I Can't Smile Without You: A Multi-level and Fixed Effects Simultaneous Equations Analysis of Spousal Correlation in Life Satisfaction

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Abstract

This paper shows that spouses' life satisfaction levels are positively correlated. Using the British Household Panel Survey, it tests whether this is due to correlated effects, as a consequence of assortative mating or shared social environment, or to endogenous effects generated by altruistic preferences between partners. A simple multi-response, multilevel model reveals that there is a positive correlation between partners' unobserved fixed and time-varying determinants of life satisfaction, which is consistent with correlated effects. However, further regressions reveal a positive and statistically important correlation between respondent life satisfaction and partner past life satisfaction, even after controlling for individual fixed effects and allowing for correlated effects in within-couple time-varying characteristics. This is consistent with the idea of altruism within a marriage. I also find evidence that couples with high levels of life satisfaction are less likely to terminate their relationship in the future.

Key words: Life Satisfaction, Matching, Altruism, Marriage, Multi-level Modelling, Longitudinal

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"You know, I feel sad when you're sad, I feel glad when you're glad,
If you only knew what I'm going through, I just can't smile without you." - *Barry Manilow*

1. Introduction

Economists' formal microeconomic models suggest that individuals within a marriage behave as if their utility or well-being levels are interdependently related. The maintained assumption is that there exists a degree of altruism within the couple, which makes the well-being of one partner one of the main determinants of well-being for the other partner (Becker, 1973, 1974; Friedman, 1985). Yet, despite the popularity of such an assumption in the modelling of married couples in traditional microeconomic theory, the idea that there may be a direct spillover of well-being between spouses has rarely been tested empirically.

This paper aims to do just that. It examines the extent and the underlying mechanisms of spousal[1] correlation in subjective well-being data, particularly self-rated life satisfaction (LS). In a long-run panel of randomly sampled individuals I find, as anticipated, a strong correlation between partners' LS scores. However, the observed raw correlation in LS may reflect three different processes. First, individuals who are born happy, or are born with innate predispositions that make them happy, may tend to marry those who are similar to them. This matching of fixed personal characteristics on the marriage market is analogous to the concept of assortative mating (Becker, 1974). Manski (1995) refer to such phenomenon as correlated effects of social interactions.

Second, given that marriage allows individuals to share with their partner the kind of physical and emotional resources that may not be available for each person to obtain outside marriage (Waite and Gallagher, 2000), correlated effects may also arise from the shared social environment (which can either be time-invariant or time-variant) that is simultaneously affecting LS for both spouses.

Lastly, the observed correlation may be the result of a direct spillover of LS within the couple. The idea is that if a husband cares about his wife, then her LS becomes one of the main determinants of his own LS, and *vice versa*. This is analogous to the concept of altruism (Becker, 1974), whereby an increase in well-being of one spouse can spillover to the other spouse. It is also likened to the endogenous effects in Manski's terminology.

[1] I use the term "spouse" and "marriage" loosely here, as the current article considers both legally married couples and those who live together.

This paper uses eight waves of the British Household Panel Surveys (BHPS) data to examine the extent of spousal correlation in LS. In particular, it investigates whether the observed similarity in LS within the couple is due largely to assortative mating, common environmental factors, or direct spillovers of LS from one partner to the other. The longitudinal research strategy that involves following each couple annually seems to be the most appropriate way to study the underlying mechanisms in the observed correlation between spouses' LS more rigorously. This is the approach that is taken here. In order to test the hypothesis that the observed correlated effect in LS is merely a reflection of partners sharing similar individual effects and the same social environment, I first estimate a multi-response, multi-level model (MR-MLM) of partners' LS that allows for nonzero correlations between husband's and wife's unexplained residuals. This first specification will shed some lights to the extent of correlations in the unobserved determinants of partners' LS. Here, assortative mating on LS and shared environmental effects will be picked up by correlated individual random effects and unobserved time-varying effects in the male and female LS equations.

The latter specifications incorporate spillover effects into the model by introducing each partner's LS as a right-hand side variable in the MR-MLM equations. Under endogenous effects of LS, I expect each partner's LS to be correlated, even after individual traits have been introduced or factored out completely from the regression equations. This will be the key test of correlated versus endogenous effects. As a further result, I will also analyse whether couples with higher LS stay married longer in the panel.

The estimated results show that there are statistically significant satisfactions to be gained from an increase in the spouse's LS. The evidence is robust to the control for correlated effects between husband's and wife's time-varying residuals, and even after having factored out completely both spouses' individual fixed characteristics from the LS regression equations. This suggests that not all of the correlation in spouses' LS comes from the matching of fixed individual characteristics on the marriage market and the shared social environment simultaneously affecting partners' LS. In addition to this, there is strong evidence that couples with higher LS levels are significantly less likely to separate or divorce in the future. This implies that spousal correlation in LS may also have important implications in predicting marital stability for the couple.

There are similarities in terms of research question and analytic strategy between this paper and previous studies that examined similarities in husband's and wife's behaviours such as smoking (Clark and Etile, 2006), political preferences (Kan and Heath, 2006), and sporting

activities (Farrell and Shield, 2002), as well as other personal characteristics such as years of schooling (Rose, 2004) and physical attributes (Buss and Barnes, 1986). However, the results suggest that it may also be important in the estimation of spillover effects of behaviours for researchers to try and difference out the individual fixed effects from biasing the impacts of right-hand side variables.

The plan for this article is as follows: Section 2 reviews relevant past research on marriage and well-being. Section 3 addresses theoretical issues revolve around the different interpretations of the correlation between partners' LS: assortative mating, shared environmental factors, and altruism, and discuss empirical implications and predictions. Section 4 describes the data. Statistical models are then formulated and estimation methods are considered in Section 5. Section 6 discusses the results, and Section 7 concludes.

2. Marriage, subjective well-being, and spillovers

Previous research on marital status and emotional well-being is clear on one point: married persons are significantly happier and more satisfied with life than those who are divorced, separated, widowed, or single across different countries and time periods (Gove et al., 1983; Mastekaasa, 1994; Marks and Lambert, 1998; Stack and Eshleman, 1998). The large psychological benefits of marriage persist even when the selection of happy people into marriage is controlled for in the analysis (Frey and Stutzer, 2006; Mastekaasa, 1992), and are often shown to be stronger for men than for women. Both cross-sectional and longitudinal studies confirm the overall psychological benefits of marriage (for a review, see Oswald and Wilson, 2005).

There are several explanations for the protection effects of marriage. On the grounds that two can live almost cheaply as one, marriage may work simply because it provides higher real income per partner. This reduces the risk of mental health problems that often come with poor standard of living (Ross et al., 1990; Ross, 1995; Smock et al., 1999). Second, marriage provides the partners with a source of constant emotional and instrumental support, which may act as an important buffer against stress and depression for the person who experienced negative shocks in life events (Berkman, 1988; Kessler and Essex, 1982; Marks and Lambert, 1998). In other words, the negative impacts of shocks in life events appear to be significantly lower for married individuals than those of other marital groups. Third, marriage provides the partners with a sense of belonging and social reality, in which they are the only two people living and operating in their own world. This shared sense of meaning can be an important

foundation for emotional well-being (Berger and Kellner, 1964; House et al., 1982). Marriage also encourages people to engage less in risky activities and more in healthy ones – perhaps for the sake of their partner (Power et al., 1999; Umberson, 1987). For example, married people smoke and drink less, and these healthy behaviours may provide an important source of both physical and emotional well-being for the partners.

Although many studies have been able to provide empirical evidence for some observable behaviours that signify altruism between spouses, which are considered as important foundations for subjective well-being in marriage (Folbre and Nelson, 2000; Johnson and Huston, 1998), very few studies have attempted to establish a direct empirical evidence for the motivation behind caring – that utility or well-being of spouses are interdependent within marriage (Becker, 1974)[2]. Previous studies on emotional spillover often focused on ill-being such as measures of stress and strain. The common finding has been that there is a statistically significant daily spillover of stressful experiences between two individuals within the same marriage, whereby stress experienced by an individual's partner in the workplace leads to stress being experienced by the individual at home (Bolger et al., 1989; Jones and Fletcher, 1993; Pittman et al., 1996; Repetti, 1989; Roberts and Krokoff, 1990; Rook et al., 1991; Sears and Galambos, 1992; Westman and Vinokur, 1998; Westman and Etzion, 1995)[3].

One question of interest is whether the evidence of spillover in the stress literature can also be generalised and applied to other types of spousal correlation in subjective scales, especially to measures of global well-being that are averaged over a longer period of time than stress. Given that measures of stress and depression are specifically designed to capture only the recent fluctuations of affective well-being (e.g., moods and emotions) and that altruism, by definition, means unselfish concern for the welfare of others, it is unlikely that previous evidence on ill-being spillovers will be sufficient as a prerequisite evidence of altruism between partners. Although several studies have found a moderate correlation between ill-being and well-being (Chamberlain, 1988; Michalos, 1991), others have shown that these components appear to behave differently over time and to have differing relationships with other variables (Liang, 1985; Stock et al., 1986). Research into the validity

[2] A few exceptions come from studies on the similarities in the reported income satisfaction by members of the same household (see, for example, Plug and Van Praag, 1998). Although Bonke and Browning (2003) found some evidence from the European dataset that husbands and wives often report very different levels of financial satisfaction.

[3] However, the existing evidence seems to suggest that, on average, the buffering effect of marriage still outweighs the negative spillover effect between husband's and wife's stress and strain. That is, despite the negative spillover of stress and strain, married people still fare better than people of other marital group from adverse life events.

of the two constructs has also shown that there is a clear distinction in terms of determinants between measures of well-being and ill-being (see Bradburn, 1969; Diener; 1984; Diener et al, 1999, Headey et al, 1985, 1993; Pavot and Diener, 1993). Because measures of cognitive well-being such as LS frequently form a separate factor and correlate with predictor variables in a unique way, it seems worthwhile to separately assess this construct in the research.

Of the very few studies on the topic, Rose (1955) was one of the first to report cross-sectional correlation between LS within marriage. The author showed that spouses may feel something is wrong with their marriage when one or both feel unhappy with life. In that case, even if there was nothing wrong with their marriage, low levels of happiness detected between couples may have shattered their confidence and may lead towards separation and divorce. Argyle (1999) made a conjecture in his study on the effect of marriage on subjective well-being that one spouse's happiness may encourage the happiness of the other in a marriage. More recently, Anderson et al. (2003) found that people in romantic relationships are more likely than others to report similar levels of positive emotional experiences such as happiness, amusement, and pride over time.

Numerous cross-sectional studies have reported spousal correlation in LS (Bookwala and Schluz, 1996; Tambs and Moum, 1992). However, as far as I am aware, the only paper that has conducted a longitudinal analysis on whether there is a substantial long-term interdependent relationship between spouses' LS within marriage is innovative work by Schimmack and Lucas (2006). Their methods and data set are different from the one set out in this paper and the respective projects began independently. Using the German panel data and time-lagged cross-spouse correlation method, they found that spousal correlation in LS is due mainly to the shared stable component of LS within the couple, i.e. there is strong evidence of assortative mating for LS, and high genetic similarity between spouses. Thus, prior research provide that there is cross-section and longitudinal evidence that well-being, as well as ill-being, are highly correlated between spouses.

3. Theory

In this section, I will briefly discuss the three underlying mechanisms that may account for the raw correlation between husband's and wife's LS levels at the cross-section: assortative mating, shared social environment, and altruism. I will also outline the empirical tests that I will appeal to in the estimations to distinguish between these three different interpretations.

3.1 Assortative mating

The first explanation is that the observed spousal correlation in LS may have been the outcome of assortative mating on the marriage market (Becker, 1974). People may for the purpose of procreation choose partners who are phenotypically similar to them. Hence, people who are born happy, or are born with innate predispositions that make them happy, may tend to marry each other. One reason for this is because the decision to marry somebody who is like us could make living together easier as he or she may enjoy the same kind of lifestyle, such as leisure and sporting activities, whilst someone else with a completely different set of personalities may not. Such positive assortative mating or homogenous matching on the marriage market is supported by the evidence that a number of lifestyles are highly correlated within the couple (Contoyannis and Jones, 2004). In addition to this, there may also be unobserved correlations in the measurement errors between spouses over time, which could have been influenced by husband's and wife's fixed individual characteristics.

Positive assortative mating market may induce correlated effects in LS, via similarities in the unobserved individual traits that determine LS for each spouse. I control for this by first allowing for nonzero correlations between partners' individual random effects before removing them from potentially biasing the right-hand side variables altogether via individual fixed effects estimation.

3.2 Shared social environment

The second explanation also views the observed correlation as a correlated effect; what appears to be a direct spillover of LS from one partner to the other may be no more than the result of omitted common factors affecting both spouses' LS. For example, a positive shock in future family income (i.e. one partner receiving a promotion at work) can result in an increase in both spouses' LS, regardless of whether the other partner has also received a promotion or not. The observed spousal similarity in LS could thus be a spurious relationship stemming from the fact that some life events affect both spouses simultaneously.

In order to control for the correlated effects from spouses sharing the same social environment, both male and female LS equations will be written with a simultaneous structure that allows for nonzero correlations in contemporaneous unobservable shocks.

3.2 Altruism

The last interpretation of the raw spousal correlation in LS views the association as a result from altruism, i.e. a spillover of LS from one partner to the other (Becker, 1974; Friedman, 1985). The basis for this explanation is that transmissions of LS occur between closely related partners who identify with and care for each other and share a great part of their lives together. In altruistic model, the LS of one partner acts as a positive externality for the other partner which in turn increases the current level and influences future growth in LS for the latter (Larson and Almeida, 1999; Westman and Vinokur, 1998)[4].

The idea of altruism within marriage is consistent with many studies that found positive correlation betweens between subjective well-being and altruistic behaviours or goals in many other social settings outside of marriage. For instance, Benson et al (1980) find a positive correlation between LS and time spent in a variety of helping activities. Using panel data, Thoits and Hewitt (2001) found volunteer work leads to greater happiness, LS, self-esteem and even physical health for the individual. Konow and Earley (2007) found using various experiments in laboratory that the tasks of giving and helping others and many other self-less acts are capable of raising and sustaining happiness at a higher average level than other goals, like the pursuit of material wealth. Frey *et al* (2004) show how LS may often depend more on the processes (i.e. from helping others) than returns or outcomes of the actions. More closely related to this paper, Shawarze and Winkelmann (2003) and Bruhin and Winkelmann (2007) found some evidence of altruism using the German Panel data. They were able to demonstrate that an exogenous increase in children LS can lead to an increase in LS for the parents, as well as showing that predicted altruists are more likely to make transfer payments.

One possible empirical implication for altruism in marriage is that, holding own LS at t-1 constant, respondent LS from at t will depend on partner LS at period t-1, even after controlling for the correlated effects between husband's and wife's individual time-invariant and time-varying characteristics.

3.4 Empirical implications

[4] There may, of course, be other kinds of interactions between partners' LS. For instance, if something affects one spouse's LS positively and it enhances the desirability for the person to re-enter the marriage market (e.g. he or she wins at the lottery), this may affect the other negatively. In those cases, an external positive shock to one partner's LS may have a negative impact on the other's LS.

The above three interpretations of spousal correlation in LS suggest the followings three empirical implications. First, the two dependent variables will be partners' self-rated LS scores at period *t*. Second, assortative mating and shared social environment imply that there will be within-couple correlations at two different levels of residuals, which lead us to a multi-level model with a multi-response structure that allows for nonzero correlations in husband's and wife's individual random effects and unobserved time-varying characteristics. Third, regarding the right-hand side variables, the main explanatory variables of interest in the test for spillover effects would be partner's lagged LS. In order to try and get as close an exogenous movement in partner LS as possible, respondent lagged LS will also be important in the estimation.

The above arguments yield the following three main empirical predictions:

- If there is positive assortative mating over individual traits that contribute to LS, partners' estimated random effects will be positively and statistically significantly correlated.
- If partners share the same social environment, then partners' estimated time-varying residuals will be positively and statistically significantly correlated.
- Altruism implies that the current level of respondent LS will be correlated with partner's lagged LS, even after we control for nonzero correlations between partners' individual traits and time-varying effects.

In the following sections, I will try and evaluate the above predictions using long-run British panel data.

4. Data

The present investigation uses data from the British Household Panel Survey. This is a nationally-representative sample of persons aged 16 and over in 1991, who have been re-interviewed every year after. The study interviewed separately all adult members of the household with respect to their income, employment status, marital status, health, and attitudes. There is both entry into and exit from the panel, leading to unbalanced data with an increased number of individual interviews over time. This is due to the inclusion of children who turn 16 in the original household sample, refresher samples, and of the new members of household formed by original panel members.

As well as questions on socio-economic status, individuals were also asked from Wave 7 onwards to indicate how satisfied they are with their life from 1 (*very dissatisfied with life*) to 7 (*very satisfied with life*). The LS question is located in a self-completed section of the BHPS survey, which is strategically placed at the end of the questionnaire after individuals had been asked about their household and individual characteristics.

I analyse all married and cohabiting individuals for the years 1996-2006 (Waves 7-15)[5]. The initial unbalanced panel with nonmissing information on LS (Sample 1) includes 63,191 observations or 14,255 individuals[6]. Of which, 10.397 individuals are married.

The raw correlation between partners' current LS is presented in Figure 1, where a noticeable positive relationship between male LS and the average female LS is obtained. In an OLS regression for the male sample, the estimated coefficient on the partner's current LS is 0.263 with a standard error of 0.005. For female, the equivalent coefficient is 0.285 with a standard error of 0.006. The results do not change if robust regression techniques are used. Thus, the OLS results provide some first evidence that there is a statistically important correlation between partners' LS.

For the spillover regressions, I consider all couples observed consecutively over two periods with information on lagged LS. This leaves us with approximately 17,000 observations on couples with both own and partner lagged LS in total (Sample 2).

It may also be possible that any spillover effects picked up in Sample 2's regression will be biased downward if individuals with high levels of LS are more likely to remain in partnership. Given that I cannot sufficiently control for the duration of marriage, I consider also the spillovers effect between spouses who stay together in every wave in the BHPS. This leaves us with roughly 6,400 observations on couples observed in all waves in this balanced sub-sample (Sample 3)[7].

Descriptive statistics for Samples 1, 2, and 3 are reported in Appendix A. The variable means and standard deviations are almost identical between Samples 1 and 2. Individuals in stable couple (Sample 3) report slightly higher LS, are older, have higher real household income per capita, are more likely to own home outright, and are less likely to be cohabiting than Samples 1 and 2.

Given that there may be a selection effect in moving from Sample 1 to Sample 3, as a number of contemporaneous shocks may simultaneously affecting the stability of the

[5] LS question was only introduced in wave 7 onwards, but was left out in wave 11.
[6] A couple who live together in t-1, and are married at t, will also be included.
[7] The missing rate is 6.84% across the sample.

relationship and LS of both spouses, I also compute an inverse Mills ratio using a selection variable that equals to 1 at period *t* if the individual is observed in all BHPS waves and 0 otherwise. This selection equation estimated using a probit on Sample 1 is reported in Appendix B, as a function of age, age-squared, employment status, marital status, education levels, physical health status, log of real household income per capita, number of young (aged 11 and under) and older (aged 12 and over) children in the household, homeownership status, regional and wave dummies, and current and lagged regional household prices. The last two variables are used as instruments that predict the probability of moving from Sample 1 to Sample 3, but that are not *ceteris paribus* significantly correlated with LS of both spouses[8].

4. Analytic strategy

To first assess the spousal correlation in the unobserved determinants of LS between spouses, I estimate a MR-MLM of male and female LS. This method has an advantage over the time-lagged cross-spouse correlation method used by Schimmack and Lucas (2006) to assess the spousal correlation in LS in that it allows random intercepts for each family to be estimated (Raudenbush and Bryk, 2002; Raudenbush et al., 1995; Rowe and Hill, 1998)[9]. The multi-response structure permits both male and female LS to be estimated simultaneously in a single equation, thus allowing for nonzero correlations between unobserved individual traits and time-varying residuals of the equations for each dependent variable (Gareis et al., 2003). The MR-MLM model of spouses' LS can be written as follows:

$$\begin{aligned} LS_{i,t} &= \theta_1 X_{i,t} + u_i + \varepsilon_{i,t}, \\ LS_{-i,t} &= \theta_2 X_{i-,t} + u_{-i} + \varepsilon_{-i,t}, \end{aligned} \qquad (1)$$

where $LS_{i,t}$ is the self-reported LS score of individual *i* at period *t* (1 = very dissatisfied, …, 7 = very satisfied). $LS_{-i,t}$ is the partner's LS. X is a vector of demographic and socioeconomic controls that are known to be strong predictors of LS in other studies (i.e. Blanchflower and Oswald, 2004; Powdthavee, 2007), which include age, age-squared, education, employment status, physical health status, and a dummy representing whether the respondent is cohabiting

[8] By estimating standard LS equations, I find both current and lagged regional household prices to be insignificantly related to LS, *ceteris paribus*. However, both regional household price variables significant raise the probability of selection from Sample 1 to Sample 3.

[9] With only two levels of data, this is equivalent to estimating a random effects model in the standard economic literature.

or married as well as other household variables known to be important in the LS literature such as household income, homeownership, a dummy for whether or not the couple has children. I also include a variable representing the number of years the respondent has been married or cohabiting within the panel to potentially control for the quality of marriage within the sample.

The parameters *u* and ε represent within-individual (level two) and within-occasion within-individual (level one) random variations respectively. Typically, the residuals are assumed to be normally distributed: for individual *i*, $u_i \sim N(0, \sigma_i^2)$ and $\varepsilon_{i,t} \sim N(0, \sigma_{i,t}^2)$. Evidence of assortative mating on LS will be picked up by a nonzero correlation between u_i and u_{-i} (i.e. $Cov(u_i, u_{-i}) \neq 0$). Similarly, evidence of shared social environment will be picked up by a nonzero correlation between $\varepsilon_{i,t}$ and $\varepsilon_{-i,t}$ (i.e. $Cov(\varepsilon_{i,t}, \varepsilon_{-i,t}) \neq 0$). I assume cardinality in LS scores, whereby the difference between a LS score of 1 and 2 is assumed to be the same as the difference between 3 and 4. This is a justifiable assumption as studies have shown that it makes virtually no difference whether one assumes cardinality or ordinality of the well-being scale (see Ferrer-i-Carbonell and Frijters, 2004).

To test for a direct evidence of altruism, equation (1) is rewritten to include respondent lagged LS and partner lagged LS in the following manner:

$$\begin{aligned} LS_{i,t} &= \alpha_1 LS_{i,t-1} + \beta_1 LS_{-i,t-1} + \theta_1 X_{i,t} + u_i + \varepsilon_{i,t}, \\ LS_{-i,t} &= \alpha_2 LS_{-i,t-1} + \beta_2 LS_{i,t-1} + \theta_2 X_{-i,t} + u_{-i} + \varepsilon_{-i,t}, \end{aligned} \qquad (2)$$

Here, $LS_{-i,t-1}$ refers to the lagged life satisfaction score of *i*'s partner, whilst $LS_{i,t-1}$ represents the lagged life satisfaction score of individual *i*. Note that equation (2) is equivalent to the prospective change model outlined by Larson and Almeida (1999) which has been used in the sociology and psychology literature to test for the spillover effects of stress and strain between partners within a couple. As mentioned earlier, the decision to include respondent lagged LS is for us to try and get as close an exogenous movement in partner LS as possible. The parameters α and β are the coefficients of LS spillover for the individual's own and the spouse's LS recorded in the previous year. By allowing for the correlated effects in partners' individual random effects and time-varying residuals whilst holding $LS_{i,t-1}$ constant, a positive and statistically significant β would imply that there is a spillover effect (or an

evidence of altruism) from one partner's LS in the previous year on the respondent's LS today (Bolger and Zuckerman, 1995).

Nevertheless, there is an important limitation to the estimation of equation (2) which concerns the assumption of zero correlation between the right-hand side variables and the individual random effects. In situations where the unobserved individual traits are correlated with partner lagged LS (i.e. $Cov(u_i, LS_{-i,t}) \neq 0$), MR-MLM will produce inconsistent spillover estimates. For example, a husband who was born with personality traits that make him happy is likely to report high levels of LS in every survey. The same predispositions may also make him more sensitive to changes in his wife's LS compared to other husbands, regardless of whether or not his wife shares the same personality traits as he does. This may leads to an overestimation on the spillover coefficient for husbands.

In order to deal with the unobserved heterogeneity in the reported LS, equation (2) can be rewritten as:

$$\tilde{LS}_{i,t} = \alpha_1 \tilde{LS}_{i,t-1} + \beta_1 \tilde{LS}_{-i,t-1} + \theta_1 \tilde{X}_{i,t} + \tilde{\varepsilon}_{i,t},$$
$$\tilde{LS}_{-i,t} = \alpha_2 \tilde{LS}_{-i,t-1} + \beta_2 \tilde{LS}_{i,t-1} + \theta_2 \tilde{X}_{-i,t} + \tilde{\varepsilon}_{-i,t},$$

Here, the data are expressed in deviations from mean (so that $\tilde{LS}_{i,t} = LS_{i,t} - LS_i$). Note that the unit intercept (i.e., individual fixed effects) in equation (1) are factored out from equation (3), and the estimates will no longer be biased as a result from the presence of latent individual effects in LS levels. Equation (3) can then be estimated using normal ordinary least squares, or a seemingly unrelated regression to allow for a correlation between husband's and wife's time-varying residuals, $\tilde{\varepsilon}$.

5. Results

5.1 Assortative mating, shared social environment, or altruism?

Table 1 reports the estimates from MR-MLM estimation on Sample 1 without respondent and partner lagged LS variables. There are two main results of interest here.

First, there is a positive and statistically important correlation between husband's and wife's unobserved individual random effects. The estimated correlation coefficient between spouses' individual traits is 0.361, thereby supporting the first hypothesis that there is a

positive matching on individual traits that determine LS between spouses. These individual effects take two possible values for partners (0.628 for men and 0.704 for women), both of which are statistically significant at the 1% level.

Second, MR-MLM yields an estimated correlation coefficient between spouses' time-varying residuals that is positive and statistically well-determined at 0.140. Thus, there is some evidence which suggests that partners share a significant proportion of their environment that simultaneously affecting their LS. The time-varying effects are statistically important at the 1% level for both spouses (0.757 for men and 0.827 for women).

In short, these two results together are consistent with positive assortative on LS and that partners share the same environment that simultaneously affecting their LS levels.

Table 1's other results appear to be consistent with previous studies on subjective well-being in the literature[10]. There is a non-linear relationship between LS and age, minimising at around early 40 for both men and women. Women seem to prefer to be married than merely cohabiting with a partner. Self-employment and full-time employment appear to have positive and statistically important impacts on LS for both men and women, although the sizes of the coefficients are notably larger for men than women. There is a negative and statistically significant relationship between qualifications and LS that is more well-defined for females than for males. Physical health problems are detrimental to LS for both spouses, whilst wealth – in the form of household income and homeownership status – is positively correlated with LS for both men and women. A dummy variable representing whether or not the couple has children (aged below 16) is negative and statistically well-defined only for men. Lastly, the number of years being married or cohabiting in the sample, albeit not necessarily with the same partner, appears to have a positive and statistically significant relationship with LS only for men.

Table 2 incorporates a direct test for within-couple altruism by including respondent and partner lagged LS into the multi-level estimation. The first two columns estimate equation (2) without allowing the residuals between male and female LS equations to be correlated. The results from the MR-MLM model are reported in Columns 3 and 4. The last column calculates the social multiplier for the spillover effect of LS within the couple.

As anticipated, the partner's lagged LS variable enters respondent LS equations in all specifications with a positive and statistically well-determined manner (all being significant at the 1% level). For Columns 1 and 2, the estimated coefficients on partner lagged LS are

[10] See Blanchflower and Oswald (2004), for example.

0.066 and 0.081 for husbands and wives, respectively. The estimated spillover coefficients from partner to respondent represent around 14% for men and 17% for women of their own spillover of LS from period *t*-1 to *t*. Interestingly, the size of the estimated coefficients on partner lagged LS rose marginally, albeit statistically insignificantly, when we introduce the correlation between partners' individual traits and time-varying residuals (the estimated coefficients on partner lagged LS are now 0.096 and 0.114 for husbands and wives). This suggests that, once we control for partner lagged LS in respondent LS equations, there is in fact some evidence of a *negative* matching in the individual traits that determine LS (the estimated correlation coefficient between partners' individual random effects is now -0.070 and statistically significant at the 1% level). It is possible that, conditioning on altruism by controlling for the correlation between respondent and partner LS, individuals may tend to choose to marry those with fixed characteristics that are inherently different from themselves. This may include negative matching of unobserved abilities in the labour market (i.e. people with higher abilities may be happier with their life compared to those with lower abilities), as suggested by the negative assortative mating on earnings (Becker, 1974). The spillover coefficients from partner lagged LS to respondent LS in the MR-MLM setting represent around 20% for men and 24% for women of their own spillover of LS from period *t*-1 to *t*. Although the estimated coefficient on partner lagged LS is larger for women than for men, we cannot reject the null hypothesis that the two coefficients are not of the same size. As for the evidence of shared social environment, the estimated correlation coefficient between partners' time-varying residuals continues to be positive and statistically well-defined at 0.178.

The results obtained in Columns 3 and 4 thus suggest that there is a statistically important spillover effect (or an endogenous effect in Manski's terminology) between spouses' LS over time. The results are robust to control for correlated effects between spouses' LS through allowing for nonzero correlations between husband's and wife's individual random effects and unobserved time-varying effects in the regression.

Column 5 moves to examine the social multiplier for the spillover effects. Following Glaeser et al (2003), the idea is to estimate whether there is a further social interaction between partners' LS after one partner's lagged LS has gone up by one unit. In other words, an increase in the wife's lagged LS results in an increase in her husband's LS at *t*. At the same time, an increase in the husband's lagged LS also raises his wife's LS at *t*. The consequential increases in both partners' LS at *t* can then have yet another spillover impact on one another, which further raises each other's current LS levels even more. Column 5 estimates an aggregate model of equation (2) – with LS being aggregated at the couple level –

in order to obtain the social multiplier for partner lagged LS[11]. The estimated spillover coefficient in the aggregate model is 0.163 with a standard error of 0.034. This is larger than the spillover coefficients obtained in the previous two columns, thereby implying that there is some evidence of social multiplier in the case of couples' LS. Given that a social multiplier is derived by dividing the estimated coefficient obtained at the aggregate level by the one obtained at the individual level, the social multipliers for men and women are therefore 1.7 and 1.4, respectively.

Casting the social multiplier aside, one question of interest is how large are the initial spillover effects compared to other socio-economic influences of LS? The means (standard deviations) of $LS_{i-,t-1}$ are 5.33 (1.18) and 5.39 (1.24) for men and women. A move from one standard deviation below the mean of $LS_{i-,t-1}$ to one standard deviation above is therefore a change from 4.15 to 6.51 for men and from 4.15 to 6.63 for women. Taking the conservative central estimates of $LS_{i-,t-1}$ from Columns 3 and 4 to be 0.096 for men and 0.114 for women, the implied changes in LS for the respondent are approximately 0.23 and 0.28 for men and women. Given the distributions of LS, these are fairly large effects. It is equivalent to around a 46-percentage-point increase in the household income for men and a 70-percentage-point increase for women. It is roughly the same as gaining full-time employment for men, and can offset around 30%-40% of the negative impacts brought about by anxiety and depression for both males and females.

Table 3 re-estimates equation (2) on individuals who were with their partner in every wave of the BHPS (Sample 3). Surprisingly, the estimated coefficients on partner lagged LS appear to be insignificantly different from those obtained in the first four columns of Table 2; the estimated spillover effects do not seem to be statistically significantly larger for individuals in more stable relationships. This suggests that we can carry on using all of the married and cohabiting individuals with information on own and partner lagged LS (Sample 2) in our test for altruism. It is also worth noting that the coefficients on the inverse Mill's ratio are negative and statistically significant for women but not for men. This is somewhat puzzling; the negative inverse Mill's ratio coefficients in the female sub-sample regressions suggest that women with lower LS are less likely to select themselves from Sample 1 to Sample 3. However, it does not necessarily suggest that women with lower LS are less likely to be separated or divorced and therefore fall out from the sample (it merely indicates that women with higher LS are less likely to be married or cohabiting in every wave of the

[11] Note that the individual random effects now become family random effects in the aggregate model.

BHPS). The negative coefficients on the inverse Mill's ratio could have come from the fact that young couples are happier, and they are more likely to move a lot more than older couples. I will do a more formal test on whether couples with higher LS are more or less likely to separate or divorce in the future later in the paper.

Table 4 examines whether or not the spillover effects vary between married and cohabiting couples using MR-MLM model. Adding an interaction effect between the two spillover coefficients and the cohabiting dummy, the interaction coefficients are negative albeit statistically insignificant. I also test (though not reported here) whether the spillover effects vary significantly between couples with and without children, but found no statistically significant variations between the two groups.

So far we have been assuming in our regression equations that the correlation between the respondent's unobserved individual traits and partner lagged LS is zero. However, this is a very strong assumption, one of which is unlikely to hold in the estimation of LS (see Ferrer-i-Carbonell and Frijters, 2004). If there is indeed a significant correlation between individual fixed effects and partner lagged LS, then such unobserved heterogeneity will induce another type of correlated effects between partners' LS. In an attempt to control for unobserved heterogeneity, Table 5 presents fixed effects (FE) estimates from equation (3) using Sample 2. Columns 1 and 2 estimate equation (3) separately for men and women, whilst Columns 3 and 4 allow for nonzero spousal correlations in the time-varying residuals via seemingly unrelated estimation of the transformed data.

There are three striking results. First, as expected, there is a sharp drop in the coefficients on partner lagged LS for both men and women compared to those obtained in Table 2, although they remain statistically well-determined at the 1% level. The coefficients on partner lagged LS are now 0.022 for men and 0.032 for women. This suggests that there is an important unobserved heterogeneity bias on partner lagged LS that needs to be taken into account in both male and female LS equations.

Second, the coefficient on respondent lagged LS is now negative and statistically well-defined for both males and females. Considering that we are essentially estimating demeaned LS on demeaned right-hand side variables, the negative coefficient on respondent lagged LS might just be reflecting a mean reversal in own LS from period t-1 to t. In other words, the higher the level of own lagged LS the less likely that the respondent will experience a large change in LS from t-1 to t.

Third, despite the statistically important correlation between husband's and wife's residuals in last two columns of Table 5, the estimated spillover effects between FE model

and the seemingly unrelated FE model are virtually the same. Hence, the evidence suggests that it makes virtually no difference to the estimated coefficients on partner lagged LS whether one allows for nonzero correlations in the time-varying residuals or not.

In summary, the above results suggest that there is strong evidence of spillover effects of LS within marriage, even after individual traits have been introduced or factored out completely from the regressions.

5.2 Termination of partnership

Up to this point, this paper has concentrated on the impact of partner lagged LS on respondent current LS level. Such an approach seems to be of some worth in its own right. However, in order to show that LS within the couple also has important implications on observable behaviours, I now estimate a marital dissolution equation.

Of those married and cohabiting individuals in Sample 1, there are 501 couples (roughly 2% of the sample) who moved from being married or cohabiting with a partner to separation, divorce, or single in the marital status while they were still in the panel[12]. The key hypothesis to be tested is that couples with higher LS levels are less likely to be separated or divorced in the future.

Table 6 present estimates and marginal effects obtained from a probit model with random effects on whether the couple terminates their relationship at period t+1. Here, the partners' LS enter the probit equation in additive form. Controlling for other contemporaneous socioeconomic statuses of both spouses, male and female LS at period t are negative and statistically robust at the 1% level. Holding husband's LS constant, a unit increase in his partner LS significantly reduces the probability of marital dissolution by roughly 0.2% and, *vice versa*, around 0.1% for wives (although I cannot reject the null hypothesis that the two coefficients are the same). These are sizeable effects considering that the conditional predicted probability of the estimated model (assuming the random effects = 0) is 0.4%. Thus, there is strong evidence that the levels of LS within the couple are important predictors of marital dissolution in the future.

Table 6's other results show that there is a statistically well-determined convex relationship between women's age and the probability of marital dissolution at t+1. However, this may be due to the inclusion of those who moved into widowhood at t+1 as well.

[12] To avoid selection bias, I also include moving into 'widowed' status into the analysis. The regression results are qualitatively similar with or without the widowed group.

Cohabiting individuals are more likely to separate from their partner compared to those who are married. Real income is negatively albeit statistically insignificantly related with future termination of partnership. There are no statistically important relationship between both male and female employment statuses and the probability of marital dissolution in the future in our sample. Though not reported here, almost all education and physical health problem dummies are statistically insignificant for both men and women. Lastly, the longer the couples are married or cohabiting in the sample the less likely that they are going to separate at t+1[13].

6. Conclusions

This paper has adopted multi-level and fixed effects simultaneous equation approaches to study within-couple relationship between partners' self-rated LS levels. The primary objective of the paper was to determine whether the observed spousal correlation in LS is due largely to assortative mating on LS, shared social environment, or altruism. The paper also addresses a number of methodological difficulties in trying to distinguish between the three interpretations of spousal correlation in LS, in particular the nonzero correlations between husband's and wife's individual traits and unobserved time-varying effects, and the unobserved heterogeneity bias in respondent LS equations..

The first set of results suggests that there is indeed a spousal correlation in the raw data. Further, a multi-response multi-level model, without partner lagged LS as one of the independent variables, reveals that there is a positive and statistically important correlation between male and female individual traits and time-varying effects: this is consistent with assortative mating on LS and shared social environment between spouses.

In order to distinguish between correlated effects (assortative mating and shared social environment) and endogenous effects (altruism), own and partner lagged LS were then introduced into the simultaneous regression equations. Partners' LS are positively and statistically significantly correlated even after controlling for nonzero correlations between partners' individual random effects and time-varying residuals. In other words, this paper finds strong evidence to support within-couple altruism in that partner lagged LS is interdependently related with the respondent's own LS, even when matching on LS and

[13] It should however be noted here that although couples with high LS levels are significantly less likely to end their relationship with their current partner, people who divorced are likely to bounce back from their separation and be more satisfied with life in the long run (see Gardner and Oswald, 2006).

shared social environment within the household have been controlled for in the estimation. The results are also robust to controls for individual fixed effects of both spouses.

There are at least two important implications of our empirical analysis of spousal correlation in LS. The first is purely descriptive: the evidence seems to provide strong statistical supports in terms of validity for many economic models that were built around the assumption that utility is interdependently related between members of the same household (Becker, 1974).

Second, the evidence of altruism within the couple implies that there is such a thing as a practical incentive for each person in a relationship, when trying to maximise own well-being, to place some weights on making the other person feel better off as well. Provided that LS is a good in itself, the incentive to make the other person happier is mutually beneficial for both partners and also potentially for their offspring. This is reflected in our results that couples with high levels of LS are significantly less likely to end their relationship with their partner at period t+1.

More generally, the empirical approach of this paper can be extended and applied to distinguish between different explanations of other types of similarity in couples behaviours and characteristics that are not specific to partners' subjective well-being.

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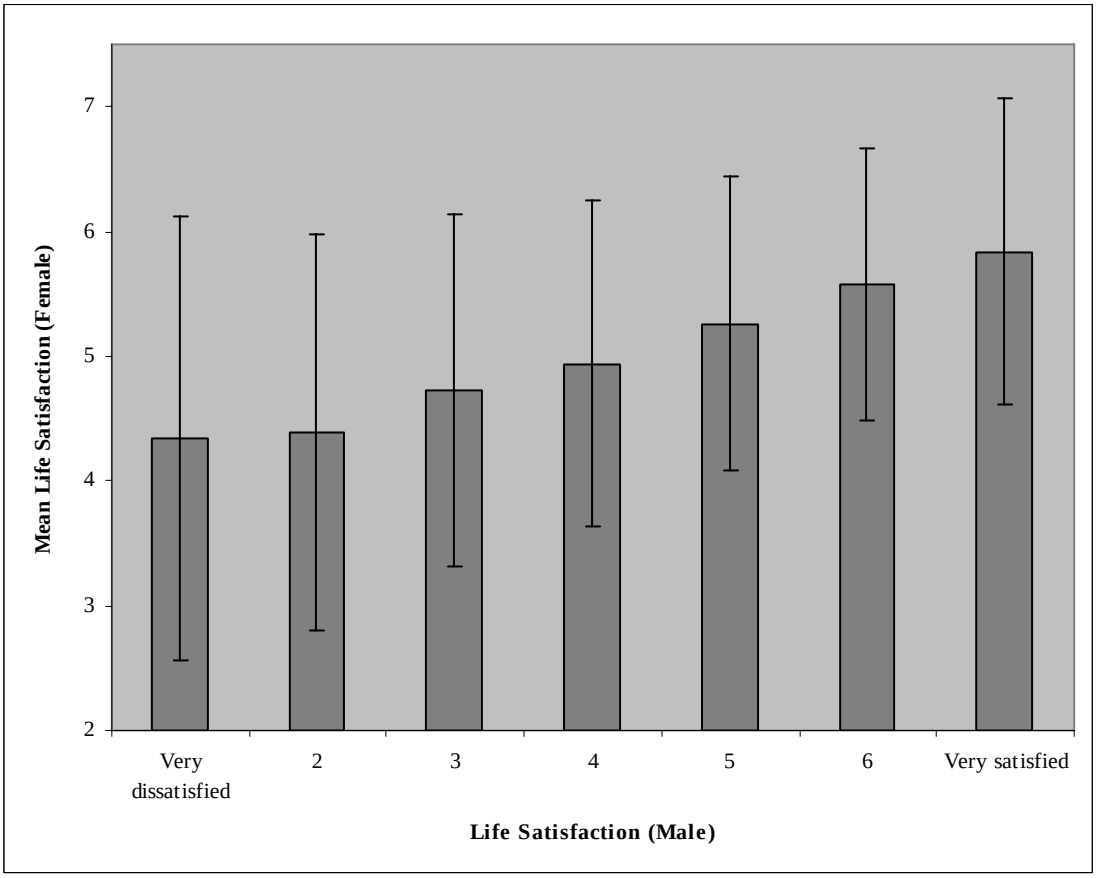
Figure 1: Cross-tabulation of Life Satisfaction for Men with Summary on Mean Life Satisfaction for Women: BHPS 1996-2006



Note: Observations are taken from Sample 1. Error bars are reported in the figure.

Table 1: Multi-Response Multi-Level Model of Life Satisfaction for All Married and Cohabiting Couples (Sample 1)

	MR-MLM	
Dependent variable: Life satisfaction	**Male**	**Female**
Age	-0.039**	-0.027**
	(0.004)	(0.004)
Age-squared/100	0.050**	0.034**
	(0.004)	(0.004)
Cohabit	0.000	-0.076**
	(0.024)	(0.026)
Self-employed	0.311**	0.147**
	(0.029)	(0.039)
Employed full-time	0.280**	0.104**
	(0.023)	(0.018)
CSE grade 2-5	-0.007	-0.192**
	(0.052)	(0.049)
O-level	-0.028	-0.107**
	(0.027)	(0.028)
A-level	-0.072**	-0.137**
	(0.029)	(0.032)
Teaching	-0.055	-0.075
	(0.038)	(0.042)
1st degree	-0.034	-0.123**
	(0.035)	(0.038)
Higher degree	-0.079	-0.091
	(0.053)	(0.066)
Health problem: arms, legs, hands, etc.	-0.161**	-0.182**
	(0.023)	(0.026)
Health problem: sight	-0.093	-0.084
	(0.057)	(0.067)
Health problem: hearing	-0.092**	-0.068
	(0.035)	(0.052)
Health problem: skin conditions/allergy	-0.140**	-0.085**
	(0.032)	(0.030)
Health problem: chest/breathing	-0.207**	-0.158**
	(0.029)	(0.033)
Health problem: heart/blood pressure	-0.230**	-0.136**
	(0.025)	(0.028)
Health problem: stomach/digestion	-0.222**	-0.268**
	(0.030)	(0.033)
Health problem: diabetes	-0.237**	-0.236**
	(0.043)	(0.058)
Health problem: anxiety/depression	-0.851**	-0.739**

	(0.036)	(0.030)
Health problem: alcohol or drugs	-0.681**	-1.535**
	(0.110)	(0.184)
Health problem: epilepsy	-0.336**	-0.331**
	(0.094)	(0.108)
Health problem: migraine	-0.382**	-0.381**
	(0.034)	(0.024)
Health problem: other	-0.437**	-0.430**
	(0.034)	(0.028)
Have at least one child in the household	-0.056*	-(0.031)
	(0.025)	(0.026)
Log (real household income per capita)	0.079**	0.072**
	(0.011)	(0.011)
Own home outright	0.199**	0.190**
	(0.022)	(0.023)
Number of years married/cohabiting in the panel	0.006*	0.003
	(0.003)	(0.003)
Intercept	5.067**	5.273**
	(0.124)	(0.128)
Intercept: individual random effects	0.628**	0.704**
	(0.015)	(0.017)
Intercept: time-varying effects	0.757**	0.827**
	(0.007)	(0.008)
Correlations between residuals	*Cov*	*Corr*
u(i)	0.240**	*0.361*
	(0.012)	
v(it)	0.111**	*0.140*
	(0.005)	
N	28846	
2*Log-likelihood	166874.00	

Note: * < 5%; ** < 1%. Standard errors are in parentheses. MR-MLM = multi-response, multi-level model. Life satisfaction is recorded on a 7-point-scale, with 1 = very dissatisfied and 7 = very satisfied. The reference categories include married, not employed, lower than CSE level, and no physical health problem.

Table 2: Multi-level and Multi-Response Multi-Level Models of Life Satisfaction for All Married and Cohabiting Couples with Respondent and Partner Lagged LS Variables (Sample 2)

	MLM		MR-MLM		MLM
Dependent variable: Life satisfaction	**Male**	**Female**	**Male**	**Female**	**Couple**
Partner's life satisfaction at t-1	0.066**	0.081**	0.096**	0.114**	0.163**
	(0.006)	(0.007)	(0.006)	(0.007)	(0.034)
Life satisfaction at t-1	0.483**	0.469**	0.482**	0.474**	0.317**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.034)
Age	-0.016**	-0.017**	-0.012**	-0.015**	-0.022**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Age-squared/100	0.023**	0.019**	0.019**	0.017**	0.027**
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
Cohabit	-0.032	-0.075**	-0.022	-0.064**	-0.043*
	(0.024)	(0.025)	(0.023)	(0.025)	(0.019)
Self-employed	0.218**	0.093	0.218**	0.098**	0.180**
	(0.030)	(0.041)	(0.029)	(0.040)	(0.031)
Employed full-time	0.201**	0.052**	0.201**	0.043*	0.116**
	(0.025)	(0.020)	(0.024)	(0.020)	(0.021)
CSE grade 2-5	-0.006	-0.032	-0.005	-0.020	0.063
	(0.041)	(0.041)	(0.041)	(0.040)	(0.042)
O-level	-0.027	-0.038	-0.030	-0.037	-0.010
	(0.023)	(0.023)	(0.022)	(0.023)	(0.023)
A-level	-0.025	-0.106**	-0.028	-0.100**	-0.028
	(0.024)	(0.028)	(0.024)	(0.028)	(0.026)
Teaching	-0.039	-0.072	-0.040	-0.082*	-0.026
	(0.031)	(0.036)	(0.031)	(0.035)	(0.034)
1st degree	-0.042	-0.049	-0.046	-0.054	-0.035
	(0.030)	(0.033)	(0.030)	(0.033)	(0.030)
Higher degree	-0.009	-0.082	-0.018	-0.068	-0.045
	(0.046)	(0.059)	(0.046)	(0.059)	(0.051)
Health problem: arms, legs, hands, etc.	-0.127**	-0.114**	-0.123**	-0.107**	-0.144**
	(0.026)	(0.022)	(0.026)	(0.030)	(0.030)
Health problem: sight	-0.133	-0.063	-0.134	-0.065	-0.123
	(0.069)	(0.082)	(0.069)	(0.081)	(0.081)
Health problem: hearing	-0.075	-0.212**	-0.059	-0.218**	-0.211**
	(0.039)	(0.059)	(0.039)	(0.058)	(0.051)
Health problem: skin conditions/allergy	-0.108**	-0.020	-0.101**	-0.017	-0.110**
	(0.036)	(0.033)	(0.035)	(0.033)	(0.037)
Health problem: chest/breathing	-0.154**	-0.109**	-0.151**	-0.103**	-0.180**
	(0.031)	(0.059)	(0.031)	(0.035)	(0.037)
Health problem: heart/blood pressure	-0.141**	-0.116**	-0.142**	-0.106**	-0.148**
	(0.027)	(0.031)	(0.027)	(0.031)	(0.031)

Health problem: stomach/digestion	-0.212**	-0.243**	-0.211**	-0.242**	-0.263**
	(0.035)	(0.039)	(0.035)	(0.038)	(0.040)
Health problem: diabetes	-0.123**	-0.180**	-0.118**	-0.179**	0.150**
	(0.042)	(0.059)	(0.042)	(0.058)	(0.054)
Health problem: anxiety/depression	-0.758**	-0.679**	-0.734**	-0.637**	-0.877**
	(0.042)	(0.036)	(0.042)	(0.035)	(0.039)
Health problem: alcohol or drugs	-0.471**	-1.183**	-0.438**	-1.054**	-0.939**
	(0.137)	(0.254)	(0.135)	(0.258)	(0.179)
Health problem: epilepsy	-0.258**	-0.297**	-0.243*	-0.242*	-0.424**
	(0.099)	(0.116)	(0.098)	(0.114)	(0.116)
Health problem: migraine	-0.255**	-0.271**	-0.241**	-0.260**	-0.369**
	(0.038)	(0.027)	(0.037)	(0.027)	(0.033)
Health problem: other	-0.420**	-0.337**	-0.407**	-0.324**	-0.447**
	(0.041)	(0.033)	(0.040)	(0.033)	(0.038)
Have at least one child in the household	-0.028	-0.105**	-0.068**	-0.118**	-0.060**
	(0.020)	(0.022)	(0.021)	(0.022)	(0.016)
Log (real household income per capita)	0.054**	0.045**	0.050**	0.040**	0.046**
	(0.014)	(0.014)	(0.015)	(0.014)	(0.012)
Own home outright	0.090**	0.110**	0.080**	0.102**	0.124**
	(0.021)	(0.022)	(0.020)	(0.022)	(0.016)
Number of years married/cohabiting in the panel	0.003	-0.001	0.002	-0.002	0.010**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Intercept	2.025**	2.388**	1.870**	2.238**	2.588**
	(0.138)	(0.145)	(0.138)	(0.145)	(0.109)
Intercept : individual random effects	0.040**	0.048**	0.035**	0.038**	0.242**
	(0.006)	(0.007)	(0.005)	(0.006)	(0.017)
Intercept : time-varying effects	0.837**	0.966**	0.843**	0.968**	0.757**
	(0.010)	(0.012)	(0.010)	(0.011)	(0.006)
Correlations between residuals			*Cov*	*Corr*	
u(i)			-0.039**	*-0.070*	
			(0.004)		
v(it)			0.161**	*0.178*	
			(0.008)		
N	17079	17079	17079		20765
2*Log-likelihood	46151.93	48880.26	94322.20		49316.88

Note: * < 5%; ** < 1%. Standard errors are in parentheses. MLM = multi-level model. MR-MLM = multi-response, multi-level model.

Table 3: Multi-level and Multi-Response Multi-Level Models of Life Satisfaction for Couples Who Have Been Together for 15 Years in the BHPS (Sample 3)

	MLM		MR-MLM	
Dependent variable: Life satisfaction	**Male**	**Female**	**Male**	**Female**
Partner's life satisfaction at t-1	0.063**	0.094**	0.080**	0.127**
	(0.010)	(0.013)	(0.010)	(0.013)
Life satisfaction at t-1	0.484**	0.306**	0.488**	0.327**
	(0.011)	(0.012)	(0.011)	(0.012)
Inverse Mill's Ratio	-0.016	-0.153*	-0.015	-0.148**
	(0.053)	(0.068)	(0.052)	(0.060)
Intercept	2.114**	4.155**	1.993**	3.859**
	(0.343)	(0.411)	(0.340)	(0.038)
Intercept : individual random effects	0.072**	0.236**	0.067**	0.206**
	(0.009)	(0.016)	(0.008)	(0.015)
Intercept : time-varying effects	0.634**	0.716**	0.638**	0.729**
	(0.013)	(0.015)	(0.013)	(0.015)
Correlations between residuals			*Cov*	*Corr*
u(i)			-0.010	*-0.084*
			(0.008)	
v(it)			0.109**	*0.160*
			(0.010)	
N	6041	6041	6041	
Log-likelihood	14867.15	16521.16	31024.31	

Note: * < 5%; ** < 1%. Standard errors are in parentheses. MLM = multi-level model. MR-MLM = multi-response, multi-level model. Same controls as in Table 2.

Table 4: Multi-Response Multi-Level Models of Life Satisfaction for All Married and Cohabiting Couples with Interactions on Marital Status (Sample 2)

	MR-MLM	
Dependent variable: Life satisfaction	**Male**	**Female**
Partner's life satisfaction at t-1	0.098**	0.118**
	(0.007)	(0.007)
Life satisfaction at t-1	0.487**	0.475**
	(0.007)	(0.007)
Cohabit	0.204	0.101
	(0.118)	(0.127)
Partner's life satisfaction at t-1*cohabit	-0.010	-0.009
	(0.018)	(0.019)
Life satisfaction at t-1*cohabit	-0.033	-0.023
	(0.019)	(0.020)

Note: * < 5%; ** < 1%. Standard errors are in parentheses. MLM = multi-level model. MR-MLM = multi-response, multi-level model. Same controls as in Table 2.

Table 5: Fixed Effects and Seemingly Unrelated Models of Life Satisfaction for All Married and Cohabiting Couples (Sample 2)

Dependent variable: Life satisfaction	FE		SUFE	
	Male	**Female**	**Male**	**Female**
Partner's life satisfaction at t-1	0.022**	0.032**	0.023**	0.030**
	(0.009)	(0.010)	(0.007)	(0.008)
Life satisfaction at t-1	-0.086**	-0.118**	-0.092**	-0.117**
	(0.009)	(0.009)	(0.008)	(0.008)
Age-squared/100	-0.005	-0.010	-0.005	-0.010
	(0.011)	(0.012)	(0.011)	(0.012)
Cohabit	-0.039	-0.122*	-0.042	-0.117*
	(0.053)	(0.055)	(0.044)	(0.047)
Self-employed	0.096	0.080	0.104*	0.069
	(0.053)	(0.063)	(0.043)	(0.052)
Employed full-time	0.112**	0.054	0.120**	0.046
	(0.040)	(0.030)	(0.033)	(0.024)
CSE grade 2-5	-0.455	0.416	-0.499	-0.700**
	(0.395)	(0.371)	(0.318)	(0.242)
O-level	-0.280	0.200	-0.302	-0.056
	(0.247)	(0.231)	(0.199)	(0.155)
A-level	-0.263	0.418	-0.302	0.257
	(0.251)	(0.249)	(0.202)	(0.168)
Teaching	-0.632*	0.145	-0.579*	0.099
	(0.308)	(0.304)	(0.250)	(0.200)
1st degree	-0.460	0.283	-0.485*	0.162
	(0.287)	(0.257)	(0.231)	(0.178)
Higher degree	-0.460	-0.036	-0.416	-0.134
	(0.332)	(0.362)	(0.268)	(0.264)
Health problem: arms, legs, hands, etc.	-0.047	-0.130**	-0.044	-0.124**
	(0.024)	(0.037)	(0.027)	(0.030)
Health problem: sight	-0.022	0.016	-0.012	-0.018
	(0.045)	(0.093)	(0.066)	(0.076)
Health problem: hearing	-0.015	-0.036	-0.014	-0.047
	(0.053)	(0.080)	(0.043)	(0.064)
Health problem: skin conditions/allergy	-0.120*	-0.072	-0.106**	-0.074*
	(0.048)	(0.045)	(0.039)	(0.037)
Health problem: chest/breathing	-0.065	0.010	-0.044	-0.027
	(0.047)	(0.052)	(0.039)	(0.042)
Health problem: heart/blood pressure	-0.088*	-0.080	-0.092**	-0.080*
	(0.039)	(0.044)	(0.032)	(0.035)
Health problem: stomach/digestion	-0.058	-0.179**	-0.042	-0.178*
	(0.045)	(0.049)	(0.037)	(0.040)
Health problem: diabetes	0.143	0.034	0.136*	-0.020

	(0.078)	(0.103)	(0.064)	(0.085)
Health problem: anxiety/depression	-0.496**	-0.412**	-0.486**	-0.378**
	(0.055)	(0.045)	(0.045)	(0.037)
Health problem: alcohol or drugs	-0.418**	-0.926**	-0.331*	-0.844**
	(0.159)	(0.329)	(0.130)	(0.263)
Health problem: epilepsy	0.293	0.221	0.309*	0.188
	(0.197)	(0.193)	(0.159)	(0.153)
Health problem: migraine	-0.083	-0.200**	-0.074	-0.184**
	(0.054)	(0.039)	(0.043)	(0.031)
Health problem: other	-0.213**	-0.262**	-0.212**	-0.275**
	(0.049)	(0.041)	(0.040)	(0.033)
Have at least one child in the household	0.008	0.076*	0.013	0.069*
	(0.036)	(0.038)	(0.029)	(0.031)
Log (real household income per capita)	0.026	0.023	0.023	0.019
	(0.022)	(0.023)	(0.018)	(0.019)
Own home outright	0.118**	0.095*	0.112**	0.080*
	(0.040)	(0.042)	(0.033)	(0.035)
Intercept	5.827**	5.831**	6.458**	6.753**
	(0.367)	(0.363)	(0.309)	(0.301)
Correlation between residuals			0.111	
Breusch-Pagan test of independence: chi(2)			207.54**	
N	17079	17175	16756	16756
R-squared (within)	0.026	0.033	0.021	0.029

Note: * < 5%; ** < 1%. Standard errors are in parentheses. FE = fixed effects. SUFE = seemingly unrelated fixed effects. Same controls as in Table 2.

Table 6: Probit with Random Effects Model of Termination of Partnership at Period t+1 (Sample 1)

Termination of partnership at t+1	**REPROB**	**MFX = 1 Pr|X=0.004**
Male's life satisfaction	-0.098**	-0.0011
	(0.020)	
Female's life satisfaction	-0.163**	-0.0018
	(0.019)	
Male's age	0.016	0.0002
	(0.015)	
Male's age-squared/100	-0.010	-0.0001
	(0.016)	
Female's age	-0.078**	-0.0009
	(0.015)	
Female's age-squared/100	0.083***	0.0010
	(0.016)	
Male's self-employed	0.152	0.0021
	(0.096)	
Male's employed full-time	-0.035	-0.0004
	(0.077)	
Female's self-employed	0.057	0.0007
	(0.132)	
Female's employed full-time	0.077	0.0009
	(0.061)	
Cohabit	0.159**	0.0021
	(0.063)	
Number of years married/cohabiting in the panel	-0.118**	-0.0014
	(0.009)	
Have at least one child in the household	0.009	0.0001
	(0.095)	
Log (real household income per capita)	-0.011	-0.0001
	(0.040)	
Own home outright	-0.085	-0.0009
	(0.076)	
Intercept	1.213**	
	(0.443)	
Regional and wave dummies	Yes	
Rho	0.201 (0.054)**	
N	25992	
Log-likelihood	-1106.405	

Note: * < 5%; ** < 1%. Standard errors are in parentheses. The regression also includes both husband's and wife's education levels and physical health problems.

Appendix A: Means and Standard Deviations of the Variables: BHPS 1996-2006

	Sample 1		Sample 2		Sample 3	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
N	31659	31532	17079		6041	
Life satisfaction at t	5.31 (1.20)	5.36 (1.26)	5.30 (1.18)	5.35 (1.24)	5.38 (1.10)	5.37 (1.18)
Life satisfaction at t-1			5.33 (1.18)	5.39 (1.24)	5.40 (1.11)	5.41 (1.17)
Age	48.17 (15.55)	45.54 (14.92)	48.88 (15.18)	46.45 (14.81)	53.87 (12.64)	51.35 (12.40)
Age-squared/100	25.62 (16.03)	22.97 (14.64)	26.20 (15.85)	23.77 (14.80)	30.61 (14.20)	27.90 (13.30)
Cohabit*	0.17 (0.38)	0.17 (0.38)	0.14 (0.35)	0.14 (0.35)	0.03 (0.16)	0.03 (0.16)
Self-employed*	0.12 (0.33)	0.04 (0.20)	0.12 (0.33)	0.04 (0.20)	0.13 (0.34)	0.04 (0.20)
Employed full-time*	0.58 (0.49)	0.55 (0.49)	0.58 (0.49)	0.55 (0.49)	0.55 (0.50)	0.54 (0.49)
CSE grade 2-5*	0.04 (0.20)	0.05 (0.22)	0.04 (0.20)	0.05 (0.22)	0.04 (0.19)	0.05 (0.22)
GCE O-level*	0.23 (0.42)	0.27 (0.45)	0.23 (0.42)	0.28 (0.45)	0.22 (0.42)	0.29 (0.45)
GCE A-level*	0.19 (0.40)	0.16 (0.36)	0.20 (0.40)	0.16 (0.36)	0.19 (0.39)	0.12 (0.33)
Teaching qualification*	0.08 (0.28)	0.07 (0.25)	0.08 (0.28)	0.07 (0.25)	0.09 (0.29)	0.07 (0.25)
First degree*	0.10 (0.30)	0.10 (0.29)	0.11 (0.31)	0.09 (0.29)	0.10 (0.30)	0.08 (0.28)
Higher degree*	0.03 (0.18)	0.02 (0.14)	0.03 (0.18)	0.02 (0.14)	0.03 (0.18)	0.02 (0.14)
Health problem: arms, legs, hands, etc.*	0.09 (0.29)	0.08 (0.28)	0.10 (0.30)	0.08 (0.28)	0.10 (0.30)	0.09 (0.28)
Health problem: sight*	0.01 (0.11)	0.01 (0.11)	0.01 (0.10)	0.01 (0.11)	0.01 (0.10)	0.01 (0.11)
Health problem: hearing*	0.04 (0.20)	0.02 (0.14)	0.04 (0.20)	0.02 (0.14)	0.05 (0.23)	0.02 (0.14)
Health problem: skin conditions/allergy*	0.05 (0.21)	0.06 (0.25)	0.05 (0.21)	0.07 (0.25)	0.05 (0.22)	0.06 (0.24)
Health problem: chest/breathing*	0.07 (0.25)	0.06 (0.23)	0.07 (0.25)	0.06 (0.23)	0.06 (0.23)	0.05 (0.23)
Health problem: heart/blood pressure*	0.11 (0.32)	0.09 (0.29)	0.12 (0.32)	0.09 (0.29)	0.15 (0.36)	0.12 (0.32)
Health problem: stomach/digestion*	0.05 (0.22)	0.04 (0.21)	0.05 (0.22)	0.05 (0.21)	0.05 (0.22)	0.05 (0.21)
Health problem: diabetes*	0.03 (0.18)	0.02 (0.14)	0.04 (0.18)	0.02 (0.14)	0.04 (0.19)	0.02 (0.15)
Health problem: anxiety/depression*	0.03 (0.18)	0.06 (0.24)	0.03 (0.18)	0.06 (0.24)	0.02 (0.15)	0.04 (0.21)
Health problem: alcohol or drugs*	0.00 (0.05)	0.00 (0.03)	0.00 (0.05)	0.00 (0.03)	0.00 (0.04)	0.00 (0.02)

Health problem: epilepsy*	0.01 (0.08)	0.01 (0.07)	0.01 (0.08)	0.00 (0.07)	0.00 (0.06)	0.01 (0.07)
Health problem: migraine*	0.04 (0.20)	0.12 (0.32)	0.04 (0.20)	0.12 (0.32)	0.04 (0.19)	0.12 (0.32)
Health problem: other*	0.04 (0.19)	0.07 (0.25)	0.04 (0.19)	0.07 (0.25)	0.04 (0.20)	0.07 (0.25)
Log (real household income per capita)	8.99 (0.69)	8.98 (0.70)	9.04 (0.64)	9.04 (0.64)	9.08 (0.61)	9.08 (0.61)
Own home outright*	0.26 (0.44)	0.25 (0.44)	0.27 (0.44)	0.27 (0.44)	0.37 (0.48)	0.37 (0.48)
Have at least one child in the household*	0.08 (0.27)	0.08 (0.27)	0.08 (0.27)	0.08 (0.27)	0.09 (0.28)	0.09 (0.28)
Number of years married/cohabiting in the panel	9.81 (4.44)	9.79 (4.46)	10.49 (4.24)	10.49 (4.24)	15 years	

Note: Standard deviations are in parentheses. * signifies dummy variables.

Appendix B: Instrumental Regression for Selection Bias (Probit Model on Sample 1)

	Sample 1 into Sample 3	
Dependent variable: stay for 15 waves	**Husband**	**Wife**
Regional house price at t	0.204**	0.326**
	(0.029)	(0.035)
Regional house price at t-1	0.113**	0.236**
	(0.028)	(0.029)
Age	0.169**	0.160**
	(0.010)	(0.010)
Age-squared/100	-0.144**	-0.140**
	(0.010)	(0.010)
Cohabit	-0.985**	-0.882**
	(0.083)	(0.076)
Self-employed	0.110	-0.133
	(0.066)	(0.082)
Employed full-time	0.147**	0.105**
	(0.055)	(0.038)
CSE grade 2-5	0.193	0.211*
	(0.117)	(0.102)
O-level	0.038	0.118*
	(0.063)	(0.055)
A-level	0.091	0.058
	(0.068)	(0.071)
Teaching	0.184*	0.055
	(0.084)	(0.086)
1st degree	0.101	0.005
	(0.084)	(0.082)
Higher degree	-0.006	0.048
	(0.133)	(0.159)
Health problem: arms, legs, hands, etc.	-0.046	-0.107*
	(0.048)	(0.048)
Health problem: sight	-0.027	0.123
	(0.108)	(0.115)
Health problem: hearing	0.119	-0.049
	(0.074)	(0.100)
Health problem: skin conditions/allergy	0.052	0.031
	(0.070)	(0.064)
Health problem: chest/breathing	-0.076	-0.069
	(0.074)	(0.070)
Health problem: heart/blood pressure	0.019	-0.038
	(0.056)	(0.057)
Health problem: stomach/digestion	-0.018	-0.136*
	(0.067)	(0.065)

Health problem: diabetes	-0.099	-0.099
	(0.107)	(0.131)
Health problem: anxiety/depression	-0.263**	-0.226**
	(0.083)	(0.061)
Health problem: alcohol or drugs	-0.258	-0.259
	(0.214)	(0.295)
Health problem: epilepsy	-0.329	0.017
	(0.260)	(0.213)
Health problem: migraine	-0.049	0.006
	(0.079)	(0.051)
Health problem: other	-0.003	-0.127*
	(0.074)	(0.057)
Number of young children	0.132**	0.154**
	(0.025)	(0.023)
Number of older children	0.109**	0.092**
	(0.028)	(0.027)
Log (real household income per capita)	0.083**	0.113**
	(0.030)	(0.028)
Own home outright	0.178**	0.135**
	(0.050)	(0.047)
Intercept	-6.178**	-8.236**
	(0.405)	(0.389)
Regional dummies	Yes	Yes
Wave dummies	Yes	Yes
N	39280	41145
Pseudo R-squared	0.198	0.159

Note: * < 5%; ** < 1%. Standard errors are in parentheses. The dependent variable is a dummy representing 1 if the person is married or cohabiting throughout 15 waves of the BHPS, and 0 otherwise.