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The Impact of Economic Inequality and Gender Parity on Educational Assortative Mating: Evidence from the Luxembourg Income Study

David Monaghan

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David Monaghan

Ph.D Candidate, Sociology

The Graduate Center of the City University of New York

Abstract

Though extensive research has described the prevalence of educational assortative mating, the causes of its variation across countries and over time is not well understood. Using data from the Luxembourg Income Study Database, I investigate the impact on marital sorting of both inequality between educational strata and increasing gender parity in the labor and educational markets. I find that in countries with greater returns to education, the odds of any sort of union that crosses educational boundaries is substantially reduced. However, there is only modest evidence of a relationship between returns to education and marital sorting within countries. I find that across countries, gender parity in educational attainment is related to reduced odds of female hypergamy and to increased odds of male hypergamy. Labor market parity between males and females appears to explain little of the variance in marital sorting by education either between or within countries.

Keywords: assortative mating, inequality, gender parity, returns to education, cross-national research

The Impact of Economic Inequality and Gender Parity on Educational Assortative Mating:

Evidence from the Luxembourg Income Study

Though in most romantic films and novels each partnership appears as irreducibly unique, social scientists long ago discovered striking regularities in union formation, indicating that our marriages and partnerships are not as special as we would perhaps like to believe. The most powerful principle of partnership patterning, researchers note, is *homogamy* - the tendency to marry or partner with somebody who is similar in terms of race, ethnicity, income, occupation, religion, family socioeconomic status, or some other relevant characteristic (Kalmijn 1998). Virtually all partnerships are homogamous in one way or another, and most are in multiple dimensions.

In recent years scholars have devoted increasing attention to the proclivity to mate with those who are educationally similar. *Educational homogamy* (or *educational assortative mating*) has long been understood to be an important indicator of the social distance separating educational strata (Blau & Duncan 1967; Mare 1991; Lipset & Bendix 1959, Ultee & Luijkx 1990). Recently, researchers have also become concerned that increases in educational homogamy could exacerbate economic inequality between households (Blossfeld & Buchholz 2009) and could even reduce intergenerational social mobility by concentrating cultural advantage within families (Mare 1991; Haller 1981; Fernandez & Rogerson 2001).

Educational homogamy has been found to be the norm nearly everywhere it has been studied (Blossfeld 2009, Blackwell 1998), but its prevalence varies both across countries (Domański & Pryzbysz 2007; Smits, Ultee & Lammers 1998) and within countries over time (e.g. Mare 1991, Smits 2003). But what leads to greater or lesser educational resemblance within couples is, at this point, not well established. Some have claimed that educational homogamy can be augmented by increased economic inequality between educational strata, as this would work as a disincentive to marrying 'down' (e.g. Schwartz & Mare 2005). Others have suggested that women's increased economic power has fundamentally shifted the dynamics of coupling in advanced societies such that unions among the educationally equal are gaining at the expense of those in which the woman marries 'up' (Esteve, García-Román, & Permanyer 2012).

Determining what causes more or less educational homogamy requires investigating how its prevalence varies both across countries as well as within them over time. However, very little research has attempted to do this. Most studies of temporal variation in assortative mating have focused on a small number of countries and remained at the level of description (e.g. Hou & Myles 2008). Those examining a larger set of countries have not inquired into the potentially causal influence of either economic inequality or shifting gender relations (e.g. Smits 2003). Meanwhile cross-national studies which investigated these factors have been cross-sectional in nature (Torche 2010; Fernandez, Guner & Knowles 2005).

The present study addresses this gap in the research, and makes two additional contributions. First, it examines the prevalence of different types of non-homogamous

unions separately. Specifically, I probe the prevalence of partnerships in which the female matches 'up' educationally (female hypergamy), in which the male matches 'up' (male hypergamy)[1], and of three forms of higher/lower coupling. This allows me to determine whether the relationship between potentially explanatory factors and the odds of union formation vary across types of unions. Second, this study is, to the best of my knowledge, the first to directly and explicitly model the prevalence of unions in which the *male* has less education than his partner ('male hypergamy').

The paper is organized as follows. First, I review the theoretical and empirical literature on educational assortative mating, with a focus on contextual factors thought to make assortative mating more common. After introducing the data and defining the countries and couples included, I then discuss the generation of my dependent variables – the estimated odds of types of non-homogamous unions in each country-year observation – through loglinear modeling. A description of the construction of explanatory variables and a delineation of modeling strategies follows. Finally I present empirical results and discuss the implications of my findings.

[1] Conventionally, hypergamy and hypogamy have been described in relation to the female partner, such that "hypergamy" described a woman marrying "up" and "hypogamy" described a woman marrying "down". Since I feel that this focus on female matching is arbitrary and somewhat gender-biased, I opt to use only the term "hypergamy" and to designate *who* is engaging in "marrying up".

Theoretical Background and Prior Research

Why is Educational Homogamy the Norm?

Partner choice is a joint function of opportunity and preference, both of which are molded by social structure. Opportunities for meeting potential mates occur within places such as schools, workplaces, bars and nightclubs, granting these contexts a profound influence on coupling by limiting the pool of eligibles (Blau 1994). Within heterogeneous social contexts, individuals exercise selectivity in forming bonds with others. Judgments about individuals which govern openness to the formation of interpersonal bonds are in turn informed by socially generated knowledge and opinion.

Blossfeld and Timm (2003) argued that the most important institutional context for generating educationally homogamous unions is the educational system itself. In schools, most individuals progress through a series of grades with peers from the same birth cohort. Schooling persists well past the onset sexual maturity, and permits plentiful opportunity for interaction and flirtation. Schools therefore are important marriage markets. Individuals typically delay marriage until after exiting education, when they begin full-time employment and can start an independent household (Mare 1991). And because individuals leave educational institutions at different points along the educational pipeline, they tend to marry those who exit along with them and who therefore have a similar level of educational credentialing.

Becker's (1981) rational choice model begins by postulating an unstructured marriage market in which mating is impacted only by individual preferences. He asks us to imagine that the traits individuals take into account when choosing a partner can be

reduced to one, which he calls *quality*, and that individuals have a uniform preference for a partner of the highest quality possible. Further, individuals are differentiated in terms of quality, and everyone's quality is known. In a heterosexual marriage market, this would result in the 'highest quality' woman pairing off with the 'highest quality' man, the second highest-quality women with the second highest-quality man, and so on. Thus rational marriage markets produce something like pure status homogamy. And as educational attainment is an indicator of 'quality', rational actors in free marriage markets will sort along educational lines.

Others posit that union-formation occurs through a process of 'cultural matching'. From this perspective, similar tastes, worldviews, and interests form the basis for the establishment of intimacy through conversation ('clicking' with somebody), and offer the promise of a smoother relationship in which important life decisions can be made without dramatic conflict (Kalmijn 1994, 1998; DiMaggio & Mohr 1985). However, as Bourdieu (1984) has argued, tastes and interests are differentiated by class and are an expression of one's cultural capital, which is both forged through and confirmed by the educational system (Bourdieu & Passeron; DiMaggio & Useem 1978). As a result, cultural matching theory joins rational-choice in predicting educational homogamy as a norm.

Accounting for Variation in Educational Assortative Mating

Descriptive studies show diverse within-country trends in assortative mating. Researchers have described marital sorting as having risen recently in South Korea (Park and Smits 2005) and Ireland (Halpin and Chan 2003), while having fallen in most East Asian countries (Smits and Park 2009), in Denmark (Breen & Andersen 2010), in Norway

(Birkelund & Heldal 2003) and in Great Britain (Halpin and Chan 2003). A U-shaped pattern of decreasing and then increasing marital sorting has been found in China (Han 2010) and in three Eastern European post-socialist societies (Katrňák 2008). Research looking at the United States has for the most part documented recent increases in assortative mating, especially since the 1970s (Blackwell 1998, Hou & Myles 2008, Kalmijn 1991, Mare 2000, Qian & Preston 1993, Pencavel 1998, Schwartz & Mare 2005), though other research has found a pattern of static or even declining homogamy (Fu & Heaton 2008, Kremer 1997, Mare 1991, Rosenfeld 2008). Most of these studies, however, make little attempt to account for why these trends might be occurring.

Attempts to account for variance in educational assortative mating are more common in studies which examine many countries, most of which are cross-sectional. A few studies have investigated the effects of the dominant religion (Domański & Pryzbysz 2007; Smits 2003; Smits & Park 2009) and dominant welfare state regime (Domański & Pryzbysz 2007), but most have focused on the roles played by inequality (and especially inequality between educational strata), changing patterns of gender relations, and modernization or development.

Returns to education. There are strong reasons to believe that the strength of the association between economic status and education could depress the likelihood of marrying outside one's educational group. From a rational choice perspective, individuals mate on the basis of the perceived returns to marriage, at least some of which are economic. This predicts that net of other considerations, those with high earning potential tend to intermarry. But people usually choose a partner fairly young, before earning

potential can be realized, infusing marriage markets with a high degree of uncertainty (Oppenheimer 1988). People therefore rely on knowable attributes such as educational credentialing as 'signals' of future earnings (Spence 1973). However, the reliability of educational credentialing as indicator of future earnings depends on the return to education prevailing in a given country at a given time. Where there is a steep educational gradient in earnings, educational certificates are powerful indicators of future economic status, and there will be a strong disincentive to "marry down" educationally.

The cultural-matching perspective argues that feelings of 'clicking' and 'compatibility' drive partner choice rather than pecuniary calculations. However, where educational strata are more economically differentiated they will likely also be more culturally differentiated. This is because consumption patterns will likely be more distinct, as different products or brands tend to be marketed to and consumed by people in different income ranges.

Heightened inequality may also reduce *opportunities* for interaction between people of differing educational levels. For example, in the United States residential segregation by income seems to have been exacerbated by surges in income inequality over the past few decades (Jargowsky 1996, Massey 1996, Reardon & Bischoff 2011). Since much of this increase in inequality has been a result of rising returns to education (Lemiuex 2006), it follows that residential segregation by educational attainment has also increased (Domina 2006). To the extent that people either meet their partners in their neighborhood or through their neighbors' social networks, an upturn in residential segregation would boost homogamy without a shift in preferences.

Empirical research into the influence of inequality on assortative mating has only just begun. Schwartz and Mare (2005) noted that the tendency towards homogamy has tended to rise and fall with overall socioeconomic inequality in the United States in the late 20th century. Torche (2010), examining Brazil, Mexico and Chile, found that the strength of the 'barrier to marriage' was closely related to differences in earnings between educational categories.

The most extensive study of this relationship was that of Fernandez, Guner & Knowles (2005), which examined the relationship between the correlation in spouses' education and the returns to education in 34 (mostly) European and Latin American countries. The authors find a strong positive relationship between these two measures, controlling for potentially confounding variables. Additionally, they employed an instrumental variables strategy in order to estimate a causal impact of inequality on educational homogamy for a smaller subset of European countries.

Gender parity. Over the past half-century women have in many countries made tremendous gains in education and the labor market (OECD 2006, Jaumotte 2003), altering the nature of heterosexual union-formation. Greater economic independence has enabled women to delay marriage and childbearing and to ground their identities in personal career achievement rather than in that of their husbands (Goldin 2006). It has also empowered women within family units, making it easier for women to exit bad marriages (Sayer & Bianchi 2000, Kalmuss & Strauss 1982, Schoen et al 2002) and to perform a smaller share of household labor (Shelton & John 1996).

It is possible that improvements in women's status could bring about more educational assortative mating. In the context of women's greater labor force participation, men have increasingly come to value a partner's potential income and to hold domestic skills in lower regard (Buss, Shackelford, Kirkpatrick & Larsen, 2001; Blossfeld & Timm 2009; Hou & Myles 2008). Men, and in particular highly educated men, appear to have turned away from a traditional preference for lower-status partners. In a sense, in terms of what matters to them in a partner, men are coming to resemble women. As a result, improvements in women's relative status could result in greater educational homogamy at the expense of female hypergamy.

An alternative scenario is the 'love match' thesis. According to this theory, women's improved socioeconomic position enables them to choose a partner free of the urgent press of economic necessity. Therefore, they would be able to marry for love, rather than having to choose a partner who can provide for them and their families but might otherwise not be optimal (Fernandez, Guner & Rodgerson 2005). Therefore, greater female economic power could result in more educationally heterogeneous partnerships. But as Schwartz (2012) argues, it does not necessarily follow that because women are free to choose their partners that they would be more likely to choose partners dissimilar to themselves in terms of education, status, or income.

Empirical research on this question is mixed. There is evidence that the odds of marrying at all have improved for higher- relative to lower-earning women, and for better-relative to less-educated women (Goldstein & Kenney 2001;Sweeney & Cancian 2004, Sweeney 2002), suggesting that male preferences have indeed shifted. Esteve, Garcia-

Roman, and Permanyer (2012), analyze a sample of 56 countries, and find a strong negative relationship between higher female educational attainment and the prevalence of female hypergamy. Further, research has found increasing correlation between spouses' labor market statuses (Verbakel , Luijkx, & de Graaf 2008) and earnings (Schwartz 2010) in recent cohorts. However, Fernandez, Guner & Knowles (2005) find a negative relationship between marital sorting and a composite measure of women's social status once inequality has been controlled for, supporting the 'love match' thesis.

Economic development. Modernization theory has long claimed that in the long run economic growth and development bring about socioeconomic equality and greater mobility (e.g. Lipset 1959, Marshall 1950). In the study of educational assortative marriage, an extension of modernization theory has been articulated in the work of Jeroen Smits and colleagues. They argue that if modernization, measured through economic growth, ought to make societies more equal and 'open', and if educational heterogamy is an indicator of social openness, then economic development ought to lead to declines in educational homogamy (Ultee & Luijkx 1990).

Smits, Ultee and Lammers (1998) estimated the prevalence of educational homogamy in 65 countries, and found an 'inverted-U' shaped relationship between homogamy and economic development which they interpreted as support for the 'openness' thesis. Smits (2003) proceeded to investigate social closure among the highly educated in fifty-five countries, looking at two age cohorts within these countries as proxy for within-country change. The U-shaped pattern disappeared, and an inverse linear relationship between development and the homogamy was found to obtain. Additional

support for the negative impact of economic development on educational homogamy was found by Smits & Park (2009).

However, the democratic optimism of modernization theory long ago foundered on the shoals of increasing inequality in a number of rich countries since the 1970s (Alderson & Neilsen 2002). This 'great u-turn' undermines the presumption that GDP growth necessarily results in declining educational homogamy.

Research Questions

This study aims to shed light on what might increase the prevalence of assortative mating, focusing on the impacts of greater economic inequality and gender parity. I ask whether unions in which partners' educational levels differ are less common when the economic distance separating different educational strata is greater. In countries where educational strata are more economically dissimilar, are unions which cross educational lines more rare? And within countries, as educational strata become more disparate, do the odds of such unions decline?

I also investigate gender-specific patterns, asking whether increasing economic distance between educational groups impact in the same way upon the prevalence of unions in which the male has more education as it does on the prevalence of partnerships in which the reverse is true (relative to homogamy)? Does the female hypergamy become less common within countries as women move closer to parity in the labor and educational

markets? The answers to these questions shed light on the larger matter of in what ways social context shapes coupling decisions in modern, market-based societies.

Data & Methods

Data

Data are drawn from the Luxembourg Income Study (LIS) Database[2], an archive of harmonized nationally-representative income surveys from high and middle income countries (Luxembourg Income Study Database (LIS) 2013). LIS has collected data from participating countries in waves roughly five years apart[3] beginning in the mid 1980's, permitting the examination not only of patterns across country contexts but also of trends within countries over a fair expanse of time. The number of datasets available varies by country because countries have elected to begin contributing data to LIS at different points in time. My measures of marital sorting, employment, education and income were generated using LIS microdata. Additional data on per capita income were drawn from the World Bank's online data archive[4].

Study Universe

To ensure that I investigate comparable cases, I restrict analysis to 'rich countries', according to a classification schema developed by the International Monetary Fund[5]. There

[2] For more information about LIS, see http://www.lisdatacenter.org/
[3] Beginning in 2000, LIS began gathering data more frequently, in 4 and then 3 year intervals.
[4] Accessible at http://data.worldbank.org/
[5] The IMF divides economies into two classes: 'advanced' and 'developing'. The IMF presently designates 35 economies as 'advanced'. According to the IMF, this classification, though not based on 'strict criteria', nonetheless provides a 'meaningful method of organizing data' (IMF 2013).

are 34 such countries, 26 of which have contributed data to LIS. From these countries I include all country-year observations available in LIS from the mid-1980s through 2010 in which educational attainment, marital status, income, and employment were sufficient and reliable[6].

This produced a final list of 25 countries each observed between 1 and 6 times, a total of 96 country-year observations. The mean number of observations per country is 3.8. For all but two countries (South Korea and Slovakia) there are multiple observations, and for 14 countries there are at least four observations. Thus, though this is an unbalanced panel, there are sufficient numbers of observations for most countries to estimate both between and within cluster effects.

Within countries I study the marital patterns of *prevailing young heterosexual married or cohabiting unions*. Though newlyweds are arguably preferable for investigating the response of the incidence of homogamy to changing socioeconomic conditions (Raymo & Xie 2000, Kalmijn 1994), this is not possible using LIS data, which do not permit newlywed identification. Additionally, focusing on newlyweds necessitates the exclusion of cohabiting partnerships, and in some European countries (e.g. Sweden) to do so would eliminate a substantial portion of all long-term couples given a rough societal equivalence between marriage and cohabitation (Hamplova 2009). On the other hand, including *all* prevailing unions runs the risk of having results driven by unions which were inaugurated long ago, under drastically different social conditions. Restricting to young couples reduces overlap between the cohorts included in subsequent observations and the impact of

[6] The requirement that educational attainmnet be reliably identifiable necessitated the exclusion of Australia.

selective dissolution (see Blackwell & Lichter 2000, Gullickson 2006, and Schwartz & Graf 2009 for studies which use a similar strategy). I define 'young unions' as those in which the male is between 25 and 35 years of age. This age window contains a lower bound which allows individuals to complete tertiary schooling (in 'normative' time) and an upper bound which makes it unlikely that the union in question is much more than a decade and a half old.

Generating Dependent Variables through Loglinear Modeling

Because educational systems vary substantially between countries, establishing equivalence between levels of educational attainment cross-nationally is challenging. To harmonize data on educational attainment LIS relies upon the International Standard Classification of Education (ISCED-97), a 7-level scheme created by UNESCO. However, the specificity of educational categories in the income surveys collected by LIS varies dramatically both across and within countries. In order to categorize educational attainment in a manner that is both accurate within countries and comparable across them, LIS developed a three-level educational classification that I rely upon here. Educational attainment is defined as 'low' for those whose education falls in ISCED levels 0-2; as 'medium' education for those at ISCED levels 3 or 4, and as 'high' for those at ISCED levels 5 and above. To illustrate what this means in concrete terms: for the United States, individuals without a high school diploma or its equivalent are classed in the 'low' group; those with a high school diploma or postsecondary training short of an associate's degree

are classed as 'medium'; and those with an associate's degree or higher are considered to have 'high' attainment.

I performed weighted cross-tabulations of male partner's educational attainment by female partner's educational attainment in order to generate counts of couple-types for each country-year observation. In order to minimize the effects of varying sample sizes I standardized the number of couples in each country-year at 10,000. This resulted in a 3x3x96 contingency table with a total of 864 cells.

Loglinear models have been used at least since Mare (1991) to estimate patterns and trends in homogamy. The most basic form of loglinear analysis I employ takes the form

$$\log(Y_i) = \alpha + ME + FE + CY + \varepsilon_i$$

Where each Y_i represents the count of a cell in a contingency table, ME and FE are a set of dummy variables describing male and female educational attainment respectively, and CY represents the country-year observation (also coded as a large set of dummy variables). Because the educational levels of men and women are represented as separate dummies, this model allows educational distributions to differ by gender, but constrains this imbalance to be constant across countries. More importantly, though, the model constrains male and female educational levels to be independent within unions. That is, it assumes sorting into marriage occurs randomly with respect to educational levels. If this model describes the data well, we could conclude that no substantial assortative mating by educational attainment exists in the country-year observations represented here.

Conversely, the model that would permit maximum flexibility in marital sorting would include all possible interactions:

$$\log(Y_i) = \alpha + ME + FE + CY + ME * FE + ME * CY + FE * CY + ME * FE * CY + \varepsilon_i$$

This is, however, a model that contains as many parameters as there are cells in the contingency table; it is saturated. We can effectively analyze assortative mating patterns if we strip out terms in which male and female dummy variables are made to interact, and replace them with parameters which specify some particular pattern of assortative mating. This takes the following general form:

$$\log(Y_i) = \alpha + ME + FE + CY + \varphi + ME * CY + FE * CY + \varphi * CY + \varepsilon_i$$

Where φ represents some set of parameters characterizing an assortative mating specification.

Note that this model 'controls' for marginal distributions of female and male education within married and cohabiting couples, and permits these marginal distributions to vary by country. This enables us to model assortative mating net of imbalances in male and female educational attainment which could, in a mathematical sense, produce some degree of 'necessary' intermarriage. In other words, if there were far more highly educated women than men in a country, we would expect to see more partnerships crossing educational boundaries in this country simply because some of the women had to 'match down' in order to find any mate at all. Loglinear models tell us the degree of assortative mating that is *not* a result of such mathematical imbalances. However, importantly, it

corrects for gender imbalances in education within *individuals in couples*, not in the country populations as a whole.

I make use of two separate specifications of the above model, the *quasi-symmetry model* and the *gendered hypergamy model*; these models are presented graphically in Figure 1. The quasi-symmetry model contains three separate parameters. One describes any union in which one partner has 'medium' education and the other has 'low' education, another describes partnerships between individuals of 'high' and 'medium' attainment, and the final describes partnerships between those of 'high' and 'low' attainment. The quasi-symmetry model enables us to estimate the prevalence of these types of partnership *relative to educational homogamy*. That their prevalence is relative to homogamy is given by the assignment of any homogamous partnership to the reference group (the zeros on the diagonal). This model allows us to see whether the various heterogamous pairings are engaged in with differing frequency relative to homogamy, and permits the odds of these types of non-homogamous couplings to vary between country-year observations.

(Figure 1 about here)

The gendered hypergamy model contains, by contrast, two parameters. One of these captures couples in which the male's education exceeds that of the woman ('female hypergamy'), and the other captures the inverse situation ('male hypergamy'). Once again, this specification models the prevalence of these types of unions relative to homogamy. Its permits us to estimate the odds of heterogamous relationships in which the woman 'matches up' separately from the odds of relationships in which the male 'matches up', and allows these odds to vary across country-years.

Fit statistics for loglinear models appear in Table 3. The Aikake Information Criterion and Bayesian Information Criterion (AIC and BIC) are statistics which penalize models for inclusion of additional parameters. The individual numbers mean little in and of themselves; better fit is indicated by lower AIC and BIC in comparable models. I also present a fit statistic called the *dissimilarity index*[7], tells us the percentage of couples which were miscategorized by a model (Agresti 2007).

(Table 1 about here)

As stated above, the independence model presumes that distributions of male and female education are both independent of each other and invariant across the country-years in this sample. As these assumptions are both unrealistic, it is not surprising that the model does not fit the data well; it misclassifies nearly 30% of all unions. The gender-specific hypergamy and quasi-symmetry models correct both of these assumptions and fit the data far better. However, of the two, the quasi-symmetry model is superior. Whereas about 7% of unions remain mis-categorized by the former model, the latter is accurate for over 99% of unions. The gender-specific hypergamy model is, however, substantively interesting, and so we retain its results.

The exponentiated coefficients from these models can be interpreted as estimated odds-ratios of witnessing particular types of non-homogamous unions in the country-year in question, relative to the odds of witnessing a homogamous union. An odds-ratio of 0.50

[7] Mathematically, the dissimilarity index is defined as $DI = \frac{\sum |Y_i - \hat{Y}_i|}{2 \sum Y_i}$.

for medium-low intermarriage, for example, can be interpreted as meaning that in the country-year in question, unions consisting of one partner with medium and one with low educational attainment are half as likely as those in which partners have the same level of education. I use the exponentiated regression coefficients from the quasi-symmetry and gender-specific hypergamy models as my dependent variables in the analysis that follows below. Further analysis and interpretation of loglinear models appears in the Appendix.

Explanatory Variables

Returns to Education. In order to measure returns to education, I first, for each country-year, calculate the median post-tax, post-transfer personal income (net income) for working aged adults (aged 25-50) in each educational strata. Post-tax and transfer income is preferable to gross income because it is closer to real disposable income, and differences in disposable income better express differences in lifestyle and standard of living that obtain between educational strata in various countries. In all countries, though in some more than in others, tax-and-transfer policy substantially mitigates inequality between educational groups which would be generated through the market alone, but the extent to which this occurs varies drastically across countries (Rainwater & Smeeding 2003). *Personal* income is used because household income is endogenously determined by homogamy.

From these median income measures I create income ratios – that between medium and low strata, the high and medium strata, and the high and low strata. Finally, I take a weighted average of these three ratios to generate *average returns to education*. Each ratio is weighted according to the proportion of the population to which each ratio applies (i.e.

the high/medium income ratio is weighted by the sum of the proportions of the population with high and medium educational attainment). Returns to education would be 1.0 for a country in which there was, on average, no economic benefit to more educational credentialing, and returns to education of 2.0 would signify that attaining a higher credential tends on average to result in a doubling of (post-tax and transfer) income.

Measures of Gender Parity. We measure the societal gender parity through measures of relative equality in employment and in education. Parity in the labor force is measured by calculating the ratio of the proportion of men actively employed to that of women. This ratio is equal to 1.0 in a country-year in which women were equally likely to be employed as men, and 0.5 in a country in which they were half as likely to be employed, and will be referred to as *male employment advantage*.

Gender parity in education is measured first by tabulating the educational distributions (into low, medium, and high groups) of men and women in each country-year. I then compare these educational distributions by using Lieberson's Index of Net Difference[8] (Lieberson & Heise 1975; see also Feliciano 2005). This measure ranges between -1 and 1. An NDI of 1 indicates that each and every male in the country-year is better educated than each and every woman, which would be possible only if the least educated man was better educated than the best educated woman. An NDI of -1 would imply precisely the opposite. Where educational distributions of men and women are

[8] Calculated as $NDI = pr(MaleEd > FemaleEd) - pr(FemaleEd > MaleEd)$.

equal on average, NDI is equal to 0. This statistic will be used as our measure of *male educational advantage*.

Economic development. Economic development is measured as (log) gross national income per capita, adjusted for purchasing power parity in 2013 international dollars.

Modeling Strategies

In modeling panel data, researchers typically face a choice between fixed- and random-effects designs. For my purposes the most important distinction regards the types of relationships between predictor and the outcome variables that fixed- and random-effects models allow us to estimate. Fixed effects models by design are incapable of modeling the variance between units in the outcome variable. Random-effects designs model the variance both within- and between units, but force researchers to choose whether a predictor variable should be considered fixed or time-varying within units.

I employ, first, a technique which permits flexible identification of both within- and between-country effects: the linear mixed-effects model (Fitzmaurice, Laird & Ware 2011). This model makes use of mean-centering in order to generate two distinct and uncorrelated parameters to estimate within- and between-unit effects separately. It takes the basic form:

$$Y_{it} = \alpha + \bar{X}_i + X^*_{it} + Z_i + W_{it} + \mu_i + \varepsilon_{it}$$

In this model, the response variable Y is observed in country *i* at time *t.* We are interested in modeling both within and between effects of variables *X.* We enter a vector $\bar{X}_i$ which consists of within-country means of variables *X*. These variables are constant within

i, and coefficients of these variables capture the variance in the response attributable to between-country variance in *X*. We also enter a vector of within-country *mean-centered* variables X_{it}^{*} which are generated by $X_{it}^{*} = X_{it} - \bar{X}_i$. These are time-varying within countries, and capture change in *X* that occurs within countries over time. Because these variables X_{it}^{*} are mean-centered, they are not correlated with $\overline{X}_i$. The model also includes a vector of variables Z_i which are fixed within countries, a vector of time-varying covariates W_{it}, and a random error term μ_i.

However, the influence of phenomena measured by my explanatory variables might take some time to impact upon union-formation. However, in my mixed-effects models, independent and dependent variables are measured contemporaneously. As a result, there is a chance that the mixed-effects models will underestimate the effects of these variables. Therefore, I estimate a second set of models using lagged explanatory variables. The extent of these lags is not constant across observations as LIS data is collected at irregular intervals dictated by participating countries, but they average about 4 years. To ensure, as much as possible, that we eliminate the possibility of confounding by unmeasured factors, I include country fixed-effects as well as a time-trend variable. These models are specifically designed to provide careful and robust estimates of within-country relationships; they do not address variance across countries.

Results

Descriptive Statistics

First, I address how the prevalence of non-homogamous pairings varied across countries – in which countries are these unions relatively common, and in which are they rare? And which sorts of heterogamy are more frequently encountered? For each country, I calculated the mean of each heterogamy odds-ratio across observations, and present these in Table 1. With a single exception (the odds of female hypergamy in Switzerland), all of the odds-ratios are below 1.0, and are for the most part substantially so. This is confirmation of what has often been noted before - that educational homogamy is the norm nearly everywhere. However, not all types of heterogamy are equally uncommon. High-low partnering is rare in all countries – on average homogamous unions are 8.7 times more likely to be observed than high/low partnerships. Comparatively, medium-low partnerships are not nearly as uncommon; homogamous unions are only about 2.08 times as likely to be witnessed as medium-low couplings.

(Table 2 about here)

(Table 3 about here)

Within heterogamy types, there is also substantial variance across countries. Consider, for example, the odds of female hypergamy. In some countries, such as the United States, such unions are quite uncommon among young couples. In fact, among young American couples, my estimates suggest that male hypergamy is slightly more common that female hypergamy. However, in Switzerland, after adjusting for marginal

distributions of male and female education, the odds of witnessing a couple in which women marry 'up' educationally is slightly higher than 1.0, meaning that such couples are slightly more likely than those that are homogamous. Medium-low partnering is most common, relative to homogamy, in France and Germany, and least common in South Korea. Unions between those with high and medium education are commonly encountered in Canada and the Netherlands, and unusual in Luxembourg and Greece.

Descriptive statistics for independent variables are presented in Table 2. As with Table 1, the statistics presented are each country's mean across all of its observations. Average returns to education are, as we would expect, all above 1.0, but vary substantially. In Sweden, for instance, attaining more educational credentialing is associated with an increase in income of only 17.3%; returns to education are low also in Denmark, Norway, Finland, and Switzerland. In the United States, on the other hand, there is an 86.4% return to education.

Mean male educational advantage is positive in Austria, Taiwan, and the Netherlands, but negative in Ireland, Finland, and Sweden; in these latter countries women are, on average, better educated than men. Employment advantage is everywhere above 1.0, and indeed it was above 1.0 for every individual country-year observation. However, in some countries the average male employment advantage is not very large. In Sweden males are only about 5.4% more likely to work than females, likely a result policies consciously promoting female employment (Gornick, Meyers & Ross 1997). Females are substantially less likely than males to be employed in 'conservative' or 'familist' welfare states such as Spain and Italy (Esping-Andersen 1991, Saraceno 1994).

What Affects the Odds of Unions Between Educational Strata?

Next, we turn to an examination of the prevalence of unions between educational groups. In the first three columns of Table 4 I present the results of regressions predicting the odds of three different forms of higher/lower educational intermarriage - medium/low, high/medium, and high/low – relative to homogamy. Independent variables have been divided into 'between' and 'within' country measures. The former allow us to look at the something akin to cross-sectional variance for the country-set. 'Within' country variables represent deviations around each country's mean, and are somewhat similar to variables in a fixed-effects model. In addition to the variables discussed above, all models include two additional parameters: a time trend variable equal to the year of each observation (measured continuously) and a country-level variable indicating the total number of observations for each country in the dataset. The former is displayed, as its results are somewhat theoretically important. The latter variable merely ensures that observations with more cases are not unduly influencing the results, and its coefficients are suppressed.

(Table 4 about here)

At the country-level, the return to education is a strong negative predictor of educational intermarriage. The first model reveals that a one-unit increase in the average return to education reduces the odds of medium-low intermarriage by 34% relative to homogamy. In practical terms, this indicates that the odds of medium-low intermarriage drop from roughly 0.55 in a country in which there is a 25% return to education (average return=1.25) to 0.38 where the return to education is 75% (1.75). Similarly, a one-unit increase in returns to education across countries is related to an 18% decrease in the odds

of high/medium intermarriage. The odds of high/low intermarriage are also significantly lower in countries with higher returns to education. The expectation of the odds of high/low intermarriage drops from 0.10 in a country where the return to education is 1.5 to 0.04 in a country where additional education doubles expected income. This movement – a 6% decrease in the odds of a relatively rare intermarriage – may seem small, but it translates to most of a standard deviation in this variable. These results are displayed graphically in Figure 2.

Within-country effects of returns to education on intermarriage probability are quite weak overall. There is what appears to be a negative impact of within-country increases in returns to education on the odds of high/low intermarriage, and a moderate *positive* impact on the odds of medium/low intermarriage (for both, $p<.10$).

(*Figure 2 about here*)

Male employment advantage appears to *negatively* predict medium/low intermarriage, and to *positively* predict high/medium intermarriage, but only within countries. To interpret this, it is important to recall that male employment advantage has been declining over time in most countries (i.e. there has been a movement toward parity), so the actual historical trend is opposite that indicated by the coefficients. That is, it would seem that increasing labor market parity is related to increases in low-medium intermarriage and to decreases in high-medium intermarriage. This could indicate gender-specific effects – that increases in female employment are leading to more moderately educated women pairing off with less educated men, while simultaneously leading highly educated women (and men) to engage in more homogamy. The interaction of specific

educational-level patterns with hypergamy patterns is not, however, directly tested in this analysis.

Finally, there is no relationship between (log) per capita income and any form of higher/lower intermarriage, but we do witness a significant negative time-trend for medium-low intermarriage. The time-trend only reaches statistical significance in the presence of control variables; we are not witnessing a bivariate time-trend left unexplained by the other predictor variables, but one whose partial relationship only emerges in the full model.

What Affects the Odds of Women and Men 'Matching Up'?

In the final two columns of Table 6 I model the odds of female and male hypergamy. The between-country effect of returns to education is negative for *both* forms of homogamy, which is particularly interesting given that these two marital patterns are negatively correlated. This suggests, as do the results discussed above, that countries in which income is more steeply related to education unions tend to be substantially more educationally homogamous. Further, this relationship is gender-blind; the coefficient for returns to education between countries is near-identical in these two models. There is a no statistically-significant relationship between male employment advantage and the odds of hypergamy (both between and within countries). In sum, these models suggest that increasing labor market parity between men and women which is not driving up homogamy at the expense of female hypergamy, but that instead in countries where educational groups are more unequal *both* men and women are inclined towards homogamy.

The strongest relationships in these models are those between male educational advantage and both kinds of hypergamy. These relationships are in the 'expected' direction – male educational advantage is related to greater odds of females marrying up and to decreased odds of males marrying up, relative to homogamy. This result would at first seem obvious. However, recall that the marginal distributions of education for both males and females in each country are 'controlled' for in the loglinear models which produced the dependent variables in the first place, at least among men and women in unions. The relationship between male educational advantage and predicted hypergamy is therefore in need of explanation.

None of the within-country variables attain significance in these models, although a substantial amount of the within-country variance is explained by them. We witness a negative time trend that is statistically significant in the model predicting female hypergamy. This relationship *is* statistically significant (at $p<.001$) and substantially stronger in a bivariate relationship with the outcome. This implies that independent variables explain some, but not all, of the downward trend.

Further Investigations into Within-Country Change

The models in Table 4 achieve little traction in detecting within-country effects. However, it is possible this result is due to the fact that within-country measures for intermarriage parameters and explanatory variables are measured for the same years. I address this possibility by a final set of analyses in which returns to education, male employment advantage, male educational advantage, and gross national income are lagged. Results are given in Table 5.

(Table 5 about here)

Average returns to education does appear to have a direct impact on one type of higher/lower union – that between high and medium educated individuals. It also registers a mild negative effect on the odds of female hypergamy. These, taken together, seem to suggest that indeed higher returns to education are leading to an increase in assortative mating at the expense of female hypergamy, principally among the highly educated. Male employment advantage appears to be negatively related to both the odds of high/low unions and to female hypergamy, and to be positively related to male hypergamy. This gives the impression that where men are more dominant in the labor market, they enjoy a higher probability of pairing with better-educated women. Male educational advantage registers a negative relationship with high/medium union formation and high/low union formation, and is positively associated with male hypergamy.

We witness negative relationships between gross national income and both high-medium union formation and female hypergamy. The former contradicts the finding in studies such as Smits (2003) which imply lower social closure as a result of development, and suggests instead that female hypergamy is a 'traditional' pattern that becomes less common as countries become wealthier, a finding consistent with Esteve, García-Román & Permanyer (2012).

Conclusions

This study provides additional evidence for the hypothesis that greater inequality between educational strata increases the prevalence of educational assortative mating. It is clear from mixed-effects models that this relationship obtains cross-nationally. In countries in which educational strata are more similar in terms of income it is far more common for unions to be formed across educational lines. Conversely, where educational strata are economically dissimilar they also appear unlikely to choose each other as partners. Further, we found that this relationship appears gender-blind; both male and female hypergamy are less common in countries where educational strata are more unequal.

Within countries, this same relationship was observed, but more inconsistently. My fixed effects model indicated a negative effect of increased returns to education on the odds of union formation between high- and medium educated individuals. And in mixed-effects models a negative relationship was found between within-country returns to education and the odds of high/low union formation.

What explains the combination of strong cross-national results and weaker within country results? It may be that union-formation patterns respond only very slowly to changes in the economic relationship between educational strata. Furthermore, within countries returns to education do not change very rapidly; in fact, in this sample 85% of the variance in returns to education is *between* countries. Patterns of partnering appear largely insensitive to minor within-country fluctuation in returns to education. However,

fixed-effects models results point to the possibility that the partner choice of the highly educated is more sensitive to these shifts.

Within countries, the relationship between female educational and economic position and union-formation was also quite ambiguous. There is some evidence that within countries the movement towards gender parity in employment is increasing the odds of medium/low intermarriage and lowering that of high/medium intermarriage. This may be due, on the one hand, to increased homogamy among the highly educated, and on the other, to an increased tendency of moderately educated women to pair with less educated men. In fixed-effects models, however, the movement toward parity in employment predicted higher odds of high/low intermarriage and female hypergamy, and lower odds of male hypergamy. On the whole, though, this does not present one single overall pattern. I conclude that the impact of improvements in women's labor market and educational position relative to men does not have a strong or consistent influence on partnering decisions for the countries in this sample. Further research is doubtless needed in this matter.

Finally, there is strong evidence of effects of educational disparities between males and females on the prevalence of hypergamy at the country-level. Countries in which males are on average more highly educated than females experience higher prevalence of hypergamy, and this is not simply due to random sorting among differently-sized groups. In interpreting this result, it is important to recall that the measure for 'educational advantage' is drawn from the whole population, not simply that of couples. This means that potentially the effect of population-level differences in educational attainment has an

impact on marital behavior over and above the differences that appear in the marginal distribution of couples in unions. This is consistent with a *normalizing* of gendered patterns of 'marrying up' in countries in which one gender or the other is significantly over-represented among the more educated. That is, nations in which men are more educated than women are, it would seem, 'hyper-hypergamous', in that more men engage in marrying down than would occur through random matching, because marrying down is perhaps expected and encouraged in these countries.

This study underscores the need to look at mechanisms operating both within and across countries. Focusing simply on changes in assortative mating within countries can lead us to ignore the overwhelming variance between countries, which could be the result of something like cumulative causation. Such long-term, 'slow' causal processes are not the ones which quantitative social scientists are accustomed to investigating, but they most likely are quite common and important (Pierson 2004). Nonetheless, identifying causal effects with accuracy and reliability in long time frames across multiple countries is challenging and difficult, and interpretation of results in such studies needs to be cautious and judicious. And, indeed, without investigating within-country effects one can make the mistake of reading history (or social reality) sideways – allowing cross-sectional variation to stand in for change over time within societies (Raymo & Xie 1998).

Research on the relationship between inequality and assortative mating is still developing, but it is generally pointing towards a consensus that inequality does indeed affect marital patterns. Parallel research supports the conception of the reverse causal relationship as well – that assortative mating increases inequality between households and

exacerbates inequality in the next generation by dampening mobility (e.g. Fernandez & Rogerson 2001). These two strains of research, taken together, point to the possibility of a 'private' back-door mechanism through which increases in inequality reproduce stratification through rational responses of people to more unequal social environments. Such environments, it seems, discourage the mixing of socioeconomic classes, and can lead to a hardening of class boundaries.

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Tables & Figures

Table 1: Fit Statistics from Loglinear Models

	Log Likelihood	AIC	BIC	Index of Dissimilarity
Independence Model	-306493.17	718.85	600853.6	.2924
Gender-Specific Hypergamy	-17349.26	79.01	30412.74	.0693
Quasi-Symmetry	-2384.37	12.42	782.09	.0065

Table 2: Descriptive statistics for marital-education patterns in developed countries. Quantities are means across observations for each country

	Number of Observations	Odds of Medium/Low Partnering	Odds of High/Medium Partnering	Odds of High/Low Partnering	Odds of Female Hypergamy	Odds of Male Hypergamy
Austria	3	0.344	0.409	0.056	0.733	0.192
Belgium	4	0.475	0.415	0.102	0.265	0.510
Canada	3	0.563	0.632	0.285	0.478	0.657
Czech Republic	3	0.463	0.332	0.058	0.363	0.342
Denmark	5	0.605	0.455	0.176	0.521	0.425
Estonia	2	0.491	0.383	0.091	0.220	0.335
Finland	5	0.778	0.502	0.241	0.500	0.594
France	5	0.683	0.348	0.143	0.530	0.395
Germany	4	0.614	0.468	0.283	0.717	0.334
Greece	4	0.410	0.313	0.079	0.230	0.386
Ireland	3	0.469	0.518	0.172	0.257	0.698
Israel	6	0.394	0.410	0.059	0.230	0.526
Italy	6	0.384	0.309	0.034	0.214	0.601
Korea, Republic of	1	0.280	0.330	0.027	0.436	0.236
Luxembourg	3	0.366	0.226	0.056	0.304	0.176
Netherlands	5	0.591	0.541	0.142	0.623	0.380
Norway	5	0.581	0.397	0.080	0.361	0.472
Slovakia	1	0.447	0.339	0.066	0.289	0.367
Slovenia	3	0.484	0.307	0.085	0.364	0.335
Spain	5	0.556	0.476	0.146	0.374	0.451
Sweden	4	0.550	0.425	0.150	0.359	0.524
Switzerland	2	0.474	0.411	0.073	1.062	0.134
Taiwan	5	0.374	0.336	0.044	0.634	0.157
United Kingdom	3	0.350	0.320	0.093	0.211	0.432
United States	6	0.305	0.347	0.037	0.255	0.344
Mean	3.8	0.483	0.403	0.115	0.429	0.404
S.D.	1.35	0.124	0.090	0.073	0.210	0.154

Source: Luxembourg Income Study

Table 3: Descriptive Statistics of independent variables. Quantities are country-level means (averaged across observations for each country)

	Average Returns to Education	Mean Male Educational Advantage	Mean Male Employment Advantage	Mean Per Capita Income (PPP adjusted international $)
Austria	1.501	0.090	1.242	28,046
Belgium	1.204	0.003	1.286	20,290
Canada	1.451	-0.026	1.210	32,546
Czech Republic	1.524	0.079	1.146	14,926
Denmark	1.223	0.014	1.079	23,772
Estonia	1.569	-0.153	1.053	11,810
Finland	1.283	-0.059	1.091	20,834
France	1.421	0.051	1.207	20,648
Germany	1.397	0.069	1.195	28,280
Greece	1.398	-0.001	1.577	20,922
Ireland	1.473	-0.089	1.414	24,236
Israel	1.343	0.001	1.361	19,033
Italy	1.218	-0.017	1.670	23,033
Korea, Republic of	1.817	0.166	1.514	24,280
Luxembourg	1.637	0.099	1.441	47,583
Netherlands	1.307	0.114	1.617	22,764
Norway	1.249	-0.001	1.192	26,942
Slovakia	1.384	-0.065	1.073	6,450
Slovenia	1.693	0.008	1.086	17,886
Spain	1.406	-0.006	1.759	21,392
Sweden	1.173	-0.078	1.054	25,260
Switzerland	1.263	0.176	1.241	36,610
Taiwan	1.513	0.114	1.557	15,547
United Kingdom	1.671	0.005	1.159	30,603
United States	1.864	-0.007	1.204	31,916
Mean	1.439	0.020	1.297	24,826
S.D.	0.185	0.078	0.208	7,519

Source: Luxembourg Income Study; World Bank

Table 4: Mixed-effects regressions of intermarriage probability on predictor variables (94 obs.; 25 country clusters). Huber-White standard errors are employed.

	Medium/Low Intermarriage Probability	High/Medium Intermarriage Probability	High/Low Intermarriage Probability	Female Hypergamy	Male Hypergamy
Between-Country Measures:					
Returns to Education	-.344 (.096)***	-.182 (.064)**	-.123 (.053)*	-.303 (.155)*	-.304 (.082)**
Male Employment Advantage	-.155 (.095)	.042 (.084)	-.035 (.049)	-.034 (.159)	-.059 (.092)
Male Educational Advantage	-.147 (.244)	-.250 (.229)	-.259 (.166)	1.968 (.496)***	-1.556 (.337)***
Within-Country Measures:					
Returns to Education	.213 (.117)$^{+}$	-.129 (.098)	-.127 (.071)$^{+}$	.154 (.253)	.206 (.210)
Male Employment Advantage	-.144 (.056)*	.087 (.023)***	-.008 (.021)	-.022 (.055)	.025 (.105)
Male Educational Advantage	.004 (.402)	.020 (.223)	.176 (.105)$^{+}$	-.085 (.391)	-.448 (.823)
Log GNI/Capita	.038 (.046)	.019 (.053)	.049 (.028)$^{+}$	-.057 (.148)	-.023 (.060)
Time Trend	-.007 (.003)*	.001 (.003)	-.001 (.001)	-.011 (.005)*	.012 (.008)
Constant	.906 (.461)*	.419 (.529)	-.107 (.281)	1.752 (1.439)	.898 (.521)$^{+}$
RMSE	.083	.0528	.0315	.0949	.1554
R^2 Between	.505	.216	.281	.606	.817
R^2 Within	.070	.142	.087	.451	.271

Source: Luxembourg Income Study; World Bank
***p<.001, **p<.01, *p<.05, $^{+}$p<.10

Table 5: Fixed-effects models of estimating the odds of higher/lower intermarriage and hypergamy with lagged independent variables (69 obs; 23 country clusters). Huber-White standard errors employed.

	Medium/Low Intermarriage Probability	High/Medium Intermarriage Probability	High/Low Intermarriage Probability	Female Hypergamy	Male Hypergamy
Lagged variables					
Returns to Education	.2101 (.1552)	-.2336 (.1125)*	-.0529 (.0521)	-.2748 (.1331)$^{+}$	.1248 (.2278)
Male Employment Advantage	.0802 (.0895)	.0145 (.0604)	-.0911 (.0337)*	-.1429 (.0446)**	.2087 (.0791)*
Male Educational Advantage	.5783 (.3412)	-.5111 (.1989)*	-.1838 (.1012)$^{+}$	-.3919 (.3337)	1.490 (.8194)$^{+}$
Log GNI/Capita	-.0990 (.1109)	-.1801 (.0897)$^{+}$	.0399 (.0431)	-.4351 (.1970)*	-.4679 (.3729)
Time Trend	.0035 (.0056)	.0036 (.0042)	-.0052 (.0028)$^{+}$	-.0001 (.0074)	.0458 (.0169)*
Constant	.9963 (1.1042)	2.458 (.9190)*	.0149 (.3922)	5.296 (1.841)**	3.808 (3.379)
RMSE	.1572	.0971	.0614	.2007	.2717
R^2 Between	.0957	.0443	.1442	.0323	.1146
R^2 Within	.2789	.3511	.1996	.6542	.3306

Source: Luxembourg Income Study; World Bank
***p<.001, **p<.01, *p<.05, $^{+}$p<.10

Figure 1: Quasi-Symmetry and Gender-Specific Hypergamy Models

A. Quasi-Symmetry Model

Male Education ---------->

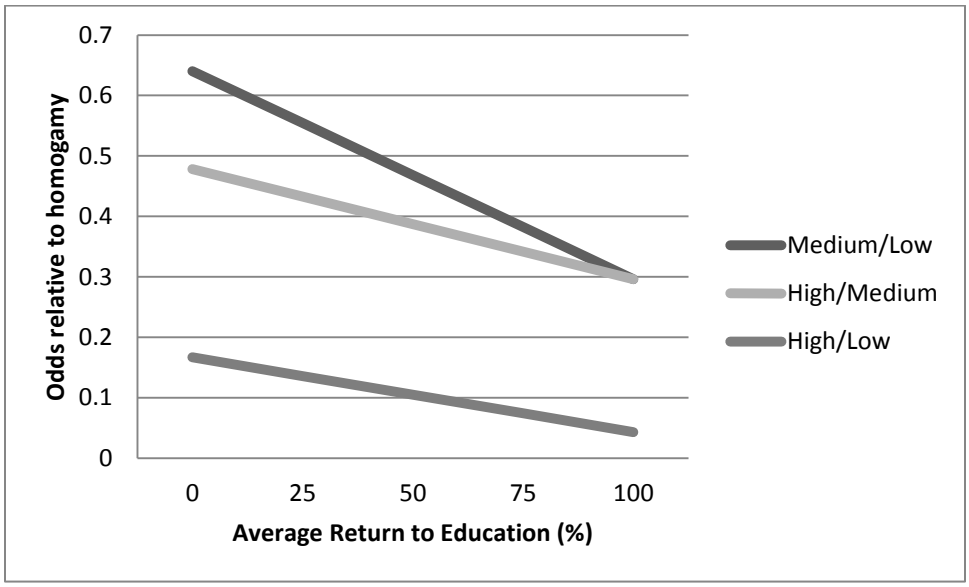
<----Female Education	L	M	H
L	0	1	3
M	1	0	2
H	3	2	0

B. Gender-Specific Hypergamy Model

Male Education ---------->

<----Female Education	L	M	H
L	0	2	2
M	1	0	2
H	1	1	0

Fig. 2: Odds of three forms of higher/lowerIntermarriage relative to homogamy, by returns to education (between-country effects).



Source: Luxembourg Income Study

Appendix

The table below presents fit statistics from loglinear models of increasing complexity. First, we present the independence model, which misclassifies about 30% of cases. As stated in the main paper, it presumes that the distributions of male and female education do not vary by country. Since this is an unreasonable assumption, I next test a model which contains interaction terms between country-year and male education and between country-year and female education. This model continues to presume that couples are formed randomly with respect to each member's educational attainment – that people do not take education into account when choosing a partner. The fit statistics show clearly that this model is a substantial improvement over complete independence, but still leaves about 20% of unions misclassified. From this I conclude that in the country-years in this data, substantial dependence exists between male and female educational attainment – that is, that some pattern of assortative mating with respect to education prevails.

Next, I test three different models in which male and female educational levels interact, but which constrain this interaction to be the same across all country-year observations. The *homogamy model* includes a dummy variable set to 1 if male education and female education are equal, and 0 otherwise. This model presumes that people simply prefer to mate with those who are similar, and show no further discrimination among their non-equals. This model represents a substantial improvement on the independence models above, but leaves about a tenth of cases misclassified. I also test the quasi-symmetry and hypergamy models without country-year interaction terms. Both of these models perform better than the simple homogamy model, and the quasi-symmetry model performs particularly well.

Finally, I test three models in which intermarriage patterns are permitted to vary across country-year observations. These are very large models, with 576 estimated in the homogamy model, 672 in the hypergamy model, and 768 in the quasi-symmetry model (each estimated on 864 degrees of freedom). All three models show improvement over counterpart models lacking country-year interactions. Of the three, the homogamy model is the least effective at describing the data, as it misclassifies about 8% of unions. The gender-specific hypergamy model performs slightly better, failing about 7% of the time. But the quasi-symmetry model virtually re-recreates the data, misclassifying fewer than 1% of all unions. The parameters from this model are thus most reliable.

Table 1: Fit Statistics from Loglinear Models

	Log Likelihood	AIC	BIC	Index of Dissimilarity
Independence Model	-306493.17	718.85	600853.6	.2924
Country-Education Interactions added	-76161.81	341.12	147427.4	.2148
Intermarriage Parameters without country-year interactions				
Homogamy	-23416.86	105.66	41943.56	.0900
Gender-Specific Hypergamy	-23047.63	104.01	41211.20	.0880
Quasi-Symmetry	-8461.69	38.90	38.90	.0530
With country-year interactions				
Homogamy	-19858.55	89.99	35126.07	.0785
Gender-Specific Hypergamy	-17349.26	79.01	30412.74	.0693
Quasi-Symmetry	-2384.37	12.42	782.09	.0065