Is it Money or Marriage that Keeps People Alive?

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August 2002

Abstract

It is believed that the length of a person's life depends on a mixture of economic and social factors. Yet the relative importance of these is still debated. We provide evidence in this paper that marriage has a much more important (positive) effect on longevity than high income does. For men, it almost exactly offsets the large negative effect of smoking. Economics, however, plays little or no role. After controlling for health at the start of the 1990s, we find no reliable evidence that income affects the probability of death over the subsequent decade.

Keywords: Mortality, health, income, marriage.
JEL Classifications: I12, J12,

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1. Introduction

The epidemiological evidence suggests that the length of a person's life depends on a mixture of economic and social factors. Yet their relative importance is still debated. For all sorts of reasons, including the appropriate design of economic and social policy, it is important to understand which set of forces matters most in prolonging healthy life.

The paper explores this issue by using recent longitudinal data from the British Household Panel Survey and the British Retirement Survey. Panel data have the crucial advantage that it is possible to control for health at the start of the period. We estimate equations for the probability of death over the 1990s. After examination of the data our main focus becomes a specific question: is it money or marriage that keeps people alive?

The findings seem of interest. To our surprise, we can detect only minor effects from economics. Marriage, by contrast, has a large effect on mortality risk.

2. Previous research

2.1 Socio-economic status, health, and mortality

In pioneering work, Marmot, Shipley and Rose (1984) reported results for the Whitehall study. Here 17,000 British male civil servants, aged between 40 and 64, were interviewed in the late 1960s, and their mortality recorded over the following 10 years. The men were classified according to employment grade, and a steep inverse relation between grade and mortality was observed. Men working in the lowest grade were observed to have mortality rates some three times those of workers in the highest grade. Even after controlling for age and health factors (such as smoking, obesity and exercise) the relationship between mortality and employment status remained.

Marmot et al (1991) subsequently updated these results with a second study (Whitehall II) undertaken in the late 1980s. The authors here examined the relationship between morbidity and employment grade for approximately 10,000 civil servants, both male and female, aged between 35 and 55. Workers with lower socio-economic status were more likely to suffer from a range of illnesses and to report low self-reported health status, and less likely to exhibit 'healthy' behaviour. Kuh and Wadsworth (1993) instead examine the relationship between *parental* socio-economic status and adult health in a cohort of over 3,000 British men and women aged 36 years. Parental social class and childhood health are both found to be strongly predictive of health status at age 36, even after controlling for current economic status.

Similar evidence has been reported for the United States. Duleep (1986) examines the relationship between income and mortality using data on white males, aged 35 to 65, drawn from the 1973 Current Population Survey (CPS). Income displays diminishing marginal returns in the way in which it reduces mortality: the gains from income are particularly pronounced for the very poor.[1] McDonough et al (1997), who examine the Panel Study of Income Dynamics (PSID), observe similar results. Persistent low income is found to be an especially good predictor of early mortality, but income instability is also an important factor amongst middle-income households.

Moore and Hayward (1990) study the National Longitudinal Study (NLS) of Mature Men, where a cohort of American men aged 55 or more were followed over the

[1] It has long been recognised that there is also a negative association between income inequality and aggregate health outcomes (Rodgers, 1979, Le Grand, 1987). Wilkinson (1996) has argued this reflects causation and that inequality leads to poor health. Recent research has, however, cast doubt on this assertion. Gravelle (1998) shows that the observed negative relation can result from aggregation bias, even when there is no relation between health and inequality, if individual health exhibits diminishing returns to individual income. Gravelle, Wildman and Sutton (2002) cast doubt on the original aggregate evidence and show results are very sensitive to how inequality is measured and to which functional form is specified. At the individual level, Daly et al (1998) find the association between inequality and health is not strong. Lynch et al (2001) examine the potential psychosocial pathways by which inequality could adversely impact on health, and find little evidence of a relationship with health outcomes in wealthy countries. Finally, Deaton and Paxson (2001) note that adult mortality rates declined most rapidly during the period when income inequality increased.

period 1966 to 1983. After controlling for age, education, race, marital status, income and health status, substantial differences in mortality rates by lifetime (longest) occupation remain. In contrast, the independent effect of occupation in the last job is limited and the effect of income, whilst negative, only on the border of statistical significance. Menchik (1993) uses the same data to examine racial differences in mortality rates. Black men are found to have substantially raised mortality rates (equivalent to five years of increased age) relative to whites. This is attributed to the lower levels of income and wealth, and greater experience of poverty, within the black population.

Feldman et al (1989) and Lahelma and Valkonen (1990) measure socio-economic status by education, and once again observe an inverse relation with mortality. Nevertheless, where comparisons are possible, income or wealth appear to be more powerful predictors of mortality risk (see Duleep, 1986, and Menchik, 1993). Finally, Iversen et al (1987), Moser et al (1984), Morris et al (1994) and Martikainen and Valkonen (1996) demonstrate that individuals who experience unemployment suffer greater mortality risk than comparable individuals who are continuously employed.

Whilst the correlation between low socio-economic status and poor health is well documented, few studies have addressed to what degree the relationship is truly causal. If low income is associated with reduced access to or quality of medical treatment, or if low-income workers are exposed to greater occupational risk factors, socio-economic status may have a causal impact upon health. Alternatively, the correlation between health and wealth may reflect rational decision-making by consumers. Individuals who expect a long duration of life may accumulate assets to finance their retirement, whilst those with a limited life expectancy may run down their wealth. Economic theory also predicts that those in good health will have higher labour force participation rates and be more productive, hence earning higher wages (Luft, 1975, and Lee, 1982). The direction

of causation then runs from health to income. Other genetic and behavioural factors may cause a positive association between health and wealth. (e.g. common tastes for work and good health). Smith (1999) contains a comprehensive discussion of such issues.

Ettner (1996) addresses the issue of causality by using an instrumental variable model -- where income is instrumented by the state unemployment rate, the respondent's work experience and parental education, and the spouse's education, experience, and parental education. These variables are assumed to be correlated with income but uncorrelated with health. The estimated income effect is, in nearly all cases, of larger magnitude than traditionally observed, which suggests a causal role for income upon health.

Adams et al (2001) adopt an alternative approach. The authors test for the *absence* of effects of socio-economic status upon innovations in health. This hypothesis will, in general, only be accepted if no causal link is present and there are no persistent hidden factors that mould both initial status and subsequent innovations. Consistent with previous evidence, a statistically significant positive association between health and socio-economic status is observed. Yet, when the incidence of new health problems -- conditioning on initial health and socio-economic status -- are instead examined, the authors conclude that there is no causal link from wealth to mortality or sudden onset of health conditions. There does, however, remain an association between wealth and the incidence of gradually worsening health conditions and mental problems. This suggests that the observed association between socio-economic status and mortality does not result from a direct causal link, but rather that it indirectly reflects variation in health conditions, as a result of wealth differences and unobserved factors.

2.2 Marriage, health, and mortality

That mortality rates are lower for married individuals has long been known (one of the first examples is that of Farr, 1858). Hu and Goldman (1990) observe that the relationship holds in 16 developed countries. Manor et al (2000) observe the same pattern for Israel, as does Rahman (1993) for Bangladesh. The reasons for this excess mortality among the unmarried are still subject to debate.[2]

Why might marriage be protective? First, it may reduce stress and stress-related illness (perhaps as a result of greater social integration). Second, marriage may encourage healthy types of behaviour, and discourage risky or unhealthy ones (drinking, substance abuse, etc). A spouse also makes it more likely that the individual receives adequate care in times of illness. Finally, marriage may increase material well-being, not only by increasing family income, but also as a result of economies of scale from pooling resources and the specialisation of household tasks. Alternatively, there may be no beneficial effects of marriage upon health, but rather it may simply be that more healthy individuals are 'selected' into marriage.

Gove (1973) argues that the reduced mortality rates of the married can, in part, be attributed to the psychosocial status of marriage in society and the greater social isolation of unmarried individuals. As with mortality, married individuals show favourable psychological well-being and mental health, and the specific types of mortality with which marriage are most strongly related are those that are strongly linked to social factors (e.g. suicide, murder, accidental deaths). Rodgers (1995) offers equivalent evidence using a matched case-control methodology. House et al (1982) find that individuals with extensive social networks have lower mortality rates, though an independent effect of marriage remains. Schoenbach et al (1986), however, suggest that

[2] For a more detailed description of the literature studying the relationship between marriage, health and mortality see Wilson and Oswald (2002).

the beneficial effects of social networks are limited to elderly people who have few other social ties.

Hu and Goldman (1990) argue that if more healthy individuals are selected into marriage, then mortality rates among the unmarried will be lower where these groups form a larger proportion of the population. In this case, where fewer people are married, the stock of single individuals in the population will have, on average, better health, and the aggregate mortality differential will be lower. Whilst the evidence is generally supportive, Goldman (1993) suggests that the conditions for such evidence to be conclusive are stringent, and that aggregate data produce unpredictable patters in relative mortality rates.

Lillard and Waite (1995) examine the extent to which the beneficial effects of marriage can be accounted for by financial wealth, living arrangements, and marital history. For women, but not for men, much of the benefits of marriage are found to result from increased financial security. For both men and women, the benefits of marriage are also found to cumulate with marriage duration.

Lillard and Panis (1996) note that if marriage does have protective effects then those individuals in poor health have a larger incentive to marry. This kind of adverse selection acts counter to matching selection, whereby the healthy marry. The authors do find that healthy men are less likely to marry, and to marry later. Nevertheless, unobserved factors lead to a positive association between good health and marriage, and overall this positive effect is found to dominate. The excess mortality of divorced men is then shown to be largely associated with their inferior health; but, both for the widowed and never married, health status has little role in explaining their excess mortality. In contrast, for the UK, Ben-Shlomo et al (1993) discover that initial health and socio-economic status largely explain the inferior mortality rates of the never married, but not

those of the separated or divorced. Murray (2000) finds that even after controlling for health in early adulthood, marriage still significantly reduces mortality.

Hence, while there is substantial evidence that marriage is associated with reduced mortality risk, questions remain as to why.

3. Data

3.1 The BHPS

The British Household Panel Survey is a nationally representative sample of more than 5,000 British households, containing over 10,000 adults (see Taylor, 2002). Respondents have been interviewed annually from 1991 to 2000. If an individual leaves their original household, all adult members of their new household are also interviewed. If the household moves location, and remains within the British Isles, they are interviewed at their new location. An indicator records whether the respondent exits the survey due to death. Individuals who subsequently refuse to respond to the full survey are contacted in subsequent waves in an attempt to obtain basic information as to their status. The BHPS also contacts death registers to ascertain whether non-responders have subsequently become deceased.

Attention is here restricted to respondents aged over 40 at the time of interview in 1991 and whose mortality status is known in the year 2000. Covariates are measured in 1991, with the exception of household income, which is calculated as mean income from the 1991 and 1992 waves. This two-year averaging should be less prone to measurement error and be a better approximation of permanent income than a single-year income variable.[3] The estimation sample then records mortality for the period 1993

[3] The two-year average was here found to provide a better fit for mortality than a single-year income measure.

to 2000. The sample with non-missing values of covariates contains some 1667 men and 2090 women, with 327 and 346 observed deaths. The mortality rates are 19.6 percent and 16.6 percent respectively.

3.2 The BRS

The British Retirement Survey (BRS) was initially conducted in late 1988 and early 1989. Approximately 3,500 interviews were conducted with a nationally representative cohort of individuals aged 55 to 69. The spouses of the sample members were also interviewed (irrespective of age). A follow up survey in 1994 re-interviewed surviving respondents, and recorded who were deceased. One problem with this survey is that non-response is relatively high, with attrition accounting for 26 percent of the original survey respondents. (For the BHPS the comparable figure is 17 percent.)

We restrict attention to respondents aged between 55 and 69 in 1988, and ignore those partners outside this age range. Mortality status is recorded over the period 1988 to 1994, and covariates are measured in 1988. The resulting sample consists of 1189 men and 1329 women, with 199 and 168 observed deaths, and associated mortality rates of 16.7 percent and 12.6 percent respectively.

4. Econometric Approach

Mortality risk is modeled as a function of personal characteristics (age, education, and marital status), income (household income per adult-equivalent), and health (whether a smoker, and self reported health status). Throughout the paper, marriage is measured in the formal sense, and does not include co-habitation per se. Separate equations are estimated for males and females. Mortality risk for individual i is expressed:

$$m_i^* = y_i'\delta + x_i'\beta + z_i'\lambda + u_i, \qquad \text{i} = 1,\ldots, \text{n}. \qquad (1)$$

where m* is the latent mortality variable, y is income, x the vector of personal characteristics, z the vector of health characteristics, u the conformable error term with mean zero and constant variance, and φ, β and γ the parameters to be estimated. The quantity m* can be interpreted as a stock of health which, when negative, results in death. The probability that, over the sample period, individual i dies, is given by:

$$\Pr(m = 1) = F\left(y_i'\delta + x_i'\beta + z_i'\lambda\right), \qquad i = 1,\ldots, n. \qquad (2)$$

Previous research has shown the log odds of mortality to be approximately linear in age for those aged over 30 (Thatcher, 1999). This corresponds to the case where F(.) is the logistic distribution function and parameters are estimated by maximum likelihood.

5. Results

5.1 The BHPS

Tables 1a and 1b present the simplest results, and examine the influence of wealth, health, and marriage upon mortality, for males and females respectively. In each case, the marginal effects of the estimates are reported.

In column one of Table 1a, for the British Household Panel, household income enters the mortality equation as a categorical variable capturing the quintiles in income. For men, mortality risk (between the years 1993 and 2000) is observed to be monotonically decreasing in income (in 1991). A male in the lowest income quintile in 1991 is 7.6 percent more likely to die over the period 1993-2000 than an otherwise similar male in the highest income quintile. For men in the second lowest income quintile, the comparable figure is 4.9 percent. As with previous studies, we find income is most strongly related to mortality for those on low incomes.[4] Estimates are not,

[4] We cannot, here, distinguish between absolute and relative income effects upon mortality.

however, well determined, and only the marginal effect of lowest income quintile approaches conventional statistical significance levels. Column two, of Table 1a, instead examines log household income per adult household member. The coefficient on log income is estimated to be negative and is statistically significantly different from zero. Calculated at the mean, the marginal effect of a one-unit increase in log household income per head is estimated to reduce the mortality risk by -4.1 percent. Alternatively, moving from one standard deviation below mean income to one standard deviation above is predicted to reduce the mortality rate by -4.6 percent.

For women, in column one of Table 1b, when household income quintiles are included in the mortality equation, we find only weak evidence of a link between household income and mortality. The relationship between income and mortality does not follow a clear pattern and there is no statistical difference in mortality rates between women in the lowest and highest income quintiles. In column two, of Table 1b, when log household income per adult household member enters the mortality equation, the estimated coefficient is relatively small and not statistically significantly different from zero. In contrast to men, where income predicts quite large reductions in mortality risk, the correlation between income and mortality amongst women is, here, largely absent.

Marriage is found to be associated with substantially lower rates of mortality, for both men and women. Married men are predicted to be some -9.0 percent less likely to die over the period than unmarried men. For women, the effect is smaller.[5] Women married in 1991 are approximately -3.5 percent less likely to die over the period 1993 to 2000 than otherwise similar unmarried women.

Unsurprisingly, age has a very strong influence upon the probability of survival over the period. An extra year of age increases mortality risk by approximately 1.1 percent for men, and 0.9 percent for women. Finally, more educated men and women

have lower rates of mortality. For men, lower mortality rates are observed for individuals with degree level qualifications. A male educated to degree level is predicted to have a 4 percent lower mortality risk than men with no formal qualification. Nevertheless, the estimate is not particularly well determined. For those men with intermediate qualifications or no formal qualifications, mortality rates are very similar. For women, in contrast, the gains from education are very similar for those with degree level or intermediate qualifications, with approximately a 2 percent lower probability of mortality in each case. Again, however, the coefficients are not statistically different from zero.[6]

The results discussed so far have been based on equations in which health dummy variables are excluded. To what extent can differences in health explain the observed patterns in mortality rates? Controls for self-reported health[7] and smoking are, in later columns, added to the mortality equation. For males, in Table 1a, the parameters upon the income variables are now attenuated by up to a half, and are no longer statistically different from zero. See columns IV to VI of Table 1a. As with Adams et al (2001), once we condition upon initial health, we do not find strong evidence of a causal link from income on to mortality. This suggests that the beneficial effects of money are to a large degree felt, indirectly, via improved health. Or, to put it differently, income has no immediate effect on mortality risk, though it may operate with a long lag through an effect on health. Whether the link between income, or education, and health reflects a direct effect of economic prosperity upon health, health onto wealth, or a correlation between unobserved factors that cause both good health and higher incomes, is, however, unclear.

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[5] Gove (1973) and Lillard and Waite (1995) similarly observe larger beneficial effects for males.
[6] If we omit education from the mortality equation previous results are substantially unchanged.
[7] Idler and Kasl (1991) find self-reported measures of health status to be good predictors of mortality, even after adding stringent controls for the presence of health problems, physical disability, and biological or life-style risk factors. Subjective health questions may then be informative for life expectancy information, even in the presence of detailed assessments of health.

For women, the effect of income on mortality was previously limited, and the addition of controls for health further attenuates its effect. A similar pattern is observed with respect to education. Controlling for existing health status weakens the estimated education effects by up to a half, and they are no longer statistically different from zero.

Whereas a large part of the beneficial effects of income upon mortality, for men, are found to accrue from improved health, only to a limited degree do differences in health explain the excess mortality of the unmarried. The addition of health controls reduces the estimated marginal effect of marriage from -9.0 percent to -6.1 percent. For women, controlling for health reduces the marginal effect upon marriage from -3.5 percent to -2.9 percent. For both men and women, mortality rates remain statistically significantly lower for the married. This suggests that there are beneficial effects of marriage, upon mortality risk, independent of any selection of the most healthy into marriage.

Marriage thus keeps you alive. The effect is large. After controlling for health status, a married male is predicted to be -6.1 percent less likely to die over the period 1993 to 2000. The excess mortality of the unmarried is here similar to that of a smoker (5.8 percent). For women, being a smoker increases the risk of death by 5.1 percent, while being married reduces the risk of mortality by -2.9 percent

In summary, if initial health in 1991 is not held constant, greater income is associated in BHPS data with reduced mortality risk for men. This is, in large part, due to the positive association between health and economic prosperity. There is a much smaller effect of income upon mortality once initial health is controlled for; it is not possible to reject the null that the income effect is zero. For women, in contrast, the effect of household income is slight in all cases. Within the BHPS, the married, both male and female, are at significantly lower risk of mortality. Whilst the married are healthier (according to their self-reported health status), this is found to offer only a

partial explanation for their reduced mortality rates. Significant protective effects from marriage remain.

The impact of employment history upon mortality risk, for men, is analysed in columns three and six of Table 1a. An additional year of unemployment (compared to being employed for that year) is predicted to increase the risk of mortality by 1.3 percent, and this effect is statistically different from zero. Unemployment is thus, for men, associated with greater risk of early death. In part, this may be due to the reduced income, and inferior health (both physical and psychological), as a result of joblessness. Nevertheless, in column six of Table 1a, we observe an independent effect of unemployment even after controlling for both income and health status, and an additional year of unemployment is predicted to raise the probability of death by 1.2 percent. The effect continues to be well determined.[8] For women, unemployment experience is not found to be positively associated with mortality. This may partly reflect the sample of middle aged and older women analysed.

In Table 2a and 2b, we investigate in detail the influence of marriage upon mortality, for males and females respectively. In column one of Table 2a, we estimate the standard male mortality equation, and find marriage is associated with an 8.7 percent lower probability of mortality for this sample. In column two we separate out the unmarried marital states, and examine the impact of having never being married, being separated or divorced, or widowed, relative to being married, upon the probability of dying over the period. We obtain large, statistically well-determined, and similar marginal effects. Relative to being married, being never married in 1991 increases the risk of death between 1993 and 2000 by a remarkable 10.6 percent, being separated or divorced in 1991 by 9.4 percent, and being widowed by 8.0 percent.

[8] The labour market history measures are calculated from recall data, and are then prone to recall bias. The distinction between unemployment and being out of the labour force may then be subject to some error.

These estimates may, of course, reflect a correlation between health and marriage. Poor health may act as an impediment to marriage, or make it more likely a marriage dissolves. Health may be correlated between couples, and those individuals who are widowed likely to be less healthy. In column four of Table 2a, we control for the respondent's health status and whether they are a smoker in 1991. The marginal effects of marital status upon subsequent mortality are indeed attenuated and are no longer statistically different from zero, though they remain jointly statistically significant different from being married (LR test statistic: $\chi^2(3) = 16.73$). The marginal effects do, however, remain large. Being single, in 1991, is now predicted to increase the probability of subsequent mortality by 6.6 percent, compared to 10.6 percent previously. Being separated or divorced is associated with a 7.6 percent increased risk of death (compared to 9.4 percent) and being widowed 5.1 percent (compared to 8.0 percent).

Although differences in health account for over 30 percent of the mortality risk for the never married and widowed, they account for less than 20 percent of the effect of being separated or divorced. Other studies using UK data have observed similar patterns. Ben-Shlomo et al (1993) show that initial health and socio-economic status largely explain the inferior mortality rates of the never married, but not those of the separated or divorced. Murray (2000) demonstrates that even after controlling for health in early adulthood, marriage still significantly reduces risk of early death. For the US, Lillard and Waite (1995) observe the same kinds of effects for all unmarried groups, whilst Lillard and Panis (1996) find the excess mortality of divorced men is largely associated with their inferior health, but, both for the widowed and never married, large effects continue to hold.

For women, in Table 2b we find that women who are never married are at no greater risk of mortality than those women who are married in 1991. Women who are widows in 1991 are 3.8 percent more likely to die between 1993 and 2000 than an

otherwise similar married woman. After controlling for health variables, this falls to 3.3 percent. In both cases the estimates are statistically significantly different from zero. Women who are separated or divorced in 1991 are found to be uniquely disadvantaged. In column two of Table 2b, they have a 7.2 percent greater risk of mortality, and after controlling for health status, in column four, some 5.1 percent. Both effects are well determined. For the US, Lillard and Waite (1995) similarly document a large effect upon mortality for females who are separated or divorced. Here it is marital dissolution that raises the risk of mortality. Those women who never marry are found to be at no greater mortality risk than married women.

Columns three and six of Tables 2a and 2b then examine the individual's marital history, rather than simply their current marital state. For men, in Table 2a, the number of years married is predicted to reduce the risk of mortality. Each extra year of being single (relative to being married) increases mortality risk by 0.15 percent. For an extra year separated or divorced, the figure is 0.35 percent, and a year widowed 0.36 percent. The last effect is not, though, statistically robust. After controlling for health status in 1991, the marginal effects fall to 0.10 percent, 0.24 percent and 0.23 percent respectively, and the estimates are not well determined. For men, the benefits of marriage cumulate over time, and in part this is due to the superior health of those individuals with marriages of longer duration.

For women, in Table 2b, the number of years spent single has no strong impact upon mortality risk, when compared to being married. However, each extra year of being separated or divorced (relative to being married) increases mortality risk by 0.19 percent. An extra year widowed does so by 0.15 percent. These estimates are also statistically different from zero. After controlling for health status in 1991, the respective estimates are 0.13 percent and 0.15 percent, and only the latter is well determined. For women, the length of time spent separated or divorced has a negative impact upon the

probability of death. In part this is due to their inferior health, which itself could reflect a cause or consequence of marital dissolution. Females who have been widowed for a longer duration are also found to be at a greater risk of mortality, but here existing health status is not found to play a large role.

5.2 The BRS

Tables 3a and 3b present mortality equations, estimated for the BRS data. Again, we report the marginal effects of the estimates. The BRS data contain a smaller number of individuals, and covers a shorter time span, than the BHPS. As a result, we observe a small number of deaths within the BRS data (199 males and 168 females, compared to 327 males and 346 females for the BHPS). Perhaps for this reason, our statistical results from BRS are much less clear-cut.

For men, as in the BHPS, we observe mortality risk to be a declining function of log household income per adult. A male in the lowest income quintile in 1988 is 10.4 percent more likely to die over the period 1988 to 1994 than a similar male in the highest income quintile (column one, Table 3a). For men in the second lowest income quintile the comparable figure is 12.2 percent. When log household income per adult enter the mortality equation (Table 3a, column two), the marginal effect is estimated to be -3.9 percent (compared to -4.1 percent for the BHPS) and is statistically well determined. However, as with the BHPS, when controls for labour market experience, or health status, are added, the effect of log household income is attenuated and is no longer statistically significantly different from zero.[9]

For women, in Table 3b, we do not find strong evidence of a link between household income and mortality. Consistent with evidence for the BHPS, the

[9] In contrast, Attanasio and Emerson (2001) find, using the BRS data, even after controlling for initial health status that an individual's wealth *ranking* is an important determinant of mortality risk.

relationship between income and mortality does not follow a clear pattern and there is no statistical difference in mortality rates between low and high-income females.

Marriage is again associated with reduced rates of mortality for both men and women. The effects are, however, not well determined at conventional statistical significance levels and, contrary to the standard result, we find the excess mortality of the unmarried to be greater for women. A married male is predicted to be 2.8 percent less likely to die over the period 1988 to 1994 than a similar unmarried man. After controlling for initial health status this figure falls to 2.4 percent. The comparable figures for females are 3.7 percent and 2.9 percent respectively. Whilst the estimated effects of marriage upon mortality for women are very similar to those obtained from the BHPS, the estimates observed for men are substantially smaller. It is not clear why. It may be that as the BRS sample extends over time, the benefits of marriage become more transparent.

Finally, within the BRS, education is associated with reduced rates of mortality, even after controlling for income and initial health. For men, lower mortality rates are observed for individuals with intermediate educational qualifications, but not for those with degrees. (The opposite was observed for the BHPS.) A male with an intermediate qualification is predicted to have a 4.5 percent lower risk of mortality than a man with no formal qualification. Moreover, this estimate is statistically different from zero. For men with degrees, within the BRS, we find no evidence of reduced risk of death relative to those with no formal qualifications. For women, as in the BHPS, the beneficial effects of education are very similar for degree level and intermediate qualifications, with around a 6 percent lower probability of mortality in each case. Controlling for health status attenuates the estimated marginal effects, to around 5 percent, but they remain statistically well determined.

The British Retirement Survey results provide some corroboration of the patterns found in the British Household Panel Data, but do not appear to stand persuasively on their own.

6. Conclusions

Although it is known that the length of a person's life depends on a mixture of economic and social factors, the relative importance of these is still debated. We study this by using longitudinal British data from the British Household Panel Survey and the British Retirement Survey. Longitudinal data have the advantage that it is possible to control for the individual's health at the start of the survey period.

This paper shows that marriage has a much more important effect on longevity than income does. For men, the effect is positive and substantial. It almost exactly offsets the large (negative) consequences of smoking. For women, the effect is approximately half the size of the smoking effect. Exactly how marriage works its magic remains mysterious. Perhaps a strong personal relationship improves mental health and helps the individual to ward off physical illness. More research here is certainly needed.

Economics has less to contribute. Controlling for health at the start of the 1990s, we find no reliable evidence that a person's income at the start of the period affects the probability of death during the ensuing decade. Perhaps income takes a long time to make a difference, so that health at the start of the 1990s is influenced by the person's economic prosperity much earlier in life (income and health status in 1991 are indeed strongly correlated). We find evidence, for men, that a history of unemployment contributes to premature mortality.

Marriage, not money, is apparently what keeps people alive.

Acknowledgements

We are grateful for useful comments and advice from Angus Deaton and George Davey Smith. The Economic and Social Research Council (ESRC) provided research support. The usual disclaimers apply. The British Household Panel Survey data were made available through the UK Data Archive. The data were originally collected by the ESRC Research Centre on Micro-social Change at the University of Essex, now incorporated within Institute for Social and Economic Research. Neither the original collectors of the data nor the Archive bear any responsibility for the analyses or interpretations presented here.

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TABLE 1a

Male Mortality Equations (BHPS)

Dependent Variable: Deceased between 1993 and 2000

Regressors (1991)	*Males I*	*Males II*	*Males III*	*Males IV*	*Males V*	*Males VI*
1st Income quintile (Lowest)	0.0756			0.0373		
	(0.0401)			(0.0340)		
2nd Income quintile	0.0486			0.0136		
	(0.0362)			(0.0302)		
3rd Income quintile	0.0281			0.0016		
	(0.0325)			(0.0280)		
4th Income quintile	-0.0052			-0.0035		
	(0.0307)			(0.0286)		
Ln(Household Income p.h.)		-0.0408	-0.0295		-0.0188	-0.0090
		(0.0171)	(0.0175)		(0.0162)	(0.0165)
Years Unemployed			0.0130			0.0122
			(0.0036)			(0.0033)
Years Out of the Labour Force			0.0014			0.0005
			(0.0007)			(0.0006)
Married	-0.0898	-0.0896	-0.0721	-0.0618	-0.0610	-0.0474
	(0.0245)	(0.0244)	(0.0239)	(0.0221)	(0.0220)	(0.0212)
Age	0.0111	0.0113	0.0103	0.0113	0.0113	0.0110
	(0.0008)	(0.0008)	(0.0010)	(0.0008)	(0.0008)	(0.0010)
Education: Intermediate	-0.0047	-0.0053	-0.0018	0.0059	0.0053	0.0092
	(0.0196)	(0.0196)	(0.0199)	(0.0189)	(0.0188)	(0.0189)
Education: Degree	-0.0390	-0.0413	-0.0365	-0.0137	-0.0149	-0.0099
	(0.0239)	(0.0234)	(0.0242)	(0.0258)	(0.0254)	(0.0260)
Smoker				0.0582	0.0574	0.0505
				(0.0201)	(0.0200)	(0.0195)
Health: Excellent				-0.0261	-0.0261	-0.0275
				(0.0186)	(0.0185)	(0.0183)
Health: Fair				0.0880	0.0891	0.0885
				(0.0262)	(0.0262)	(0.0262)
Health: Poor				0.1945	0.1931	0.1907
				(0.0453)	(0.0448)	(0.0453)
Observations	1667	1667	1647	1667	1667	1647
Log-L	-615.8	-617.2	-601.7	-583.3	-584.2	-570.7
Pseudo R^2	0.254	0.252	0.261	0.293	0.292	0.299

1. The independent variables are measured at the start of the period, ie. in 1991.
2. All columns are estimated by the Logit Maximum Likelihood technique. Marginal effects are reported, and are calculated at the mean for continuous variables and as the discrete change for categorical variables. Positive coefficients denote a greater probability of mortality in the period.
3. Standard errors (calculated by the delta method) are in parentheses.
4. The base individual is single with no academic qualification, and in columns four to six is also a non-smoker with good health status.
5. Household income is averaged for the years 1991 and 1992. Household income per head is calculated as mean income per household per adult equivalent (the number of adults plus ½ the number of children aged less than 18).
6. The Pseudo R^2 is calculated using the method of McFadden (1974).
7. The marginal effect on the years unemployed and years out of the labour force are relative to the (omitted) years employed.

TABLE 1b

Female Mortality Equations (BHPS)

Dependent Variable: Deceased between 1993 and 2000

Regressors (1991)	*Females I*	*Females II*	*Females III*	*Females IV*	*Females V*	*Females VI*
1st Income quintile (Lowest)	0.0095			-0.0109		
	(0.0245)			(0.0198)		
2nd Income quintile	0.0033			-0.0143		
	(0.0232)			(0.0191)		
3rd Income quintile	0.0110			-0.0087		
	(0.0249)			(0.0202)		
4th Income quintile	-0.0374			-0.0437		
	(0.0197)			(0.0167)		
Ln(Household Income p.h.)		-0.0109	-0.0158		0.0004	-0.0045
		(0.0130)	(0.0130)		(0.0122)	(0.0122)
Years Unemployed			-0.0077			-0.0073
			(0.0047)			(0.0043)
Years Out of the Labour Force			0.0000			0.0000
			(0.0002)			(0.0002)
Married	-0.0356	-0.0348	-0.0333	-0.0290	-0.0285	-0.0270
	(0.0132)	(0.0132)	(0.0132)	(0.0122)	(0.0122)	(0.0121)
Age	0.0085	0.0087	0.0085	0.0085	0.0087	0.0084
	(0.0006)	(0.0006)	(0.0007)	(0.0006)	(0.0006)	(0.0007)
Education: Intermediate	-0.0222	-0.0239	-0.0214	-0.0089	-0.0099	-0.0077
	(0.0140)	(0.0140)	(0.0140)	(0.0141)	(0.0142)	(0.0142)
Education: Degree	-0.0170	-0.0240	-0.0215	-0.0054	-0.0115	-0.0091
	(0.0204)	(0.0191)	(0.0192)	(0.0211)	(0.0200)	(0.0201)
Smoker				0.0510	0.0529	0.0530
				(0.0153)	(0.0156)	(0.0156)
Health: Excellent				-0.0397	-0.0401	-0.0386
				(0.0119)	(0.0120)	(0.0120)
Health: Fair				-0.0031	-0.0029	-0.0025
				(0.0123)	(0.0124)	(0.0124)
Health: Poor				0.0930	0.0931	0.0939
				(0.0269)	(0.0269)	(0.0273)
Observations	2090	2090	2062	2090	2090	2062
Log-L	-672.7	-676.2	-660.4	-644.9	-648.3	-632.7
Pseudo R^2	0.283	0.279	0.279	0.312	0.309	0.309

1. See notes Table 1a.

TABLE 2a

Male Mortality and Marital Status (BHPS)

Dependent Variable: Deceased between 1993 and 2000

Regressors (1991)	*Males I*	*Males II*	*Males III*	*Males IV*	*Males V*	*Males VI*
Ln(Household Income p.h.)	-0.0374	-0.0368	-0.0325	-0.0161	-0.0155	-0.0123
	(0.0169)	(0.0169)	(0.0169)	(0.0160)	(0.0160)	(0.0159)
Married	-0.0866			-0.0596		
	(0.0245)			(0.0220)		
Never Married		0.1058			0.0662	
		(0.0444)			(0.0384)	
Separated/Divorced		0.0940			0.0759	
		(0.0471)			(0.0433)	
Widowed		0.0796			0.0513	
		(0.0389)			(0.0336)	
Years Never Married			0.0015			0.0010
			(0.0007)			(0.0006)
Years Separated/Divorced			0.0035			0.0024
			(0.0017)			(0.0014)
Years Widowed			0.0036			0.0023
			(0.0025)			(0.0022)
Age	0.0110	0.0110	0.0110	0.0109	0.0110	0.0109
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Education: Intermediate	-0.0059	-0.0058	-0.0083	0.0042	0.0042	0.0022
	(0.0192)	(0.0191)	(0.0190)	(0.0184)	(0.0183)	(0.0182)
Education: Degree	-0.0389	-0.0395	-0.0446	-0.0138	-0.0145	-0.0183
	(0.0230)	(0.0228)	(0.0221)	(0.0248)	(0.0247)	(0.0240)
Smoker				0.0537	0.0537	0.0557
				(0.0196)	(0.0196)	(0.0196)
Health: Excellent				-0.0261	-0.0261	-0.0269
				(0.0182)	(0.0181)	(0.0181)
Health: Fair				0.0833	0.0829	0.0852
				(0.0257)	(0.0256)	(0.0257)
Health: Poor				0.1846	0.1838	0.1845
				(0.0442)	(0.0441)	(0.0440)
Observations	1639	1639	1639	1639	1639	1639
Log-L	-600.7	-600.6	-604.0	-569.8	-569.6	-571.8
Pseudo R^2	0.246	0.246	0.242	0.285	0.285	0.282

1. See notes Table 1a.
2. Marginal effects for the years single, years separated and divorced, and years widowed are relative to the (omitted) years married.

TABLE 2b

Female Mortality and Marital Status (BHPS)

Dependent Variable: Deceased between 1993 and 2000

Regressors (1991)	*Females I*	*Females II*	*Females III*	*Females IV*	*Females V*	*Females VI*
Ln(Household Income p.h.)	-0.0112	-0.0104	-0.0106	-0.0003	0.0001	-0.0001
	(0.0128)	(0.0127)	(0.0129)	(0.0120)	(0.0120)	(0.0121)
Married	-0.0362			-0.0300		
	(0.0132)			(0.0122)		
Never Married		0.0087			0.0097	
		(0.0232)			(0.0219)	
Separated/Divorced		0.0719			0.0505	
		(0.0344)			(0.0299)	
Widowed		0.0379			0.0325	
		(0.0162)			(0.0150)	
Years Never Married			-0.0002			-0.0001
			(0.0004)			(0.0004)
Years Separated/Divorced			0.0019			0.0013
			(0.0009)			(0.0008)
Years Widowed			0.0016			0.0015
			(0.0007)			(0.0007)
Age	0.0084	0.0085	0.0087	0.0083	0.0084	0.0085
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Education: Intermediate	-0.0208	-0.0193	-0.0195	-0.0076	-0.0066	-0.0069
	(0.0141)	(0.0141)	(0.0144)	(0.0142)	(0.0142)	(0.0144)
Education: Degree	-0.0177	-0.0146	-0.0154	-0.0048	-0.0018	-0.0032
	(0.0197)	(0.0203)	(0.0206)	(0.0208)	(0.0215)	(0.0216)
Smoker				0.0513	0.0507	0.0530
				(0.0154)	(0.0154)	(0.0156)
Health: Excellent				-0.0400	-0.0402	-0.0402
				(0.0119)	(0.0118)	(0.0120)
Health: Fair				-0.0043	-0.0039	-0.0036
				(0.0122)	(0.0122)	(0.0123)
Health: Poor				0.0916	0.0893	0.0905
				(0.0268)	(0.0266)	(0.0270)
Observations	2058	2058	2058	2058	2058	2058
Log-L	-659.0	-657.6	-658.1	-631.5	-630.7	-631.0
Pseudo R^2	0.271	0.273	0.272	0.302	0.303	0.302

1. See notes Table 1a.
2. Marginal effects for the years single, years separated and divorced, and years widowed are relative to the (omitted) years married.

TABLE 3a

Male Mortality Equations (BRS)

Dependent Variable: Deceased between 1988 and 1994

Regressors (1988)	*Males I*	*Males II*	*Males III*	*Males IV*
1st Income quintile (Lowest)	0.1038		0.0424	
	(0.0472)		(0.0399)	
2nd Income quintile	0.1220		0.0681	
	(0.0488)		(0.0419)	
3rd Income quintile	0.0408		0.0035	
	(0.0393)		(0.0346)	
4th Income quintile	0.0156		0.0011	
	(0.0366)		(0.0338)	
Ln(Household Income p.h.)		-0.0391		-0.0197
		(0.0145)		(0.0147)
Married	-0.0281	-0.0304	-0.0244	-0.0276
	(0.0288)	(0.0289)	(0.0278)	(0.0278)
Age	0.0123	0.0133	0.0122	0.0125
	(0.0026)	(0.0026)	(0.0025)	(0.0025)
Education: Intermediate	-0.0454	-0.0499	-0.0360	-0.0385
	(0.0221)	(0.0215)	(0.0213)	(0.0209)
Education: Degree	0.0002	-0.0065	0.0115	0.0078
	(0.0341)	(0.0332)	(0.0344)	(0.0340)
Health: Fair			0.0649	0.0650
			(0.0296)	(0.0293)
Health: Not good			0.2200	0.2236
			(0.0384)	(0.0368)
Observations	1189	1189	1189	1189
Log-L	-507.4	-510.3	-482.3	-484.3
Pseudo R^2	0.055	0.050	0.102	0.098

1. The independent variables are measured at the start of the period, ie. in 1988.
2. All columns are estimated by the Logit Maximum Likelihood technique. Marginal effects are reported, and are calculated at the mean for continuous variables and as the discrete change for categorical variables. Positive coefficients denote a greater probability of mortality in the period.
3. Standard errors (calculated by the delta method) are in parentheses.
4. The base individual is single with no academic qualification, and in columns four to six also reports good health status.
5. Household income per head is calculated as mean income per household per adult.
6. In the BRS, households are equivalent to benefit units, which **only** include adults.
7. The Pseudo R^2 is calculated using the method of McFadden (1974).

TABLE 3b

Female Mortality Equations (BRS)

Dependent Variable: Deceased between 1988 and 1994

Regressors (1988)	*Females I*	*Females II*	*Females III*	*Females IV*
1st Income quintile (Lowest)	0.0205		-0.0059	
	(0.0338)		(0.0300)	
2nd Income quintile	0.0006		-0.0179	
	(0.0317)		(0.0282)	
3rd Income quintile	-0.0015		-0.0289	
	(0.0301)		(0.0265)	
4th Income quintile	-0.0260		-0.0356	
	(0.0301)		(0.0264)	
Ln(Household Income p.h.)		-0.0134		-0.0059
		(0.0120)		(0.0124)
Married	-0.0366	-0.0358	-0.0286	-0.0280
	(0.0201)	(0.0191)	(0.0189)	(0.0182)
Age	0.0072	0.0073	0.0073	0.0072
	(0.0022)	(0.0021)	(0.0021)	(0.0020)
Education: Intermediate	-0.0616	-0.0641	-0.0513	-0.0529
	(0.0190)	(0.0176)	(0.0182)	(0.0178)
Education: Degree	-0.0602	-0.0572	-0.0527	-0.0483
	(0.0246)	(0.0238)	(0.0234)	(0.0244)
Health: Fair			0.0419	0.0419
			(0.0230)	(0.0229)
Health: Not good			0.1332	0.1308
			(0.0312)	(0.0307)
Observations	1328	1328	1328	1328
Log-L	-482.5	-483.7	-469.4	-470.7
Pseudo R^2	0.043	0.041	0.069	0.067

1. See notes for Table 3a.