Who delays childbearing? The relationship between fertility, education and personality traits*

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Abstract

Using data from the British Household Panel Survey, this paper assesses the role of personality traits on timing of motherhood and investigates whether, and in what way, personality traits can explain the differences in maternity timing between more and less educated women. The estimates of a Log-logistic model of the time to first child birth show that there is a statistically significant relationship between the Big Five personality traits and timing to motherhood. The results also show that even though there is some self-selection into education in terms Openness, the fertility timing gap seems to be mainly driven by high educated women who are particularly "open-minded".

JEL codes: J13, I2
Keywords: childbearing postponement, time to first childbirth, personality traits, Big Five

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1 Introduction

The last two decades of the XX century have witnessed a steep increase in childbearing age all over Europe. In England and Wales, for example, the mean age at first birth jumped from 25.2 in 1980 to 30 in 2004. Delaying to have the first child has two potentially adverse effects on fertility. First, it reduces the time-span for having more children, and therefore it may reduce completed cohort fertility (Kohler et al., 2002); and second, it may also result in involuntary childlessness given that after the age of thirty the probability of a successful pregnancy decreases (Gustafsson, 2001).[1] So, further rises in the age at first birth could accentuate the problem of the low fertility levels in Europe. This calls for a better understanding of what it is driving childbearing postponement.

Microeconomic theory explains fertility through a trade-off between working career and motherhood, and point to career planning as one of the main motives for postponing childbearing.[2] Since children demand a substantial time investment in their childcare and upbringing, the transition to motherhood entails important opportunity costs. First, there is the current opportunity cost of the forgone wage during the period spent out of work. And then, there is an expected future opportunity cost associated with the scarring effect of the career interruption. This effect will be stronger the steeper is the lifetime earnings profile and the earlier the work interruption occurs. Several studies provide empirical evidence of the maternity penalty. Amuedo-Dorantes and Kimmel (2006) analyse the motherhood wage gap and find that college-educated women gain in delaying first birth until the age of 30. Miller (2005) finds that motherhood delay leads to a substantial increase in career earnings, and that the postponement premium is largest for college-educated women. Given that more educated (or skilled) women are the ones expected to have steeper earning profiles, economic theory also predicts that more educated women postpone childbirth more. Ellwood et al. (2004) find that the costs of childbearing are vastly higher for high skilled women, for whom the

[1] "The progressive postponement of family formation in Western countries may have a negative effect on the ability to conceive, not only because the biological component (fecundability) declines with age but also because the behavioural component (sexual activity) significantly decreases as well." Sexual activity decreases in one's 30s (Rizzi and Alessandro (2006)).

[2] Happel et al. (1984), on the other hand, argue that it is consumption smoothing that is the main incentive for postponing motherhood.

age-earnings profiles are steeper, and that having children later may reduce their costs. So, a great part of the empirical literature in economics on childbearing postponement focuses on the effect of education, which is assumed to capture the higher opportunity costs of maternity.

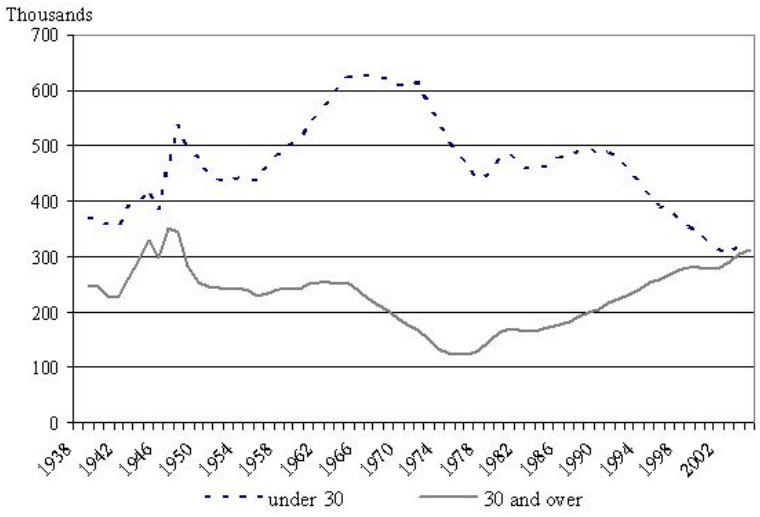
In disciplines other than economics researchers have looked at different kind of determinants of fertility behaviour such as traits and attitudes (Miller (1992), Kohler (2003) and Von der Lippe (2006)). There is a growing interest on such non-cognitive skills in economics as well but essentially on their impact on earnings (Goldsmith et al.(1997), Duncan and Dunifon (1998), Bowles et al. (2001), Dunifon et al. (2001), Cawley et al. (2001), Zax and Rees (2002), Groves (2005), Nyhus and Pons (2005), Mueller and Plug (2006)). Another strand of research led by Heckman has stressed the importance of both cognitive and non-cognitive skills in human development (Heckman, 2000; Heckman and Rubinstein, 2001; Carneiro and Heckman, 2003; Heckman et al. (2006); Cunha and Heckman, 2007; Heckman and Masterov, 2007).

The main aims of this paper are to assess the role of personality traits on timing of childbearing and to investigate whether, and in what way, personality traits can explain the differences in maternity timing between more and less educated women. The personality traits are measured by the Big Five, collected for the first time in the British Household Panel Survey (BHPS) in wave 15(2005). To our best knowledge there is no other study examining the relationship between the Big Five personality traits and timing of motherhood and so, this paper contributes to both the literature on childbearing postponement and to the recent literature on the non-cognitive skills.

The paper is set out as follows. The next section presents some stylized facts on fertility and explains why personality traits are expected to matter in fertility decisions. Section 3 focus on the relationship between education and fertility and explores how personality traits might lie behind that relationship. Section 4 describes the data, define the Big Five personality traits and gives an overview on how they are measured. The statistical model is presented in section 5, followed by the results in section 6. The discussion of the results in section 7 concludes the paper.

2 Fertility and personality traits

The trend of childbearing postponement started with the 1940s cohort in England and Wales and the Netherlands and, sooner or later, other European countries followed (Frejka and Sardon,2006). As it stands, the postponement of maternity seems to be irreversible (Billari, 2005).[3] Britain is a particularly interesting country to study fertility issues for it is at the same time the western European country with the highest percentage of teenager mothers (30.8 births per 1000 population (UNICEF, 2001)),[4] and one of the European countries with a highest average age at first birth. The age at first birth has been rising continuously since the 70s, reaching 30 in 2004.



Source: Office for National Statistics (from Table 3.1 published in Birth Statistics 1837-1983 Historical series FM1 Vol No 13, and Table 3.2 in FM1 Vol No's 11 to 33). It refers to births within and outside marriage and in England and Wales only.

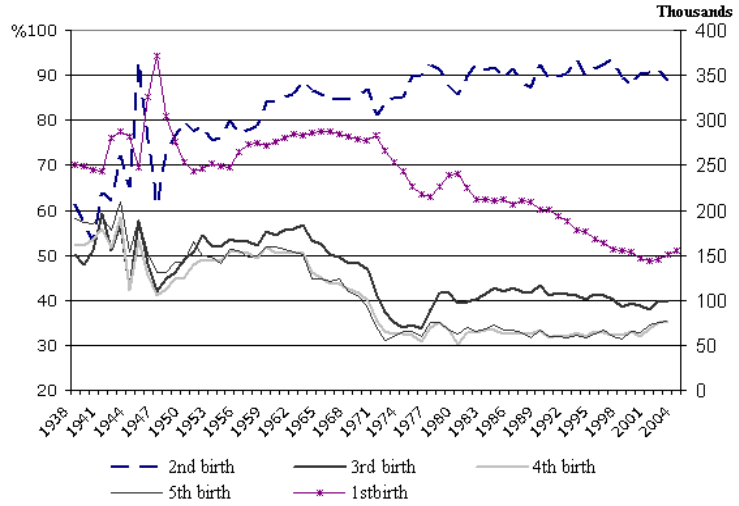
Figure 1: Live births by age group(1938-2004)

Figure 1 shows a decline in live births among women past the age of 30 between the mid 60s and mid 70s followed by a continuous increase. Whereas the decline was essentially due to a fertility decline in high order births, the increase was due to the postponement of the first birth and to some catching up by women who had postponed childbearing. Figure 2 shows that controlling for the trend in the previous parity - the decline in the level of first births decreases the base of women for second order births, and so on - the trends of higher parities among

[3] Whether or not all the changes encompassed by the so-called second demographic transition are persistent or not is debatable (Coleman, 2004).

[4] Britain is also the only country in Western Europe which did not experienced a significant decline in teenage fertility rates in the last thirty years (Goodman et al., 2004).

women who do become mothers virtually did not change since the beginning of the 80s (that corresponds roughly to the 1960 cohort). The decline in total live births has been driven by a decline in first births (also depicted in figure 2 having a scale in thousands).



Source: Birth Statistics data. Data taken from Table 4.1 published in Birth Statistics 1837-1983 Historical series FM1 Vol No 13, FM1 Vol No 18, and Table 4.2 in FM1 Vol No's 20 to 33. It refers to births within marriage and in England and Wales only.

Figure 2: Live births as a proportion of previous parity live births in the year before

In fact, Britain is also one of the countries with a highest percentage of childlessness: in 2005, nearly one in five women in their mid forties (that is, those born around 1960) were childless (Social trends 37, Office for National Statistics).[5] Given that childlessness seems to be mostly involuntary (Testa and Toulemon (2006)), this suggests that women may be postponing for too long. Thus, the childlessness phenomenon stresses the importance of understanding the factors driving the delay in having children.

These trends in fertility can be seen as part of a broader demographic change that came to be known as Second Demographic Transition, and which is usually described by a rise in premarital cohabitation, postponement of marriage, a rise in divorce rates, low fertility rates, lone parenthood and an increase in extramarital childbearing. In other words, the changes in fertility were accompanied by important social and cultural changes, as well as changes in the economic structure (mass education, increasing female participation both in education and labour

[5] A significant increase in childlessness was also observed in Finland, Netherlands, and West Germany (Frejka and Sardon, 2006 and Gustafsson, 2001).

market) and important technological changes (like the birth control pill, which translated into widespread contraception).

Sociologists and demographers tend to have a macro-perspective, and favour cultural/ideological explanations for these demographic patterns. Van de Kaa's theory on the second demographic transition is itself about a changes in values. As Van de Kaa (2004) puts it, the second demographic transition is characterized by the transition to an individualistic family model in which the right to self-determination is a guiding principle. So, Van de Kaa's theory is about a change in values that resulted in a greater weight being given to individual preferences. In this new era of full control of conception and less social control, women can actually assess the benefits of childbearing and then, in a sort of cost-benefit analysis, decide whether or not they want to have a(nother) child. This view complements the traditional economic approach that concentrates on the costs (Gustafsson and Kalwij, 2006). Also in Hakim's preference theory (Hakim, 2003) women's preferences are seen as the main determinant of women's choices. This, as the author points out, allows one to ackowledge the heterogeneity in lifestyle preferences and choices.

According to the psychology literature, behaviour or attitudes are manifestations of a combination between basic traits and external influences such as cultural norms, for example (McCrae and Costa (1999)). Whereas the basic traits are fundamentally stable, behaviours and attitude can change. So, by reinterpreting preferences as basic traits and combining the insights from psychology with the theories mentioned above, one is led to believe that personality traits must have gained explanatory power in terms of fertility behaviour. In fact Kohler et al. (1999), who study intergenerational transmission of fertility, show that whereas shared environment plays a centre role for the oldest cohort, for the youngest cohort it is genetics that matters most. They interpret their findings as suggesting that a decline in social control over time gave room for genetically mediated differences to express themselves. Based on the above mentioned theories, one would expect personality traits to have an impact on fertility behaviour.

3 Education, childbirth postponement and personality traits

Another interesting question is whether personality traits also help explaining the maternity timing gap between more and less educated women. And in that case, how? The association between education and postponement of fertility is indisputable: more educated women delay motherhood with respect to less educated women. Most studies do find evidence of a positive relationship between education and age at first birth (Rindfuss et al. (1996), Ermish and Ogawa (1994), Bloemen and Kalwij (2001), Nicoletti and Tanturri (2005) and Klasen and Launov (2006)). However, the nature of this relationship is far less clear.

The difficulty in studying the relationship between education and fertility is that it is, most probably, spurious. Even if education were a perfect proxy for current and potential wages (which is clearly a strong assumption) so that education would always be associated with higher childbearing costs, education could still be endogenous if more educated women also have different preferences (traits) that alter their *perceived* childbearing costs thereby affecting their fertility behaviour. For example, if more educated women are, at the same time, more career-oriented (Bratti, 2006) and that drove them to get more education and delay childbearing, then education would be endogenous. This is the typical self-selection problem. Given that some personality traits are known to be correlated with educational outcomes, namely Conscientiousness and Openness (John and Srivastava, 1999), exactly the same reasoning would apply to personality traits if these are also found to be associated with fertility outcomes.

A couple of studies do manage to get around the endogeneity problem. McCrary and Royer (2005) use the differences in the age at which a child enrols in school as identification strategy. Their results suggest that increases in female education lead to small and statistically insignificant changes in fertility choices, and therefore indicate a limited causal role for education in a women's fertility planning. Fort (2006) relies on an educational reform for identification - a nationwide reform that took place in Italy in the early 1960s that increased compulsory schooling from 5 to 8 years. She finds that education causes childbearing post-

ponement only for women for whom the reform is binding, and therefore would have had their first child by young ages, and that the incentives to postpone births operate only at younger ages (19-22). Since these results suffer from low external validity they do not provide a far-reaching explanation for the observed relationship between educational qualifications and childbearing postponement. Consequently, self-selection is still a plausible story for why there is a fertility timing gap between more and less educated women. However, it is not the only one; there is an alternative story. In fact, some authors suggest that high educated women are not particularly career-oriented (Wilkie, 1981; Mott and Shapiro, 1983; Sobotka and Testa, 2006), and others show that more educated women are as keen to have children as lower educated women, maybe even more so (Weston et al., 2004; Heiland, 2005; Yu, 2006).[6]

So far, more educated women were seen as a homogeneous group - sharing the same career prospects and fertility preferences - but it might well be that the mean is hiding substantial heterogeneity. It does not seem very reasonable to assume that high educated women are equally career-oriented, for instance. Two papers point out that the field of education is as important as the level of education in explaining fertility behaviour, or even more. Martín-García and Baizán (2006) show that difference in the field of education is associated with important fertility differences among women with the same level of education. Hoem et al. (2006), who study the relationship between education field and childlessness, find that women with formation in teaching and health care have much lower permanent childlessness at each educational level than in any other major grouping and that women educated in arts and humanities have unusually high fractions permanently childless. This illustrates the point that there might be substantial heterogeneity (traits-wise) among more educated women.

As there is no reason to expect less educated women to be less heterogeneous in terms of their personality traits than more educated women (see section 4.2), the existence of heterogeneity in personality traits alone cannot explain the fertility timing gap *between* more and less educated women. However, if the differences in personality *manifest* themselves more in the fertility behaviour of more educated

[6]The data used in this paper also show a positive correlation between education and the expectation about having children in the future among childless women - see section 4.

women (perhaps because they have more chances of following their intrinsic preferences) we could have among the more educated group women behaving quite differently. We could have high educated women behaving somewhat close to less educated women (in terms of timing to motherhood), and others delaying so much that they alone would be driving the fertility timing gap. There is evidence of higher inter-individual variation in births among more educated women. Since childlessness is one of the factors behind the increase in the average inter-individual variation in births (Kohler et al. (1999), Shkolnikov et al. 2004); it is a phenomenon particularly acute among high educated women (Sobotka and Testa, 2006; Gustafsson, 2006); and it is strongly related to severe childbearing postponing, there is good reason to expect high educated women to have a more disperse distribution of age at first birth as well - indeed, our data confirms it (see section 4). So, what is left to see is whether personality traits manifest themselves more in the fertility timing of more educated women. In other words, the testable hypothesis here is that personality traits matter more for more educated women - in which case they would account for a bigger share of explained variation of time to first birth.

Summing up, a priori there are two possible ways through which personality traits might help explaining the fertility timing gap between more and less educated women: one is that women self-select into education according to personality traits that also influence their fertility behaviour (the self-selection story); the other one is that heterogeneity in personality traits translates into high inter-variation in time to first birth especially for more educated women, so that there is a particular type of more educated woman that is severely postponing childbirth and therefore responsible for the fertility timing gap between more and less educated women.

4 Data

This analysis uses the first 15 waves of the British Household Panel Survey (BHPS). The BHPS is conducted annually since 1991 on a nationally representative sample of more than 5000 households. Given that BHPS is household-based, each year every adult (16 years old or more) within the household is interviewed.

A consolidated marital, cohabitation and fertility file containing the retrospective lifetime histories and subsequent panel data related to respondents' partnerships and childbearing gives us the fertility history of the BHPS respondents (Pronzato, 2007). In this file there are 16,015 women with complete information on their fertility histories. From these 16,015 women, 439 were dropped because of missing information on their educational qualifications. Therefore, there are 15,576 women for whom there is both complete information on their fertility histories and (some) information on their educational attainment - i.e. education qualifications are available in at least one wave.

Wave 15 (2005) includes, for the first time, questions on personality traits. Given that these variables are essential for the analysis, only the women who "survived" as BHPS respondents up until the last wave, and for whom these variables are not missing, are included in the sample (7,702 observations). Finally, women who were older than 75 by the time of the last interview were also excluded to minimize potential recall errors. So, the final sample consists of 7,094 individuals.

Table 6 (in the appendix) shows the summary statistics. The great majority of the sample 68% had a child . The mean age at first birth is 24.6 years old. As expected more educated women (those with A-levels or higher educational qualifications) have the first child later - there is a 2 years gap between the two educational groups. The distribution of age at motherhood for the less educated women (who did have a child) is quite skewed to the left, whereas the distribution for the more educated women seems to be more dispersed (fig. 4 in the appendix). In fact, the standard deviation of age at motherhood is bigger for more educated group (5.027 vs 4.668) and the Levene's robust test statistic for the equality of variances between the two groups rejected the null hypothesis that the variances are equal. [7]The data show very clearly that childlessness is particularly prevalent in the more educated group: whereas the mothers are evenly split by the two educational qualifications groups, among the childless women almost 2/3 (64%) have A-levels or higher qualifications. However, when childless woman are asked if they think they will have children, the percentage saying 'yes' is higher among

[7]We used this test statistic instead of the traditional F-test because based on a test on the normality we can reject that this variable is normally distributed. Levene's test statistic is robust under nonnormality.

the more educated women. [8]

The education variable is a dummy variable that assumes value 1 if the highest level of education qualification ever obtained is A-levels or higher educational qualification, and 0 otherwise.[9]This means that it could happen that, for a restricted group of women, those qualifications were obtained after the child was born. Due to data limitations it is not possible to accurately know the age at which individuals got their highest education qualifications,[10] and therefore it is not possible to know whether childbirth preceded the end of studies or vice-versa. But to have an indication of the dimension of that group we constructed a variable 'Education prior to birth'[11] and compared it with the 'Highest Education Qualification'. Only for 583 women the latter is higher than the former, i.e. 12% of the women who did have a child continued to study after childbirth. This is, by construction, a lower-bound but it also true that the women for whom it is not possible to calculate a proper 'Education prior birth' variable are the older ones (those who had the child before the BHPS started) and therefore the less likely to resume studies after having had a child. This exercise allows us to assume that, by and large, women finished their studies before giving birth. Therefore, in the analysis we will use the 'Highest Education Qualification'.

4.1 Big Five: the measure of personality traits

The measures of basic traits used here are the Big Five personality traits as defined by the Five-factor model developed in Personality Psychology. This is a hierarchical model in which five mains domains of personality are extracted from a larger set of more specific personality characteristics.[12] According to this

[8]This could just be due to the fact that the childless women who are more educated are also younger - on average. However, the results of a multinomial logit of the expectations on future childbearing on education qualifications and age still show this positive association between education and the expectation of having a child.

[9]The A-levels are exams taken at the end of secondary school when students are 16-18 years old (after compulsory school). These exams are a screening device for entrance in university as well as important signals for the labour market.

[10]A variable 'age finished studying' can be constructed using the variables age left school/further education for those who had stopped studying by the time of their 1st interview, but there are some problems with these variables.

[11]This variable is the highest qualification, if the woman is childless; it is equal to the highest qualification in the first observation if the woman had the child before the BHPS; and it equal to the highest qualification in the wave before the one in which the women already had the first child, if the woman had a child during the 'BHPS years'.

[12]The Big five are empirical concepts, that is, they are not a theory of personality (Srivastava, 2006).

classification the five main personality dimensions are: Extraversion (Vs Introversion), Agreeableness (Vs antagonism), Conscientiousness (Vs lack of direction), Neuroticism (Vs emotional stability) and Openness (Vs closedness to experience).

Extraversion is mainly characterized by sociability. Extroverts tend to be sociable, talkative and assertive as opposed to reserved and quiet. Agreeableness relates to the willingness to help others, to be caring, gentle, co-operative, kind and affectionate; it contrasts a prosocial orientation toward others with antagonism. Someone who scores high on Conscientiousness tends to follow the rules, to be reliable, well-organized, self-disciplined; the low scorers tend to be undependable, disorganized, lazy and negligent. Neuroticism summarizes traits related to emotional stability. High scorers in Neuroticism tend to be anxious, depressed, insecure. Openness to experience - also called autonomy - relates to unconventionality and intellect. Someone who scores high on Openness tends to question the conventions, to be imaginative, creative, curious about the world, complex and broad-minded.

The purpose of the Five-factor model is to provide a personality taxonomy that can be used to describe major personality differences within the population - it is not meant to give a detailed description of an individual's personality. Even though is not universally accepted, the five-factor model is the one gathering more consensus as a general taxonomy for the personality structure (John and Srivastava, 1999).

According to the Five Factor Theory, the five factors of personality capture basic tendencies which are regarded as biologically based dispositions and capabilities, and that is the view taken here. In fact, it has been shown that the genetic contribution to individual differences in personality is quite substantial (Jang et al., 1998; Plomin and Caspi, 1999; Loehlin, 2005).[13]

The genetic influence on personality is one of main mechanisms of continuity over the life course. The meaning of continuity in this context is rather ambiguous.

[13] Albeit it is consensual in behavioural genetics that about half of the variance in personality is shaped by genes, the more reliable measurement of traits from multiple perspectives (peer, spouse, or observer ratings in addition to self-report questionnaires) yields heritability estimates for personality that are even higher than this: Riemann et al., 1998 estimated heritabilities of .66 to .79 for the composite of questionnaire and ratings (Loehlin, 2005). Note: heritability is a statistic that describes the effect size of genetic influence and refers to the proportion of observed (phenotypic) variance that can be explained by genetic variance (Plomin and Caspi, 1999); not to be confounded with parents-offspring correlation (Loehlin, 2005)

In fact continuity has been measured in several different ways in psychology and each one corresponds to a different definition. Even though there are a few studies that look at continuity at an individual level, most studies use measures that look at continuity at a group level. What is more, great part of the studies focuses on continuity from childhood to adolescence. But when looking specifically at adulthood, the empirical evidence is that personality is indeed quite stable. That is not to say that personality stops changing in adulthood but that the changes that occur are small in magnitude (Caspi and Roberts, 2001; Srivastava et al. 2003). Using genetics jargon, one could say that whereas the personality traits genotype is "fixed", there is some room for the phenotype to change in response to the environment, one of the main mechanisms thought to produce changes in personality (Alea et al. (2004)). But individuals tend to respond to the environment in way that it is consistent with their existing personality and so, the person-environment transactions can be, at the same time, a powerful mechanism in promoting continuity (Caspi and Roberts, 2001). In other words, the changes that do occur reinforce personality consistency - Roberts and DelVecchio (2000) show that traits become increasingly consistent with age. On the other hand, cross-section studies suggest that the modest changes in personality throughout adulthood are as follows: Extroversion, Neuroticism and Openness decrease, and Agreeableness and Conscientiousness increase (McCrae and Costa, 1999) - which is very intuitive.

One can think that the Big Five capture personality in the same way Spearman's g is used to measure general intelligence. The difference is that in the case of personality there is not one factor only but five. In fact, the Five-factor model has its origins in the work of Cattell who was a protegé of Spearman - in 1933 Cattell published an analysis of non-intellective traits that maybe regarded as the first glimpse of the Big five (Digman, 1996). Both the Big Five and Spearman's g are measures resulting from the use of factor analysis - a statistical method for data reduction pioneered by Spearman.

Just as many intelligence tests are designed to measure the Spearman's g, many of widely used personality questionnaires are designed to measure the Big Five traits. The more commonly used Big-Five instruments are: the Goldberg's

100-item Trait Descriptive Adjectives (TDA), the Costa and McCrae's NEO Personality Inventory (the 240-item NEO PI-R and the 60-item NEO-FFI) and John, Donahue and Kentle's 44-item Big Five Inventory (BFI).

Whereas TDA follows a lexical approach and is a list of 100 single adjectives, the other two follow a questionnaire approach and use questionnaire scales - the NEO's items are full sentences and the BFI's items are short phrases. Each of these instruments has been thoroughly tested and their validity is well established (John and Srivastava, 1999).

The choice of the instrument is dictated either by the research question (whether one is interested in broadly defined personality traits or in specific traits) or by the research setting, that is, by the time that the survey can spare for the personality questionnaire. In surveys where the participants' time is at premium, a short instrument like the BFI that takes five minutes to complete is an efficient solution (John and Srivastava, 1999).

There is a trade-off between having a measure of personality dimensions in surveys - like the longitudinal studies - and its quality. To have a 44-item in a longitudinal study would make the questionnaire as whole too burdensome. But despite the superiority of long instruments over the short ones, in terms of psychometric properties the costs associated with short instruments are not that high (Gosling et al., 2003).[14]

4.2 The Big Five in the BHPS

Due to time constrains a short version of the well-established 44-item BFI was used in the BHPS, the BFI-S.[15] Gerlitz and Schupp (2005) show that the BFI-S displays strong internal coherence; that to a large extent it is able to replicate the results of the 25-item BFI; and that the reliability test produced a satisfactory result. The BFI-S is composed of fifteen questions, three on each of the five

[14] In fact, those authors developed even shorter measures (5 and 10-item inventories) and showed that they reach adequate levels in each the criteria against which they were evaluated, therefore being reasonable proxies for longer Big-Five instruments.

[15] The BFI-S was designed by GSOEP Researchers. The GSOEP introduced a measure of personality traits in 2005 based on a pretest. "A pretest was conducted in 2004 on a number of different short item scales to test the Big Five approach, with the goal of developing a useful and widely applicable short item scale (BFI-S) for the 2005 SOEP survey. The short inventory of questions developed in the present study, BFI-S, contains 15 items and can be completed within two minutes." Gerlitz and Schupp (2005).

personality domains- see table 1. Each question rates on a 7-point scale ranging from 1 ('Does not apply to me at all') to 7 ('Applies to me perfectly').

Even though in the BHPS the internal consistency of personality trait scales obtatined from the BFI-S questions - as measured by the values of the Cronbach's alpha[16] - is not impressive, this should not be of great concern because it results from the small number of items used to assess each trait.[17] In fact some researchers argue that alphas are misleading when calculated on scales with small number of items (Gosling, 2004). Short instruments like the BFI-S are meant to optimize validity and not reliability.

Table 1: The Big Five personality traits in the BHPS

Personality Traits	Questions in BHPS	Alpha	AIC
Extraversion	Is talkative Is outgoing, sociable Is reserved	0.5384	0.2777
Agreeableness	Is sometimes rude to others Has a forgiving nature Is considerate and kind to almost everyone	0.5275	0.2750
Conscientiousness	Does a thorough job Tends to be lazy Does things efficiently	0.5138	0.2789
Neuroticism	Worries a lot Gets nervously easily Is relaxed, handles stress well	0.676	0.4077
Openness	Is original, comes up with new ideas Values artistic, aesthetic experiences Has an active imagination	0.6731	0.4110

Alpha: Cronbach's Alpha; AIC: Average interitem correlation

The personality trait scales to which table 1 refers to were constructed using all the people in BHPS's wave 15 (men and women) who replied to the personality traits questions. Each personality scale was constructed only for the observations for which none of the three answers relating to that personality trait is missing. The scales were then standardized for the sample used in the estimations to have mean zero and standard deviation one. These standardized personality traits were the ones used in the analysis.

The distributions of each of the standardized personality traits, by educa-

[16]The Cronbach's alpha measures how well a set of variables measures a single unidimensional latent construct.

[17]The Cronbach's alpha is a function of the number of items used (as well as of the average inter-correlation among the items); the higher the number of items, the higher is the Cronbach's alpha.

tional group, can be seen in figures 5 to 9 in the appendix. The distribution of Conscientiousness for the more educated group is more skewed to the right, reflecting the well-known association between that trait and educational attainment. The other interesting thing to notice relates to the Openness trait. The distributions are similar for the two groups, but the one of the more educated group is shifted to the right.

Ideally, the personality traits should be measured before the event of interest, childbirth. Unfortunately, that is not the case here. As mentioned before, the personality traits were assessed in the last wave used in the analysis. Even though the personality traits are fundamentally stable, this might create biases and a reverse causality problem. As an attempt to overcome these problems, we are going to focus mainly on Openness when looking at the results. As it was said previously, this trait decreases with age. Given that we expect a positive relationship between Openness and time to first childbirth, the estimated coefficient, if anything, would be bigger if measured before childbirth. In other words, the we expect our estimated coefficients to be downward biased and not upward biased. By focusing on Opennes, we also avoid the reverse causality problem as there is no reason to expect childbirth to affect the mother's Openness - but again, if it does, one would expect the effect to be negative i.e. the woman would become less "open-minded" after having had the child.

5 Statistical model

Since our aim is to explain time to first birth, we will use a dynamic model. This kind of model, unlike the linear or logistic models, take into account not only whether the event (childbirth) occurred or not but also when it occurred by having time as the dependent variable. Thus, it is necessary to establish when the clock starts ticking. The most natural "time origin" is the moment when individuals became at risk of experience the event. In the case of childbirth, the onset of risk is the age at menarche. As the BHPS does not have information on the women's menarcheal age, we will set it to 13 years old.[18] The duration time

[18] According to Creighton (2005) the onset of puberty in girls occurs between the ages of 8 and 13.5 years, and Thomas et al. (2001) propose 13.3 years old as the mean age at menarche in Britain.

ends with whichever event happens first: the first child is born, end of the study (those are the right-censored cases) or the 50th birthday, by assumption the age at menopause.[19]

The survival time data used here come from a panel data with retrospective data, where the survival time is measured in months. The survival times can be treated as observations on a continuous random variable, or as observations on a discrete random variable according to the underlying behavioral process that generates them. But it also depends on the process by which the data were recorded, i.e. one can also have observations on an intrinsically continuous random variable that are recorded in a grouped from. In this case, it is appropriate to use a continuous specification if the ratio of the length of the intervals used for grouping to the typical spell length is small (Jenkins, 2005). Given the nature of the process at stake - getting pregnant and giving birth -, the smallness of the ratio between the length of the intervals used for grouping and the typical spell length (1/161), and also the low value of the incident rate (0.0041743), we chose a continuous specification.[20]

We use a Log-logistic regression model which, in its linearized form, can be written as

$$ln(T) = \beta' X + \epsilon \tag{1}$$

Where T is the survival time and ϵ follows a Logistic distribution.[21] This distribution can have a non-monotonic hazard function and therefore can accommodate the hazard suggested by the literature and by the shape of the Kaplan-Meier estimate of the empirical hazard (see fig. 10 in the appendix). The model specification was based on several tests and the choice of the log-logistic, in particular,

[19] Based on data on age at menopause obtained for 67 and 26 countries, Thomas et al. (2001) calculated the mean age of menopause to be 49.24 years (SD 1.73). (obs: in their study there is no data specifically for Britain).

[20] When working with grouped data - when an event is known to occur in an interval (j-1, j) instead of being known to occur in a particular point in time - researchers usually set the duration equal to j and treat this as the exact duration. By doing so, the likelihood contribution of the observation becomes the probability density of experiencing a transition at duration j, and the likelihood based on this probability density yields inconsistent estimates of the parameters of the hazard rate. This is the so-called time-aggregation bias. So, what is crucial to know is whether the bias is negligible or not. Petersen (1991) shows that if the incident rate is smaller that 0.1, the relative bias - the asymptotic value towards which the bias converges - is small, i.e., less than 5%

[21] the distribution of epsilon follows from the assumption that the survival time follows a Log-logistic distribution

was determined by the AIC.[22]

In the full-model the vector of covariates, X, includes the highest educational qualifications attained, the standardized personality traits variables, dummies for the women's birth cohorts and family background variables such as parental education, number of siblings, a dummy indicating whether the women lived with both parents up to the age of 16 and the area in which she lived during childhood (inner city, suburbs or rural area).[23]To test for a potential omitted variables problem we also run the model allowing for unobserved heterogeneity (frailty). Even though the test rejected the non-existence of unobserved heterogeneity, the estimated coefficients are very similar and therefore the results presented in the next section do not take unobserved heterogeneity into account.

In order to investigate whether personality traits matter more for the more educated women than for the less educated- one of the aims of this paper - we have to compare the estimated coefficients for the personality traits of the two groups i.e. we have to run (1) for the two groups separately.

6 Results

Table 2 reports the maximum likelihood estimates of our model of time to first child birth. The first column shows the estimated coefficients of the personality traits when no other covariates are included. All the other personality traits are statistically significant (at a 5% level). Whereas increases in Agreeableness, Extroversion and Neuroticism accelerate childbirth (failure), increases in Conscientiousness and Openness lengthen time to motherhood.

When education is added to the list of covariates (mod.2) all the estimated personality traits coefficients remain significant at a 5% level with the exception of Conscientiousness. This was expected given that this personality trait is known to be the most important in terms of educational success. In terms of the changes

[22]Starting with the generalized Gamma model (the most flexible one) we tested for the appropriateness of the Exponential, Weibull and Log-normal models. Of these, only the Log-normal was not rejected. Then, the comparison of the AIC of the Log-normal with the AIC of the Log-logistic showed that the latter was lower, which makes the Log-logistic the preferred model. The choice of a parametric model over a non-parametric one was due to the fact that the shape of hazard of having a first child is known. In this case, the use of a parametric model is justified on efficiency grounds.

[23]Neither labour market participation nor marital status were included in the list of covariates because these variables are endogenous.

in the coefficients' sizes, Openness shows the biggest proportional change. The decrease in the Openness coefficient reveals the also known positive relationship between this personality trait and educational qualifications. And, as we knew from the literature, education delays childbirth. Every thing else equal, the estimated survival time for more educated women (women with A-levels or higher qualifications) is 1.32 times bigger than the one for less educated women.

However, not everything is equal i.e. family background is an important determinant of educational attainment. So, not surprisingly, when all the family background variables and the cohort dummies are added (mod.3), the effect of education qualifications on timing of motherhood is weakened. The personality traits coefficients also change but not nearly as much. Interestingly, the effects of Agreeableness, Conscientiousness and Extroversion become bigger.

For the full model (mod.3), the estimated median survival time is 166.94 months, which means that the estimated median age at first birth is 26 years and 11 months (i.e. according to the estimates this is the age at which half of the women has had a child). Figure 3 shows the estimated hazards calculated using different values for some of the covariates (educational group and Openness trait), all the other covariates at their mean. Besides showing that more educated women delay childbirth with respect to less educated women, this figure shows interesting differences in the childbearing hazard by level of Openness within each educational group. It also shows that less educated women who score high on Openness have a lower childbirth hazard than more educated women who score low on that trait, even though this result might be partly driven by the assumption that the coefficients are the same for the two groups (which might exacerbate the effect of the personality trait for the less educated women and dwarf the effect for the more educated).

6.1 Estimates from the separate models

By running the regression on a sample of less and more educated women together one is imposing that the coefficients and the baseline hazards are equal across groups. However, a test on the whether the baseline hazard is the same for the two groups rejected that hypothesis. So, we will now look at the results from

Table 2: Estimates of the Log-logistic model for the whole sample

	mod.1	mod.2	mod.3
highestQ		0.2747***	0.1965***
		0.0158	*0.0174*
zA	-0.0631***	-0.0476***	-0.0484***
	0.0089	*0.0086*	*0.0089*
zC	0.019 *	0.0146	0.0206*
	0.0089	*0.0087*	*0.009*
zE	-0.0221**	-0.0273***	-0.0427***
	0.0084	*0.008*	*0.0085*
zN	-0.0292 ***	-0.0256**	-0.0199*
	0.008	*0.0078*	*0.0081*
zO	0.1035 ***	0.0688***	0.0557***
	0.0084	*0.0084*	*0.0088*
livbothupto16			0.1072 ***
			0.0209
nsibs			-0.0225***
			0.0038
mother's education			0.0853***
			0.0097
inner city area			-0.1073***
			0.03
village, town, etc			-0.0905***
			0.0195
coh1960to70			0.0113
			0.0192
coh1971to90			-0.0074
			0.0218
cons	5.1127	4.9547	4.7976
	0.0079	*0.0116*	*0.0375*
lngamma			
cons	-1.0488	-1.0781	-1.1158
	0.012	*0.012*	*0.0129*
Nobs	6911	6911	5686

***, ** and * indicate significance at 0.1%, 1% and 5% level.
Standard errors in italics

the separate regressions.

Table 3 shows the results of the full model estimated separately for the less and more educated women. The first interesting thing to notice is that the coefficients of Conscientiousness and Neuroticism are significant in the less educated group but not in the more educated group. Then, more importantly, the personality traits that are significant in both groups are bigger, in absolute terms, in the more educated group.

To have a better grasp on the impact of personality traits in timing of motherhood, we performed some simulations for each of the models. Once again, we will focus on the Openness trait. Table 4 shows the estimated median survival

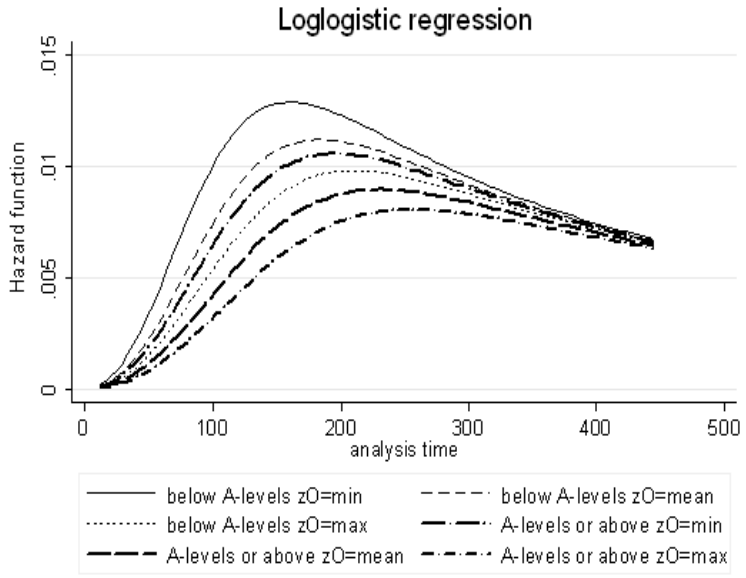


Figure 3: Estimated Hazard functions by educational group and level of Openness

time for different levels of Openness for a representative woman - that is, for a woman born before 1960, who lived with both parents up to the age of 16, who lived in a village, town, etc and for whom all the other covariates assume their mean value. In a way, this table conveys similar information to the one illustrated in fig.3: a low educated woman who scores the maximum value in Openness is predicted to have the first child later than a more educated woman that scores the minimum value in that trait (at 26 years and 5 months vs. 24 years and 9 months). The last two columns clearly show the bigger impact of Openness in the more educated group. Whereas for this group an increase in Openness from the 25th percentile to the 75th percentile increases time to first childbirth by roughly 9%, for the less educated group the increase is just 5%.

Finally, we calculated a measure of explained variation for use with censored survival data for each of the groups, with the purpose of comparing them. We will call it R-squared. This measure is intended for use with proportional hazard models. In non-proportional hazard models, as the one used here, this measure is not interpretable as a measure of explained variation. However, it can be used as an indication (see Royston, 2006 for details), and here it is used just for comparison purposes. We also calculated this R-squared using a Cox-model specification and the results are qualitatively the same.

As it can be seen in table 5, personality traits alone explain more variation in

Table 3: Estimates of the Log-logistic model for the less educated group and for the more educated group

	less educated		**more educated**	
Variable	mod.1	mod.2	mod.1	mod.2
zA	-0.043***	-0.0517 ***	-0.0545***	-0.0478***
	0.0123	*0.0128*	*0.0121*	*0.0125*
zC	0.04**	0.0412**	-0.014	-0.0048
	0.0122	*0.0127*	*0.0123*	*0.0127*
zE	-0.0232	-0.0299*	-0.0302**	-0.0527***
	0.0119	*0.0125*	*0.0111*	*0.0116*
zN	-0.0469***	-0.0347**	-0.0067	-0.0073
	0.0113	*0.0119*	*0.0108*	*0.0111*
zO	0.0432***	0.0376**	0.0925***	0.0762***
	0.012	*0.0126*	*0.0117*	*0.0121*
livbothupto16		0.1229***		0.072**
		0.0318		*0.0278*
nsibs		-0.0205***		-0.027***
		0.0049		0.006
mother's education		0.0867***		0.081***
		0.0184		*0.0113*
inner city area		-0.0761		-0.1164**
		0.0432		*0.0431*
village, town, etc		-0.0284		-0.1315***
		0.0321		*0.0243*
coh1960to70		-0.0217		0.0558*
		0.0304		*0.0245*
coh1971to90		-0.1601***		0.0882**
		0.0361		*0.0272*
cons	4.9508	4.7578	5.2265	5.032
	0.0122	*0.0616*	*0.0104*	*0.048*
lngam				
cons	-1.0516	-1.0977	-1.1091	-1.1433
	0.0172	*0.0188*	*0.0168*	*0.0178*
Nobs	3088	2413	3823	3273

***, ** and * indicate significance at 0.1%, 1% and 5% level.
Standard errors in italics

Table 4: Predicted median survival time for different levels of Openness

	min	p(25)	p(75)	max	max-min	p(75) - p(25)
low educated	132.82	142.72	150.24	159.79	26.98	7.52
high educated	139.32	168.06	182.67	202.72	63.40	14.61

timing of first child for the more educated women than for less educated women: the R's-squared are 2.01% and 1.3% respectively. A difference persists even when allowing for unobserved heterogeneity. These results suggest that our hypothesis that personality traits matter more for more educated women than for less educated women (in terms of childbearing timing) holds.

These figures may come across as quite small and one could be tempted to

Table 5: R-squared of the different models

set of covariates	less educated			more educated		
personality traits	x		x	x		x
family background		x	x		x	x
R-squared	0.0132	0.0184	0.0326	0.0201	0.0450	0.0594

say that, in the end, personality traits are unimportant in explaining timing of motherhood. Two remarks are in order here. First, even though the R-squared gives us some idea about the explained variation in the models, it can not be interpreted as a proper explained variation measure; and then, the R-squared of the model with the personality traits only is not terribly smaller than the one with just the traditional background variables (4.50% and 1.84%, for the more and less educated groups respectively) - and yet, the literature unanimously recognize family background as an important factor in explaining fertility timing. It would very interesting to contrast the R-squared of family background reported here with the R-squared of other studies on timing of childbearing but unfortunately that is not possible as they are never reported. So, it is not possible to ascertain whether such R-squared is standard, or if it is unusually small.

7 Discussion and Conclusions

Using the British Household Panel Survey, this paper assesses the role of the Big Five personality traits on timing of motherhood, thereby contributing to both the literature on fertility timing and to the recent strand of economics literature on non-cognitive skills.

By reinterpreting intrinsic preferences as personality traits, and by taking on board the idea that preferences are key in women's fertility choices, one can expect to see an association between personality traits and fertility timing. In fact, the estimates of a Log-logistic model presented here are evidence of such relationship. Whereas increases in Agreeableness, Extroversion and Neuroticism accelerate childbirth, increases in Conscientiousness and Openness delay motherhood.

The results on Agreeableness and Openness are in line with Miller's (1992) results on the determinants of childbearing motivation. He finds that Nurtu-

rance[24] has a significant positive relation with women's positive childbearing motivation whereas for Autonomy[25] the relation is negative. This seems to suggest that Agreeableness and Openness influence both childbearing motivation and behaviour. More agreeable women are more motivated to have a child and do it earlier; women who score high on Openness are less motivated to have a child and delay doing so.

Taking into consideration that Agreeableness includes traits such as altruism and tender-mindedness, the association between being agreeable and being keen on having children (and consequently giving birth early) is not surprising. As for the Openness trait, its positive relation with time to motherhood might be explained by the fact that "more open-minded" people are more autonomous in terms of their values i.e. they are ready to question the conventions, tend to undertake actions that are based on their own beliefs (Van der Zee et al., 2002) and tend to believe that it is good to think for oneself (Langston and Sykes, 1997). In that respect, more "open-minded" people might be less vulnerable to the social pressure for having children. Moreover, because people who score high on Openness usually have wide interests, they are less likely to be exclusively family-oriented. Consequently, they might value their careers more and therefore face higher psychological childbearing costs.

Miller (1992) does not find a significant association between Affiliation[26] and women's positive childbearing motivation, whereas we find a negative association between Extroversion and time to first childbirth.

The other aim of this paper was to investigate whether, and in what way, personality traits can explain the gap in maternity timing between more and less educated women. Very often researchers attempting to study the causal effect of education on fertility timing dwell with the potential endogeneity between education and career-orientation, the idea being that more career-oriented women self-select into education. The problem is, of course, that career-orientation is usu-

[24]Someone who scores high on this trait gives sympathy and comfort; assists others whenever possible; offers a helping hand to those in need - a trait related to Agreeableness.

[25]Someone scoring high on this trait tries to break away from restrains, confinement, or restrictions; enjoys being unattached, free, not tied to people, places, or obligations; may be rebellious - a trait associated with Openness

[26]Someone scoring high on this trait enjoys being with friends and people in general, accepts people readily, makes efforts to win friendships and maintain associations with people - related to Extraversion.

ally unobserved. Given that personality traits are correlated with both education and fertility decisions (and they are usually unobserved) they are another source of endogeneity. So, self-selection into education in terms of personality traits could be one of the explanations for the maternity timing gap between more and less educated women. Our results show that there is some self-selection into education in terms of Openness but that is not the whole story - the estimated coefficient of Openness in a model where education is added to the list of covariates is smaller that in a model where the set of covariates is composed of the personality traits only, but by no means is the effect of Openness washed away.

An alternative story to the one of selection would be that there is substantial heterogeneity, traits-wise, among less *and* more educated women but these differences in the personality traits manifest themselves more in the fertility behaviour of the more educated women. As a consequence, there would be a particular group among the more educated women (characterized by some personality traits) severely postponing childbirth. The results support this alternative story. First, personality traits explain more variation in timing of first birth for the more educated women than for less educated women. And then, within the more educated women, the moderate and highly "open-minded" face significantly lower hazards of childbirth.

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Table 6: Summary statistics

		Had child	Childless
highestQ (in %)		68.62	31.38
below A-levels	45.42	49.67	36.12
Above A-levels	54.58	50.33	63.88
edQpriorb1 (in %)			
below A-levels	53.64	61.65	36.12
A-levels or above	46.36	38.35	63.88
birth cohorts (in %)			
bornbefore1960	42.98	53.64	19.68
coh1960to70	23.33	28.74	11.50
coh1971to90	33.69	17.63	68.82
livbothupto16 (in %)	(nobs: 6250)		
no	19.76	18.85	22.39
yes	80.24	81.15	77.61
nsibs (in %)	(nobs: 6263)		
0	9.68	9.50	10.20
1	30.02	27.11	38.43
2	24.65	24.25	25.81
3 or more	35.65	39.14	25.56
mother's education (in %)	(nobs: 5851)		
never went to school	0.92	1.11	0.39
left school no quals	54.47	61.38	34.76
left sch w some qual	23.28	20.41	31.47
got further ed quals	17.02	14.15	25.21
got uni/highr degree	4.31	2.95	8.16
father's education (in %)	(nobs: 5584)		
never went to school	1.11	1.25	0.70
left school no quals	49.00	54.01	34.47
left sch w some qual	15.83	13.59	22.33
got further ed quals	27.15	25.83	30.98
got uni/highr degree	6.91	5.32	11.51
area lived in childhood (in %)	(nobs: 6265)		
inner city	9.91	10.74	7.52
suburban area	21.55	20.58	24.36
village, town, etc	68.54	68.69	68.12
age at last int			
min	15	16	15
25th perc	30	37	20
median	42	47	26
75th perc	56	59	40
max	75	75	75
age end studies	(nobs: 6270)		
min	5	5	13
25th perc	16	16	16
median	18	18	19
75th perc	23	24	22
max	75	75	70

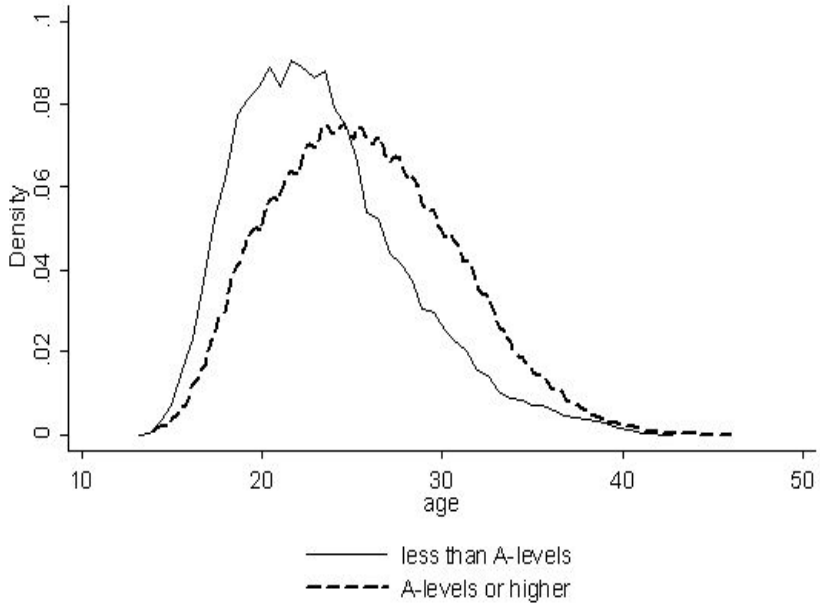

Figure 4: Age at motherhood by educational group

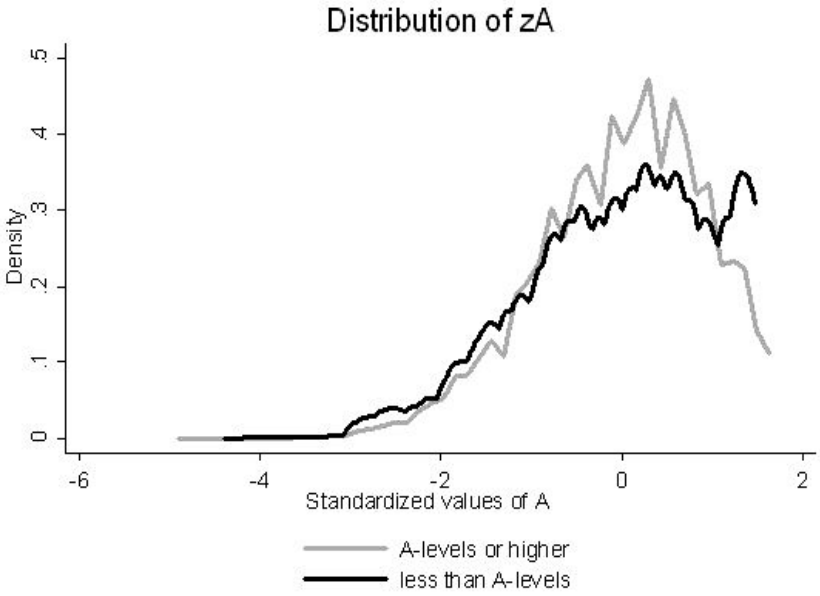

Figure 5: Distribution of 'Agreeableness' by educational group

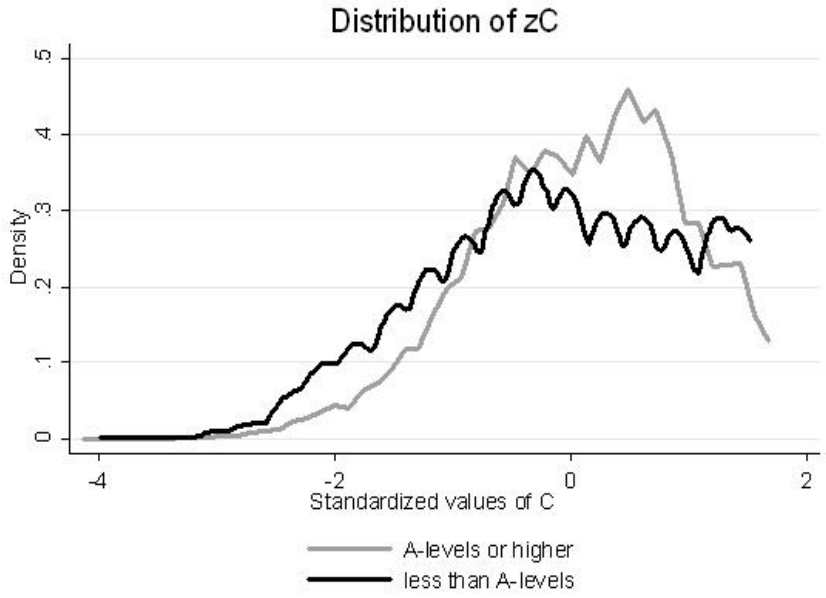

Figure 6: Distribution of 'Conscientiousness' by educational group

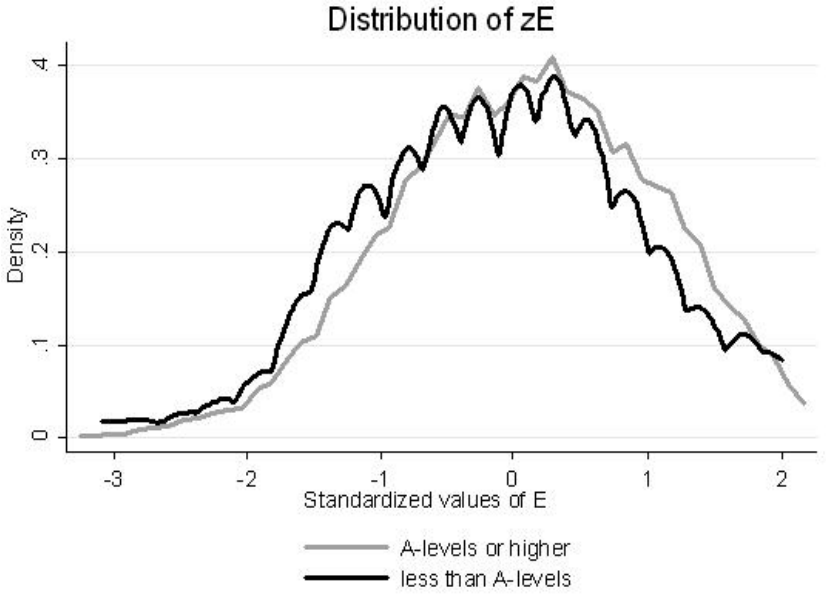

Figure 7: Distribution of 'Extraversion' by educational group

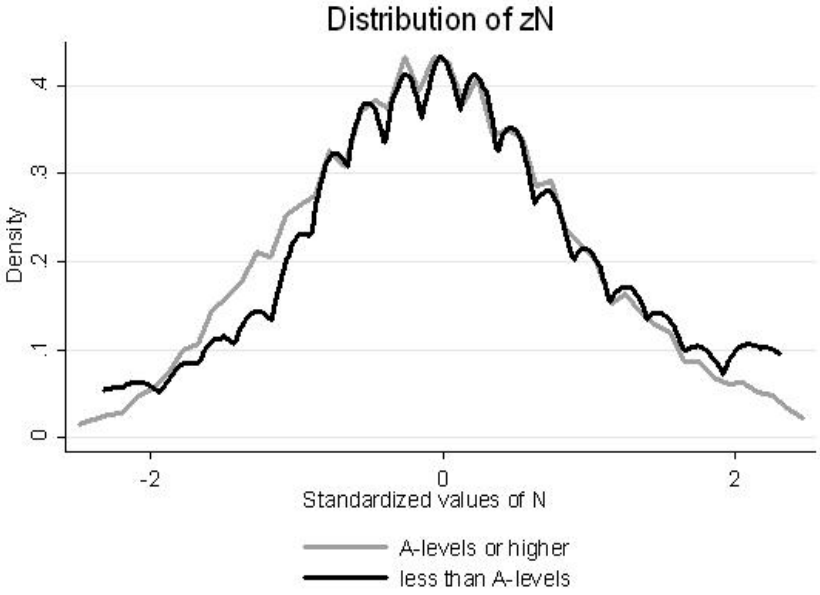

Figure 8: Distribution of 'Neuroticism' by educational group

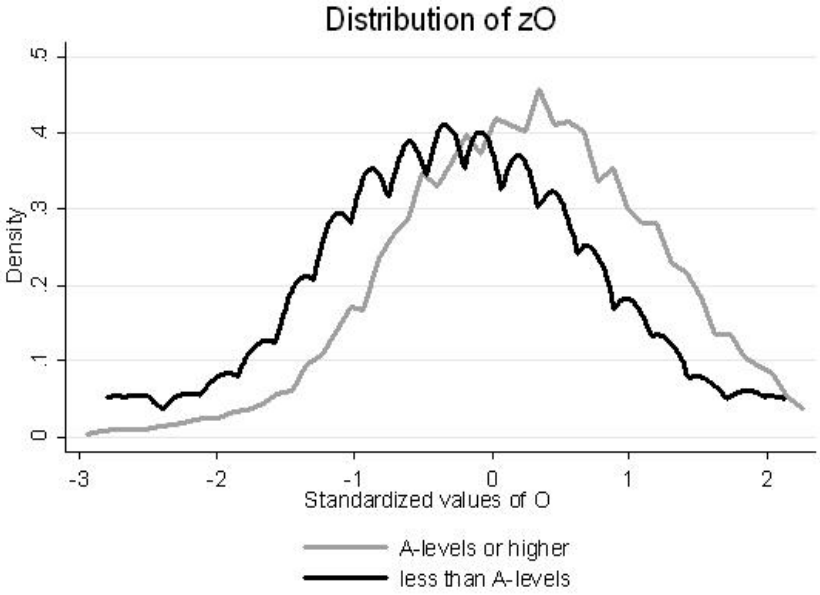

Figure 9: Distribution of 'Openness' by educational group

Table 7: Summary statistics (cont.)

		below A-levels	A-levels or above
For the mother's sub-sample	(nobs: 4868)		
age at first childbirth			
min	14	14	14
25th perc	21	20	22
median	24	23	25
75th perc	28	26	29
max	46	42	46
mean age at first childbirth	24.58	23.41	25.73
child born in a union (in %)	(nobs: 3575)		
no	19.22	21.69	16.93
yes	80.78	78.31	83.07
child conceived in a union (in %)	(nobs: 3565)		
no	31.61	37.49	26.15
yes	68.39	62.51	73.85
For the childless women's sub-sample	(nobs: 2226)		
think will have children (in %)	(nobs: 1976)		
no	19.13	23.92	17.57
varied over time	9.92	10.1	9.86
yes	70.95	65.98	72.57

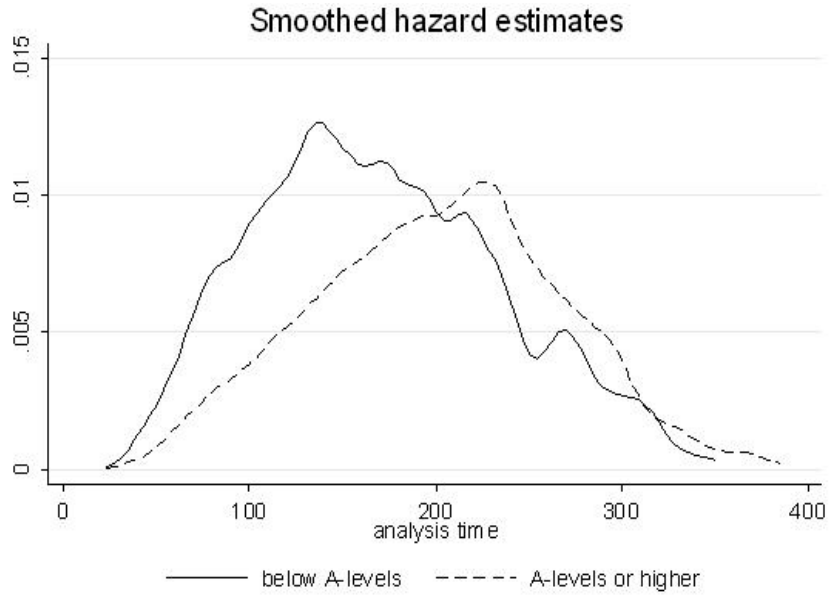

Figure 10: Non-parametric hazard functions by educational group