force of attraction' is between Social Sciences and Engineering, while the maximum occurs for the combination of Humanities and Agriculture. The perhaps intuitive interpretation of these comparisons in terms of the CS

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graduated more than 10 years apart is much lower, at 2.94, compared to that for couples who graduated within 10 years of each other, whose H is 5.27.

[13]Within the CS model, Siow (2015) derives a test of positive assortative matching across an ordered matching dimension, which asks whether local log odds ratios are above 0 for all 2x2 comparisons along the diagonal of the match matrix. In our unordered match case, this corresponds to asking whether the ratios are above 0 for all pairwise field-of-study comparisons.

model is that the value of matching within one's field of study (relative to a given mixed-field alternative) is particularly high for pairs of fields involving Agriculture and is relatively low for pairs of fields involving Social Sciences (with the exception of the pairing with Agriculture). While graduates in Social Sciences are relatively 'open' to matching with graduates from other fields of study (and while Science and Engineering are also highly compatible), the value of matching within one's field is very high when the alternative is a non-homogamous match between a graduate in Humanities and one in Agriculture.

Table 1: 'Local' Log Odds Ratios

Field Pair		log odds	Field Pair		log odds	Field Pair		log odds
SoS	Eng	1.84	Eng	Ser	3.00	Ser	Sci	3.69
SoS	Hum	2.20	Eng	Hum	3.06	Hum	Hea	3.79
Sci	Eng	2.24	Eng	Edu	3.17	Agr	Eng	3.89
SoS	Sci	2.34	Eng	Hea	3.17	Agr	Edu	4.19
SoS	Ser	2.55	Sci	Hum	3.19	Ser	Edu	4.30
SoS	Edu	2.65	Hea	Edu	3.39	Agr	SoS	4.33
SoS	Hea	2.73	Hea	Sci	3.44	Agr	Sci	4.93
Edu	Hum	2.98	Hea	Ser	3.53	Agr	Ser	5.43
Edu	Sci	2.99	Ser	Hum	3.68	Agr	Hea	5.45
						Agr	Hum	5.86

Notes: Each entry shows the value of the log odds ratio for a given pair of fields of study calculated using college-to-college matches observed in the 2003-2013 EU-LFS, weighted by LFS sample weights. Fields of study: Education (Edu), Humanities (Hum), Social Sciences (SoS), Science (Sci), Engineering (Eng), Agriculture (Agr), Health (Hea), and Services (Ser).

For comparison, the log odds ratio corresponding to the education-*level* 2x2 match matrix considering only the level of education, i.e., college vs. less than college, is 1.83. All of our pairwise field comparisons thus display a stronger tendency towards positive assortative matching than the much studied educational dimension of homogamy.

3.3 Decomposing FSH Trends

A natural inquiry is whether FSH changes over time. Our data provide only limited time coverage, but it is tempting to plot the aggregate evolution of H. However, such changes may be due to several distinct potential sources: H can change over time thanks to marriage-market-wide shocks to FSH affecting all market participants, thanks to a changing propensity towards FSH across successive graduation cohorts, or, possibly, thanks to a changing composition of our sample over time with respect to the years since graduation when matched couples are observed. To provide an informative view of the EU-wide trends in FSH, we thus estimate log-linear (Poisson) regressions (used widely in sociology and demography, see, e.g., Schwartz and Mare, 2005, or Blossfeld, 2009) to decompose trends in FSH to aggregate year, graduation-cohort year, and years-since-graduation effects.

Specifically, the analysis distinguishes types of ij couples (where $i, j = 1, ..., K$ denotes fields-of-study groups) corresponding to additional indices we now introduce: t for the calendar year when a given matched couple is observed, y for graduation year of the matched college graduate, and s for the years since graduation ($s = t - y$). Our FSH trend analysis is performed separately from the perspective of either gender, but we omit the gender subscript here for the sake of the exposition.[14] We consider separately two balanced 'data windows' in terms of years since graduation: $s = 0, 1, ..., 5$ and $s = 6, 7, ..., 10$. This allows us to separately track FSH trends early vs. late after college graduation. The full $0 \leq s \leq 5$ window is observed (in the 2003-2013 LFS samples) for graduation cohorts $y = 2003, ..., 2008$; the $5 < s \leq 10$ window is observed for graduation cohorts $y = 1998, ..., 2003$.

We follow the literature (e.g., Schwartz and Mare, 2005), and focus on FSH trends by conditioning on a set of fully saturated time-constant fixed effects λ_{ij}, which corresponds to the average tendency to match across fields of study. The matches corresponding to the ij (8x8) match matrices observed across the available ty combinations are explained as follows:

$$\ln \mu_{ijyt} = \lambda + \lambda_{ij} + \sum_{l=t,y,s} (\lambda_{il} + \lambda_{jl}) + \gamma_y^D + \gamma_t^D + \gamma_s^D, \quad (2)$$

[14]When two members of a college-educated couple graduated in different years, the y index (as well as the s index) will differ for this couple depending on whether we measure FSH from the perspective of male or female college graduates.

where λ_{it} and λ_{jt} denote a set of time-changing (marginal) fixed effects, and where γ_t^D denotes a calendar-time homogamy fixed effect, which corresponds to diagonal elements of the match matrix. This traditional list of controls is expanded by also allowing for graduation-cohort effects in order to focus on the role of colleges in structuring matching markets for college graduates. Specifically, λ_{iy} and λ_{jy} capture the cohort-specific marginal distributions by gender, and γ_y^D, which again corresponds to diagonal elements of the match matrix, tracks the evolution of homogamy across successive graduation cohorts. Finally, we parametrize the evolution of FSH by years s since graduation in a similar fashion using γ_s^D. The γ_t^D parameter captures the aggregate market-wide evolution of FSH conditional on the cohort structure of the matching market captured by the γ_y^D and γ_s^D parameters. The often-cited feature of this approach is that the γ parameters are estimated whilst conditioning on own-type marginals, i.e., that they are 'marginal-free' (similar to the H index).

Specifications based on equation 2 were estimated for the EU-wide sample of respondents.[15] In none of our estimated specifications do the γ_y^D or the γ_t^D coefficients reach conventional levels of statistical significance, individually or jointly; they also all remain small. We thus detect no evidence of EU-wide time or graduation-cohort trends. However, in the $0 \leq s \leq 5$ window we find that FSH increases rapidly after the year of graduation (year 0) with no further gradient detected in the $5 < s \leq 10$ window. Table 2 shows estimated γ_s^D coefficients for the $0 \leq s \leq 5$ window. The first column, based on all female respondents, implies that FSH increases immediately after graduation and is relatively flat afterwards.

There are two key mechanisms that could underlie this pattern: First, matches effectively formed during study years (in an education program or in social networks related to one's field of study) may lead to observable common households (matches) only with some delay after graduation. One would expect this type of FSH gradient to plateau within a few years of graduation. Second, homogamous matches could additionally be initiated within workplace interactions to the extent that workplaces are segregated across fields of study (i.e., hospitals

[15]We insert the $\mu = 1$ value into the logarithm of match counts for match-matrix cells with no observed matched couples. Robustness checks are discussed in the Appendix Section 6.

Table 2: FSH Trends in Log-Linear Regressions

Year-since-graduation effects (relative to year 0)			
γ_1^D	**0.523**	**0.796**	0.239
γ_2^D	**0.458**	**0.924**	**0.517**
γ_3^D	**0.656**	**1.022**	**0.717**
γ_4^D	**0.629**	**0.888**	**0.709**
γ_5^D	0.517	**0.954**	0.453
Same industry	n.a.	Yes	No
Number of match cells		1,280	

Notes: Each entry shows a homogamy γ_s^D coefficient from regression specifications based on equation 3. The LFS sampling weights are employed. Bolded coefficients are statistically significant at the 10% level.

vs. IT companies). Such a contribution of workplace interactions for FSH could be expected to grow in importance with years since graduation as the effect of social networks formed while in school fades away.

While we cannot directly disentangle these two mechanisms without data on the timing of initial match formation and on complete labor market histories, we can provide an initial insight into this issue by asking whether the structure of FSH is related to the couple's industry of employment. To this effect, we calculate H values and estimate γ parameters for the subset of couples sharing the same industry (when sampled) and those working in different industries.[16] The LFS data distinguish 1-digit NACE industries; we use the industry of the current employer for respondents who are employed at the time of the survey and the industry of the previous employment for jobless respondents. Of the 128,040 college-college couples in our data, we observe 30,041 couples where the partners share the same industry

[16] This is only a first-step approximation of the workplace-as-meeting-place matching channel. Respondents who currently work in different industries could have worked in the same industry at the time of the initial match formation; similarly, those who met while working in different industries may have joined the same industry after matching. Homogamous couples formed in school could also be more likely to work in the same industry. Future work on this issue requires the use of longitudinal data.

of employment and 91,614 couples working in different industries.[17]

The H value for the same-industry group is very high at 204.8%, while the H value corresponding to the different-industry group is much lower at 58.5%. Next, Table 2 contrasts the estimated FSH year-since-graduation trends for these two types of couples (observed in the $0 \leq s \leq 5$ window). We find that the gradient of FSH in terms of years since graduation is both more rapid and reaches higher levels for the same-industry group.[18] To the extent that one expects workplace interactions to gradually dominate social networks built during college studies as a source of FSH, these results are consistent with quantitatively important workplace-based matching.[19]

4 FSH and Supply Structure

The descriptive analysis provided above represents only a first step towards understanding FSH. One dimension of our analysis worth considering is that we took the total number of matched (by type) as given (exogenous) when calculating our FSH indices. In the following three sub-sections we consider also the *available* (supply) marginals $\widetilde{\mu}_{i\cdot}$ and $\widetilde{\mu}_{\cdot j}$ corresponding to the men in field i and women in field j, respectively, who could form homogamous matches. By accounting identity $\widetilde{\mu}_{i\cdot} = \sum_{j=1}^{K} \mu_{ij} + \mu_{i0} = \mu_{i\cdot} + \mu_{i0}$, where μ_{i0} is the number of unmatched men of type i. Similarly, $\widetilde{\mu}_{\cdot j} = \mu_{\cdot j} + \mu_{j0}$.

4.1 FSH Potential Across Fields

In any market equilibrium setting, matched marginals are likely to be influenced by the marginal distributions of potential partners—by supply structure. To provide initial insight

[17]The remaining group consisting of couples where at least one spouse does not have significant labor market experience was too small to generate reliable inference.

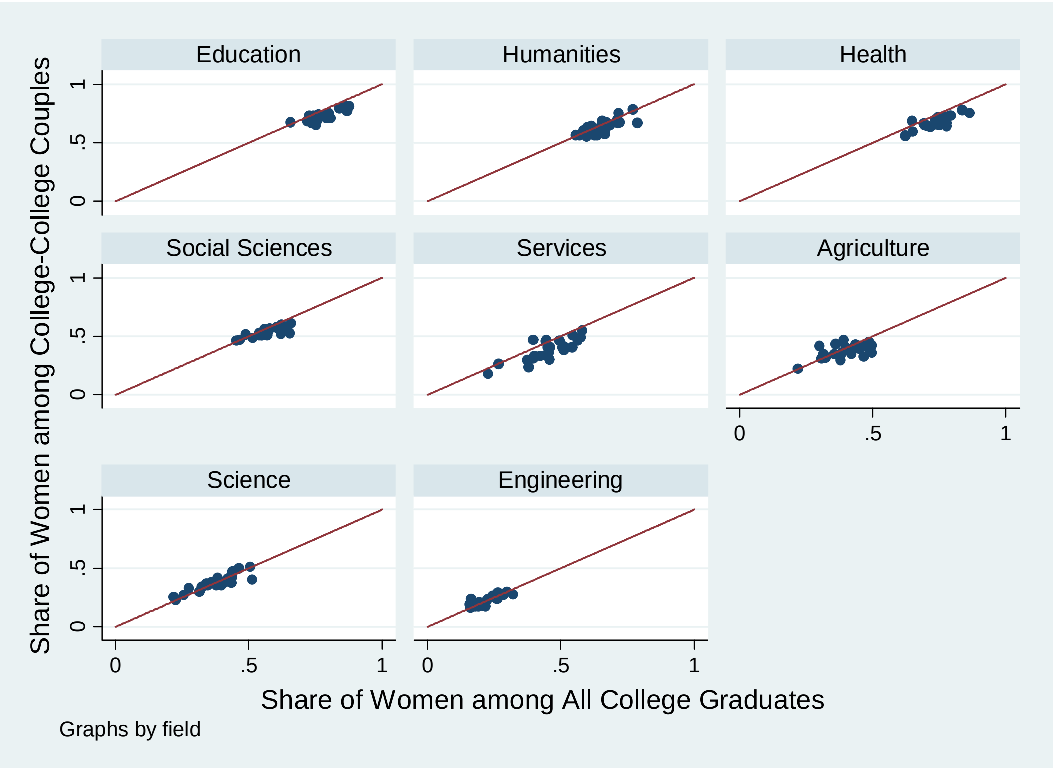
[18]We again do not detect any gradient in the $5 < s \leq 10$ window.

[19]In related work, Mansour and McKinnish (2014) study occupation-based matching. Svarer (2007) and McKinnish (2007) study the marriage market consequences of the gender composition of the workplace.

into the issue, we compare the gender structure of supply and matched marginals in Figure 2. The shares of women among available graduates, 24 for each field of study corresponding to the 24 EU countries in our data, are shown on the horizontal axis. Each graph also compares (against the 45-degree line) the share of women on all sampled college graduates to the corresponding field-specific share of women on 'college-college' couples.

Figure 2: Country-Specific Percentages of Women in College Graduates by Field

Note: For each EU country, the graphs show the share of women by field of all college graduates vs. the corresponding share of graduates who are matched to another college graduate. LFS weights are employed.



Conditioning on being matched to another college graduate does not result in a gender structure that differs markedly from that of the entire matching market of college graduates. Figure 2 thus suggests that differences between supply and matched marginals may be small,[20] but this is clearly an important avenue for future research. The Figure also il-

[20]This is consistent with the highly gender-unbalanced supply structure by field of study having only a

lustrates the limited extent of cross-country variation in the share of female graduates by field of study: Engineering is the most 'male' field in almost all countries in our data, while Education is typically the most 'female' field.

The fact that women continue to be unevenly represented across college fields of study (as shown by, e.g., Charles and Bradley, 2009) implies dramatic cross-field differences in the meeting opportunities of college graduates and in the potential for FSH. In particular, the field-of-study gender supply structure has a direct, mechanical effect on the maximum extent of FSH. Consider the most 'male' field of study, engineering, where men represent about 80% of graduates. Most male engineering graduates will not be able to find a female partner within their field of study. On the other hand, women, who form about 20% of all engineering graduates in our data, face an abundant supply of male peers (potential partners) in their field of study. It is therefore not surprising that among the marriage/cohabitation matches involving female college graduates in engineering and male college graduates in any field, 60.5% of matches are homogamous. For comparison, in services, the most gender-balanced field of study, the corresponding share is only 22.3%.

Table 3: The Share of Homogamous Couples on All 'College-College' Couples

	Women	Men
Highly 'male' fields of study	0.56	0.15
Balanced fields of study	0.37	0.44
Highly 'female' fields of study	0.19	0.50

Notes: Each entry shows the share of homogamous couples on all marriage/cohabitation couples formed by two college graduates. The LFS sampling weights are employed. Balanced fields of study are those with shares of women between 25 and 75%. The gender structure of each field of study corresponds to the average (taken across all available cohorts) of the share of women on all college graduates by country.

Table 3 provides a more general statement of these tendencies: It shows the shares of

limited effect on the ability of college graduates to form 'college-college' couples. See Bičáková and Jurajda (2015) for a similar conclusion with respect to fertility of college graduates based on a more detailed difference-in-differences analysis.

FSH couples on all couples formed by two college graduates in our EU LFS sample separately for gender-balanced and unbalanced fields of study. Clearly, the choice of study field has substantial consequences in terms of one's ability to form homogamous matches, i.e., with respect to the structure of marriage-market returns. Given the strong tendency towards FSH, the relationship of field-of-study choice to FSH potential, i.e., the endogeneity of the supply marginals with respect to FSH, is an important area for future research.

4.2 FSH Potential Across Countries

There are large cross-country differences in the extent of FSH: H values corresponding to all 'college-college' couples range from 56% in Latvia to 142% in Slovakia, with a simple cross-country average of 96.6%.[21] There is a number of potential determinants of country levels of FSH[22] and only 24 country observations in our data; this makes it difficult to provide a comprehensive understanding for these cross-country differences in marginal-free homogamy. In the concluding section, we provide suggestions for which determinants are worth exploring with more extensive data and on how cross-country comparisons can be used to study the underlying sources of FSH. In this section, we instead use the limited available cross-country comparisons to continue exploring the relationship between FSH and the gender composition of fields of study: We ask whether the extent of FSH is related to how well (how efficiently) countries utilize the potential for FSH implied by the supply structure as reflected in the

[21] The country-specific number of 'college-college' couples available in the EU LFS (shown in the Appendix Table 5) ranges from 542 for Estonia to 18,798 for Germany, and it averages at 5,335 per country. Therefore, sampling error will affect H values in small samples. The differences in H values, however, are almost equally large within the subset of countries where the number of observations is above 5,335: Here, H ranges from 61% in the Netherlands to 133% in Germany, with bootstrapped standard errors of 2.15 and 3.77, respectively.

[22] Among the possible country-level determinants of FSH are the extent of gender stereotypes in occupational choice, gender wage gaps and labor-force participation gaps by field of study, the degree to which highly 'female' fields of study are linked to family-friendly career paths, and the intergenerational transmission of FSH (as suggested in Mare, 2016, for educational homogamy).

marginal distributions of formed matches.[23]

As illustrated in the previous section, a more gender segregated composition of fields of study implies a lower potential for FSH. The maximum potential share of homogamous matches under a given marginal distribution of matches, denoted P, is given by[24]

$$P = \sum_{i=1}^{K} \widehat{\mu_i}/T \text{ where } \widehat{\mu_i} = \min[\mu_{i\cdot}, \mu_{\cdot i}]. \tag{3}$$

Achieving this maximum potential would result in a value of the H index (defined by equation (1)), which reflects two properties of the marginal distributions of matches:

$$H(P) = \ 100 * \left(\frac{P}{\sum_{i=1}^{K} (\mu_{i\cdot}\mu_{\cdot i}/T^2)} - 1 \right). \tag{4}$$

The EU-wide value of $H(P)$ is 298% and there is much variation across countries around this aggregate value.[25] Figure 3 contrasts the country-specific values of $H(P)$, the (appropriately normalized) marginal-implied potential for FSH, with the corresponding actual extent of FSH (the H value, again normalized by the random-match counterfactual). The figure suggests that countries with a higher FSH potential have a higher marginal-free extent of FSH. Further, groups of countries clearly differ in the degree to which they utilize their FSH potential: Romania, Bulgaria, Hungary, Greece, and Slovakia use more than 40% of their FSH potential. In contrast, Latvia, the Netherlands, Cyprus, Ireland, and the UK use as little as 25% of their FSH potential. Both of these groups span the entire range of FSH potential values, suggesting that varying degrees of gender segregation of field of study in college are consistent with both high and low degree of utilization of FSH potential and that the utilization rates are driven by country-level structural factors.[26]

In Figure 4 we ask whether the gender culture of a country is related to the rate at

[23] Clearly, country-level determinants of FSH are likely to joinly affect the potential for FSH.

[24] Note that P equals 1 minus the Duncan index (Duncan and Duncan, 1955), which measures the extent of gender segregation across fields of study.

[25] The EU-wide $H(P)$ value is the same, for all practical purposes, for married and cohabiting couples, as

Figure 3: Homogamy Potential $H(P)$ and Actual Extent of Homogamy H

Note: Weighted by LFS sample weights. Country codes are provided in the Data Appendix.

which its FSH potential is used: We plot the 2010 values of the Gender Gap Index (GGI), which reflects economic and political opportunities, education, and well-being for women,[27] against the FSH-potential utilization ratio $H/H(P)$. Higher gender equality is associated

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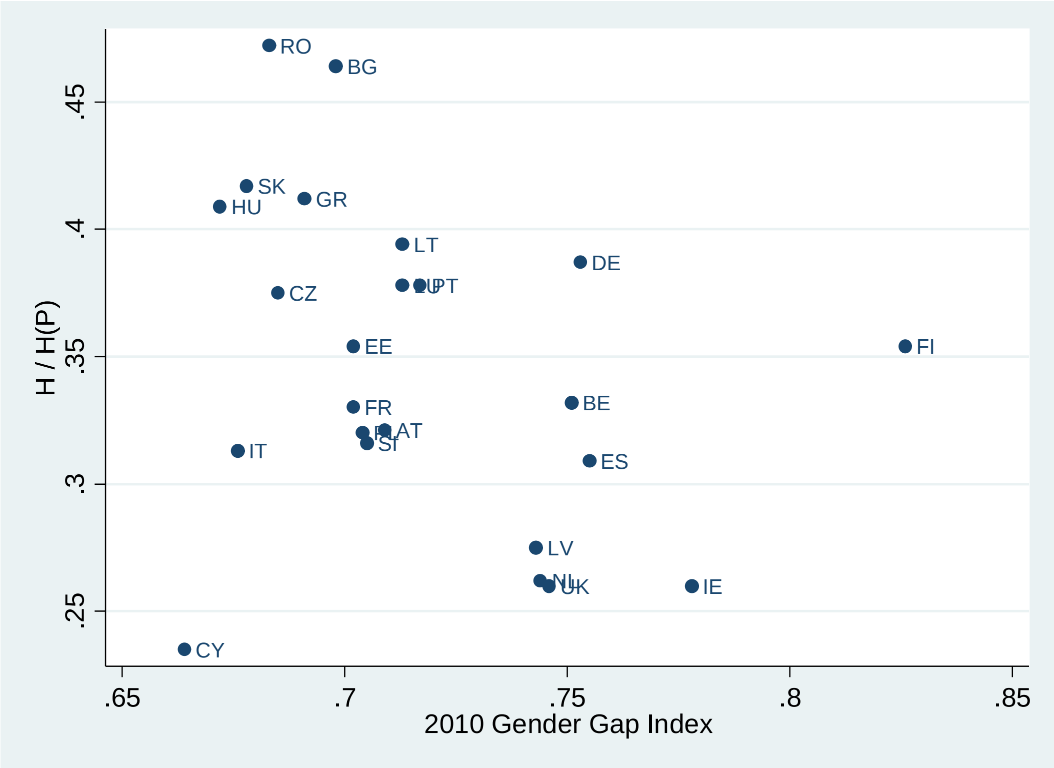
was the case with the corresponding H values.

[26]For example, Figure 3 is consistent with college students in the UK, Ireland, Cyprus, the Netherlands and Latvia (as opposed to Romania, Bulgaria, Hungary, Greece, and Slovakia) spending a significant share of their studies in classrooms with students from other fields of study (i.e., thanks to electives in more 'liberal' education systems). We are not aware of any work classifying national tertiary education systems according to this degree of overlap.

[27]The highest possible score is 1 (equality) and the lowest possible score is 0 (inequality). The index is generated by the World Economic Forum and has been used to study cross-country gender differences in, e.g., Guiso et al. (2008).

Figure 4: The Gender Gap Index and FSH-Potential Utilization Rate

Note: The highest possible GGI score is 1 (equality) and the lowest possible score is 0 (inequality).



with lower utilization of the FSH potential. One cannot reject the hypothesis that the slope of the relationship is minus one. If Cyprus is excluded, the relationship becomes statistically significant at the 0.05 level; if Finland is also excluded, the R-squared of the univariate regression with 22 data points is 0.4. Perhaps the preference for homogamous matching is higher for college graduates in countries with more traditionally defined gender roles. The mechanism underlying the correlation displayed in the figure is worth exploring in future work.[28]

[28]We also note that the GGI index is not systematically related to the FSH level (the H index) and that the presence of such a relationship with the FSH potential ($H(P)$) depends critically on whether Finland is included in the comparison.

4.3 FSH in a Behavioral Matching Model

Finally, we employ the Choo and Siow (2006) model to take a more structured look at the differences between available and matched marginal distributions of graduates. In general, interpreting matching patterns in the absence of a behavioral matching model is difficult (as discussed in, e.g., Chiappori and Salanié, in press). Unlike the H measure of FSH (or the log-linear matching function), the CS model allows for equilibrium effects on μ_{ij} of changing supplies of potential partners of types other than i and j.

Within the CS model, the local log odds ratios (discussed in Section 3.1), which correspond to the degree of complementarity of marital output, are based on contrasting type-specific measure of gains from matching: $\ln(\mu_{ij} / \sqrt{\mu_{i0}\,\mu_{0j}})$.[29] This measure compares the number of realized (college-college) matches of each type ij with the geometric mean of the number of men and women of a given type unmatched (to a college graduate) denoted by μ_{i0} and μ_{0j}, where, again, $\mu_{i0} = \widetilde{\mu}_{i\cdot} - \mu_{i\cdot} = \widetilde{\mu}_{i\cdot} - \sum_{j=1}^{K} \mu_{ij}$.[30] Figure 5 visualizes the 8x8 map of gains from homogamous matches in the EU.

Consistent with the high values of local log odds ratios reported in Section 3.1, the highest gains from matching appear on the diagonal of the match matrix in Figure 5. In particular, homogamous-match gains appear highest for graduates in Social Sciences and for those in Health. The gains from mixed-field non-homogamous matches are generally low in Agriculture and also for women in Engineering and in Services.[31] Of the mixed-field matches, matching gains are highest for couples formed by a female Social Sciences graduate and a male Science graduate, as well as for couples formed by a male Social Sciences graduate and a female graduate in Education, Humanities or Health, where they are comparable to the

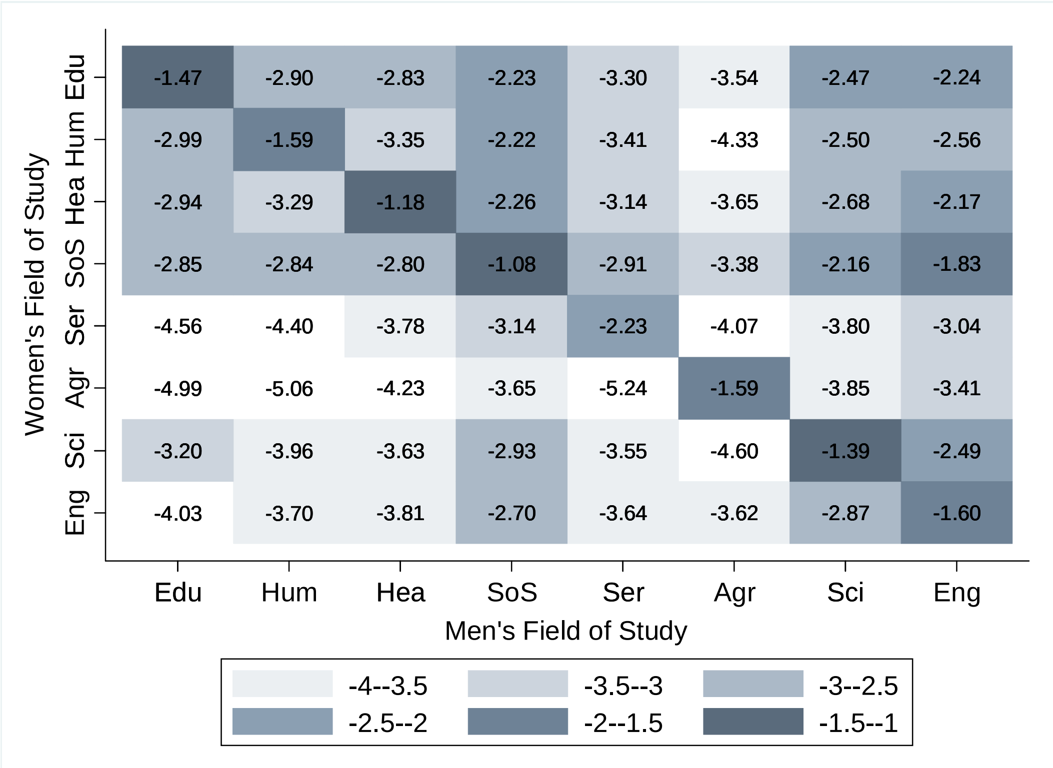
[29] In the local log odds comparison, denominators of the type-specific measures cancel out, which is why the log odds ratios are 'marginal free', i.e., independent of supply marginals (Siow, 2015).

[30] In our case, the group of college graduates unmatched to a college graduate includes both single graduates and those matched to a less educated partner.

[31] In contrast, the lowest values in Figure 1, where only matched marginals are taken into account, appeared for Health-Social Sciences and for Science-Social Sciences couples.

Figure 5: Gains from Matching in the CS Model

Note: Weighted by LFS sample weights. Fields of study: Education (Edu), Humanities (Hum), Social Sciences (SoS), Science (Sci), Engineering (Eng), Agriculture (Agr), Health (Hea), and Services (Ser).



gains from homogamous matches of two Services graduates.

Differences in matching gains across field combinations are related to the field gender composition, i.e., to the supply structure. In Figure 5, fields of study are sorted according to the share of women. Almost all of the match gains in the below-diagonal part of the matrix are lower than those in the above-diagonal part. Gains from mixed-field matches are thus generally low for women studying in highly 'male' fields. Matching gains for couples formed by female Engineering graduates (a minority in their field) and male Education or Health graduates (also a minority) are almost 50% lower compared to those for couples formed by male Engineering graduates and female Education or Health graduates (all majority groups). The underlying mechanism is that while there are few unmatched men in Education and unmatched women in Engineering (thanks in large part to the strong FSH of minority groups within highly unbalanced fields; see Section 4), lowering the denominator of the CS matching gains measure, there are even fewer male Education graduates matched to women from other fields (or female Engineering graduates matched to men from other fields).

Overall, the CS model implies that graduates in Social Sciences generate large matching gains from homogamous matches, but are not heavily 'penalized' for matching to graduates from other fields. In contrast, for graduates in Agriculture matching gains are much lower in non-homogamous compared to homogamous matches.[32]

5 Conclusions

In this paper, we provide the first systematic evidence of the extent of field-of-study homogamy (FSH) among college graduates. Our analysis covers almost all EU countries. The tendency to match within one's field of study is very strong based on both measures widely used in the sociology/demography literature and based on measures corresponding to the Choo and Siow's (2006) matching model equilibrium. In particular, it is at least as strong as the much discussed tendency to match within one's educational attainment level, and it could thus have important ramifications for household level inequality. FSH among pairs in which both partners are college graduates is similar for married and cohabiting couples and is particularly high for couples working in the same industry; it increases quickly after graduation and is stable afterwards. We also demonstrate that the gender composition of fields of study, i.e., the supply structure of the matching market of college graduates, is linked to

[32] In Figure 5, college graduates matched to less-than-college educated and single college graduates were treated as equal components of the unmatched frequencies μ_{i0} and μ_{0j}, that is, as not contributing to FSH. One could alternatively also include in the analysis the matches between college graduates and those high-school graduates who report a field of study. Interpreting such data is an important avenue for future work; it requires a *bi-dimensional* matching model, where matching is based on both education level and field of study. Chiappori et al. (2015) extend the CS framework to a multi-dimensional setting. Chiappori et al. (2014) apply such a framework to matching on education level and smoking status.

the potential for FSH, to cross-country differences in FSH, as well as to the theory-implied matching gains across match types.

This set of findings opens several important avenues for future research. First, to complete the descriptive map of marriage-market correlates of field-of-study choice, future research could relate field-of-study homogamy of couples to marital stability (as Schwartz and Han, 2014, do for educational homogamy) and other family outcomes (such as intra-household bargaining and child investment). Information on both field-of-study and income is needed to gauge the household income inequality consequences of FSH (as, e.g., Greenwood, et al., 2014, have done for educational homogamy). A more detailed disaggregation of fields of study than that available in our EU LFS data would be ideal for this purpose.

Second, researchers could elicit gender-specific *field-of-study* earnings and marriage-market expectations among high-school graduates (as Goldin, Katz, and Kuziemko (2006) and McDaniel (2010) have for the decision to obtain any type of college degree).[33] Given the increasing marriage returns to college (Chiappori et al., 2015), it is plausible that the choice of field of study is related to marriage prospects, i.e., to the gender composition of the field and the potential for FSH.[34]

Consequently, our findings motivate theoretical work endogenizing the field-of-study choice with respect to both labor-market and marriage returns.[35] To study matching markets such as we consider, one needs estimable models of matching over both ordered and unordered attributes. Future work could also employ the Choo and Siow (2006) model and combine the

[33] Ochsenfeld (in press) is an example of research inquiring into the determinants of field-of-study choice, but he does not focus on marriage-market matching explanations.

[34] However, recent literature (cited in Hastings et al., 2014) suggests that students make uninformed or short-sighted college and career choices. For example, Lavy and Megalokonomou (2015) point to the importance of teacher stereotypes in explaining academic aspirations and field-of-study choices.

[35] Chiappori et al. (2009) model the choice to attend college as dependent on both labor-market and marriage returns. Greenwood et al. (in press) explain trends in marriage, divorce, labor-force participation, and educational homogamy in a unified model. See Ge (2011) and Beffy, et al. (2012) for related empirical studies. None of this work considers field-of-study choices.

field-of-study matching structure of 'college-college' couples with their labor-supply behavior to estimate the within-match transfers implied by the model.

Next, the homogamy patterns we measure correspond to a relatively short time period (in comparison to, e.g., the 60 years of educational homogamy covered in Schwartz and Mare, 2005) and fewer than 30 countries. We thus abstain from relating FSH to country-time correlates such as the degree of development or cultural factors (as Smits, et al., 1998, do for educational homogamy). Future work can expand the coverage of FSH measurements and provide this type of evidence to help explain the country differences in FSH we uncover.

Finally, it is important that future work studies the underlying sources of the strong tendency towards FSH we document here. Longitudinal data, ideally contrasting multiple country-specific matching markets, are needed to understand the link between FSH and school-based vs. workplace-based matching. Such data could also be used to assess the hypothesis of Xie et al. (2015) that homogamy can arise as a structural consequence of the dwindling pool of potential partners over time, independent of preferences. Alternatively FSH could be due to similar earnings potential within fields of study, to preferences for matching to a partner who shares similar interests (greater match surplus within fields irrespective of earnings), or it could correspond to lower costs of finding a partner within social or workplace networks related to one's field of study.[36] Existing evidence is consistent with both preferenecs and search costs playing an important role for *education-level* homogamy. Currently, there appears to be no research eliciting FSH preferences.[37] A growing body of research focuses on the role of schools in structuring marriage markets and supporting educational homogamy (Blossfeld and Timm, 2003; Nielsen and Svarer, 2009), but this literature also does not focus on fields of study. Kaufmann et al. (2013) provide the most relevant evidence related to our study and their findings are consistent with the FSH pattern we uncover: They use a

[36]Again, to explore the costs of search channel, one would ideally work with a more detailed definition of fields of study than that available in our data.

[37]The evidence on same-education-level preferences comes mainly from on-line dating, as partner search costs are minimized in such settings (e.g., Bellot and Francesconi, 2013).

regression discontinuity approach to imply that being admitted to a particular study program increases the chances of marrying within that program. However, they also imply that the effect on matching that attending a particular university has through social networks that individuals access on the marriage market is quantitatively more important than the study-program effect. Future work based on similar identification strategies, which are not available in our data, and employing longitudinal information on the timing of match formation can shed more light on the sources of FSH.

Bibliography

Alon, Sigal, and Dafna Gelbgiser (2011) "The Female Advantage in College Academic Achievements and Horizontal Sex Segregation," *Social Science Research*, 40: 107–119.

Altonji, Joseph. G., Blom, Erica and Costas Meghir (in press) "Heterogeneity in Human Capital Investments: High School Curriculum, College Major, and Careers," *Journal of Labor Economics.*

Altonji, Joseph. G., Arcidiacono, Peter, and Arnaud Maurel (2015) "The Analysis of Field Choice in College and Graduate School: Determinants and Wage Effects," NBER Working Paper No. 21655.

Becker, Gary S. (1973) "A Theory of Marriage: Part I." *Journal of Political Economy,* 82(4): 813–46.

Becker, Gary S., Hubbard, William H. J., and Kevin M. Murphy (2010) "The Market for College Graduates and the Worldwide Boom in Higher Education of Women," *American Economic Review: Papers & Proceedings,* 100: 229–233.

Beffy, Magali, Fougère, Denis and Arnaud Maurel (2012) "Choosing the Field of Study in Postsecondary Education: Do expected Earnings Matter?" *Review of Economics and Statistics*, 94(1): 334–347.

Belot, Michèle and Marco Francesconi (2013) "Dating Preferences and Meeting Opportunities in Mate Choice Decisions," *Journal of Human Resources*, 48(2): 474–508.

Blossfeld, Hans-Peter (2009) "Educational Assortative Marriage in Comparative Perspective," *Annual Review of Sociology*, 35: 513–530.

Blossfeld, Hans-Peter, and Andreas Timm, eds. (2003) *Who Marries Whom? Educational Systems as Marriage Markets in Modern Societies.* Dordrecht, The Netherlands: Kluwer Academic Publishers.

Charles, Maria, and Karen Bradley (2009) "Indulging Our Gendered Selves? Sex Segregation by Field of Study in 44 Countries," *American Journal of Sociology*, 114(4): 924–76.

Chiappori, Pierre-André, Iyigun, Murat, and Yoram Weiss (2009), "Investment in Schooling and the Marriage Market," *American Economic Review*, 99(5): 1689–1713.

Chiappori, Pierre-André, Oreffice, Sonia, and Climent Quintana-Domeque (2014) "Bidimensional Matching with Heterogenous Preferences in the Marriage Market," University of Oxford, Department of Economics Discussion Paper No. 696.

Chiappori, Pierre-André, and Bernard Salanié (in press) "The Econometrics of Matching Models," forthcoming in *Journal of Economic Literature*.

Chiappori, Pierre-André, Salanié, Bernard, and Yoram Weiss (2015) "Partner Choice and the Marital College Premium: Analyzing Marital Patterns Over Several Decades," CEPR Discussion Paper No. 10403.

Choo, Eugene, and Aloysius Siow (2006) "Estimating a Marriage Matching Model with Spillover Effects," *Demography*, 43(3): 463–490.

Duncan, O.T. and B. Duncan (1955) "A Methodological Analysis of Segregation Indexes," *American Sociological Review*, 20: 210–217.

Fernández, Raquel, Guner, Nezih, and John Knowles (2005) "Love and Money: A Theoretical and Empirical Analysis of Household Sorting and Inequality," *Quarterly Journal of Economics,* 120 (1): 273–344.

Ge, Suqin (2011) "Women's College Decisions: How Much Does Marriage Matter?" *Journal of Labor Economics*, 29 (4): 773–818.

Goldin, Claudia (1997) "Career and Family: College Women Look to the Past." In *Gender and Family Issues in the Workplace*, F. Blau and R. Ehrenberg, eds. New York: Russell Sage Press.

Goldin, Claudia, Katz, Lawrence F., and Ilyana Kuziemko (2006) "The Homecoming of American College Women: The Reversal of the College Gender Gap," *Journal of Economic Perspectives*, 20(4): 133–156.

Greenwood, Jeremy, Guner, Nezih, Kocharkov, Georgi, and Cezar Santos (2014) "Marry Your Like: Assortative Mating and Income Inequality," *American Economic Review: Papers & Proceedings*, 104(5): 348–353.

Greenwood, Jeremy, Guner, Nezih, Kocharkov, Georgi, and Cezar Santos (in press) "Technology and the Changing Family: A Unified Model of Marriage, Divorce, Educational Attainment and Married Female Labor-Force Participation," *American Economic Journal: Macroeconomics*, forthcoming

Guiso, Luigi, Monte, Ferdinando, Sapienza, Paola, and Luigi Zingales (2008) "Culture, Gender, and Math," *Science*, 320(5880): 1164–1165.

Hastings, Justine S., Neilson, Christopher A., and Seth D. Zimmerman (2014) "Are Some Degrees Worth More than Others? Evidence from college admission cutoffs in Chile," NBER Working Paper No. 19241.

Kalmijn, M. (1994) "Assortative Mating by Cultural and Economic Occupational Status," *American Journal of Sociology*, 100: 422–452.

Kaufmann, Katja Maria, Messner, Matthias, and Alex Solis (2013) "Returns to Elite Higher Education in the Marriage Market: Evidence from Chile," mimeo.

Kirkebøen, Lars, Leuven, Edwin, and Magne Mogstad (2014) "Field of Study, Earnings, and Self-Selection," NBER Working Paper No. 20816.

Jurajda, Štěpán, and Alena Bičáková (in press) "Gender Composition of College Graduates by Field of Study and Early Fertility," *Review of Economics of the Household*.

Jurajda, Štěpán, and Alena Bičáková (2014) "The Quiet Revolution and the Family: Gender Composition of Tertiary Education and Early Fertility Patterns," IZA Discussion Paper no. 7965.

Lavy, Victor, and Rigissa Megalokonomou (2015) "Why are there too few women Engineers? The role of teachers' stereotypes,", University of Warwick, mimeo

Mansour Hani, and Terra McKinnish (2014) "Same-Occupation Spouses: Preferences and Search Costs," IZA Discussion Paper No. 8370.

Mare, Robert D. (2016) "Educational Homogamy in Two Gilded Ages: Evidence from Intergenerational Social Mobility Data," *Annals of the American Academy of Political and Social Science,* 663(1): 117–139.

McDaniel, Anne (2010) "Cross-National Gender Gaps in Educational Expectations: The Influence of National-Level Gender Ideology and Educational Systems," *Comparative Education Review*, 54(1): 27–50.

McClendon, David, Chen-Lan Kuo, Janet, and R. Kelly Raley (2014) "Opportunities to Meet: Occupational Education and Marriage Formation in Young Adulthood," *Demography*, 51: 1319–1344.

McKinnish, Terra G. (2007) "Sexually Integrated Workplaces and Divorce: Another Form of On-the-job Search," *Journal of Human Resources*, 42(2): 331–352.

Nielsen, Helena Skyt, and Michael Svarer (2009) "Educational Homogamy: How Much is Opportunities?" *Journal of Human Resources* 44(4): 1066–1086.

Ochsenfeld, Fabian (in press) "Preferences, constraints, and the process of sex segregation in college majors: A choice analysis," *Social Science Research.*

Schwartz, Christine R. (2010) "Pathways to Educational Homogamy in Marital and Cohabiting Unions," *Demography,* 47(3): 735–753.

Schwartz, Christine R. (2013) "Trends and Variation in Assortative Mating: Causes and Consequences," *Annual Review of Sociology*, 39: 451–470.

Schwartz, Christine R., and Hongyun Han (2014) "The Reversal of the Gender Gap in Education and Trends in Marital Dissolution," *American Sociological Review*, 79(4): 605–629.

Schwartz, Christine R., and Robert D. Mare (2005) "Trends in Educational Assortative Marriage from 1940 to 2003," *Demography*, 42 (4): 621–646.

Schwartz, Christine R., and Robert D. Mare (2012) "The Proximate Determinants of Educational Homogamy: The Effects of First Marriage, Marital Dissolution, Remarriage, and Educational Upgrading," *Demography*, 49 (2): 629–650.

Siow, Aloysius (2015) "Testing Becker's Theory of Positive Assortative Matching," *Journal of Labor Economics*, 33(2): 409–441.

Smits, Jeroen, Utlee, Wout, and Jan Lammers (1998) "Educational Homogamy in 65 Coutries: the Explanation of Differences in Openness with Country-level Explanatory Variables," *American Sociological Review*, 63: 264–285.

Svarer, Michael (2007) "Working Late: Do Workplace Sex Ratios Affect Partnership Formation and Dissolution?" *Journal of Human Resources*, 42(3): 583–595.

Xie, Yu, Cheng, Siwei, and Xiang Zhou (2015) "Assortative Mating without Assortative Preference," *PNAS*, 112(19): 5974–5978.

Van Bavel, Jan (2012) "Choice of Study Discipline and the Postponement Of Motherhood in Europe: the Impact of Expected Earnings, Gender Composition, and Family Attitudes," *Demography,* 47(2): 439–458.

6 Log-Linear Model Estimation Appendix

How robust are the log-linear regressions of Section 3.3 to country heterogeneity of FSH patterns? The limited country-specific sample sizes (shown below) imply that estimating the log-linear models for each EU country separately generates excessively noisy estimates based on match-type matrices featuring a large share of empty cells. We have thus estimated EU-wide specifications based on country-specific $ijyt$-type match counts where we allowed for country-specific heterogeneity by including in equation 2 either country fixed effects λ_c or, alternatively, country fixed-effect matrices λ_{ijc}. The estimated EU-wide homogamy trends (allowing for country-specific differences in average match propensities by type) were noisier than those presented in Section 3.3, but painted a consistent picture.

The estimates reported in Table 2 are based on specifications where we parametrized the year effects and the graduation-cohort effects using three-year fixed effects. Such parsimonious parametrization minimizes the extent of empty match cells. We have alternatively estimated specifications where each year and each cohort has its own γ coefficient, and these estimates led to both quantitatively and qualitatively similar conclusions. Finally, results based on defining s using the male vs. the female perspective were also broadly consistent.

Table 4: Fit Statistics for Log-Linear Regressions

$\gamma_y^D + \gamma_t^D + \gamma_s^D$	2893.7	2884.9	2923.7	1009	207
$\gamma_y^D + \gamma_t^D$	2899.0	2899.3	2932.0	1020	202
$\gamma_y^D + \gamma_s^D$	2895.1	2887.9	2925.7	1016	204
$\gamma_t^D + \gamma_s^D$	2894.4	2885.7	2923.8	1012	206
Same industry	n.a.	Yes	No	D.f.	# of parameters

Notes: The presented deviance (D) statistics correspond to log-linear model estimates shown in Table 2. Degrees of freedom and the number of parameters (minus 1) are also provided.

Table 4 shows the deviance (D) fit statistics comparing the models estimated in Table 2 to the fully saturated model.[38] The table presents D together with the number of degrees of freedom and the number of parameters. The models that do not allow for the assortative match pattern to evolve with years since graduation (i.e., models with no γ_s^D) fit data poorly relative to models that do include the γ_s^D parameters.

[38]The D statistics, which are sometimes referred to as G^2, were calculated using the `fitstat` module of `Stata`. Unlike Schwartz and Mare (2005), our samples are not large, so we do not present Bayesian statistics, which lead to identical conclusions in any case.

7 EU LFS Data Appendix

We use the 2014 release of the anonymised EU Labour Force Survey (LFS) for the reference years 2003-2013.[39] More specifically, we use the annual samples ("yearly files") except for Finland, where the annual sample does not contain information about children, so we use the specific household data file where this information is available. From the 28 EU member states covered by the EU LFS, we exclude Sweden on account of missing graduation year information, Denmark where a large part of the sample does not report educational attainment, and Croatia and Malta whose samples of college graduates are very small. The analysis-ready data thus cover 24 countries: Austria (AT), Belgium (BE), Bulgaria (BG), Cyprus (CY), Czech Republic (CZ), Germany (DE), Estonia (EE), Spain (ES), Finland (FI), France (FR), Greece (GR), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), and United Kingdom (UK). We do not use data from before 2003 since no information about the field of education was asked until then. We also cannot use the following reference years due to missing data on graduation year and/or field of study: CZ 2004 and 2005, AT 2003, BE 2003, ES 2005, IE 2003 and 2007, LT 2003, PL 2003, PT 2003, RO 2003, UK 2003.

The EU LFS is a collection of national labor force surveys from EU countries. While most of the underlying surveys are collected as short rotating panels, the publicly available version of the data does not allow linking of individuals within surveys. In order to ensure that we do not use repeated observations for the same individuals, we use data from a single annual interview wave (wave 1 in all cases when multiple waves are available in the data). The following eight fields of study are recorded in the LFS (with their ISCED codes and descriptions):

Education	100	Teacher training and education science
Humanities	200	Humanities, languages, and arts
Social sciences	300	Social sciences, business and law
Science	400	Life and physical sciences, mathematics and computing
Engineering	500	Engineering, manufacturing and construction
Agriculture	600	Agriculture and veterinary
Health	700	Health and social services
Services	800	Personal, transport, environmental, and security services

[39] The Eurostat has no responsibility for the results and conclusions presented in this paper.

Table 5: Sample Size by Country

	College Graduates		in Coll.-Coll.	in Coll.-High Sch. Couples		Unmatched	
Country	Men	Women	Couples	Men	Women	Men	Women
AT	6537	6127	2192	993	707	3352	3228
BE	34630	39831	12066	1134	2190	21430	25575
BG	5163	6478	2121	154	445	2888	3912
CY	2648	3188	1246	63	138	1339	1804
CZ	6510	6969	2502	728	826	3280	3641
DE	52778	46721	18798	8300	4816	25680	23107
EE	1018	1515	542	87	213	389	760
ES	29440	34164	8927	731	1046	19782	24191
FI	16856	20299	11026	2446	4194	3384	5079
FR	21322	23579	10031	1353	2442	9938	11106
GR	9845	10732	2385	532	506	6928	7841
HU	5674	7110	1999	366	708	3309	4403
IE	12224	15096	5621	580	1352	6023	8123
IT	23748	29492	6117	940	1573	16691	21802
LT	3738	5069	1607	192	395	1939	3067
LU	9738	10052	4730	686	751	4322	4571
LV	1415	2445	644	105	281	666	1520
NL	26905	27632	13154	3532	3899	10219	10579
PL	15106	21377	7716	1077	3435	6313	10226
PT	3677	5846	1205	95	331	2377	4310
RO	8767	9429	3550	593	552	4624	5327
SI	3990	5200	1541	231	532	2218	3127
SK	3656	4239	1223	239	350	2194	2666
UK	15684	17482	7097	662	911	7925	9474
Total	321,069	360,072	128,040	25,819	32,593	167,210	199,439

Notes: Each entry shows the number of observed graduates or marriage/cohabitation couples by type. Coll.-coll. couples are formed by two college graduates.