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*Original Citation:*

The effects of educational assortative matching on job and marital satisfaction / Alessandro Tampieri. - In: JOURNAL OF BEHAVIORAL AND EXPERIMENTAL ECONOMICS. - ISSN 2214-8051. - ELETTRONICO. - (2022), pp. 1-13. [10.1016/j.socec.2022.101883]

*Availability:*

The webpage <https://hdl.handle.net/2158/1266651> of the repository was last updated on 2022-05-03T13:41:45Z

*Published version:*

DOI: 10.1016/j.socec.2022.101883

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# The Effects of Educational Assortative Matching on Job and Marital Satisfaction\*

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April 18, 2022

## Abstract

This paper studies how the decision to attend university may affect job and marital satisfaction. We propose a theoretical model with educational assortative matching, where individuals differ in their ability and prefer to marry an educated spouse. Thus, individuals decide whether to attend university both for obtaining higher job satisfaction and for meeting educated partners. Job satisfaction is modelled to take into account the income level of the average educated individual as the reference type, toward which educated individuals compare themselves. We show that, provided that the cost of social comparison is not too strong, the average ability of educated individuals falls with assortative matching, since more low ability students are willing to attend university for marital reasons. The lower average ability ultimately raises job satisfaction because it reduces the income level of the reference type. Expected marital satisfaction also increases, as more educated individuals enter the marriage market.

**JEL Numbers:** I21, J12, J28, I31

**Keywords:** higher education, job satisfaction, marital satisfaction, educational assortative matching.

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\*I would like to thank Francesca Barigozzi, Leonardo Boncinelli, Alessandro Cigno, Gianni De Fraja, Alessandro Giofré, Majlinda Joxhe, Joanna Poyago-Theotoky, the seminar audience at ASSET 2018, the Editor Andrew Clark and two anonymous Referees for helpful comments. I am particularly indebted to Cristina Bernini, Matteo Lippi Bruni and Chiara Rapallini for many discussions that lead to substantial improvements of the paper. All errors are my own.

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# 1 Introduction

The interaction between education and marriage has been an object of recent interest in the economic literature.<sup>1</sup> In this perspective, education has been studied as a pre-marital investment to improve the quality of future spouses. The idea is that acquiring higher education has two main effects on an individual's life. On the one hand, higher levels of education are more likely to provide access to secure jobs with better salaries and higher skill levels (Card, 1999, and Harmon *et al.*, 2001, and Fabra and Camisón, 2009, among others). On the other hand, attending university increases the chances of marrying an educated spouse, who will raise household income. This second aspect occurs because of the presence of “educational assortative matching”, according to which spouses are likely to have similar educational levels, even though less educated individuals would prefer educated partners. Past research has shown strong increases in the educational resemblance of spouses since the 1940s.<sup>2</sup>

In the developments of this line of research, one aspect that has not been investigated is how education decisions, combined with marriage outcomes, influence individual well-being. Indeed, due to educational assortative matching, educational choices also affect the pool of potential spouses, and indirectly the satisfaction in marriage. Hence expectations on future job and marital satisfaction may help explain why an individual engages in higher education. This is the scope of the present paper.

We propose a theoretical model, where individuals differ in their ability and decide whether to attend university. Job satisfaction is modelled in such a way to consider both the direct gains from the job (Ross and Reskin, 1992) and the comparison among workers of the same educational level (Clark and Oswald, 1996, Luttmer 2005). The analysis focuses on graduate workers. In the comparison, educated individuals feel better if they perform relatively better than a “reference type”. This is represented by an individual with average ability among educated workers.

Together with education decisions, we model the marriage market as an exogenous matching mechanism, and we assume that the quality of a relationship is positively related to the partner's level of education. There are indeed many studies suggesting that the quality of marital relationships is positively associated with partners' education. Some examples are Hahlweg and Markman (1988), Sayers *et al.* (1998), Silliman *et al.* (2001), Halford *et al.* (2003) and Stanley *et al.* (2006). In particular, Bruze (2011) shows that individuals exhibit strong preferences for non-financial traits of the partner that relate with years of education.

The matching process can be either *random* or *assortative*. Random matching takes place when partners meet each other by chance. Thus, for each individual, a partner is randomly drawn from the population of the opposite gender. Assortative matching occurs if an educated individual meets the partner at school, or in related social occasions. With this type of

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<sup>1</sup>See Section 2 for an overview of the literature.

<sup>2</sup>See Schwartz and Mare (2005), Lewis and Oppenheimer, (2000), Smits *et al.* (2000), Pencavel (1998), Qian (1998), Qian and Preston (1993), Kalmijn (1991a, 1991b) and Mare (1991), among others.

matching, both partners have the same level of education.<sup>3</sup>

The presence of educational assortative matching implies that acquiring higher education increases the chance of marrying an educated partner (Peters and Siow, 2002). In turn, since an educated partner improves the quality of marriage, assortative matching gives an incentive to attend university. The theoretical results show that, as the probability of assortative matching increases, university attendance rises, implying that more low ability students enrol at university: indeed, high-ability students choose education regardless of the hope of a better marriage. As a consequence, the ability and working conditions of the average educated individual fall. In turn, educated workers feel better from the comparison with the reference type, and job satisfaction increases. Moreover, the expected marital satisfaction of educated persons increases, since the proportion of educated individuals increases in the marriage market.

These results require that the weight of social comparison in determining both job and marital satisfaction must be not too high for low-type individuals. Otherwise, the benefit of studying is offset by the cost of being of low type in the comparison with higher-skilled educated individuals.

We then extend the theoretical framework in several directions: first, we consider marital satisfaction as increasing in the partner’s ability. Second, we assume that marital satisfaction is also influenced by social comparison. Third, we investigate the case of different education and marital gains between genders. For each case, we find the conditions under which the results of the baseline model continue to hold.

We conclude the analysis with an empirical test to verify the positive relationship between the spouse’s educational qualification and marital satisfaction. The results are consistent with our theoretical assumption.

To the best of our knowledge, this is the first analysis that investigates an interaction between job and marital satisfaction explained by university choice.

The remainder of the paper is organised as follows. Section 2 outlines some of the relevant literature. The theoretical model is introduced in Section 3, while Section 4 shows the baseline results. Section 5 develops the extensions to the baseline analysis, and Section 6 illustrates a simple empirical exercise to show that our theoretical assumptions are empirically rooted. Concluding remarks are in the last section.

## 2 Related literature

This paper is mainly related to the literature on education and assortative matching. Peters and Siow (2002) analyse a setting where parents invest in their child’s education to increase the quality of the future spouse. They find that, in the presence of assortative matching, parental investments are efficient in large marriage markets. Thus there is an incentive to

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<sup>3</sup>Throughout the paper, we will use the term “assortative matching” and “educational assortative matching” interchangeably, referring to a positive correlation in partners’ educational level.

invest in education to match better partners. Chiappori *et al.* (2009) examine a framework with schooling investment and endogenous marital matching, where spouses specialise either in homework or market production. They find that women attain higher schooling levels than men to avoid labour market discrimination, which appears to be more typical of labour markets where a low level of schooling is required. In the same line of research, Chiappori *et al.* (2018) develop a fully-fledged structural model with a time component. Booth and Coles (2010) investigate how partnership affects the educational investment and the joint labour supply decisions of couples. They consider two matching types, one where partners marry for money and one where they marry for love. The former yields a more efficient investment, whereas romantic matching raises aggregate productivity through an increase in the number of educated women.<sup>4</sup>

Our paper shares with these studies the link between education and assortative matching. However, these contributions do not model job and marital satisfaction. In particular, these papers consider the educational choice in relation to future marriage formation but, employing models with transferable utility, they are not fit to study the role of job satisfaction, since they model household rather than individual utilities.

The paper is also related to the literature that investigates the relationship between job satisfaction and education (Meng 1990, Idson 1990, Clark 1996, Clark and Oswald 1996, Luttmer 2005 and Florit and Vila-Lladosa 2007, among others). Our contribution is mainly related to Clark and Oswald (1996) and Luttmer (2005), who highlight the role of comparison income in explaining job satisfaction. They find that satisfaction indeed falls with the income of relevant others. Our potential contribution to this empirical literature is to propose a theoretical framework to interpret the relationship between job satisfaction and education that takes into account the role of relative income.

Finally, the paper is linked to the literature on marital satisfaction. Many studies suggest that the partner's level of education positively associates with the quality of marital relationships (Hahlweg and Markman, 1988, Sayers *et al.*, 1998, Silliman *et al.*, 2001, Halford *et al.*, 2003, Stanley *et al.*, 2006, Bruze, 2011, among others). This paper can contribute to this literature by providing further evidence to the positive relationship between marital satisfaction and the partner's level of education.

### 3 The model

We study an economy with two populations of the same size, one of men and one of women. The members of each population differ in ability, labeled  $\theta_i \in [0, 1]$ ,  $i = w$  (*women*),  $m$  (*men*), respectively, distributed with same density  $f(\theta_i)$  and cumulative distribution function  $F(\theta_i)$ . Initially, each individual is single and decides whether to attend university or to work immedi-

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<sup>4</sup>Other relevant contributions in this literature are Fernandez *et al.* (2005), Baker and Jacobsen (2007), Chiappori *et al.* (2017) and Nosaka (2007).

ately.

We refer to individuals who attend university as “educated” individuals. The proportion of educated women and men is denoted as  $g_w, g_m \in [0, 1]$ , respectively. In the labour market, the payoff obtained by an educated individual is:

$$\lambda_i^{ed} = y_i - \delta (\bar{y}_i - y_i) - c, \quad (1)$$

where superscripts  $ned$  and  $ed$  stand for “not educated” and “educated”, respectively. The first part of (1),  $y_i = e\theta_i, e > 0$  represents the educational benefit in the labour market. Attending university is generally necessary to gain access to better paid, less tiring or more sophisticated jobs. Thus  $e\theta_i$  can be seen as a better salary as well as an improvement in working conditions, job quality, and hours worked.<sup>5</sup> Moreover, the educational benefit is increasing in individual ability, but it is not gender-specific. We will relax the last assumption in Section 5.3.

The second component of the educational payoff is the relative educational benefit. It depends on the relative position of an individual’s educational benefit compared to the average payoff among educated individuals  $\bar{y}_i = e\bar{\theta}_i$ , where  $\bar{\theta}_i$  is the average ability among educated. Naturally,  $(\bar{y}_i - y_i)$  could also be negative. Parameter  $\delta \in (0, 1)$  measures the importance of relative achievement and social comparison for an individual. The individual with average ability level among educated ones is the “reference type” for each  $i \in \{w, m\}$ . The assumption that workers compare their working conditions is standard in social psychology (Festinger, 1962, Adams, 1963), as well as in the economic literature on job satisfaction (Clark and Senik, 2010): it is used to model aspects of job satisfaction driven by the comparison of job conditions, such as envy, jealousy or inequity (Clark and Oswald, 1996, and Luttmer, 2005, among others). These types of assumptions are also adopted in contract theory to define envy in comparing the net compensation among workers, (Deisiraju and Sappington, 2007, Manna, 2016 and Barigozzi and Manna, 2020, among others). The last component of (1),  $c > 0$ , catches the utility cost of studying effort.

We refer to individuals who choose not to attend university as “uneducated” individuals, whose proportion in each population  $i$  is  $1 - g_i$ . A non-educated individual obtains a payoff normalised to zero,  $\lambda_i^{ned} = 0$ . The effects of comparison also exist within the group of uneducated workers, as recent evidence has shown (Clark and Senik, 2010). However, since the payoff of uneducated workers is normalised to zero, the comparison among uneducated individuals is also zero.

After deciding whether to attend university, an individual either marries one of the opposite sex or remains single. The probability of marrying, denoted by  $\eta \in (0, 1)$ , represents the exogenous chance of meeting the right person, and it is independent on the individual’s type. We assume that marriage is stable, so that individuals are not allowed to divorce.

We assume that marrying an educated partner yields a positive marital surplus,  $b > 0$ . In-

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<sup>5</sup>We abstract away from the effect on wages of changes in the labour supply of graduate workers.

deed, marriage may give idiosyncratic non-monetary benefits which are also education-specific.<sup>6</sup> Our assumption is based on extensive empirical evidence (see the introduction) showing that marriage quality increases when the partner has a high level of education. Furthermore, we will verify whether this assumption indeed holds in a novel empirical exercise in Section 6.

Regarding this last point, it is important to acknowledge the evidence of an increase in marital instability and divorce rate when women acquire more education than men (Bertrand *et al.*, 2015), which might be in contrast with our assumption. This association, though, seems to disappear in the analysis of more recent marriage cohorts (Schwartz and Han, 2014). A possible explanation is that couples who entered relationships where wives are more educated than their husbands may hold more flexible attitudes about gender in marriage. These relationships might be particularly selective of men with egalitarian values. In turn, these values are typically associated with marital stability (Lye and Biblarz 1993, Kaufman 2000).

Furthermore, the marital surplus obtained from an educated partner decreases with the distance between the individual and partner's type: more similar individuals tend to get along better. This assumption catches the effect of complementarities among partners' characteristics, and it is qualitatively similar to the way marriage literature of transferable utility (dating back to Becker, 1973) models positive assortative matching.<sup>7</sup> Given these assumptions, the marital surplus from marrying a partner is

$$\mu = (1 - |\theta_i - \theta_j|) b. \tag{2}$$

Conversely, being single or married with an uneducated partner yields a payoff normalised to zero.

Marriage benefit (2) can be easily extended by considering (i) the benefit is increasing on the partner's ability, (ii) a relative component given by the social comparison with other educated partners, or (iii) gender-specific marital benefits. Section 5 will investigate these cases.

Given the benefits and costs of attending university and marital satisfaction, the payoff matrix is the following.

Payoff matrix		
women		
men	<i>educated</i>	<i>not educated</i>
<i>educated</i>	$\lambda_m^{ed} + \mu, \lambda_w^{ed} + \mu$	$\lambda_w^{ed}, \mu$
<i>not educated</i>	$\mu, \lambda_w^{ed}$	0, 0

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<sup>6</sup>See Choo and Siow, (2006), and Chiappori *et al.* (2009) and (2018).

<sup>7</sup>In the concluding remarks, we discuss this assumption in relation to the recent developments of the literature.

### 3.1 Matching

The *expected* payoff of individuals depends on the type of matching. We outline here the matching rules of the model. We adopt a *two-pool assortative matching process with uniform assortativity* (Cavalli-Sforza and Feldman 1981). This is “a random matching process such that, with a certain probability, a member of the population matches from an assortative pool, consisting only of its own type, while the complementary fraction matches from a random pool consisting of all individuals who did not match from an assortative pool.” (Bergstrom, 2012). In our story, assortativity entails that spouses have the same level of education.

In practice, random matching occurs anytime a meeting takes place in situations that are unrelated to university attendance. For example, a match between an engineer and a labourer sharing the passion for sports is independent of their education levels. Two individuals meeting in a bar or a club can have completely different educational backgrounds. Hence, the probability for a man to marry an educated woman is given by the probability that a woman attends university, denoted by  $g_w \in [0, 1]$ , while the probability for a woman to marry an educated man is the probability that a man attends university, denoted by  $g_m \in [0, 1]$ . As a consequence, with random matching, an individual’s level of education is not related to the partner’s education.

Assortative matching takes place whenever an individual meets the partner at school. Also, meeting at school parties or in social environments related to previous school friendships are examples of assortatively matched couples. In this case, spouses have the same level of education with probability one.

We denote the probability of assortative matching as  $\gamma \in (0, 1)$  and random matching as  $1 - \gamma$ . Probability  $\gamma$  is exogenous and independent from the distribution of abilities. Somehow, this probability is determined by the institutional setting. A factor that influences  $\gamma$  is, for instance, the number of hours a student must stay at school, which depends on the education system considered. The more the students are required to spend time together, the higher the probability of finding a partner in that environment (Blossfeld and Timm, 2003). Another factor that might influence  $\gamma$  is the adoption of “ability tracking” in the educational system considered. Ability tracking separates pupils into groups by academic ability: hence its presence implies a high level of  $\gamma$ , since students with similar levels of ability will spend more time together.

To design the matching mechanism, we must make an initial assumption on the proportion of educated individuals. This is necessary since the mechanism depends on the relationship between the number of men and women who attend university. For instance, if we assume that more men than women are educated, necessarily some educated men will be matched with an uneducated woman even if the matching is of assortative type. This because the number of educated women is not sufficient to ensure an educated partner to each educated man. This problem does not emerge if we assume the same proportion of educated men and women.

We thus focus on the symmetric case, so that  $g_m = g_w$ . Notice that this does not exclude the existence of asymmetric equilibria where, say, the number of educated men is higher than the number of educated women, or *vice versa*. These equilibria are relevant: the gender gap in

education is still present in some countries. However, in other countries, the gender gap has closed, or even reversed (Evans *et al.*, 2020 and Barro and Lee, 2013). Furthermore, the model is more appealing, and the message of the paper is better highlighted by setting aside gender differences on educational levels.

The matching mechanism is illustrated in Table 1. The assumption of symmetry ensures that, with assortative matching, every educated (uneducated) individual, either a man or a woman, can find an educated (uneducated) partner.

Table 1. Marriage matching

$i$ 's matching, $i, j \in \{m, w\}, i \neq j$	Probability
ed. $i$ + ed. $j$	$\eta \left[ (1 - \gamma)g_j + \gamma \right]$
ed. $i$ + ned. $j$	$\eta \left[ 1 - \left( (1 - \gamma)g_j + \gamma \right) \right]$
ned $i$ + ed. $j$	$\eta (1 - \gamma) g_j$
ned $i$ + ned $j$	$\eta [1 - (1 - \gamma) g_j]$

## 4 Baseline results

### 4.1 University choice equilibrium

Each individual, woman or man, decides whether to attend university by comparing the alternative payoffs. The expected payoffs for an educated and uneducated individual of gender  $i$  are, respectively:

$$EU_i^{ed} = \lambda_i^{ed} + EM^{ed}, \quad (3)$$

$$EU_i^{ned} = EM^{ned}. \quad (4)$$

where

$$EM^{ed} = \eta [(1 - \gamma) g_j + \gamma] (1 - |\theta_i - \bar{\theta}_j|) b, \quad (5)$$

$$EM^{ned} = \eta (1 - \gamma) g_j (1 - |\theta_i - \bar{\theta}_j|) b, \quad (6)$$

are the expected marital benefit from being educated or not. Notice that the matching mechanism affects the chance of getting the marital surplus only. This also implies that one's level of education affects her or his marital benefit, since

$$EM^{ed} - EM^{ned} = \eta \gamma (1 - |\theta_i - \bar{\theta}_j|) b > 0.$$

Educated individuals expect to gain a higher utility from marrying an educated partner.

An individual attends university if and only if  $EU_i^{ed} \geq EU_i^{ned}$ . Hence, a *university choice equilibrium* occurs when no individual wants to change her or his choice of education. The equilibrium is thus represented by the pair of abilities  $(\hat{\theta}_w, \hat{\theta}_m)$  of individuals indifferent between studying or not. The following proposition illustrates the equilibrium existence conditions.

**Proposition 1** *Suppose  $c \in (\eta\gamma b - \bar{\theta}_i(\eta\gamma b + \delta e), \eta\gamma b + e)$ . Then a symmetric equilibrium configuration given by the pair  $(\hat{\theta}_w, \hat{\theta}_m) \in (0, 1) \times (0, 1)$  exists.*

**Proof.** We prove the existence of the equilibrium by identifying the conditions under which, by contrast, it does not exist. Symmetry in the distribution of educated individuals determines the shape of the expected payoffs, according to Table 1. A configuration where no one attends university is one such that  $EU_i^{ed} < EU_i^{ned}$ , i.e.,

$$\begin{aligned} & \theta_i(1 + \delta) - \delta\bar{y}_i - c + \eta\gamma [1 - |\theta_i - \bar{\theta}_j|] b \\ & < 0 \Leftrightarrow \\ & c > e\theta_i(1 + \delta) - \delta e\bar{\theta}_i + \eta\gamma [1 - |\theta_i - \bar{\theta}_j|] b, \end{aligned}$$

for every  $\theta_i \in [0, 1]$ , and  $i = w, m$ . Therefore a sufficient condition is that for  $\hat{\theta}_j = 1$ . In this case,  $\bar{y}_i = e$ ,  $\bar{\theta}_i = \bar{\theta}_j = 1$ ,  $g_j = 0$ ,  $\theta_i = 1$ , the condition amounts to

$$c > \eta\gamma b + e.$$

A configuration where everyone attends university is one such that  $EU_i^{ed} > EU_i^{ned}$ , which requires

$$c > e\theta_i(1 + \delta) - \delta e\bar{\theta}_i + \eta\gamma [1 - |\theta_i - \bar{\theta}_j|] b,$$

for every  $\theta \in [0, 1]$  and  $i = w, m$ . Now a sufficient condition is that for  $\hat{\theta}_j = 0$ , which amounts to

$$c < \eta\gamma (1 - \bar{\theta}_j) b - \delta e\bar{\theta}_i,$$

with  $\bar{\theta}_j = \bar{\theta}_i$  because of the symmetric equilibrium.

Thus, a credible configuration where only some individuals choose to attend university requires that the utility cost of education must lie in  $c \in (\eta\gamma b - \bar{\theta}_i(\eta\gamma b + \delta e), \eta\gamma b + e)$ . Trivial manipulation shows that this range always exists. ■

We are now in a position to verify how the probability of assortative matching  $\gamma$  influences the equilibrium outcome,  $\hat{\theta}_i$ . By equating equations (3) and (4), the level of ability  $\hat{\theta}_i$  that let an individual be indifferent between studying or not requires the following condition to hold:

$$e\hat{\theta}_i(1 + \delta) - \delta e\bar{\theta}_i - c + \eta\gamma \left(1 - \left|\hat{\theta}_i - \bar{\theta}_j\right|\right) b = 0. \quad (7)$$

Notice that  $\bar{\theta}_j - \hat{\theta}_i > 0$ : partner  $j$  is educated and thus her average ability is always higher than  $\hat{\theta}_i$ . We may thus rewrite (7) as

$$e\hat{\theta}_i(1 + \delta) - \delta e\bar{\theta}_i - c + \eta\gamma \left[1 - \left(\bar{\theta}_j - \hat{\theta}_i\right)\right] b = 0.$$

Differentiating with respect to  $\gamma$  and invoking symmetry for  $\bar{\theta}_j = \bar{\theta}_i$ , we get

$$\frac{\partial \hat{\theta}_i}{\partial \gamma} e \left[ 1 + \delta \left( 1 - \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} \right) \right] + \eta b \left[ 1 - \bar{\theta}_i + \gamma \frac{\partial \hat{\theta}_i}{\partial \gamma} \left( 1 - \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} \right) + \hat{\theta}_i \right] = 0.$$

Solving for  $\frac{\partial \hat{\theta}_i}{\partial \gamma}$  yields

$$\frac{\partial \hat{\theta}_i}{\partial \gamma} = - \frac{\eta b \left( 1 - \bar{\theta}_i + \hat{\theta}_i \right)}{e \left[ 1 + (\delta + \eta b \gamma) \left( 1 - \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} \right) \right]}. \quad (8)$$

We focus on the sign of the denominator, as the numerator is always positive. First, the ability of the reference type is given by

$$\bar{\theta}_i = E \left[ \theta_i | \theta_i > \hat{\theta}_i \right] = \frac{\int_{\hat{\theta}_i}^1 \theta_i f(\theta_i) d\theta_i}{1 - F(\hat{\theta}_i)},$$

where, by the properties of truncated distribution,

$$\frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} = \frac{f(\theta_i)}{1 - F(\hat{\theta}_i)} \left[ \bar{\theta}_i - \hat{\theta}_i \right] > 0.$$

Thus a sufficient condition for (8) to be negative is  $1 - \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} > 0$ . This condition requires that a decrease of the indifferent type must bring about a more than proportional decrease of the representative type. In other words, a fall in  $\hat{\theta}_i$  decreases the gap between the representative and the indifferent types.

The interpretation is intuitive. Social comparison negatively affects both job and marital satisfaction for the indifferent type: this is natural, given that her or his level of ability is lower than the level of the representative type and it is the lowest possible for an educated individual. Hence, if an increase in  $\gamma$  decreases the gap between the representative and the indifferent type  $\left( 1 - \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} < 0 \right)$ , then the impact of social comparison decreases, by inducing more low-ability individuals to acquire higher education, for given studying effort  $c$ . By contrast, if an increase of assortative matching increases the gap between representative and indifferent types, then the cost of low-ability types in terms of social comparison might be too high to attend university.

It follows that

**Proposition 2** *In equilibrium, the ability threshold is decreasing in the level of educational assortative matching as long as the negative effect of social comparison on the indifferent type is not too strong.*

For the remainder of the paper, we will make the following assumption,

**Assumption 1**  $\frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} < 1$ .

Assumption 1 amounts to saying that the cost of social comparison for indifferent types is sufficiently low.

We now turn to analyse how the probability of educational assortative matching  $\gamma$  affects job and marital satisfaction for educated individuals. The job satisfaction of individual with ability  $\theta_i$  can be obtained from the first part of equation (3), and it is given by the educational gain  $e\theta_i$  plus the relative effect of social comparison:

$$Job_{\theta_i}(\hat{\theta}_i) = e [\theta_i - \delta (\bar{\theta}_i - \theta_i)], \quad (9)$$

Conversely, individual  $\theta_i$ 's expected marital satisfaction is given by equation (5). Differentiating (9) and (5) with respect to  $\gamma$  we get

$$\frac{\partial Job_{\theta_i}}{\partial \gamma} = -\delta e \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} \frac{\partial \hat{\theta}_i}{\partial \gamma} > 0,$$

and

$$\begin{aligned} \frac{\partial EM_{\theta_i}}{\partial \gamma} = & \eta \left[ \frac{\partial g_i(\hat{\theta}_i)}{\partial \hat{\theta}_i} \frac{\partial \hat{\theta}_i}{\partial \gamma} (1 - \gamma) + (1 - g_j) \right] (1 - |\theta_i - \bar{\theta}_j(\gamma)|) b - \\ & [(1 - \gamma) g_j + \gamma] \frac{\partial \bar{\theta}_j}{\partial \hat{\theta}_j} \frac{\partial \hat{\theta}_j}{\partial \gamma} b > 0, \end{aligned} \quad (10)$$

given  $\frac{\partial \hat{\theta}_j}{\partial \gamma} < 0$ , while  $\frac{\partial g_i(\hat{\theta}_j)}{\partial \hat{\theta}_j} < 0$  because  $g_i(\hat{\theta}_j) = \int_{\hat{\theta}_j}^1 f(\theta_i) d\theta_i$ . The next corollary summarises the results.

**Corollary 1** *Suppose Assumption 1 holds. An increase in the probability of educational assortative matching brings about an increase in both job satisfaction and expected marital satisfaction.*

Corollary 1 is the central result of the paper and may be explained as follows. As assortative matching increases, the probability of marrying a partner with the same level of education increases. Since educated persons are preferred as partners, more individuals with relatively lower ability are willing to attend university to increase their chance of marrying an educated partner. The increase in university attendance by individuals with low ability generates a positive externality in terms of job satisfaction: as assortative matching increases, the ability of the reference type decreases, since the average ability among educated decreases. Job satisfaction increases because comparison is more likely to be positive. Finally, the increased number of educated individuals increases expected marital satisfaction.

## 4.2 Social welfare and university attendance

In this section, we verify the effects of university attendance and social welfare. We will focus on population  $i$ , because of the symmetry with population  $j$ . The share of educated individuals

have aggregate utility

$$A\mathcal{U}_i^{ed} = g_i \left\{ e \left[ \theta_i - \delta (\bar{\theta}_i - \theta_i) \right] - c + \eta \left[ (1 - \gamma) g_j + \gamma \right] \left( 1 - |\theta_i - \bar{\theta}_j| \right) b \right\},$$

while the share of uneducated ones have aggregate utility

$$A\mathcal{U}_i^{ned} = (1 - g_i) \eta (1 - \gamma) g_j \left( 1 - |\theta_i - \bar{\theta}_j| \right) b.$$

Social welfare of population  $i$  is thus:

$$\begin{aligned} W_i = g_i \left\{ e \left[ \theta_i - \delta (\bar{\theta}_i - \theta_i) \right] - c + \eta \left[ (1 - \gamma) g_j + \gamma \right] \left( 1 - |\theta_i - \bar{\theta}_j| \right) b \right\} \\ + (1 - g_i) \eta (1 - \gamma) g_j \left( 1 - |\theta_i - \bar{\theta}_j| \right) b. \end{aligned} \quad (11)$$

Rearranging and invoking symmetry, equation (11) becomes

$$W_i = g_i \left\{ e \left[ \theta_i - \delta (\bar{\theta}_i - \theta_i) \right] - c + \eta \left( 1 - |\theta_i - \bar{\theta}_i| \right) b \right\}. \quad (12)$$

The conditions of existence by Proposition 1 ensure that the part of (12) in curly brackets is positive.

We may now determine the effects of education on welfare by evaluating the relationship between social welfare and the share of educated individuals. Differentiating (12) with respect to  $\hat{\theta}_i$ , we get:

$$\begin{aligned} \frac{\partial W_i}{\partial \hat{\theta}_i} = \frac{\partial g_j}{\partial \hat{\theta}_i} \left\{ e \left[ \theta_i - \delta (\bar{\theta}_i - \theta_i) \right] - c + \eta \left( 1 - |\theta_i - \bar{\theta}_i| \right) b \right\} \\ - g_i (e\delta + \eta b) \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i}. \end{aligned} \quad (13)$$

Given that  $\frac{\partial g_j}{\partial \hat{\theta}_i} < 0$  and  $\frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} > 0$ , the relationship is always negative.

**Proposition 3** *Social welfare is increasing in the share of educated individuals.*

Notice that education acquisition is welfare-improving under the conditions of existence of a symmetric equilibrium by Proposition 1, with only some individuals attending university. These conditions ensure that the utility cost of education is sufficiently low so that social welfare increases with the number of educated individuals.

## 5 Extensions

The framework above can be enriched in several directions, to add further elements of reality to the analysis.

## 5.1 Partner's ability and marital satisfaction

In the baseline model, the marital benefit is determined by the partner's level of education and the distance between partners' types. An alternative way to model marital satisfaction is to assume that marital satisfaction is positively related to the partner's type  $\theta_j$ , as long as the partner is educated. This approach allows considering both education and the intrinsic features of partners as an explanation for marital satisfaction. Of course, the implicit assumption is that ability positively affects both the performance at work and in the relationship, which is not necessarily true. Be that as it may, it is also natural to think that there exists some human characteristic that positively affects both these aspects of life.

We start from the following assumption.

**Assumption 2** *Let the marital surplus from marrying an educated partner be*

$$\tilde{\mu} = b\theta_j. \quad (14)$$

With Assumption 2 in place, a trade-off emerges: an increase in the number of educated individuals increases the chance of marrying an educated partner, but it decreases the expected quality of that partner.<sup>8</sup> The new conditions for the existence of the equilibrium are summarised in the following proposition.

**Proposition 4** *Let Assumption 2 hold and suppose*

$$c \in (\bar{\theta}_i(\eta\gamma b - \delta e), e + \eta\gamma b).$$

*Then a symmetric equilibrium configuration given by the pair  $(\hat{\theta}_m, \hat{\theta}_w) \in (0, 1) \times (0, 1)$  exists.*

The proof is obtained similarly to Proposition 1 and is relegated to the appendix. The level of ability  $\hat{\theta}_i$  that makes an individual indifferent between studying or not requires the following condition to hold:

$$e\hat{\theta}_i(1 + \delta) - \delta e\bar{\theta}_i - c + \eta\gamma b\bar{\theta}_j = 0.$$

Differentiation with respect to  $\gamma$  gives

$$e(1 + \delta) \frac{\partial \hat{\theta}_i}{\partial \gamma} - \delta e \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} \frac{\partial \bar{\theta}_i}{\partial \gamma} + \eta b \bar{\theta}_j + \eta \gamma b \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} \frac{\partial \hat{\theta}_i}{\partial \gamma} = 0.$$

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<sup>8</sup>An alternative assumption could be  $\tilde{\phi} = b[\theta_j - \tilde{\delta}(\bar{\theta}_j - \theta_j)]$ , which mirrors the construction of job satisfaction, as it considers the relative component of marital satisfaction given by the comparison among educated partner. However, the relative component of marital benefit cannot be predicted, since

$$E[\tilde{\phi}] = b[\theta_j - \tilde{\delta}(\bar{\theta}_j - \bar{\theta}_j)] = b\theta_j,$$

so that it does not play any role in the university choice.

Solving for  $\frac{\partial \hat{\theta}_i}{\partial \gamma}$ , we get

$$\frac{\partial \hat{\theta}_i}{\partial \gamma} = -\frac{\eta b \bar{\theta}_j}{e \left[ 1 + \delta \left( 1 - \frac{\partial \bar{\theta}_i}{\partial \theta_i} \right) \right] + \eta \gamma b \frac{\partial \bar{\theta}_i}{\partial \theta_i}} < 0,$$

which is negative as long as Assumption 1 holds, as in the baseline case. Therefore

**Proposition 5** *Let Assumptions 1 and 2 hold. In equilibrium, the ability threshold is decreasing in the level of educational assortative matching.*

We now move again to examine the effects of educational assortative matching on job and marital satisfaction. Job satisfaction remains the same as in the baseline model, while expected marital satisfaction is now given by:

$$EM_{\theta_i}(\hat{\theta}_j) = \eta b \bar{\theta}_j \left[ (1 - \gamma) g(\hat{\theta}_j) + \gamma \right]. \quad (15)$$

Differentiating (15) with respect to  $\gamma$  and rearranging, we get,

$$\frac{\partial EM_{\theta_i}}{\partial \gamma} = \eta b \left[ \bar{\theta}_j \left[ \frac{\partial g_i(\hat{\theta}_j)}{\partial \hat{\theta}_j} \frac{\partial \hat{\theta}_j}{\partial \gamma} (1 - \gamma) + 1 - g(\hat{\theta}_j) \right] + \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} \frac{\partial \hat{\theta}_i}{\partial \gamma} \left( g(\hat{\theta}_j) (1 - \gamma) + \gamma \right) \right]. \quad (16)$$

The first part of (16) is qualitatively similar to that in the baseline model, and likewise, it is positive. The second part is negative, since the average quality of educated individuals declines with the increase in assortative matching. The intuition is as follows. As education levels increased with more assortativity, the presence of more educated individuals would raise the expected marital satisfaction through the mechanism outlined in the baseline case. However, this effect is now partially offset by the declining average quality of the pool of educated individuals. Therefore the result of Corollary 1, according to which an increase in the probability of educational assortative matching increases marital satisfaction, holds only when the second part of (16) is lower than the first one.

## 5.2 Marital satisfaction and social status

So far, the benefit obtained from an educated partner has been motivated by an increase in the interpersonal skills obtained by the acquisition of education, or in the benefit given by the partner's ability *per se*. A third alternative at explaining marital satisfaction could be that being married with an educated spouse gives a benefit in terms of "social prestige". The gain obtained by social comparison falls with the number of educated individuals: for instance, if everyone had an educated partner, it would not give any social gain. Hence, a way to model both individual and social marital benefit is as follows:

**Assumption 3** *Let the marital surplus from marrying an educated partner be*

$$\hat{\mu}(\hat{\theta}_j) = b \left[ 1 + \beta \hat{\theta}_j \right]. \quad (17)$$

The first part of (17) corresponds to the gain of marrying an educated partner, and it is analogous to the one in the baseline model. The second part of (17) represents the relative component, which decreases with the number of educated partners at a rate of  $\beta \in (0, 1)$ . The trade-off that occurs here is similar to that that emerges in the previous extension: the expected marital satisfaction increases with the number of educated individuals, since it is easier to marry an educated partner, but falls with the decrease in average ability.

Again, the conditions of existence (see the appendix) are similar to the baseline case.

**Proposition 6** *Let Assumption 3 hold and suppose  $c \in (\eta\gamma b - \delta\bar{y}_i, e + \eta\gamma b(1 + \beta))$ . Then a symmetric equilibrium configuration given by the pair  $(\hat{\theta}_m, \hat{\theta}_w) \in (0, 1) \times (0, 1)$  exists.*

The level of ability  $\hat{\theta}_i$  that makes an individual indifferent between studying or not requires the following condition to hold

$$e\hat{\theta}_i - \delta e\bar{\theta}_i - c + \eta\gamma b \left( 1 + \beta \hat{\theta}_i \right) = 0.$$

Solving for  $\hat{\theta}_i$  and differentiating with respect to  $\gamma$  yields:

$$\frac{\partial \hat{\theta}_i}{\partial \gamma} = - \frac{\eta b \left( 1 + \hat{\theta}_i \beta \right)}{\left[ \eta \gamma b \beta + e \left( 1 - \delta \frac{\partial \bar{\theta}_i}{\partial \hat{\theta}_i} \right) \right]},$$

which is negative for the same reasoning as in Proposition 2. It follows that

**Proposition 7** *Let Assumptions 1 and 3 hold. In equilibrium, the ability threshold is decreasing in the level of educational assortative matching.*

We now evaluate job and marital satisfaction. The former can still be obtained by equation (9), so that the result does not change compared to the baseline model. Marital satisfaction instead is now represented by:

$$EM_{\theta_i}(\hat{\theta}_j) = \eta b \left[ (1 - \gamma) g(\hat{\theta}_j) + \gamma \right] \left( 1 + \beta \hat{\theta}_j \right). \quad (18)$$

Differentiating (18) with respect to  $\gamma$  we get:

$$\begin{aligned} \frac{\partial EM_{\theta_i}}{\partial \gamma} = & \eta b (1 + \beta) \left[ (1 - \gamma) \frac{\partial g(\hat{\theta}_j)}{\partial \hat{\theta}_j} \frac{\partial \hat{\theta}_j}{\partial \gamma} + \left( 1 - g(\hat{\theta}_j) \right) \right] + \\ & \eta b \beta \left[ (1 - \gamma) g(\hat{\theta}_j) + \gamma \right] \frac{\partial \hat{\theta}_j}{\partial \gamma}. \end{aligned} \quad (19)$$

The interpretation of (19) is similar to that of (16), with similar intuition. The first part measures the increase in the expected marital satisfaction due to the larger number of educated individuals, and thus it is positive. The second part of the derivative measures the decrease in relative marital satisfaction, due to the increase in the number of educated individuals. Hence marital satisfaction increases with educational assortative matching when the importance of the relative component of marital satisfaction,  $\beta$ , is sufficiently low.

### 5.3 Differences in educational and marital benefits

Finally, we extend the analysis by considering differences in payoffs between men and women. We do so by introducing the following assumption.

**Assumption 4** *Let  $b_w > b_m$  and  $e_m > e_w$ .*

Assumption 4 makes two reasonable hypotheses. On the one hand, men may benefit less by educated women, in particular in more traditional societies where girls are expected to study less or stay at home. On the other hand, the assumption that men's educational benefit is higher than women's reflects the empirical regularity that, *ceteris paribus*, women generally face worse job conditions than men.

There is an extensive literature on the gender pay gap. For example, Burchell *et al.* (2007) show some evidence of it for European countries in the period 1990-2005. There is persistent gender inequality in many aspects of working conditions. In particular, women are under-represented in senior positions, are more likely to have part-time jobs and their health is most affected by their work. Women are also less likely to be the main earner at home because they tend to be segregated into lower-paid jobs. In addition, the gender pay gap provides an economic rationale which reinforces women's position as the primary person responsible for the home and care responsibilities.

The following proposition mirrors Proposition 1 of the baseline case and considers the conditions of existence when the payoffs differ by gender.

**Proposition 8** *Suppose Assumption 4 holds and  $c \in (\eta\gamma b_w - \delta\bar{y}_w, \min\{e_m + \eta\gamma b_m, e_w + \eta\gamma b_w\})$ . Then an equilibrium configuration given by the pair  $(\hat{\theta}_m, \hat{\theta}_w) \in (0, 1) \times (0, 1)$  exists.*

The proof of Proposition 8 is similar to that of Proposition 1, and can be found in the appendix. The analysis of the effects of assortative matching on job and marital satisfaction is analogous to the baseline model. The only difference is that we must consider a further condition ensuring that the ability thresholds are the same in the two populations. This condition is necessary because of the focus on symmetric levels of education, which determines the matching mechanism in Table 1.

We show an example of this additional condition by assuming uniform distributions. By solving the system of the indifference conditions, we find

$$\hat{\theta}_i = \frac{\delta e_i + 2(c - b_i \gamma \eta)}{(2 + \delta)e_i},$$

where

$$\frac{\partial \hat{\theta}_i}{\partial \gamma} = -\frac{b_i \gamma \eta}{(2 + \delta)e_i} < 0.$$

Hence the effects on job and marital satisfaction obtained in the baseline model are robust to this extension. Moreover, equality in the proportion of educated individuals between the two populations requires

$$\hat{\theta}_m = \hat{\theta}_w \iff b_w = \frac{e_w(b_m \gamma \eta - c) + c e_m}{\gamma \eta e_m},$$

which holds for several combinations of the parameter values.

## 6 An empirical test

A possible limitation of the analysis is the lack of an empirical validation, which is left for future research. The main problem with it is to find an adequate measure of educational assortative matching. This exogenous probability can be imagined empirically as a measure that depends on the institutional setting and education system of the population considered. It is not clear neither which measure could be used, nor if relevant information can be elicited. In addition, given the same educational institutions, the level of assortative matching would be the same within the same population. To obtain the variability with which to check the theoretical results, one would need the very same measure from datasets coming from countries with differing education systems.

Having said that, we might verify whether our assumption that educated partners provide greater marital benefit than uneducated ones is consistent with empirical evidence. This is indeed the further incentive to attend university when assortative matching is present. In the introduction, we have already shown consistency with the literature on marital satisfaction. In this section, we will additionally test the assumption with a novel exercise to make sure the theoretical analysis is empirically grounded.

To hold empirically, we must verify a positive correlation between the partner's level of education and individual marital satisfaction.

### 6.1 The dataset

We use data from the British Household Panel Survey (BHPS) that began in 1991 until 2008, and was designed as an annual survey of the adult population in UK (Taylor *et al.*, 2008). It is a nationally representative sample of more than 5,000 households, totalling approximately 10,000

individual interviews. It is a longitudinal survey in which all adult members of each household are available to be interviewed each year. The primary purpose of BHPS data is to collect detailed information on demographics and socioeconomic behaviour of the UK households, such as household's consumption, income, geographic mobility, labour market outcomes etc. Our sample includes valid observations from 1996 until 2008, except for year 2001: these are the only waves in the dataset that include the observation of marital satisfaction.

The sample consists of 22,257 married couples (44,514 individuals) of men and women aged between 16 and 65 years (the youngest married individual in the sample is 17 years old) in their working age who both provided complete information at the interview dates.

The dataset adopted also provides information for a wide range of satisfaction outcomes. Related to marital satisfaction, we consider the question "*How dissatisfied or satisfied are you with Your husband/wife/partner?*". Responses to this question ranged from 1 ("not satisfied at all") to 7 ("completely satisfied"). This index will be our variable of interest in testing the assumption on marital benefit.

Our dependent variable will be affected by a set of individual characteristics candidates to explain marital satisfaction. The key variable is whether a partner obtained a university qualification. The BHPS provides information on the educational qualification obtained, but not on the partner's level of education. Given the fact that our sample is based only on respondent couples, we are able to infer the education level of the spouse: we identify them as married partners within the same household, and we obtain the qualification information through each other. In the estimation, we also control for the respondent's educational qualification.

Consistent with the theoretical model, in which education is a discrete choice variable representing achieving a university degree, we build a dummy that takes value "one" for "bachelor degree", "higher degree" and "teaching qualification" and "zero" for lower educational qualification.

For a robust explanation of the marital satisfaction outcome, we control for a range of exogenous variables: we use gender, age, age squared, the number of kids in the household, and a set of dummies to indicate the employment conditions (employed, unemployed, disable, subsidy), the job type, if applicable (manual, administrative, professional, technician) and whether household tasks (doing grocery shopping, cooking, cleaning and ironing) are done by the respondent or not. We add six regional dummies (Southern England, Midlands, Northern England, Wales, Scotland and Northern Ireland), and control for the waves of the panel using year dummies.

In the Appendix, we include in the analysis the log of income and a measure of health as control variables. We do it separately since it is open to debate to control for income at all. A possible interpretation is that part of the benefit of an educated spouse is their income. The same point can be made about self-reported health, which might be correlated to higher education. Even so, the results are qualitatively similar to those presented in the baseline analysis.

Table 2. Descriptive analysis

Variable	Mean	Std Dev	Min	Max
Marital satisfaction (not at all=1; complete=7)	6.282	1.103	1	7
Sex of respondent (male=0; female=1)	0.5	0.5	0	1
Age	43.603	9.969	17	65
Number of children	0.935	1.077	0	7
<b>Regional dummies</b>				
Southern England	0.291	0.454	0	1
Midlands	0.135	0.341	0	1
Northern England	0.187	0.390	0	1
Wales	0.156	0.363	0	1
Scotland	0.186	0.389	0	1
Northern Ireland	0.034	0.181	0	1
<b>Economic activity dummies</b>				
Respondent to economic activity	0.995	0.070	0	1
Working	0.833	0.372	0	1
Unemployed	0.026	0.159	0	1
Long-term sick/disabled	0.044	0.205	0	1
Family care	0.091	0.288	0	1
<b>Occupational dummies</b>				
Respondent to occupation	0.834	0.371	0	1
Manual	0.525	0.499	0	1
Manager	0.153	0.360	0	1
Professional	0.099	0.299	0	1
Technician	0.100	0.301	0	1
Administrative	0.120	0.325	0	1
<b>Household tasks dummies (self=1, no=0)</b>				
Respondent to household tasks	0.997	0.049	0	1
Doing the grocery shopping	0.338	0.473	0	1
Cooking	0.389	0.487	0	1
Cleaning	0.382	0.485	0	1
Ironing	0.422	0.493	0	1
Observations	44,514			

Table 2 illustrates the descriptive statistics. By construction, it is composed only by heterosexual and married couples, so that the sample is split evenly. Average age is 44. The average number of children is very low, below one. Most couples are from Southern England and the least part comes from Northern Ireland. Most individuals are working, do a manual job and delegate to others the household tasks (either the partner, other members of the household or

some third party).

Regarding the distribution of marital satisfaction, on average respondents declare to be satisfied with their marriage (6.28 out of 7). Given such a high mean, Table 3 shows the frequency of marital satisfaction. Necessarily, a self-selection problem may arise, since individuals in a couple are more likely to be happy with their marriage. Yet, the restriction to couples is necessary to verify the relationship with the partner’s level of education. To control for self selection and the consequent attrition, in Section 6.4 we will develop the analysis for spouses in the early years of marriage.

Table 3. Frequency of marital satisfaction

Satisfaction with spouse/partner	Freq.	Percent	Cum
Not satisfied at all	227	0.51	0.51
2	403	0.91	1.42
3	907	2.04	3.45
4	1,901	4.27	7.72
5	4,033	9.06	16.78
6	11,176	25.11	41.89
Completely satisfied	25,867	58.11	100.00
Total	44,514	100.00	

Higher educational qualification is shown in Table 4, where we considered between and within variation. 19% of the sample obtained a university qualification. Table 4 shows an extremely low within-individual variation. This is natural: quite often, individuals have already concluded their educational path when marry.

Table 4. Descriptive analysis of higher education: between and within variation

Respondent/spouse’s educational qualification (no=0; university=1)	Mean	Std Dev	Min	Max
Overall	0.184	0.388	0	1
Between		0.378	0	1
Within		0.061	-0.73	1.09
Respondents		7586		
Observations		44,514		

## 6.2 Identification strategy

To test the theoretical assumption of marital benefit from educated partners, we need to consider the specific features of the model compared to the data at hand. In particular, the very low within-individual variation of higher educational qualification outlined in Table 4 suggests against the use of a fixed-effect model. We thus employ a random effects model.

We perform an ordered logit model to show the relationship between the partner’s education and marital satisfaction. From a methodological perspective, the starting point is a latent variable model:

$$s_{it}^* = x'_{it}\beta + \alpha_i + \varepsilon_{it}, i = 1, \dots, N \quad t = 1, \dots, T, \quad (20)$$

where  $s_{it}^*$  is a latent measure of marital satisfaction of respondent  $i$  in period  $t$ ,  $x_{it}$  is the vector of control variables and  $\beta$  is the vector of coefficients to be estimated. Finally,  $\alpha_i$  is the unobserved, time-invariant component, which is assumed to be unrelated to any explanatory variable, producing the random effects model, while  $\varepsilon_{it}$  is the error term. We are able to observe  $s_{it}$  which is related to  $s_{it}^*$  as follows

$$s_{it} = k \text{ if } \tau_k < s_{it}^* \leq \tau_{k+1}, \quad k = 1, \dots, K. \quad (21)$$

We assume that the threshold parameters  $\tau_k$  are strictly increasing in  $k$  ( $\tau_k < \tau_{k+1} \forall k$ ) with  $\tau_1 = -\infty$  and  $\tau_{K+1} = +\infty$ . If  $\varepsilon_{it}$  is independent and logistic-distributed, the probability of observing  $k$  for individual  $i$  at time  $t$  is

$$\Pr(s_{it} = k | x_{it}, \alpha_i) = \Lambda(\tau_{k+1} - x'_{it}\beta - \alpha_i) - \Lambda(\tau_k - x'_{it}\beta - \alpha_i), \quad (22)$$

where the cumulative distribution function  $\Lambda(\cdot)$  is the logistic function.

Finally, we perform two further estimations: first, we estimate a binary logit, using a binary variable of marital satisfaction. To do so, based on Table 3 we collapse the values of 1-5 to zero, and the value of 6-7 to one. Second, given the wide satisfaction scale of marital satisfaction available in the BHPS, we log linearise the continuous variables of the equation and employ a GLS random-effects model. These alternative specifications are more standard than the panel ordered logit and work as robustness checks.

### 6.3 Empirical results

Table 5 summarises the results. The two alternative specifications give qualitatively similar results to those of the baseline model. Husbands are happier with their marriage than wives. Marital satisfaction decreases with age, at a faster pace over time, and with kids. The Macro Regions of Residence are significant, while Occupation and Economic Activities exhibit less importance at explaining marital satisfaction. Among the household tasks, only doing the grocery shopping and cleaning have a negative impact on marital satisfaction, while cooking has no impact. Curiously, who irons in the household is generally happier with his or her marriage.

We now turn on the effect of higher educational qualification. Individual’s qualification appears not significant in the baseline analysis and slightly positive and significant by using the binary transformation. It must be stressed that respondent educational qualification cannot represent a measure of assortative matching. The reason is that there are no information of

whether spouses met at school. In other words, it is not possible to elicit how two individuals of same education level have met through a random or assortative match. Finally, marital satisfaction is positively and significantly related to the spouse's educational qualification. This result supports our central theoretical assumption.

Table 5. Estimation results

Dependent variable: marital satisfaction	Ordered logit	Binary logit	Log GLS
Female	-0.337 *** (0.081)	-0.440 *** (0.098)	-0.032 *** (0.005)
age	-0.261 *** (0.017)	-0.253 *** (0.024)	-0.062 *** (0.009)
age squared	0.296 *** (0.019)	0.281 *** (0.027)	dropped
number of children	-0.196 *** (0.020)	-0.214 *** (0.028)	-0.002 *** (0.000)
Year dummies (omitted: 2008)	yes ***	yes ***	yes ***
Regional dummies (omitted: Southern England)	yes ***	yes ***	yes ***
Occupational dummies (omitted: working)	yes	yes	yes **
Economic activity dummies (omitted: manual)	yes **	yes	yes **
Household tasks dummies			
Doing the grocery shopping	-0.230 *** (0.041)	-0.272 *** (0.058)	-0.020 *** (0.003)
Cooking	-0.056 (0.043)	-0.030 (0.062)	-0.001 (0.003)
Cleaning	-0.136 *** (0.045)	-0.201 *** (0.065)	-0.007 ** (0.003)
Ironing	0.093 * (0.050)	0.100 (0.072)	0.009 ** (0.003)
Educational qualification			
Respondent	-0.058 (0.089)	0.228 ** (0.111)	-0.002 (0.006)
Spouse	0.175 ** (0.086)	0.375 *** (0.106)	0.011 ** (0.006)
Constant		7.230 *** (0.667)	1.903 *** (0.042)
Observations			44,514

Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

## 6.4 Recent spouses

As noticed in the discussion of Table 3, the analysis may suffer from self selection, since spouses who choose to remain married are usually satisfied with their marriage. To overcome this issue, here we control for attrition by replicating the analysis in a subsample of couples that recently married.

Table 6. Spouses in the first 5 years of marriage

Dependent variable: marital satisfaction	Ordered logit	Binary logit	Log GLS
Female	-0.208 (0.202)	-0.492 * (0.301)	-0.013 (0.005)
age	-0.342 *** (0.066)	-0.357 *** (0.103)	-0.034 ** (0.016)
age squared	0.421 *** (0.085)	0.457 *** (0.136)	dropped
number of children	-0.503 *** (0.075)	-0.593 *** (0.113)	-0.003 *** (0.000)
Year dummies (omitted: 2008)	yes *	yes *	yes *
Regional dummies (omitted: Southern England)	yes	yes *	yes **
Occupational dummies (omitted: working)	yes	yes	yes
Economic activity dummies (omitted: manual)	yes **	yes **	yes **
Household tasks dummies			
Doing the grocery shopping	-0.375 *** (0.138)	-0.377 * (0.210)	-0.027 *** (0.007)
Cooking	-0.306 ** (0.135)	-0.114 (0.208)	-0.005 (0.007)
Cleaning	-0.134 (0.149)	-0.365 (0.233)	-0.005 (0.008)
Ironing	0.021 (0.159)	0.079 (0.248)	0.000 (0.009)
Educational qualification			
Respondent	0.109 (0.209)	0.720 ** (0.310)	0.004 (0.010)
Spouse	0.329 * (0.200)	0.497 * (0.283)	0.014 (0.009)
Constant		9.903 *** (2.631)	1.528 *** (0.090)
Observations			4,196

Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

We do it by exploiting the variable “marital status change”. To choose the most relevant number of years of marriage, we rely on Guven *et al.* (2009), according to which, in the BHPS, the average number of years in which an individual is observed with the same partner is between 4 and 5 years, thus representing a left-censored measure of the duration of the couple. We thus focused on a subsample with spouses who have been married five years or less. The results in Table 6 are consistent with the baseline estimation, by confirming the evidence of a positive correlation between marital satisfaction and the partner’s level of education.

## 7 Concluding remarks

In this paper, we have examined the impact of educational assortative matching on job and marital satisfaction. The key assumption is that individuals prefer to marry educated spouses. They choose whether to attend university or not, and then they are matched in the marriage market. The presence of educational assortative matching determines a positive correlation in the education level of partners. This aspect implies that individuals decide whether to attend university both for obtaining higher job satisfaction and for meeting educated partners.

As the probability of educational assortative matching increases, more low-ability students are willing to attend university to increase their chance to marry an educated partner. As a consequence, the average ability of educated individuals falls, which in turn raises job satisfaction. Marital satisfaction increases too, this due to the higher proportion of educated individuals in the marriage market. The results require that the weight of social comparison for the low-type individuals is not too strong. Finally, the empirical test corroborates the assumption made on the benefits of marrying an educated partner.

The assumptions on the shape of the utility function deserve a detailed discussion. Assuming that the utility functions depend not only on the absolute value of education, but also on its average level, follows the approach of the analysis on consumer behaviour that dates back to Veblen (1899), Duesenberry (1949) and Pollak (1976) and, more recently, employed by Corneo and Jeanne (1997) and Clark and Oswald (1998). When comparison and relative position matters in explaining utility, how individuals react to changes in population average status depends on the shape of status concern in the utility function. For instance, Clark and Oswald (1998) show that the shape of the comparison term determines the reaction of an individual to others’ behaviour.<sup>9</sup>

Applied to the case of educational choice, if the utility is comparison-concave, an increase

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<sup>9</sup>The analysis of status utility has then developed in several directions. To cite some relevant examples, Hopkins and Kornienko (2004) analysed consumption choice when status utility matters according to the degree of income inequality. Bilancini and Boncinelli (2014) distinguish between various shapes of preferences for social status according to the degree of observability of attributes.

In the literature of social competition, Hopkins and Kornienko (2010) distinguish between the inequality of endowments (the resources employed in the competition), and the inequality of rewards (i.e., the resources obtained by the competition). Bilancini and Boncinelli (2020) analysed the effects of inequality when the rewards of today are the endowments of tomorrow.

in average education induces individuals to study more. The opposite applies if utility is comparison-convex. Our assumption (in a context where education is a discrete-choice variable) sits exactly in the middle of these two scenarios: others' educational choices do not affect an individual's behaviour. Admittedly, this restriction may disregard potentially interesting effects. At the same time, it allows to highlight how educational choice is affected by the change in the opportunities of marriage.

While the model takes into account complementarities with respect to partners' types and levels of education, it sets aside potentially relevant externalities that emerge if the level of education acquired (interpreted as a pre-marital investment) is inefficiently high or low.<sup>10</sup> This limitation emerges because of the assumption of complementarities in the level of education is mixed with the assumption that marrying an educated partner yields a benefit even when the individual is not educated.

An interesting question is what would happen if, instead of positive assortativity, negative assortativity arises. Before discussing this point, it is important to highlight the fact that education assortativity emerges since students spend time together at school. As a consequence, the limit case is when the degree of assortativity is zero, which occurs when students spend no time at all together like, for instance, in case of a fully-online education system.

Be that as it may, a possible way to see the emergence of negative assortativity in an educational context could be by mixing assortativity by education with assortativity by social groups. This can be imagined in a cosmopolitan society, where the school or the university are environments where individuals of different social groups are mixed. Like in the model, differences in the degree of educational assortativity are interpreted, for instance, as the different lengths of time students stay in school, or in the implementation of ability tracking systems. But in this case, an increase in assortativity leads students to spend more time with peers coming from differing social groups.

As a consequence, the increase in educational assortativity increases the randomness of the matching. The outcome in terms of marital happiness will depend on whether and how the benefit obtained by marrying an educated partner is compensated by a possible loss from marrying a spouse out of own social group.

Finally, one may wonder how our results are affected by including relevant events in the marital life, such as divorce and remarriage. We might expect ambiguous effects, since acquiring higher education influences several aspects of an individual life in different ways. For instance, it might open the way to career oriented jobs that raise the household income but force the partner to be less present in the family context. Or it might help to obtain a job that gives benefits in terms of lifestyle but not much in terms of income. Therefore, the effects of education on the stability of marriage are not clear, *a priori*.

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<sup>10</sup>Inefficiency in the level of pre-marital investment (not necessarily meant as "education") is investigated in Peters and Siow (2002), Cole et al. (2001), Hopkins (2012) Bhaskar and Hopkins (2016), Tampieri (2016) and Bronsert *et al.* (2017), among others.

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# Appendix

## Proofs

### Proof of Proposition 4

Following the proof of Proposition 1, we identify the conditions in which, by contrast, this equilibrium does not exist. Symmetry in the distribution of educated individuals determines the shape of the expected payoffs according to Table 1. A configuration where no one attends university is one such that  $EU_i^{ed} < EU_i^{ned}$ , i.e.,

$$\lambda_i^{ed} + \eta [(1 - \gamma) g_j + \gamma] b \bar{\theta}_j < \eta (1 - \gamma) g_j b \bar{\theta}_j,$$

which can be rewritten as

$$\begin{aligned} e\theta_i (1 + \delta) - \delta e \bar{\theta}_i - c + \eta \gamma b \bar{\theta}_j &< 0 \\ \Leftrightarrow \\ c &> e [\theta_i (1 + \delta) - \delta \bar{\theta}_i] + \eta \gamma b \bar{\theta}_j, \end{aligned}$$

for every  $\theta_i \in [0, 1]$ , and  $i = w, m$ . Therefore a sufficient condition is the one for  $\hat{\theta}_i = \hat{\theta}_j = 1$ . In this case,  $\bar{\theta}_i = \bar{\theta}_j = 1$ , the condition amounts to  $c > e + \eta \gamma b$ , which is the same as in the baseline model. A configuration where everyone attends university is one such that  $EU_i^{ed} > EU_i^{ned}$ , which requires

$$c < e [\theta_i (1 + \delta) - \delta \bar{\theta}_i] + \eta \gamma b \bar{\theta}_j,$$

for every  $\theta \in [0, 1]$  and  $i = w, m$ . Hence a sufficient condition is the one for  $\hat{\theta}_i = \hat{\theta}_j = 0$ . In this case,  $\bar{\theta}_i = \bar{\theta}_j$ , while the condition amounts to  $c < \bar{\theta}_i (\eta \gamma b - \delta e)$ . Therefore, to focus on a configuration where only some individuals choose to attend university, the utility cost of education must lie into  $c \in (\bar{\theta}_i (\eta \gamma b - \delta e), e + \eta \gamma b)$ . Trivial manipulation shows that this range exists.

### Proof of Proposition 6

Following the previous approach, we prove the existence of an equilibrium with both educated and uneducated individuals by showing the conditions under which the equilibrium does not exist. A configuration where no one attends university is one such that

$$\begin{aligned} e\theta_i (1 + \delta) - \delta \bar{y}_i - c + \eta \gamma b (1 + \beta \theta_j) &< 0, \\ \Leftrightarrow \\ c &> e\theta_i (1 + \delta) - \delta \bar{y}_i + \eta \gamma b (1 + \beta \theta_j). \end{aligned}$$

Given the symmetric proportion of educated individual, we can assume  $\theta_j = \theta_i$ . For every  $\theta \in [0, 1]$ , therefore a sufficient condition is the one for  $\hat{\theta}_i = 1$ . Since in this case  $\bar{y}_i = e$ , the condition amounts to  $c > e + \eta\gamma b(1 + \beta)$ .

A configuration where everyone attends university is one such that

$$\begin{aligned} e\theta_i(1 + \delta) - \delta\bar{y}_i - c + \eta\gamma b(1 + \beta\theta_j) &> 0, \\ \Leftrightarrow \\ c &< e\theta_i(1 + \delta) - \delta\bar{y}_i + \eta\gamma b(1 + \beta\theta_j), \end{aligned}$$

for every  $\theta \in [0, 1]$ , therefore a sufficient condition is the one for  $\hat{\theta}_i = 0$ , which amounts to  $c < -\delta\bar{y}_i + \eta\gamma b$ , which is the same condition as in the baseline case. Therefore, in order to focus on a configuration where only some individuals choose to attend university, the utility cost of education must lie in this range

$$c \in (\eta\gamma b - \delta\bar{y}_i, e + \eta\gamma b(1 + \beta)).$$

### Proof of Proposition 8

Like before, we show the existence by finding the conditions under which an equilibrium with mixed educated and uneducated individuals does not exist. A configuration where no one attends university is one such that

$$\begin{aligned} e_i\theta_i(1 + \delta) - \delta\bar{y}_i - c + \eta\gamma b_i &< 0, \text{ for every } i \in \{m, w\} \\ \Leftrightarrow \\ c &> \max \{e_m\theta_m(1 + \delta) - \delta\bar{y}_m + \eta\gamma b_m, e_w\theta_w(1 + \delta) - \delta\bar{y}_w + \eta\gamma b_w\}. \end{aligned}$$

A sufficient condition is the one for  $\hat{\theta}_i = 1$ . Since in this case,  $\bar{y}_i = e_i$  for every  $i$ , the condition amounts to  $c > \max \{e_m + \eta\gamma b_m, e_w + \eta\gamma b_w\}$ . A configuration where everyone attends university is one such that

$$\begin{aligned} e_i\theta_i(1 + \delta) - \delta\bar{y}_i - c + \eta\gamma b &> 0, \text{ for every } i, \\ \Leftrightarrow \\ c &< \min \{e_m\theta_m(1 + \delta) - \delta\bar{y}_m + \eta\gamma b_m, e_w\theta_w(1 + \delta) - \delta\bar{y}_w + \eta\gamma b_w\}. \end{aligned}$$

for every  $\theta_i \in [0, 1]$ , therefore a sufficient condition is the one for  $\hat{\theta}_i = 0$ , which amounts to  $c < \min \{\eta\gamma b_m - \delta\bar{y}_m, \eta\gamma b_w - \delta\bar{y}_w\}$  while  $\eta\gamma b_i > \delta e_i \bar{\theta}_i$  in order  $c$  to be positive. To focus on a configuration where only some individuals choose to attend university, the utility cost of education must lie in the range

$$c \in (\max \{\eta\gamma b_m - \delta\bar{y}_m, \eta\gamma b_w - \delta\bar{y}_w\}, \min \{e_m + \eta\gamma b_m, e_w + \eta\gamma b_w\}). \quad (23)$$

Notice that Assumption 4 implies  $\eta\gamma b_m - \delta\bar{y}_m < \eta\gamma b_w - \delta\bar{y}_w$ , so that (23) becomes

$$c \in (\eta\gamma b_w - \delta\bar{y}_w, \min \{e_m + \eta\gamma b_m, e_w + \eta\gamma b_w\}). \quad (24)$$

In addition, we know that

$$e_w + \eta\gamma b_w > \eta\gamma b_w - \delta\bar{y}_w, \quad (25)$$

so that this range exists for  $e_m + \eta\gamma b_m > e_w + \eta\gamma b_w$ . When  $e_m + \eta\gamma b_m < e_w + \eta\gamma b_w$ , this range exists if

$$\eta\gamma (b_w - b_m) - \delta\bar{y}_w < e_m. \quad (26)$$

## Robustness check: Health an income

In this section, we include measures of health and income in the baseline empirical analysis. Table 7 summarises the descriptive statistics of these two measures.

Regarding health, the BHPS include a measure of “Self reported health” over the last twelve months, ranging from 1 (“Very poor”) to 5 (“Excellent”). Income is considered in logs. For each measure, we have added a dummy to consider the number of respondents. Table 8 shows the results, which appear to be consistent with those of the main analysis.

Table 7. Descriptive analysis for health and income

Variable	Mean	Std Dev	Min	Max	Obs
Health (very poor=1; excellent=5)	3.914	0.999	1	5	39,758
Income	17852.8	17261.59	0.6	719,676.4	43,888

Table 8. Estimation results with health and income

Dependent variable: marital satisfaction	Ordered logit		Binary logit		Log GLS	
Female	-0.332	***	-0.429	***	-0.029	***
	(0.085)		(0.102)		(0.005)	
age	-0.256	***	-0.240	***	-0.056	***
	(0.018)		(0.025)		(0.009)	
age squared	0.292	***	0.267	***	dropped	
	(0.020)		(0.028)			
number of children	-0.202	***	-0.225	***	-0.002	***
	(0.021)		(0.030)		(0.000)	
health conditions	0.163	***	-0.210	***	-0.031	***
	(0.020)		(0.027)		(0.004)	
log annual income	-0.032		-0.017		-0.001	
	(0.020)		(0.028)		(0.001)	
Year dummies (omitted: 2008)	yes	***	yes	***	yes	***
Regional dummies (omitted: Southern England)	yes	***	yes	***	yes	***
Occupational dummies (omitted: working)	yes		yes		yes	**
Economic activity dummies (omitted: manual)	yes	**	yes		yes	**
Household tasks dummies						
Doing the grocery shopping	-0.244	***	-0.294	***	-0.022	***
	(0.043)		(0.062)		(0.003)	
Cooking	-0.040		-0.028		-0.001	
	(0.046)		(0.065)		(0.003)	
Cleaning	-0.131	***	-0.221	***	-0.008	**
	(0.048)		(0.069)		(0.003)	
Ironing	0.069		0.099		0.006	
	(0.053)		(0.076)		(0.004)	
Educational qualification						
Respondent	-0.029		0.216	*	-0.000	
	(0.092)		(0.114)		(0.006)	
Spouse	0.158	*	0.332	***	0.010	*
	(0.089)		(0.109)		(0.006)	
Constant			9.903	***	1.820	***
			(2.631)		(0.051)	
Observations				39,641		39,635

Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.