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Marriage and Consumption

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Abstract

We examine theoretically and empirically consumption over the early part of the life-cycle. The main focus is on the transition from being single to living with someone else. Our theoretical model allows for publicness in consumption; uncertainty concerning marriage; differences between lifetime incomes for prospective partners and a marriage premium. We develop a two period model to bring out the main features of the impact of marriage on consumption and saving. We then develop a multi-period model that can be taken to the data on expenditures by singles and couples aged between 18 and 30. Our empirical work is based on individual based quasi-panels from UK expenditure survey data from 1978 to 2005. The model fits the data relatively well. We find that expenditure by couples leads to $20 - 40$ % more consumption than the same expenditure split between two comparable singles.

1. Introduction.

The standard life-cycle model does not suggest a very interesting life. Typically it is assumed that agents are born, they take some education, then they work, retire and die. In taking this model to consumption and savings data, account is often taken of children, but still important elements of the life-cycle are missing. In particular, most life-cycle models of consumption do not take explicit account of the possibility of people leaving the parental home, living alone, forming a cohabiting relationship, marrying, having children, divorcing, re-marrying, surviving a partner, and so on. As an illustration of the possible prevalence of these transitions, the UK General Household Survey reports that for women in 2005 aged between 25 and 34, 29% have never married, 43% are married, 21% are cohabiting and 6% are living on their own and are separated or divorced.

These figures suggest that we should consider a wide variety of family types and 'life-stages' when we consider intertemporal allocation. The (scanty) empirical evidence suggests that savings rates vary substantially across family types. The evidence presented in Avery and Kennickel (1991), Bosworth *et al* (1991), Lupton and Smith (2003) and Zagorsky (2005) for the US suggest that singles have a lower savings rate than couples without children. As a complement to the facts on US savings rates, in this paper we present some evidence on consumption paths for men and women aged between 18 and 30 using data from UK Family Expenditure Survey (FES) and its successor the Expenditure and Food Survey (EFS), from 1978 to 2005.[1] We report on expenditures rather than savings partly because it is of intrinsic interest and partly because savings requires information on assets which is generally less reliable than expenditure data.

This paper has two main objectives. First, we ask how well we can rationalise what we see in the expenditure data with a 'life-stages' model with forward looking *individuals* who allow for economies of scale in consumption if they ever become part of a couple. Our theory model indicates that one of the most important factors when considering consumption before and after marriage[2] is the economies of scale available to people living together. The second objective of the paper is to provide estimates of these economies of scale. Such estimates are useful for a number of issues, including:

- setting pensions (or other government transfers) for couples relative to singles;

- as inputs to marriage and matching models (see Weiss (1997));

- to scale cross-country GDP comparisons. For example, 22% of Danes live alone whereas only 5% of individuals in Spain live alone. This distorts comparisons of material welfare based on per capita measures.

- modelling consumption and saving decisions (the focus of this paper);

- payment for wrongful death to a surviving spouse.

Despite the importance of this concept, as Deaton (1997) remarks 'there has been little serious empirical analysis of this phenomenon ...'. One recent set of estimates is given in Browning, Chiappori and Lewbel (2006). These are based on examining the demand for individual goods; their identifying assumption is that the tastes of individuals do not change when they start living with someone else. The approach we take here is radically different. Ideally we would compare the consumption of men and women before and after they marry. There are two major impediments

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[1] We do not use the data from before 1978 since we stratify on education level and 1978 is the first year in which respondents record their education.

[2] In all that follows, we use the term 'marriage' for marriage and cohabitation.

to this exercise. First we lack good longitudinal data on the consumption of households. The second major stumbling block is that we never observe individual consumptions in many person households. To overcome the first problem we use quasi-panels constructed for individuals rather than for households. Thus we follow the population of, say, males born in 1960 from age 18 to age 30 (the oldest age we consider) as they move between different living arrangements. For the second problem, we utilise our theory model to show identification of the economies of scale parameter from the data to hand.

The lack of empirical analysis noted above is matched by a lack of theoretical analysis.[3] In section 2 we analyse a two period theory model. This is designed to isolate the key parameters and concepts when thinking about marriage and consumption. The key feature of these models is that because of economies of scale, the 'price' of consumption when married is lower than when single and this may induce a substantial shifting of expenditures between the two states. Whether per capita expenditures go up or down depends on whether the income effect of the scale economies outweighs the substitution effect. We also show the effects of varying parameters such as the probability of marriage, the extent of the marriage premium, agents' aversion to fluctuations and the ratio of men's earnings to women's earnings. Our model differs from Hess (2004), who also considers a model for consumption and marriage decisions. The main differences between our respective models is that the uncertainty in Hess (2004) stems from income uncertainty, while we have uncertainty about marriage; in Hess (2004) the economic incentive for marriage comes from risk sharing, while in our model it arises from economies of scale and the analysis in Hess (2004) focuses on the probabilities of marriage and divorce and does not consider consumption[4].

The two period model we discuss in section 2 is too simplistic to be taken as a vehicle for empirical work; rather we present it as a first formal attempt to develop a theory in this context. In section 3 we present some results for a multi-period simulation model with a variety of realistic features. Necessarily we have to ignore some important facets of decision making if the model is to be tractable enough to take to the data. For example, we do not take account of income uncertainty. This model provides a suitable framework for empirical work, as well as providing further insights into the theoretical (albeit simulation based) properties of a marriage and consumption model. In section 4 we present age paths for the relevant statistics considered in section 3. In section 5 we choose parameters to match as closely as possible the data features from section 4 and the model predictions from section 3. We find that we can match quite well most of the broad facts, but some problems remain. Our results indicate a considerable difference in the economies of scale across education groups, with the more educated enjoying greater economies of scale than the less educated. We find that expenditure by couples leads to $20 - 40$ % more consumption than the same expenditure split between two comparable singles. In the concluding section we discuss briefly the many simplifying assumptions we have had to make and how we might move forward.

2. A two period model.

2.1. Framework with uncertain marriage.

We begin by considering a very simple model with two people, M and W and two time periods $t = 1, 2$. This model is presented here purely to develop some intuition about the effect of marriage on consumption and saving; in our empirical work below we employ a multi-period model. In the first period the two agents are single (and consume separately) but know that they may form a joint

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[3]Exceptions are the papers by Guner and Knowles (2004) and Mazzocco and Yamaguchi (2006), where a life cycle model is used to explain wealth accumulation and marriage decisions.

[4]Due to data constraints, the empirical analysis focuses solely on the probability of divorce.

household in the second period with a given probability θ (we refer to the joint state as marriage). We assume $1 > \theta > 0$ so that there are positive probabilities of marrying and of staying single. For singles, consumption is equal to expenditure, denoted by $\left(c_t^M, c_t^W\right)$ for period t. For couples, second period (joint) expenditure is given by X_2. We assume that expenditure is transformed into a consumption good and consumption is shared between the two people; specifically, we assume that there is a linear transformation from expenditure to consumption (a 'Barten' technology) and the resulting consumption good is shared equally. Thus second period consumption for each person (if living together) is given by μX_2 where $\mu \in [0.5, 1]$. If $\mu = 1$ then all consumption is public ('two can live as cheaply as one') whereas $\mu = 0.5$ represents the case in which all consumption is purely private. The intermediate case allows for the single commodity having both a public and a private aspect.

On the constraint side, we choose our assumptions so that the optimal path if the probability of marriage is zero is to consume income in each period; thus, any deviations from this program can be seen as being due to the possibility of marriage. We assume that the two agents have preferences represented by a stationary intertemporally additive utility function with no discounting:

$$U^I\left(c_1^I, c_2^I, X_2; \theta, \mu\right) = u(c_1^I) + \theta u\left(\mu X_2\right) + (1 - \theta) u\left(c_2^I\right) \text{ for } I = M, W \tag{1}$$

Note that we assume the same sub-utility function $u\left(.\right)$ for each person and that we do not allow for any 'caring' so that one person does not gain anything from the other's private consumption.[5]

On the constraint side, we set all prices to unity and assume that the real interest rate is zero. Person M receives an income of $(1 - \pi)$ in the first time period and person W receives π (thus π is W's share of first period income). We also allow for a 'marriage premium' which gives higher income for married persons than for singles. This is consistent with the empirical earnings literature. The source of the premium is a matter of debate; it could be due to state dependence (people are more productive when married, perhaps due to economies of scale in household production) or correlated heterogeneity (people who are attractive in the marriage market are also attractive in the labour market). Here we shall opt for state dependence and assume that if agents do not marry then their income is the same as in the first period whereas if they do marry then incomes are multiplied $(1 + \varepsilon)$ with the marriage premium $\varepsilon \geq 0$. Thus second period expenditures are given by:

$$c_2^M = 2(1 - \pi) - c_1^M \tag{2}$$
$$c_2^W = 2\pi - c_1^W \tag{3}$$
$$X_2 = 2(1 + \varepsilon) - c_1^M - c_1^W \tag{4}$$

In this formulation the second period joint household assumes debts from the first period, if there are any (that is, if $c_1^M > (1 - \pi)$ or $c_1^W > \pi$). Conversely, if the agents stay single then they have only their own savings and second period income to finance second period consumption.

2.2. Choosing consumption paths.

Given that the two agents do not have the same preferences (for example, M does not care about c_t^W and *vice versa*) we have to consider how they make decisions. Since the formation of the joint household is not a repeated game, we do not consider the case of coordination on pre-marriage spending to be as plausible as the non-cooperative case where each person spends in the first period, taking as given the other's spending. Hence, without suggesting it is fully realistic, we

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[5]It is straightforward to include caring at the cost of extra notation but it does not change the qualitative results below so long as there is less than perfect sympathy. Note as well that the scale factor μ can be thought of as capturing some caring in the sense that consumption of the other (when together) raises the value of expenditures.

concentrate here on the non-cooperative case, but present, for completeness, the collective model where agents do coordinate, in appendix A.1. We once again emphasise that the two period case is presented solely to sharpen our intuition in an unfamiliar context; readers who do not want this are encouraged to skip to the next section which develops the multi-period model we take to the data. In the non-cooperative case, person M's maximisation program, conditional on W's choice c_1^W, is given by:

$$\max_{c_1^M} u(c_1^M) + (1 - \theta) \, u(2 \, (1 - \pi) - c_1^M) + \theta u(\mu \left(2(1 + \varepsilon) - c_1^M - c_1^W \right)) \tag{5}$$

subject to the budget constraints given in equation (2) and equation (4) (and similarly for W subject to the budget constraints given in equation (3) and equation (4)) . The fundamental trade-off in this model is between the desire to exploit the lower price of consumption in the married state and the need to self-insure against the event of staying single. The associated first order conditions are:

$$u'(\tilde{c}_1^M) - (1 - \theta) \, u'(2 \, (1 - \pi) - \tilde{c}_1^M) \;\; = \;\; \mu\theta u'(\mu \left(2(1 + \varepsilon) - \tilde{c}_1^M - \tilde{c}_1^W \right)) = \mu\theta u'(\mu\tilde{X}_2)$$
$$u'(\tilde{c}_1^W) - (1 - \theta) \, u'(2\pi - \tilde{c}_1^W) \;\; = \;\; \mu\theta u'(\mu \left(2(1 + \varepsilon) - \tilde{c}_1^M - \tilde{c}_1^W \right)) = \mu\theta u'(\mu\tilde{X}_2) \tag{6}$$

A (Nash) equilibrium is a pair of first period consumptions $\left(\tilde{c}_1^M, \tilde{c}_1^W \right)$ such that the two first order conditions are satisfied.

Without further assumptions we can only prove a limited set of analytical results. These are given in Proposition 1 (the proof is in appendix A.2).

Proposition 1. *(i) If $(1 - \pi) > \pi$ and $\theta < 1$ then $\tilde{c}_1^M > \tilde{c}_1^W$ and $\tilde{c}_2^M > \tilde{c}_2^W$.*
(ii) If there are returns to scale ($\mu > 0.5$) and $(1 - \pi) > \pi$ then $\mu\hat{X}_2 > \tilde{c}_2^W$ and $\tilde{c}_1^W > \tilde{c}_2^W$.

The first part states the rather obvious result that first period and second period single consumption is always higher for the high income person. The second result shows that the low income person always dissaves in the first period and that their second period consumption is lower when single than when married. Beyond this, we have not been able to establish any other general properties. Thus we must have recourse to calibrations to gain some insights into possible outcomes. To do the calibrations we take a benchmark model and then explore the implications of deviations from this benchmark model. The benchmark model has: a scale parameter, $\mu = 0.6$ (a value suggested by the OECD scale); the probability of marriage, $\theta = 0.85$; women's share in income, $\pi = 0.45$; the marriage premium, $\varepsilon = 0$ and an iso-elastic utility function with a coefficient of relative risk aversion (CRRA) of $\alpha = 3$. Table 1 gives the optimal values for several different cases; in each case after the benchmark we change one parameter from the latter. We present values only for those variables that are potentially observable (so that we do not include second period consumption when married since this depends on the unobservable scale parameter μ). We display first period consumptions; first period savings rates (denoted s^M and s^W); second period expenditures (if married) and the ratio of first period joint expenditures to second period expenditures, if married.

For the benchmark case we see that first period saving is negative for both persons. Thus the possibility of marriage with consequent scale effects leads to a higher consumption for singles than if there was no marriage. The second feature of the benchmark results is that the saving rate for the higher income person is lower (in absolute value) than that of the low income person so that there is a lower consumption differential amongst singles in the first period than suggested by their incomes. The third feature of the benchmark results is that per capita expenditure falls on marriage ($c_1 = c_1^M + c_1^W > X_2$). Although this holds for all values in table 1 it is not a general feature of out model. For example, for a very uneven income split ($\pi = 0.2$); low economies of scale

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α	μ	θ	π	ε	c_1^M	c_1^W	s^M	s^W	X_2	$r = c_1/X_2$
3	0.6	0.85	0.45	0	0.60	0.53	-8.3	-18.5	0.87	1.29
0.5	$*$	$*$	$*$	$*$	0.76	0.68	-38.8	-52.1	0.55	2.62
$*$	0.75	$*$	$*$	$*$	0.63	0.55	-13.8	-21.6	0.83	1.41
$*$	$*$	0.6	$*$	$*$	0.58	0.50	-6.0	-10.2	0.92	1.17
$*$	$*$	$*$	0.5	$*$	0.57	0.57	-13.4	-13.4	0.87	1.31
			$*$	0.1	0.54	0.50	1.66	-11.8	0.76	1.38

$*$ denotes the same value as the benchmark (row 1).
c_1^I and s^I are I's first period consumption and saving rate (in %) respectively.
$c_1 = c_1^M + c_1^W$. c_2^I is I's second period consumption if single.

Table 1: Model predictions

in consumption ($\mu = 0.55$) and a low marriage probability ($\theta = 0.5$) we have $\tilde{c}_1^M + \tilde{c}_1^W = 0.967$ and $\tilde{X}_2 = 1.034$.

The next case in table 1 shows that if agents are not very averse to fluctuations (the CRRA is low) then they dissave a lot in the first period. The third case indicates that stronger scale effects lead to higher first period consumption and dissaving by both partners. Thus the income effect of the stronger scale effect outweighs the substitution effect. A lower probability of marriage decreases consumption in the first period. If we equalise incomes ($\pi = 0.5$) expenditures in the married state do not change much. Finally, if we allow for a marriage premium then first period consumption falls for both people.

Comparing with the cooperative model (see appendix A.1) we see that the major difference between the two cases is that agents put less weight on the married state utility in the non-cooperative case. This is the classic public goods result: in the non-cooperative model consumption in the married state is a public good and both agents contribute too little to it. Consequently the outcome is inefficient. Moreover, first period savings levels are uniformly lower than in the cooperative case. The simulation studies also show that comparing the cooperative case with the non cooperative case:

- For the base case consumption levels by singles are lower (and savings rates are higher).

- The effect of changing the aversion to fluctuations is dramatically reversed. In the cooperative case individuals are willing to save more in the first period in order to exploit the returns to scale ('lower price') in the second period, whereas for the non-cooperative case agents consume (much) more in the first period and the ratio of c_1 to X_2 *increases*.

- Introducing a marriage premium leads to an increase in first period consumption for both people rather than a decrease.

- The other comparative dynamics results are similar to the non cooperative case except that a decrease in marriage probability leads to a reduction in saving by the high income person.

Even in this very simple model we can derive very few analytical results. In particular we cannot give general predictions of how the consumption of the high income person will change upon marriage or whether aggregated expenditures of singles are higher than expenditures of a couple. Empirical analysis is required.

3. A multi-period theory model.

To develop a model we can take to the data, we consider a relatively simple multi-period environment. Necessarily we have to abstract from many features of the decision process facing agents to be able to simulate and estimate our structural model. For example, we assume that the only sources of uncertainty are if and when an agent will marry and the income of the spouse if marriage occurs. As another example, we take marriage to be an absorbing state. For the first, over the last two decades considerable attention has been paid to the effect of earnings uncertainty on (precautionary) saving and consumption paths. Whilst this is of great importance, we assume it away here in the hope that our results are not unduly biased by ignoring all sources of uncertainty except the date of marriage and the income of the potential spouse. If there is a substantial bias then it is, of course, just as likely that analyses of the precautionary motive will be biased by ignoring marriage. As regards the assumption that the transition to marriage is permanent, it is clearly important to allow for divorce but this is left to future work. We also ignore other living arrangements than single or married; marriage premia and earnings growth.

In considering consumption and marriage, we focus attention on three principal aspects of the problem. We shall present simulation results below but here it is useful to recap briefly the main issues that we identified in the last section. The first consideration is the gains from sharing public goods within marriage which makes consumption 'cheaper' when married. This change of intertemporal prices has an ambiguous effect. If agents are reluctant to have varying levels of consumption over time (a high degree of aversion to intertemporal fluctuations[6]) then they will not exploit this price variation. Instead they will have high levels of consumption (and expenditure) when single and lower levels of expenditure when married so as to keep consumption relatively constant. Conversely if they have a low aversion to fluctuations then consumption when single will be low so that much higher consumption levels (at the lower 'price') can be achieved when together.

The second aspect we focus on is the degree of assortative mating on income. If we allow that there are differences in income between men and between women then who marries whom is important for pre-marriage decisions concerning consumption and saving. Consider, for example, a high income single woman who is certain she will marry someone. If there is no assortative mating then she is unsure whether she will marry a low income man or a high income man. In this case she will (prudently) keep consumption low when single in case she ends up with a low income spouse. If, on the other hand, there is perfect assortative mating and she is sure of marrying a high income man, then she will choose higher consumption when single.

The third and final aspect is the uncertainty concerning whether and when a single person will marry. If there are substantial gains from being married because of the publicness of consumption then marrying later is equivalent to having a lower lifetime wealth. In the extreme case, living alone for the whole adult lifetime is very expensive in consumption terms. For example, if two can live as cheaply together as 1.5 singles (a μ of 0.67) then marrying is equivalent to a 33% increase in lifetime consumption. This is of the same order as increasing education from high school to four years of college. This has strong implications for the consumption patterns of singles if marriage is uncertain. All other things being equal, those who marry early have higher lifetime consumption. Consequently a single who had a positive probability of marrying in a given year but did not marry suffers the equivalent of a negative lifetime wealth shock. How big the shock is will depend on the prior probability of marrying but in all cases consumption in the next period will be lower than it would have been in a model with no marriage.

In our multi-period model we again have the two sexes, W and M (women and men, respec-

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[6]In intertemporally additive models this corresponds to a high degree of risk aversion.

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tively), with different income shares, but now we also allow for there to be a high income level, h, or a low level, l, within each sex. Age is indexed by $t = 1, 2...L$ where L is the length of the lifetime. In period t a single woman (man) has expenditure (and consumption) denoted c_t^W (c_t^M). Couples have an expenditure denoted x_t and consumption per individual of μx_t, where $0.5 \leq \mu \leq 1$. The probability that a single person in period t will marry in period $t+1$ is denoted θ_t; in the empirical analysis these hazard rates are conditioned on age, gender and level of education. We assume that everyone is single in period 1. We also assume that after some age T ($\leq L$) the probability of marrying is zero. In the simulations $T = 20$ and $L = 40$ which corresponds to marriage taking place between 16 and 35.

There are a relatively large number of parameters in this simulation model; the previous section established the notation. Some parameters, such as the discount rate, interest rate and the female income to male income, we set *a priori*. Others, such as marriage probabilities for the two education groups, we estimate in a first stage (see subsection A.4 in the Appendix). The parameters of direct interest can potentially be estimated from the consumption data discussed in section 4. These are: the economy of scale parameter ($\mu \in [0.5, 1]$), the degree of assortative mating ($\rho \in [0, 1]$), the coefficient of relative risk aversion ($\alpha > 0$) and the ratio of low to high income within each sex ($\delta \leq 1$). The econometric question is whether we can identify these parameters robustly given the data to hand. To investigate this we present two series of figures that examine the variation in observables with changes in the parameters. This has the additional benefit that we can determine which parameters are 'critical' for the simulated outcomes in the sense that outcomes vary significantly with the parameter. It is a feature of many simulation models that outcomes of interest are often relatively insensitive to the values of many parameters, so that not much care is required in choosing these parameters. For example, the results presented below are largely insensitive to assumptions about interest rates and discount factors, so long as we do not take extreme values.[7]

To take out common trends we consider only two sets of paths of ratios. The first of these is the path of ratios of within period mean expenditures of couples, both aged t, relative to the aggregate expenditures of single men and single women aged t; denoted r_t

$$r_t = \frac{c_t^M + c_t^W}{x_t}.$$

The other observable we consider is the ratio of within period mean expenditures of single men relative to single women of the same age; denoted m_t

$$m_t = \frac{c_t^M}{c_t^W}.$$

It is these paths that we shall use in our empirical work so that it is appropriate to consider how they vary with the parameters. Figure 1 presents the age paths for singles/couples ratio, r_t, for a range of parameter values.[8] The base case is set to $\rho = 0.5, \mu = 0.65, \alpha = 3$ and $\delta = 0.8$.[9] As can be seen from the the base case, the ratio path is almost linear, with a slight reverse S-shape. The ratio is high for young people, 1.4 at age 17, and then falls with age to a value of about 1.07. The rest of the panels in figure 1 show the effects of changing different parameters.

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[7]This conclusion derives from a version of our model that does include interest rates and discounting. We do not explicitly report on this model since, as stated, this does not make difference to any of our outcomes of interest.

[8]The ratio is based on the mean expenditures over income types.

[9]The latter figure is suggested by the fact that in our income data the ratio of the first quartile to the third quartile is close to this value.

- Varying the degree of assortative mating (top left panel) does not affect the ratio paths very much at all.

- Changing the economies of scale parameter, μ, has a large impact on ratio paths (see top right panel) with a much higher ratio for younger people for higher economies of scale. This is consistent with the two period model result. This large variation suggests that we should be able to identify this parameter robustly.

- Varying the CRRA downwards increases the consumption of singles relative to couples (bottom left panel). The effect of changing CRRA is much stronger for young individuals and the effect of increasing α is much stronger than decreasing α.

- Finally, increasing the dispersion of income within each sex ($\delta = 0.7$) leads to a reduction in consumption by singles; this reflects a precautionary motive where the event being self-insured against is marrying a low income partner.

Figure 1 suggests that we can generate a variety of shapes and levels by changing the parameters of our model. Some parameters, such as ρ, do not have much effect. Finally, some parameters, such as the CRRA, α, seem to give variations in observables that would allow us to identify them. Since the scale parameter is our major parameter of interest, identification requires more information. What of our second set of ratios of the consumption of single men to single women? The results for this are given in figure 2. The base case has an almost linear path with values rising from 1.07 to 1.20. The ratio of men to women's income in our simulated model is 1.20 so that for the very youngest, men and women have about the same savings rates but as singles age women reduce their consumption proportionately. This partially reflects the selection due to low and high income agents having different marriage probabilities but it also comes about because not marrying in any period represents a bigger negative lifetime wealth shock for women than for men. When we consider the effects of varying the parameters of the model we see that most parameters have very little effect on the ratio paths.

4. Expenditure paths for singles and couples.

In this section we present expenditure patterns using data drawn from the 1978 to 2005 UK Family Expenditure Survey (FES) and its successor the Expenditure and Food Survey (EFS). The FES and EFS are a stratified sample of households in the UK with about $7,000$ households being interviewed in each year. There is no panel aspect to the FES and most of the expenditure data refers to the sample two weeks during which the members of the household keep a diary of all expenditures. We select a subsample of all $18 - 30$ years old in this period so the oldest in our sample were born in 1947 and the youngest in 1987. Later on we restrict this sample further. The initial sample consists of $80,953$ individuals of whom 47.3% are male. We stratify the sample according to whether the agent has the statutory minimum level of education or above the minimum level of education. The distribution of educational attainment across gender is shown in the Appendix A.3. By splitting the sample by education we implicitly assume that the assignment to the group does not change from the age of 18. The reason for considering the educational differences in consumption is take into account differences in lifetime wealth and the transition into marriage.

We present descriptive statistics on the expenditure paths of three groups aged $18 - 30$: single women, single men and couples without children. We chose to focus on couples without children to avoid making additional assumptions on how children influence consumption. We assume that,
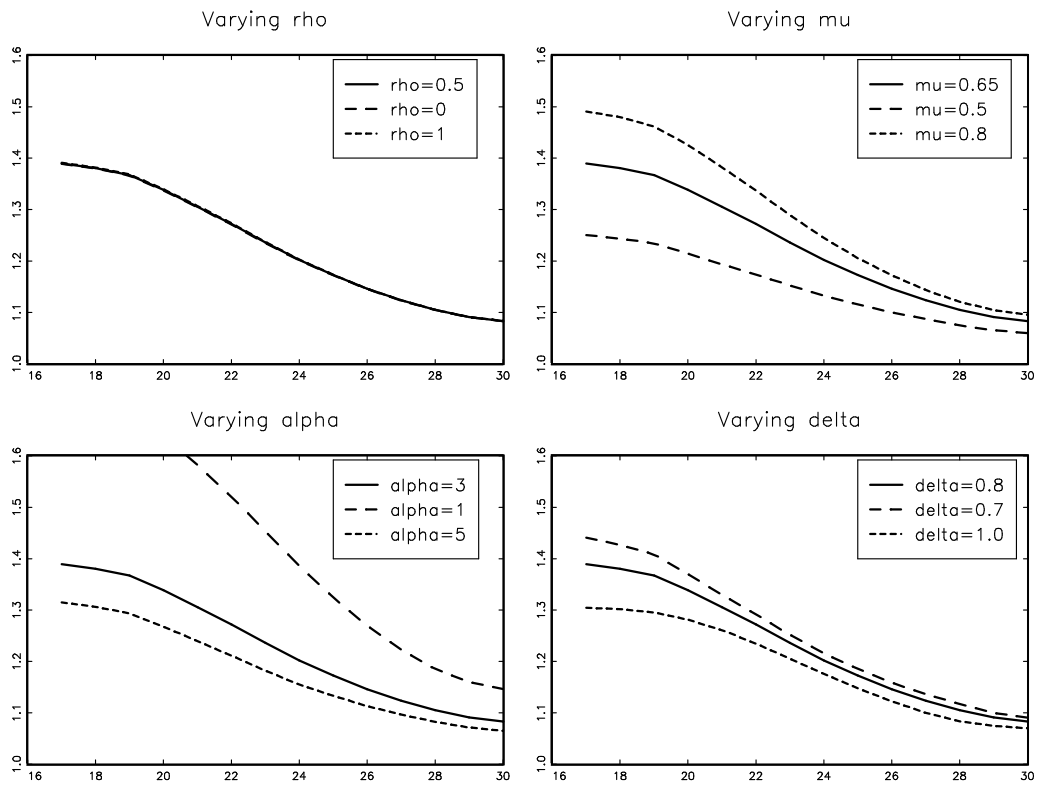
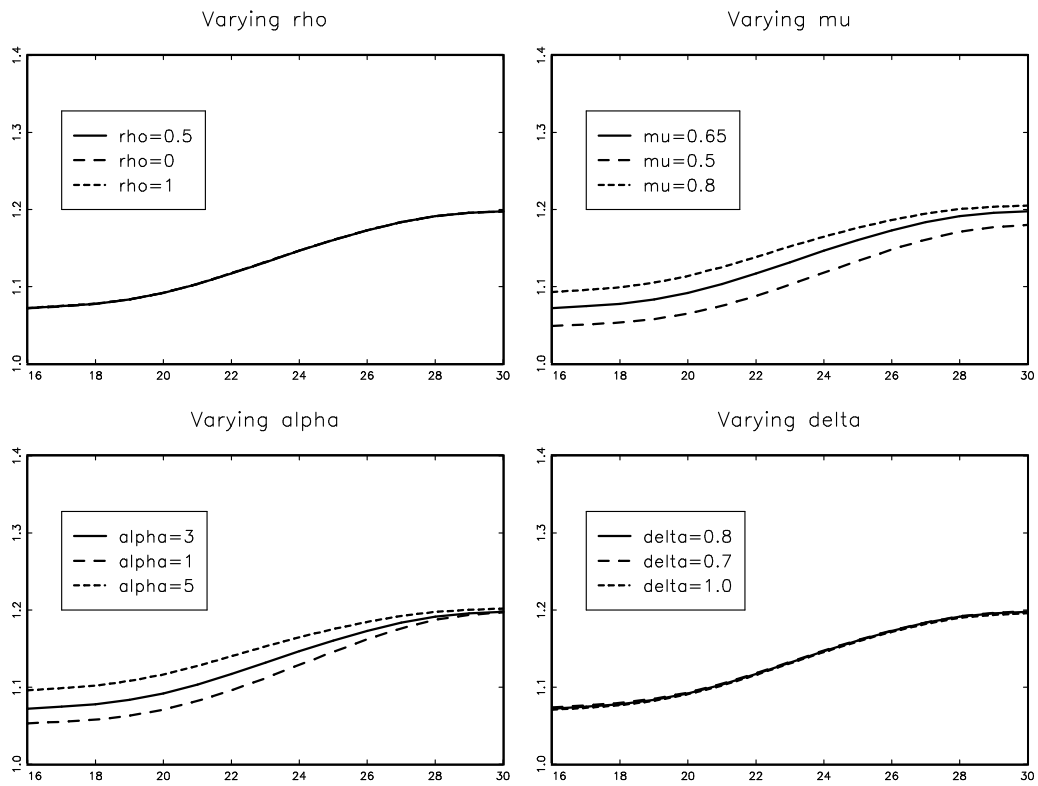Figure 1: Simulated ratio of aggregate singles to couple

Figure 2: Simulated ratio of single men to single women

conditional on both partners educational attainment, having children is uncorrelated with consumption levels. The other notable excluded group is young people still living in the parental home (the exact definition of life-stages is given in Appendix A.3). We also here assume that movement from home to living outside the parental home is uncorrelated with consumption levels. This is a strong assumption but the alternatives are either to model explicitly the home-leaving decision or to impute consumption to young people living with their parents. The first alternative is attractive but would take us too far from our primary focus and is left for future work. The second alternative is unattractive since many consumption decisions within the parental home are made by the parents (particularly for public goods) and may not be consistent with the child's preferences. Consequently we cannot bring to bear the usual intertemporal allocation methodology. Additionally, the imputation of consumption to adult children still living at home is fraught with difficulties.

In our model, we compare consumption in different life-stages. In doing this in the data we take explicit account of employment status, as well as age and cohort. Details of the relationship between employment status and life-stages are given in the Appendix A.3. We define consumption as total household expenditure exclusive of expenditures on housing.[10] These expenditures are deflated by the non-housing Retail Price Index to give real consumption in 2006 prices. To construct expenditure paths for our single men and single women we first regress real expenditures on a quadratic in age, the year of birth and a dummy for being employed. These are estimated separately for each gender and each education level. For couples we have to consider that members of the couple can have different age and different levels of education (for a detailed description of the composition of couples see Appendix A.3). Therefore we consider four types for couples corresponding to the four combinations of educational attainment of the two partners: LL, HL, LH, and HH where the first letter denotes the husband's education and the second, the wife's. For each type of couple we estimate a regression model for household expenditures. The regressors are a quadratic in the ages of the two partners, two dummies for being in employment and the year of birth of the husband[11].

For consistency with our theoretical model in the last section we present results only for the two ratios considered there. These are the ratio of aggregated single's expenditure to couples and the ratio of single men's expenditure to single women's. This also minimises the impact of period and cohort effects on our results and also allows us to ignore much of the common age trends. The first path we consider is the ratio of aggregated (equivalent) expenditures by single men and women to couples. The ratio is constructed such that we compare individuals in a couple with singles of the same age, cohort, education level and employment status. The ratio is defined as

$$r_a = \frac{(c_a^{W,e^W} + c_a^{M,e^M})}{X_a^{e^W,e^M}} \tag{7}$$

where c_a^{W,e^W} and c_a^{M,e^M} are the (predicted) expenditures of single women with education level e^W at age a and single men with education level e^M and at age a and $X_a^{e^W,e^M}$ is the (predicted) expenditure of a couple with the women with education level e^W and a man with education level e^M and both at age a. In figure 3 the ratio of predicted expenditures for aggregated single's expenditures to couples is shown for different ages. For all four types of couples, the ratios are always above 1 indicating that the expenditures of couples never exceed the sum of single men and single women. We also see that the ratio is decreasing from the age of 18 to 30 for all types of couples except couples where

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[10]We also used measures of consumption including expenditures on housing and the main findings of the qualitative empirical analyses were unchanged.

[11]We cannot also include the birth year of the wife since the difference in age of the partners is equal to (minus) the difference in their birth years.
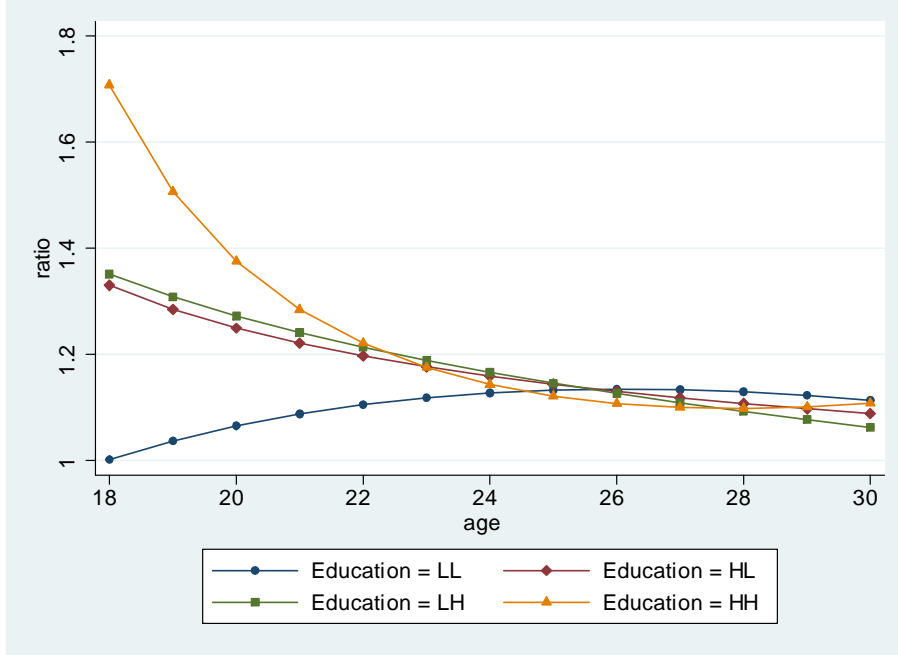
Figure 3: Ratio of aggregated singles' expenditure to couple

both partners are less educated (LL). There is considerable variation across types at age18 (from 1.0 to 1.3) but at age 30 the ratios are much more concentrated (from 1.05 to 1.10).

The second path is the ratio of single men's expenditures to that of single women defined as:

$$m_a = \frac{c_a^{M,e^M}}{c_a^{W,e^W}}$$

In figure 4 the expenditures of single men to single women is shown. This ratio is always above unity, implying that single men on average consume more that single women with the same education level The ratio varies between 1.17 to 1.30 but is not significantly different from being a constant.

We turn now to matching these paths using the theory model of section 3.

5. Estimation.

In the following we present the results of choosing parameters to match data and simulated statistics ('calibration'). As shown in section 3, some of the parameters will be hard or impossible to identify from the ratios. Instead we show that we are able to match many of the main feature of the data by choosing a set of values for our parameters. In order to match the pattern of ratios by education types, we need to introduce more heterogeneity between education groups.[12] We introduce heterogeneity in the economies of scale. The way this is done is that we allow the economies of scale to vary between all four types of couples: $\mu_{HH}, \mu_{HL}, \mu_{LH}$ and μ_{LL}.[13] Individuals know the degree of economies for each type, so the uncertainty in the model still arises from when (or ever) to get married and with whom. By introducing heterogeneity into the model, the

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[12] All parameters for the two education groups are the same except marriage transition probabilities and income.

[13] We have also tried to allow the relative risk to vary across education and gender. However, this only improved the fit marginally.
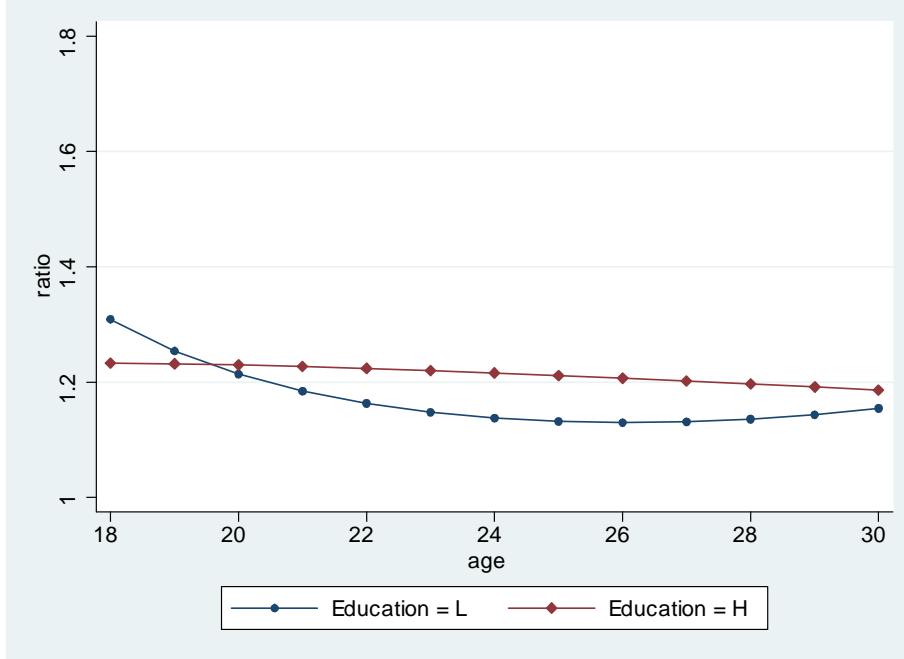
Figure 4: Ratio of single men's expenditure to single women

observed paths can almost be reproduced in the simulations. The degree of economies of scale is set to $\mu_{HH} = 0.70$, $\mu_{HL} = \mu_{LH} = 0.65$ and $\mu_{LL} = 0.60$, implying a higher degree of publicness in consumption among more educated couples compared to less educated couples. In Browning, Chiappori and Weiss (2008) similar evidence is found, although the difference between education groups is smaller. We choose the remaining parameters as $\alpha = 3$, $\delta = 0.8$ and set $\rho = 0.7$ which almost corresponds to the number found in the data. We generate the simulated paths in figure 5 and 6 and show them together with the data based paths and 95% confidence bands. For the ratio of singles to a comparable couple we match the level, ordering of education groups and trends for all types of couples, except for the 'LL'-couple. For the 'LL' couple we cannot capture the flat path found in the data, and the simulated path is above the confidence interval for young ages. The only way to capture this flat path is to assume almost no economies of scale for the 'LL'-group. We refrain from doing this and instead we acknowledge that our model does not fit well the consumption of 'LL' couples between 18-23. These young 'LL' couples have a much higher consumption than our model predicts. The simulated ratios of single men to single women match the data well and the simulated ratios are always within the 95% confidence level.

To quantify our findings we calculate how much extra income an 'always single' needs to be equally well off compared to a person who marries. In these calculations we compare a person who knows that he or she will get married at the age of 25 with a person who knows that he or she will always be single. The income differences between gender and education are set according to the 'estimation'. We determine the extra income needed such that this person is equally well off in terms of utility. The results in Table 2 show that women need a much higher compensation if they are 'always' singles than men. The compensation rate for women is between 16 and 49 percent extra income to be compensated, while the similar numbers for men are between 0 to 21 percent. In our calculation all types of persons are better of in terms of utility if they get married except for more a educated man marrying a less educated women. In this case he will be indifferent between
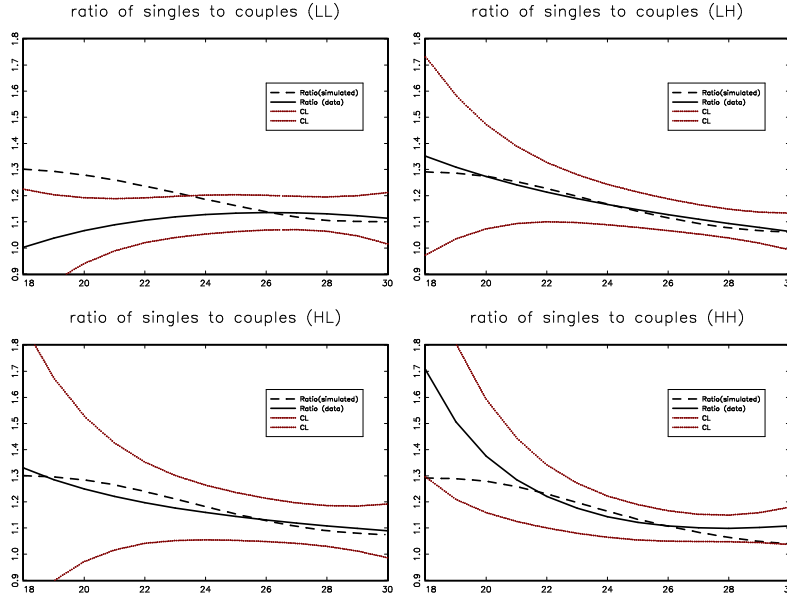
Figure 5: Comparison of actual and simulated ratios of agregated singles to couples

| Person | | | Potential partner | | μ | Compensation |
Gender	Education	Income	Education	Income		in percent
Male	L	80	L	66.6	0.60	3
Male	L	80	H	83.3	0.65	21
Male	H	100	L	66.6	0.65	0
Male	H	100	H	83.3	0.70	15
Female	L	66.6	L	80	0.60	23
Female	L	66.6	H	100	0.65	49
Female	H	83.3	L	80	0.65	16
Female	H	83.3	H	100	0.70	38

Table 2: Calculation of extra income as compensation for not getting married.

marrying and staying single. The more educated man who has an income which is 50% higher than his spouse will have to share the income at marriage but gains from the economies of scale. The woman will in general benefit both from the income sharing and the economies of scale and therefore need a higher compensation rate.

6. Conclusion.

The impact of life-stages decisions on consumption and saving has been largely confined to looking at retirement. In this paper we present theory and empirical evidence on the impact of the transition from being single to living with someone else ('marriage'). The theory identified several important parameters that determine the change in consumption over the transition from being single to living in a couple. The key features of the model are the uncertainty about marriage and the publicness in the consumption when married. These two features imply (in most cases) that two singles spend more than a comparable couple at young ages, but, the more unlikely it becomes
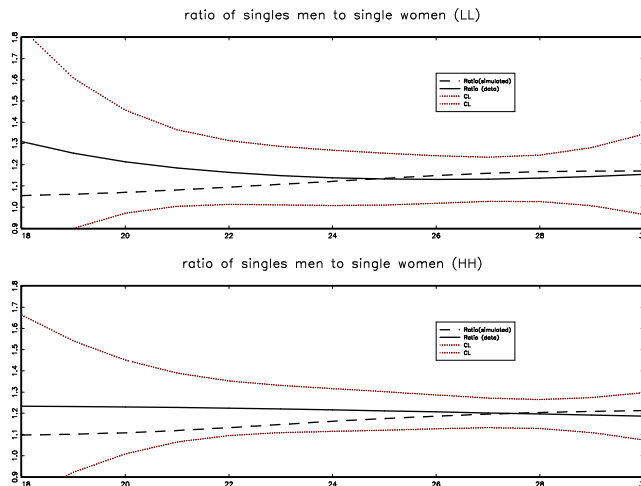
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Figure 6: Comparison of actual and simulated ratios of single men to single women

that singles will marry, the smaller the difference becomes and, eventually, couples will spend more than a comparable pair of singles. Another implication of the theory model is that the high income person (men) will have higher consumption when single than the low income person (women). The empirical evidence based on UK-FES data broadly supports these implications of the theory model. The important implication of our theory model, that aggregated singles should have higher expenditure rates than comparable couples is also consistent with the results from the US data cited in the introduction. Furthermore, the our empirical analyses document substantial differences in consumption paths across education groups.

One contribution of the paper is that we can 'estimate' the degree of economies of scale from transitions into marriage. We find that in order to replicate the observed differences between education groups we need heterogeneity in the degree of economies of scale. The calibration results indicate that more educated couples have a higher degree of publicness in the consumption than less educated couples. For a couple where both have low education the economies of scale are 0.60, which implies that a couple can live as cheaply as 1.66 low educated singles. The economies of scale for a higher educated couple is 0.70 which implies that this couple can live as cheaply as 1.43 high educated singles. Mixed couples are in between these two extremes. Our study shows that there differences in the 'economies of scale' for different education groups and these findings might be important when comparing degrees of economies of scale across countries.

Compared to previous studies our estimates of the degree of economies of scale is somehow larger than normally found. We believe this is due to the fact that our estimates are identified from transitions into marriage, where most others are based on changes in number of children in the household. It is likely that the degree of publicness is very different depending on whether it is a partner moving in or out of the household or a child. Since many of the issues where the economies of scale is used relate to setting transfers for couples relative to singles, it is important also to obtain estimates based these transitions. This is a first attempt to identify scale of economies from transitions between singles and couples

Using a simple life-cycle model, we are able reconcile some important patterns in consumptions around the transition from single to married. However, we still impose a number of simplifying assumptions in both the theory model and in the empirical analysis. First, although we extend the standard life-cycle model by explicitly modelling one life-stage transition, still we ignore other life-

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stages such as living with parents and leaving home; having children and divorce. These transitions are important and future research should address these by modelling them explicitly. Second, we assume the probability of marrying depends only on age and education, but not on lifetime wealth. Third, we do not take account of income uncertainty. Fourth, a limitation of this study is that the empirical results only allows for heterogeneity in a very restricted way. Due to the lack of panel data, the empirical evidence is based on repeated cross sections which requires matching on very broad factors such as education, employment and cohort.

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A. Appendix

A.1. Collective model

In this model agents coordinate and reach an efficient outcome; this corresponds to the *collective model* assumption of Chiappori (1988) and Browning and Chiappori (1998). As discussed in the latter paper, in models of continuing day to day interaction within marriage the collective model has considerable appeal since the two agents are playing a repeated game and there exist mechanisms for supporting efficient outcomes. It is not obviously applicable to a model in which agents coordinate before they even meet.

For the collective model we have the (joint) criterion[14]:

$$U = \left(u(c_1^M) + (1-\theta)\,u\left(c_2^M\right)\right) + \left(u(c_1^W) + (1-\theta)\,u\left(c_2^W\right)\right)$$
$$+ 2\theta u(\mu X_2) \tag{8}$$

This is maximised by choosing $\left(c_1^M, c_1^W\right)$ subject to the three budget constraints given in equation (2)-(4). The first order conditions (assuming interior solutions) are:

$$u'(\hat{c}_1^M) - (1-\theta)\,u'\left(2\left(1-\pi\right) - \hat{c}_1^M\right)$$
$$= 2\mu\theta\left(u'(\mu\left(2\left(1+\varepsilon\right) - \hat{c}_1^M - \hat{c}_1^W\right))\right)$$
$$= u'(\hat{c}_1^W) - (1-\theta)\,u'\left(2\pi - \hat{c}_1^W\right) \tag{9}$$

Even such a simple model as the one taken here yields very few interesting analytical results. The only two we have been able to find are:

Proposition 2. *(i) If $(1-\pi) > \pi$ and $\theta < 1$ then $\hat{c}_1^M > \hat{c}_1^W$ and $\hat{c}_2^M > \hat{c}_2^W$.*
(ii) If there are returns to scale ($\mu > 0.5$) then $\mu\hat{X}_2 > \min(\hat{c}_1^M, \hat{c}_1^W)$ and $\mu\hat{X}_2 > \min(\hat{c}_2^M, \hat{c}_2^W)$.
    ***Proof.** (i) The proof is as for Proposition 1.*
(ii) Suppose $(1-\pi) > \pi$ so that $\min(\hat{c}_1^M, \hat{c}_1^W) = \hat{c}_1^W$ and $\min(\hat{c}_2^M, \hat{c}_2^W) = \hat{c}_2^W$. First suppose that $\mu\hat{X}_2 < \hat{c}_2^W$. This, $\mu > 0.5$, and the budget constraint, imply

$$\hat{c}_2^W + \hat{c}_2^M > 2\mu\hat{X}_2 > \hat{X}_2 = \hat{c}_2^W + \hat{c}_2^M + 2\varepsilon$$

which is a contradiction. Therefore $\mu\hat{X}_2 > \hat{c}_2^W$.
The first order conditions and $\mu > 0.5$ give:

$$u'(\hat{c}_1^W) = (1-\theta)\,u'\left(\hat{c}_2^W\right) + 2\mu\theta u'\left(\mu\hat{X}_2\right)$$
$$> (1-\theta)\,u'\left(\hat{c}_2^W\right) + \theta u'\left(\mu\hat{X}_2\right)$$

Thus $u'(\hat{c}_1^W)$ is greater than the convex combination of $u'\left(\hat{c}_2^W\right)$ and $u'(\mu\hat{X})$. Hence, it follows that

$$u'(\hat{c}_1^W) > \min(u'\left(\hat{c}_2^W\right), u'(\mu\hat{X}_2))$$

or, given strict concavity of the utility function, that

$$\hat{c}_1^W < \max(\hat{c}_2^W, \mu\hat{X}_2).$$

But we know that $\max(\hat{c}_2^W, \mu\hat{X}_2) = \mu\hat{X}_2$ and hence $\hat{c}_1^W < \mu\hat{X}_2$ as required. ∎

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[14]In this utility function we assume equal weights for each partner. We have extended the model to allow that the two utility functions have different weights that depend on relative incomes. Although this gives a richer model, we choose not to present the results here since we assume equal sharing in our many period empirical model below.

α	μ	θ	π	ε	c_1^M	c_1^W	s^M	s^W	X_2	c_1/X_2
3	0.6	0.85	0.45	0	0.54	0.50	1.5	-11.9	0.95	1.09
0.5	$*$	$*$	$*$	$*$	0.47	0.45	14.3	0.6	1.08	0.85
$*$	0.75	$*$	$*$	$*$	0.58	0.52	-4.9	-16.4	0.90	1.22
$*$	$*$	0.6	$*$	$*$	0.55	0.48	0.2	-6.6	0.97	1.06
$*$	$*$	$*$	0.5	$*$	0.53	0.53	-5.0	-5.0	0.95	1.11
$*$	$*$	$*$	$*$	0.1	0.59	0.53	-7.2	-17.8	0.68	1.65

$*$ denotes the same value as the benchmark (row 1).
c_1^I and s^I are I's first period consumption and saving rate (in %) respectively.
$c_1 = c_1^M + c_1^W$.

Table 3: Table Collective model predictions

The first part shows that, as in the non-cooperative case, first period and second period single consumption is always higher for the high income person. The second result shows that, for the low income person, *consumption* when married (defined as μX_2 for each member of a couple) is always greater than consumption when single in either period.

Beyond this, we have not been able to establish any other general properties. Importantly, the implications for expenditure when married, X_2, relative to aggregate expenditures when single $(c_1^M + c_1^W)$, is ambiguous. Also the implications of whether the consumption of high income person increases on marriage is ambiguous. Thus, again, we must have recourse to calibrations to gain some insights into possible outcomes. Table (3) gives the results of this simulation exercise.

For the benchmark case we see that first period saving is negative for the low income person and positive (albeit small) for the high income agent. Thus the possibility of marriage with consequent scale effects leads to a lower consumption differential amongst singles than suggested by their incomes. The converse of this is that the low income agents have even lower consumption in the event that they stay single. The second feature of the benchmark results is that per capita expenditure falls on marriage ($c_1 = c_1^M + c_1^W > X_2$). The next case shows that this is not always true. If agents are not very averse to fluctuations (the CRRA is low) then they are willing to save in the first period in order to exploit the returns to scale ('lower price') in the second period. The third case indicates that stronger scale effects lead to higher first period consumption and dissaving by both partners. Thus the income effect of the stronger scale effect outweighs the substitution effect. A lower probability of marriage has qualitatively different effects on first period consumption with the lower income agent increasing saving (relative to the benchmark case) whereas the high income agent reduces saving. If we equalise incomes ($\pi = 0.5$) expenditures in the married state do not change much. Finally, if we allow for a marriage premium then first period consumption rises for both people and per capita expenditures (the second last column) fall dramatically.

Although it is almost always the case (see table 3) that $\mu \hat{X}_2 > \hat{c}_1^M$, so that consumption for both people rises on marriage, it does not always hold. This can be seen as follows. Consumption of the high income person falls on marriage when the marriage probability is low and economies of scale in consumption are small: for example changing the benchmark example in table 3 to have $\mu = 0.53$, $\theta = 0.5$ gives $\hat{c}_1^M = 0.538$, $\hat{c}_1^W = 0.467$ and $\mu \hat{X}_2 = 0.527$.

The conclusions from the simulations show that first period saving can be positive for either, both or neither of the agents. Moreover, changing the parameters has a fairly dramatic effect on savings rates. The other important conclusions we take from the Table are that we would generally expect per capita expenditures to fall on marriage and consumption on both persons rises on marriage, but also that the observables are quite sensitive to the model parameters.

A.2. Proof of proposition 1.

(i) The first order conditions give

$$u'(\hat{c}_1^M) - u'(\hat{c}_1^W) = (1 - \theta)(u'(\hat{c}_2^M) - u'(\hat{c}_2^W))$$

which implies, given strict concavity of the utility function, that

$$\hat{c}_1^M > \hat{c}_1^W \Leftrightarrow \hat{c}_2^M > \hat{c}_2^W \text{ and } \hat{c}_1^M < \hat{c}_1^W \Leftrightarrow \hat{c}_2^M < \hat{c}_2^W. \tag{10}$$

Now suppose that $\hat{c}_1^M < \hat{c}_1^W$. Since $(1 - \pi) > \pi$, we have $\hat{c}_2^M = 2(1 - \pi) - \hat{c}_1^M > \hat{c}_2^W = 2\pi - \hat{c}_1^W$, which contradicts (10). Therefore we must have $\hat{c}_1^M > \hat{c}_1^W$ and $\hat{c}_2^M > \hat{c}_2^W$.

(ii) Suppose $(1 - \pi) > \pi$ so that $\min(\hat{c}_1^M, \hat{c}_1^W) = \hat{c}_1^W$ and $\min(\hat{c}_2^M, \hat{c}_2^W) = \hat{c}_2^W$. First suppose that $\mu\hat{X}_2 < \hat{c}_2^W$. This, $\mu > 0.5$, and the budget constraint, imply

$$\hat{c}_2^W + \hat{c}_2^M > 2\mu\hat{X}_2 > \hat{X}_2 = \hat{c}_2^W + \hat{c}_2^M + 2\varepsilon$$

which is a contradiction. Therefore $\mu\hat{X}_2 > \hat{c}_2^W$. The first order conditions and $\mu \leq 1$ give:

$$\begin{aligned} u'(\tilde{c}_1^W) &= (1 - \theta)u'(\tilde{c}_2^W) + \mu\theta u'\left(\mu\tilde{X}_2\right) \\ &\leq (1 - \theta)u'(\tilde{c}_2^W) + \theta u'\left(\mu\tilde{X}_2\right) \end{aligned}$$

Thus $u'(\tilde{c}_1^W)$ is smaller or equal to a convex combination of $u'\left(\tilde{c}_2^W\right)$ and $u'\left(\mu\tilde{X}\right)$. Hence, it follows that

$$u'(\tilde{c}_1^W) < \max(u'\left(\tilde{c}_2^W\right), u'(\mu\tilde{X}_2))$$

or, given strict concavity of the utility function, that

$$\tilde{c}_1^W > \min(\tilde{c}_2^W, \mu\tilde{X}_2).$$

But we know that $\min(\tilde{c}_2^W, \mu\hat{X}_2) = \tilde{c}_2^W$ and hence $\tilde{c}_1^W > \tilde{c}_2^W$ as required.

A.3. Descriptive statistics of the data

A.3.1. Life-stages and education

We define five different life-stages for young people: living with parents, single, couple without children and couples with children and a fifth category which contains other living arrangement as lone parent, living in an extended family and living with non-relatives. We define "single with parents" as unmarried individuals living with at least one parent. "Single" is defined as one person households, while couples included both married and cohabiting couples. In Table (4), we show the composition of different life-stages for individuals in the data. The table shows that the residual group account for around 15 percent. In the paper we will primarily focus on the first four life-stages.

In the paper we distinguish between two different education levels: minimum education (L) and above minimum education (H). Minimum education is defined as the minimum level of education required for the particular birth cohorts. In Table (5) the educational distribution for women and men is shown. Figure (7) and (8) show the changes in life-stages over age.

A.3.2. Employment status.

In Table (6), we show the employment rate for men with minimum education across different life-stages.[15] The table shows that men in couples without children always have the highest employment

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[15] We use men with minimum education because for this group unemployment then is the main reason for not working.

	Women		Men		Total	
	No obs.	pct	No obs.	pct	No obs.	pct.
Single with parents	10,284	24.1	14,876	38.9	25,160	31.1
Single	2,507	5.9	3,215	8.4	5,722	7.1
Couple without children	8,436	19.7	6,787	17.7	15,223	18.8
Couple with children	12,786	30,0	8,825	23.0	21,611	26.7
Other living arrangement						
Lone parent	3,306	7.8	82	0.2	3,388	4.2
Living in extended family	2,255	5,3	1,436	3.8	3,691	4.6
Living with non-relatives	3,093	7,3	3,065	8.0	6,158	7.6
Total	42,667	100.0	38,286	100.0	80,953	100.0

Table 4: Lifestages of 18-30 years old, 1978-2005

	Women	Men	Total
Min. level of educ.	22,391	21,757	44,148
	(0.52)	(0.57)	(0.55)
Above min. level of educ.	20,276	16,529	36,805
	(0.48)	(0.43)	(0.45)
Total	42,667	38,286	80,953

NOTE: Numbers in brackets are column percentage

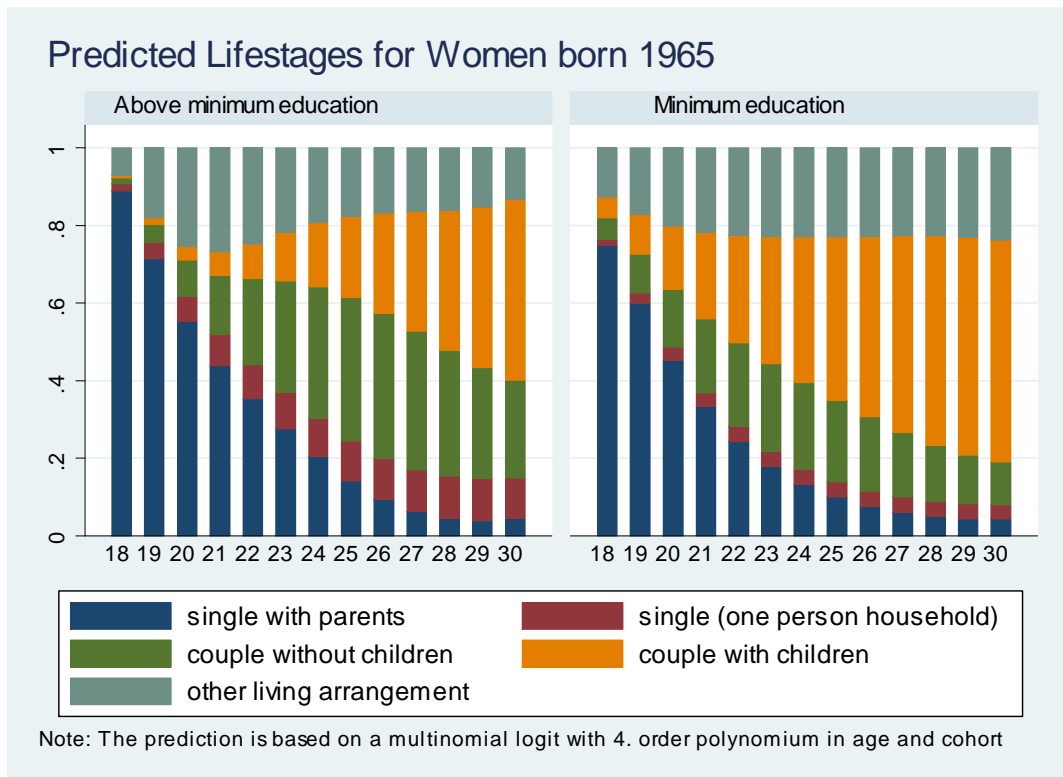Table 5: Educational Attainment of 18-30 years old, 1978-2005
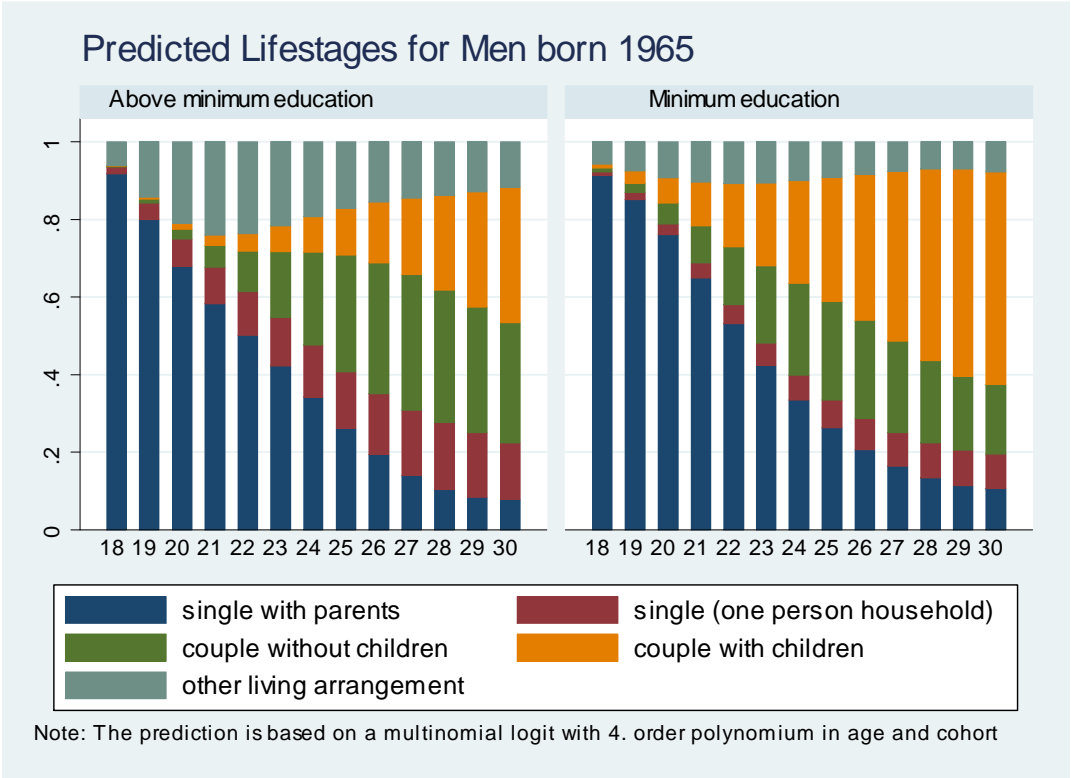

Figure 7: Lifestages for women

Figure 8: Lifestages for men

	Aged 20		Aged 25		Aged 30	
	rate	No obs	rate	No obs.	rate	No obs
Single with parents	0.78	1,044	0.78	442	0.77	182
Single	0.45	47	0.75	118	0.79	151
Couple without children	0.86	72	0.92	442	0.93	326
Couple with children	0.57	87	0.81	562	0.84	1,148
Other living arrangement	0.68	132	0.80	161	0.79	146
All	0.75	1,382	0.83	1,725	0.84	1,953

Table 6: Employment rate for men with minimum education, 1978-2005

rate and single men have an employment rate below the average. For singles with parents we see an other pattern. At age 20 singles with parents have an employment rate above the average, while when we look at singles with parents at age 30, they have an employment rate much below the average. This indicates that there might be correlation between the timing of transitions and the employment status.

A.3.3. Household composition and consumption.

In Table (7) we present some basic statistics on household composition and unconditional mean real consumption for each household type.

	Number of adults		Number of children		Expend. (in 2006 £)	
	mean	std	mean	std	mean.	std
Single with parents	3.34	0.90	0.53	0.87	477	297
Single	1	.	0	.	178	157
Couple without children	2	.	0	.	332	226
Couple with children	2.01	0.08	1.73	0.82	273	184
Other living arrangement	2.57	1.39	0.85	1.12	354	290
All	2.44	1.03	0.76	1.02	354	265

Table 7: Household composition and consumption over different lifestages, 1978-2005

A.3.4. Couples

To get information on the couples, we use information on the partner. Notice, that the partner does not need to be within the age group 18-30. In Figure (9), we show the age difference between "husband" and "wife"[16]. The graph shows that women aged 20 tend to form partnerships with men who are on average four years older, while men in a couple at aged 20 have a partner of the same age. When looking at couples at age 30, there is on average an age difference between husband and wife of around two years. The graph clearly shows that the composition of couples changes over the age span.

Educational attainment of the partner is shown in table (8). The table confirms that there is sorting according to education. However, the table also shows that women with more that than minimum level of education are almost equally likely to live with a man with a lower level of education as with the same level of education.[17] Based on Table (8) we can calculate the degree

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[16]Couples do not need to be formally married.

[17]Couples where the women is better educated than the man tend to be couples where the women also is much younger than the man
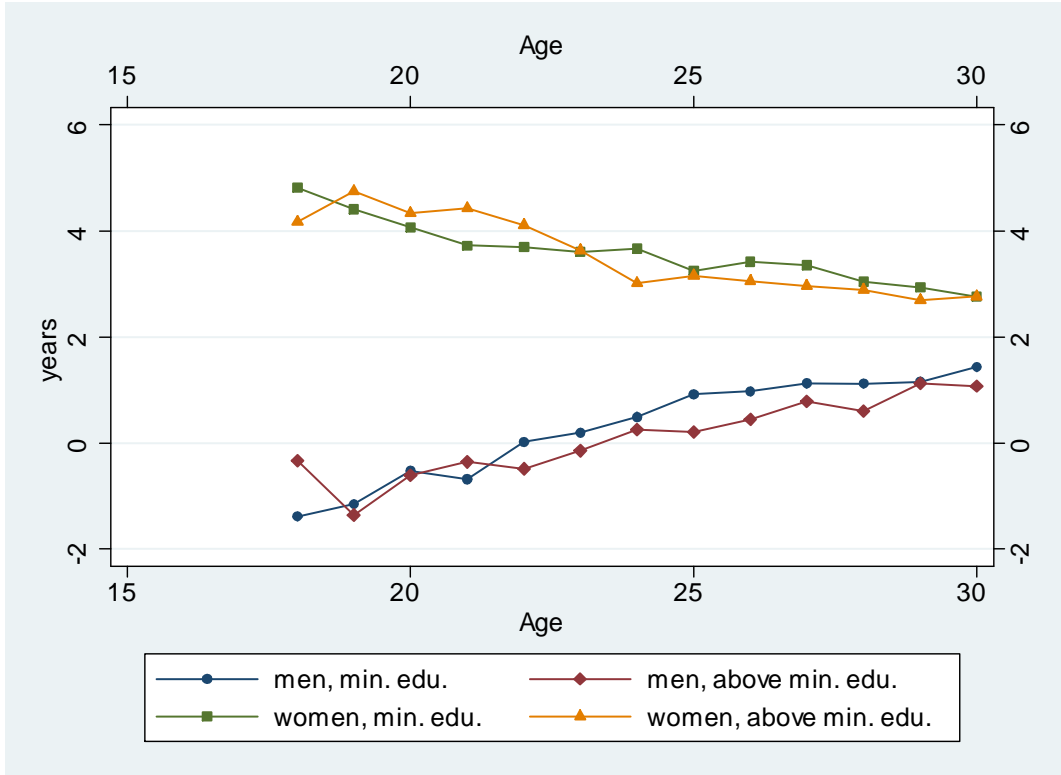
Figure 9: The age difference between husband and wife

of assortative mating as the fraction of couples with same education. The number is found to be 0.77.

A.4. Transition probabilities

In order to test the theoretical model we need estimates of the transition probability from being single to being in a couple.[18] Given that the data available are cross sections it is not possible to observe individuals making a transition. Furthermore we only have very limited retrospective

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[18]Thougout the paper we define individuals in a couple as individuals who are either married or cohabiting. The definition of cohabiting is based on the IFS definition.

	Partner's education			
	Min. education		Above min. education	
	No obs.	pct	No obs.	pct
Women, min. education	10,397	82.82	2,156	17.18
Women, above min education	3,760	42.40	5,107	57.60
Men, min. education	7,681	74.57	2,620	25.43
Men, above min. education	1,601	29.70	3,789	70.30

Table 8: Educational attainment of the partner for individuals 18-30 years old living in a couple, 1978-2005

information so it is not possible to infer the transition rates on the basis of this.[19] Therefore, we have to estimate these transition probabilities by an indirect approach based on the fraction observed in each state in different years. To do this we have make three assumptions. Firstly, we assume that there are three type of family arrangement: single (either living in a one person household or living in the parental home), couple without children and couple with children. By this assumption we ignore the group of lone parents with children, living with non relatives and in extended families; in the sample this group amounts to 15 percent. Secondly, we assume that the only transitions which are possible is from single to couple without children and from couple without children to couple with children. This means that we ignore the possibility that of divorce, separation and being widow. From 1991 and onwards we can distinguish between never married, divorced, separated and widowed. For this certain period we find that 93 percent of the group of single is never married. This suggests that our assumption may not be strongly violated. Furthermore, this assumption ignores that some may within a year move from being single to live in a couple with children. Unfortunately we can not check this part of the assumption by using the FES data. Thirdly, we assume that the transition probabilities are determined by age, birth cohort and educational attainment.

Under the assumptions mentioned above we can derive a transition matrix. We allow that the transition may depend of educational attainment, e, age, a and year of birth, b.

$$\Lambda(e,a,b) = \begin{pmatrix} \lambda_{11}(e,a,b) & 1-\lambda_{11}(e,a,b) & 0 \\ 0 & \lambda_{22}(e,a,b) & 1-\lambda_{22}(e,a,b) \\ 0 & 0 & 1 \end{pmatrix},$$

where state 1 refers to single, state 2 to couple without children and state 3 to couple with children. Hence, $\lambda_{11}(e,a,b)$ is the probability of staying single conditioned on being single at age a. To estimate the transition probabilities we use the fraction of the sample population in each of the three states, R

$$R(e,a,b) = \begin{pmatrix} r_1(e,a,b) \\ r_2(e,a,b) \\ r_3(e,a,b) \end{pmatrix},$$

where $r_j(e,a,b)$ is the fraction of education e, at age a, and born in year b observed in stated j. The transition equation is given by:

$$R(e,a+1,c) = \Lambda(e,a,c)'R(e,a,c).$$

From this equation we derive two condition (the last condition is redundant) which can be used to identify the transition parameters:

$$\begin{aligned} r_1(e,a+1,b) &= \lambda_{11}(e,a,b)r_1(e,a,b) \Rightarrow \\ \lambda_{11}(e,a,b) &= \frac{r_1(e,a+1,b)}{r_1(e,a,b)} \end{aligned} \quad (11)$$

Given these three assumptions, the estimation can be performed in two steps. In the first step we predict the fraction in each state on the basis of age, birth cohort and educational attainment. By estimating a multinomial logit for each combination of educational attainment we obtain the predicted values. In order to allow the choice of state to depend on age and year of birth explanatory variables. In the second step, equation (11) used to obtain estimates of $\lambda_{11}(s,e,a,c)$. The predicted transition probabilities for a women and man born in 1965 are shown in Figure (10).

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[19]For example, only from 1991 do we have information on if single individuals have been married before.
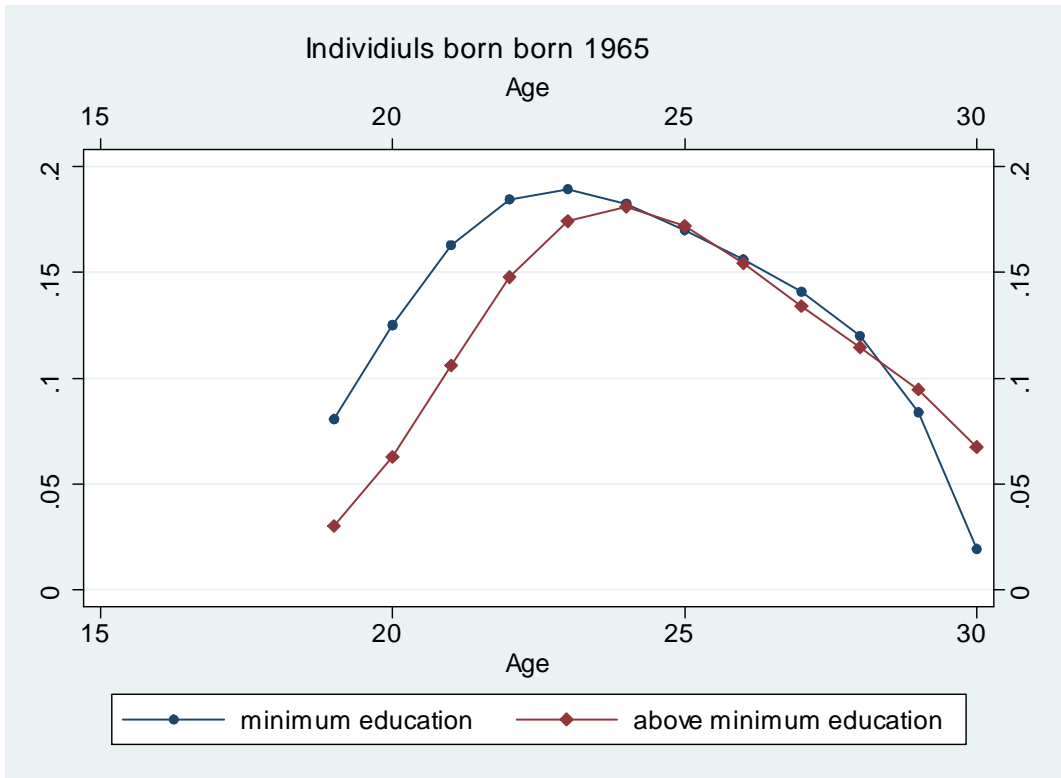
Figure 10: The transistion probability from single to couple

The transition probabilities show that less educated have a higher probability of forming a couple earlier compared to more educated. The transition probabilities are estimated from 18-30 years old. In the simulations we need transition probabilities up to 35. Instead of estimating the transition probabilities from 30 to 35 we set them to 1 per cent in each year.