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

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Non-Technical summary

In many developed countries fertility rates are now too low for the population to replace itself from one generation to the next. In this context, fertility timings are particularly relevant, especially the age at first birth. Childbearing age has increased all over Europe. In England and Wales, for example, the mean age at first birth jumped from 25.2 in 1980 to 30.2 in 2006. Delaying motherhood has three potentially adverse effects on fertility. Firstly, it reduces the time-span for having more children; secondly, it may result in involuntary childlessness; and finally, it allows for downward revision of childbearing intentions.

Great part of the empirical literature sees education as one of the main driving forces of childbearing postponement. The idea is that more educated women face higher maternity costs than less educated women because they have to forgo higher wages or put on hold better careers when having a child. In this paper we use the British Household Panel Survey (BHPS) to explore other possible determinants. We assess the role of personality traits in timing of childbearing and 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 2005. The Big Five personality traits correspond to the following five main personality dimensions: Extraversion (vs Introversion), Agreeableness (vs Antagonism), Conscientiousness (vs Lack of Direction), Neuroticism (vs Emotional Stability) and Openness (vs Closedness to Experience). To the best of our knowledge there is no other study examining the relationship between the Big Five personality traits and timing of motherhood.

Given that nowadays women's fertility reflects, to a greater extent, their basic preferences and that personality traits are intimately related to individual's preferences, we expect to find an association between personality traits and fertility. Indeed, we find that whereas high levels of Agreeableness, Extroversion and Neuroticism accelerate childbirth, high levels of Conscientiousness and Openness are associated with childbirth postponement.

The nature of the relationship between education and postponement of fertility is far less clear. We explore two possible ways through which personality traits might help explain the fertility timing gap between more and less educated women: one is that some of the personality traits that drive some women to study more also influence their fertility behaviour; the other one is that individual differences in personality traits translate into variation in time to first birth especially among more educated women. Our results support both hypotheses i.e. on the one hand, personality traits influence both education and fertility decisions; on the other hand, more educated women do not equally delay childbirth compared with less educated women: the more "open-minded" ones postpone childbearing for longer.

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

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Using data from the British Household Panel Survey, this paper assesses the influence of personality traits on the 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. We estimate a log-logistic model of the time to first child birth and show that there is a statistically significant relationship between the Big Five personality traits and timing to motherhood. The results also show that within the more educated group, women who have an average to high score on Openness have lower hazards of childbirth.

Keywords: childbearing postponement, time to first childbirth, personality traits, Big Five

JEL classification: J13, I21, Z0

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INTRODUCTION

At the end of the 20^{th} century, fertility decline and sub-replacement fertility have become widespread and this development has been more persistent than in other periods in history (Morgan and Taylor, 2006). In this context, fertility timings are particularly relevant, especially the age at first birth. Delaying motherhood has three potentially adverse effects on fertility. Firstly, it reduces the time-span for having more children, and therefore it may reduce completed fertility (Kohler et al., 2002); secondly, it may also result in involuntary childlessness given that after the age of thirty the probability of a successful pregnancy decreases, even more so after the age of thirty-five (Leridon, 2004); finally, it allows for downward revision of childbearing intentions due to competing interests (Morgan and Taylor, 2006). In fact, Kohler, Billari and Ortega (2002) argue that the lowest-low fertility in Spain and Italy is highly associated with childbearing postponement, and recent evidence suggests that the slowing down of childbearing postponement in some countries is associated with a rise in total fertility rate (Sobotka, 2008).

Education has been seen as one of the main culprits of delayed motherhood. The trade-off between working career and motherhood is on the basis of this positive association between education and childbearing postponement. Since children demand a substantial time investment in their childcare and upbringing, the transition to motherhood entails two important opportunity costs, the current opportunity cost of the forgone wage during the period spent out of work, and the expected future cost associated with the forgone human capital accumulation due to the career interruption, which is bigger the steeper is the (concave) lifetime earnings profile and the earlier the work interruption occurs (Cigno and Ermisch, 1989). And so, given that more educated (or skilled) women are those expected to have steeper earning profiles, they are also expected to postpone childbirth more.

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. Ellwood et al. (2004) find that the costs of childbearing are vastly

higher for high skilled women, for whom the age-earnings profiles are steeper, and that having children later may reduce their costs. Van Bavel (2009) finds that both the starting wage and the steepness of the earnings profile are associated with postponement. Correll et al. (2007) not only provide evidence of the maternity wage penalty but also of hiring discrimination.

Many studies on childbearing postponement have focused on childbearing costs, more specifically on education for it is assumed to capture the higher opportunity costs of maternity. One remark is in order here. In most cases we only observe women's revealed preference i.e. the result of the weighting between childbearing costs and benefits. To assume that education is a mere proxy for childbearing costs is perhaps too simplistic; the level of education might also reflect the value of children. Moreover, looking at the effect of education on childbearing decisions thinking of education in terms of a proxy for childbearing costs and not taking into account the rewards of parenthood amounts to assume that women value children equally. This is clearly a strong assumption. Different women faced with the same costs might take different decisions because they value children differently or because they weight costs and rewards in a different way - in fact, what matters for decision making are the perceived costs and rewards. In other words, women's traits and attitudes should be taken into account. However, only a few studies do it (Miller, 1992; Kohler, 2005 and Von der Lippe, 2006).

The aim of this paper is twofold: the first aim is to assess the influence of personality in timing of childbearing. The measure of personality used is the Big Five personality traits. To the best of our knowledge there is no other study examining the relationship between the Big Five and timing of motherhood. The second aim is to investigate whether, and in what way, personality can explain the differences in maternity timing between more and less educated women.

FERTILITY AND PERSONALITY TRAITS

The trend of childbearing postponement which started in the U.S among the cohorts of the late 1930s, was then picked up by England and Wales and the Netherlands, and sooner or later by other European countries as well (Frejka and Sardon, 2006). Whereas in the U.S. the postponement process ceased, in Britain the age at first birth has been rising continuously since

the 70s, reaching 29.3 in 2007[1]- one of the highest average age at first birth in Europe. At the same time, Britain is the western European country with the highest teenager fertility rate and the only one which did not experience a significant decline in teenage fertility rates in the last thirty years, having that in common with the U.S. (Kaplan et al., 2004). All this makes Britain a particularly interesting country to look at when studying fertility timing.

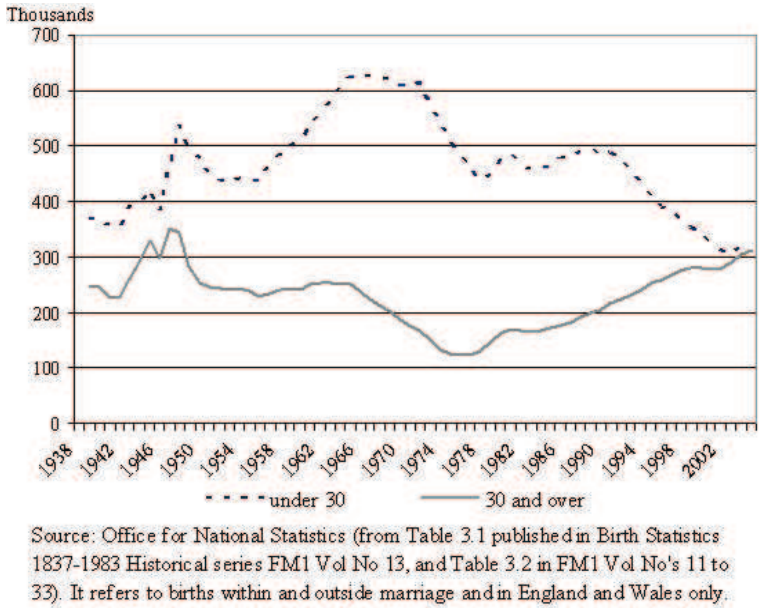

Figure 1: Live births by age group(1938-2004)

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 and higher order births. More recently, the decline in fertility has been mainly driven by a decline in first births and the trends of higher parities have leveled off since the 1980s (Sigle-Rushton, 2008). This suggests that following the 1960 cohort, the women who decide to become mothers did not change their behaviour so much. The biggest change has been the increase in childlessness. In Britain nearly one in five women in their mid forties (that is, those born around 1960) were childless in 2005 (Social trends 37, Office for National Statistics). Given that childlessness is one of the main determinants of the increase of inter-individual diversity

[1]Birth Statistics 2007, Series FM1 No.36. This is the standardized mean age at first birth which takes into account the effects of changes in population's age structure over time

in the number of children women have, the trends above suggest that the variability of number of children in Britain must have increased as it happened in the U.S. In fact, Shkolnikov et al. (2004) show that the proportions of women having half of children decreased from 0.30 (in the 1933-34 cohort) to 0.26 (in the 1958-59 cohort) in the U.S. and from 0.30 to 0.28 in England and Wales (for the 1944-45 cohort and the 1955-56 cohort, respectively). These countries are the ones where there is more variability in terms of the number of children women have.

These trends in fertility can be seen as part of the so-called Second Demographic Transition (Lesthaeghe and van de Kaa, 1986; van de Kaa, 1987). According to Van de Kaa and Lesthaeghe the declining fertility rates are associated with a transition to an individualistic family model, characterized by self-development, individual autonomy and gender equality. In other words, the change in values that resulted in a greater weight being given to individual preferences was one of the major determinants of the Second Demographic Transition. The idea is that in a new era in which women gained control over their fertility and in which social control weakened, having children became a matter of choice. Only from then on could women decide, according to their preferences and by assessing the benefits and costs of childbearing, whether or not to have a(nother) child. 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 acknowledge 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 basic traits are fundamentally stable, behaviours and attitudes can change.

Interpreting basic traits as preferences, the theories above suggest that personality traits must have gained explanatory power in terms of fertility behaviour. Using Danish twin data to study the intergenerational transmission of fertility Kohler et al. (1999, 2002) document moderate effects of shared family environment and low genetic effects, except for the cohorts experiencing the demographic transitions. They interpret their findings as suggesting that the weakening of social norms regarding childbearing over time gave room for genetically mediated differences (e.g. in personality) to be expressed as observed fertility outcomes. Given that

nowadays women's fertility reflect, to a greater extent, their intrinsic preferences and that personality traits are intimately related to individual's preferences, we expect to find an association between personality traits and fertility.

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. That being the case, how? The association between education and postponement of fertility is indisputable: more educated women delay motherhood compared with less educated women. Most studies do find evidence of a positive relationship between education and age at first birth (Wilkie, 1981; Rindfuss et al., 1996, Ermisch 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 might be spurious, as the paper by Billari and Phillipov (2001) so well argues. Cognitive ability, for example, which is known to be associated with education might also be related to timing of childbearing (Retherford and Swell, 1989; Shearer et al., 2002). Another example is career-orientation: if more career-oriented women strive to obtain more education, and if that characteristic also leads them to delay childbearing, then education would be endogenous (Bratti, 2006). In fact, the thorough review of the empirical psychological literature on women's career development by Phillips and Imhoff (1997) conveys precisely the idea that women's decisions about career and family are highly intertwined and that they are shaped quite early in women's lives.

Some studies try 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 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 postponement only for women for

whom the reform is binding, and therefore would have had their first child at young ages. Since these results suffer from low external validity they do not provide an overall explanation for the observed relationship between educational qualifications and childbearing postponement. The results of Rodgers et al. (2008), who use a behaviour genetic model, suggest that differences in education (and cognitive ability) amongst sisters in the same family are not causally related to differences in age at first birth. Taken together the available evidence suggests that selection is one important mechanism behind the association between education and fertility.

However, there might be other explanations as well. 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, and maybe even more so (Weston et al., 2004; Heiland et al., 2005; Yu, 2006).[2] This might be particularly true for the younger generations for whom completing secondary school is rather common. In other words, the extension of the educational system weakened selection into education.

More educated women are usually considered as a homogeneous group, sharing the same career prospects and childbearing costs. However, there is no reason to assume homogeneity among more educated women in what concerns their attitude towards children. It is not reasonable to assume that highly educated women value children equally. 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 differences in the education field are associated with important fertility differences among women with the same education level. Hoem et al. (2006), who study the relationship between education field and childlessness, find that women with qualifications in teaching and health care have a much lower permanent childlessness, at each educational level, than women in any other major grouping and that women educated in arts and humanities have unusually high fractions of permanent childlessness. This illustrates the point that there might be substantial heterogeneity among more educated women in what childbearing behaviour is concerned.

[2]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 'Data'.

In fact, there is evidence of higher inter-individual variation in births among more educated women (Shkolnikov et al., 2004). But is there evidence on heterogeneity in terms of timing of motherhood? Sullivan (2005) found that it was heterogeneity across racial groups that better explained the bimodal pattern of hazard of first births observed in the U.S. in the beginning of the 1990s, but as far as education is concerned there is no evidence. However, there are good reasons to expect more educated women to be more heterogeneous in terms of timing of motherhood. The argument is as follows: being childlessness one of the factors behind the increase in the average inter-individual variation in births (Kohler et al., 1999 and Shkolnikov et al., 2004), and strongly related to severe childbearing postponing, it is plausible that highly educated women have a more disperse distribution of age at first birth. Indeed, our data confirms it (see following section).

Kohler and Rogers (2003) show that the overlapping sources of genetic influences on education and fertility are relatively small. As such, it could be that the personality traits that play a role in selection into education have no bearing in fertility decisions, in which case we would expect more and less educated women to be similar in terms of the personality traits that matter in terms of fertility preferences. That being the case, personality traits (alone) would not contribute to explain the fertility timing gap *between* more and less educated women. However, if differences in personality *manifest* themselves more in the fertility behaviour of more educated women - perhaps because they are less subject to the social pressure of having children - that is to say, if there is a mismatch between the preferences and behaviour of less educated women in that for these women delaying is not so socially acceptable and therefore they do not it as much regardless of their intrinsic preferences, then personality would play a part in the explanation for the timing gap between the two educational groups. This would be consistent with more heterogeneity in terms of fertility timing among more educated women.

So, another possible explanation for the fertility timing gap between more and less educated women is that the *average* age at motherhood among more educated women is being pushed up by a particular type of more educated women who are severely postponing childbirth - as opposed to resulting from more educated women behaving more or less alike, all delaying childbearing compared with less educated women.

Summing up, a priori there are two possible ways through which personality traits might help explain 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 selection story); the other one is that heterogeneity in personality traits translates into variation in time to first birth especially among more educated women, in which case personality traits should matter more for highly educated women.

DATA

This analysis makes use of 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 provides 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.

In 2005, the BHPS asked 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. Finally, only women aged between 18 and 75 by the time of the last interview were included in the sample. The women younger than 18 were excluded to ensure that all women in the sample could have obtained the high school certificate, and the women older than 75 were excluded to minimize potential recall errors. So, the final sample consists of 6,596 women.

The majority of the women in the sample (71%) had a child (Table 5 in the appendix). Among the mothers, the mean age at first birth is 24.6 years old . As expected more educated

women (those with high school certificate or higher educational qualifications) have their first child later - there is a 2 years gap between the two educational groups (Table 6 in the appendix). The distribution of age at motherhood for the less educated women (who did have a child) is quite concentrated at young ages, whereas the distribution for the more educated women seems to be more dispersed (Figure 2).

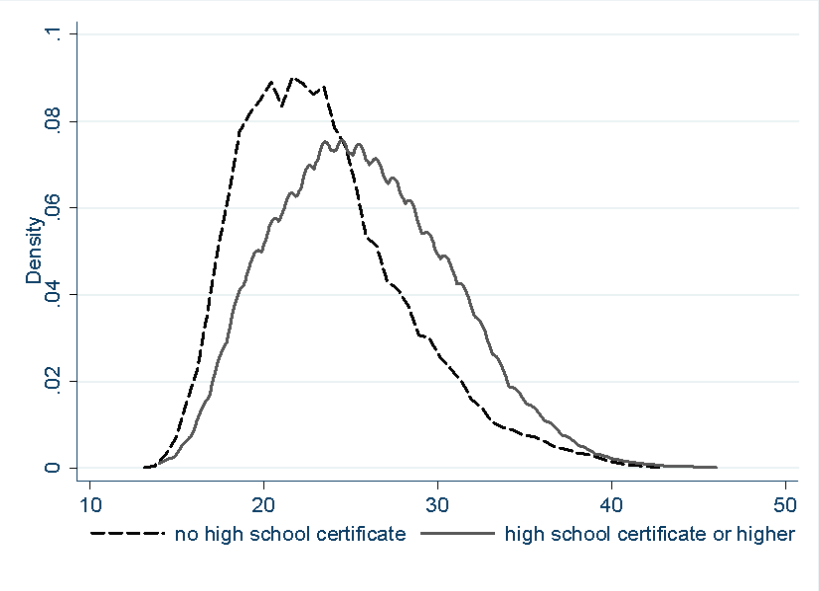

Figure 2: Age at motherhood by educational group

In fact, the standard deviation of age at motherhood is bigger for the more educated group (5.02 vs 4.68) 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 against the hypothesis that the standard deviation is bigger for the more educated group.[3] The data show very clearly that childlessness is particularly prevalent in the more educated group. Whereas the mothers are evenly split between the two educational qualifications groups, among the childless women more than 70% have at least an high school certificate (Table 5 in the appendix). However, when childless woman are asked if they think they will have children, the percentage saying 'yes' is higher among the more educated women (Table 6 in the appendix).[4]

[3]We used this test statistic instead of the traditional F-test because this variable is not normally distributed and Levene's test statistic is robust under nonnormality.

[4]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 about future childbearing on education

Education is a dummy variable that assumes value 1 if the highest level of education qualifications ever obtained is high school certificate or higher qualifications, and 0 otherwise.[5] Ideally, we would use the education level before childbirth, as this event might truncate women's educational attainment. As is this is unobservable we have to assume that the observed educational qualifications were obtained before childbirth. This is not an unreasonable assumption as for most women childbearing does follow the end of formal education (Kiernan, 1980; Blossfeld and Huinink, 1991) and the highest educational qualifications considered are not just higher education qualifications but also high-school graduation.

The Big Five: a 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 main domains of personality are extracted from a larger set of more specific personality characteristics.[6] According to this 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.

qualifications and age still show this positive association between education and the expectation of having a child.

[5] What here is called high school certificate is in fact the A-levels, which 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.

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

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 it 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).[7]

The genetic influence on personality is one of the main mechanisms of continuity over the life course. 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. When looking at continuity throughout adulthood, the empirical evidence is that personality is 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. This is one of the main mechanisms thought to produce changes in personality (Alea et al., 2004). However, individuals tend to respond to the environment in a way that it is consistent with their existing personality and so, the person-environment interactions 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.

One can think that the Big Five capture personality in the same way Spearman's g is used

[7] Although 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); it is not to be confounded with parents-offspring correlation (Loehlin, 2005)

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-intellectual 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: Goldberg's 100-item Trait Descriptive Adjectives (TDA), 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 a 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).[8]

[8]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.

The Big Five in the BHPS

Due to time constraints a short version of the well-established 44-item BFI was used in the BHPS, the BFI-S.[9] 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 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 obtained from the BFI-S questions - as measured by the values of the Cronbach's alpha[10] - is not impressive, this should not be of great concern because it results from the small number of items used to assess each trait.[11] In fact some researchers argue that alphas are misleading when calculated on scales with a small number of items (Gosling, 2004). Short instruments like the BFI-S are meant to optimize validity and not reliability.

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 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 distribution of Conscientiousness for the more educated group is more left-skewed than the distribution for the less educated group, reflecting the well-known association between that trait and educational attainment. As for the Openness trait the distributions are similar for the two groups, but the one of the more educated group is shifted to the right. The distributions of the other three personality traits, by educational groups, are even more similar thus

[9]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).

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

[11]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.

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

corroborating the hypothesis that the two groups of women are not very different, trait-wise (the distributions of personality traits by educational group can be found in the appendix)

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 personality traits are fundamentally stable, this might create biases and a reverse causality problem. 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. So, as an attempt to overcome the potential biases and reverse causality problem, we are going to focus mainly on Openness when looking at the results because this trait decreases with age. Given the positive correlation between Openness and time to first childbirth, and that the observed variance of Openness is expected to be bigger than the one we would have were women's personality traits to be measured before childbirth, we expect our estimated coefficients to be downward biased. We expect the observed variance of Openness to be bigger than the one we would have were women's personality traits to be measured before childbirth (and therefore younger) because with age some women become less

'open-minded'. In fact, Figure 3 shows that the distribution of Openness for the oldest cohort is more disperse than the others precisely because of the higher concentration of observations at the bottom of the distribution.[12] By focusing on Openness, 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.

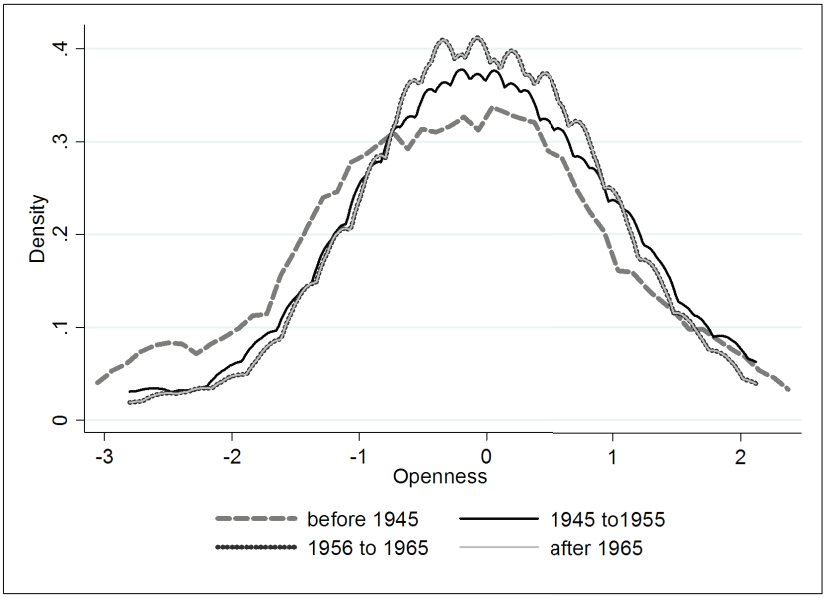

Figure 3: Distribution of 'Openness' by cohorts

STATISTICAL MODEL

Since our aim is to explain time to first birth, we will use a duration model. This kind of model, unlike the linear or logistic models, takes 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 experiencing 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

[12]Tests on the equality of variances between cohorts confirm that the variance of Openness decreases from the oldest cohort to the youngest, and that the differences are statistically significant.

menarcheal age, we will set it to 13 years old.[13] The duration time ends with whichever event happens first: the first child is born, the end of the study (those are the right-censored cases) or the 50th birthday, by assumption the age at menopause.[14]

The survival times used here come the fertility history of the BHPS respondents, and is measured in months. The survival times can be treated as observations on a continuous or discrete random variable according to the underlying behavioral process that generates them. Another aspect to take into consideration when deciding the nature of the variable - whether continuous or discrete - is the process by which the data were recorded, as one can have observations on an intrinsically continuous random variable that are recorded in a grouped form. In this case, it is appropriate to use a continuous specification provided that 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 incidence rate (0.0041743), we chose a continuous specification.[15]

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.[16] In this model the hazard function can be non-monotonic and therefore can accommodate the hazard suggested by the literature and by the shape of the Kaplan-Meier estimate of the empirical hazard (see Figure 10 in the appendix). The model specification was based on several tests and the choice of the

[13] 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.

[14] Based on data on age at menopause obtained for 26 countries (there is no data specifically for Britain), Thomas et al. (2001) calculated the mean age of menopause to be 49.24 years (SD 1.73).

[15] 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%

[16] The distribution of ϵ follows from the assumption that the survival time follows a Log-logistic distribution

log-logistic, in particular, was determined by the AIC.[17]

In the full-model the vector of covariates, X, includes the highest educational qualifications attained, the standardized personality traits, 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).[18]

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 estimate equation (1) for the two groups separately.

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 personality traits are statistically significant (at the 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 the 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 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 know from the literature, education is associated with delaying childbirth. Every thing else

[17] 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.

[18] To test for a potential omitted variables problem we also run the model allowing for unobserved heterogeneity (frailty) and the estimated coefficients are very similar.

equal, the estimated survival time for more educated women (high school certificate or higher qualifications) is 1.32 times bigger than the one for less educated women.[19]

Table 2: Estimates (whole sample)

	(1)	(2)	(3)
agreeableness	-0.063***	-0.047***	-0.048***
	(0.009)	(0.009)	(0.009)
conscientiousness	0.019*	0.015	0.020*
	(0.009)	(0.009)	(0.009)
extroversion	-0.023**	-0.028***	-0.043***
	(0.008)	(0.008)	(0.009)
neuroticism	-0.029***	-0.025**	-0.020*
	(0.008)	(0.008)	(0.008)
openness	0.103***	0.068***	0.056***
	(0.008)	(0.008)	(0.009)
highest qualifications		0.276***	0.197***
		(0.016)	(0.017)
intact family			0.107***
			(0.021)
sibs			-0.022***
			(0.004)
mother's education			0.085***
			(0.010)
suburban area			ref
inner city area			-0.107***
			(0.030)
village, town, etc			-0.090***
			(0.020)
born before 1960			ref
cohort 1960-1970			0.011
			(0.019)
cohort 1971-1990			-0.008
			(0.022)
constant	4.953***	5.112***	4.798***
	(0.012)	(0.008)	(0.037)
ln gamma			
constant	-1.075***	-1.047***	-1.116***
	(0.012)	(0.012)	(0.013)
Observations	6596	6596	5678

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

However, not everything is equal i.e. family background is an important determinant of educational attainment. So, not surprisingly, when all family background variables and cohort dummies are added (mod.3), the "effect" of education qualifications on timing of motherhood weakens. The personality traits' coefficients also change but not nearly as much. Interestingly, the estimated coefficients of Agreeableness, Conscientiousness and Extroversion become bigger. For the full model (mod.3), the estimated median survival time is 166.94 months, which means

[19]This is the so-called time ratio, i.e. exp(0.276).

that the estimated median age at first birth is 26 years and 11 months. [20]

By specifying the distribution of survival time we are implicitly specifying the hazard function. Therefore, we can estimate the hazard function and obtain an approximation to the probability of having survived exactly t months conditional on having survived until then.

Figure 4 shows the estimated hazards calculated using different values for some of the covariates (educational group and Openness trait), while all the other covariates are set at their mean.

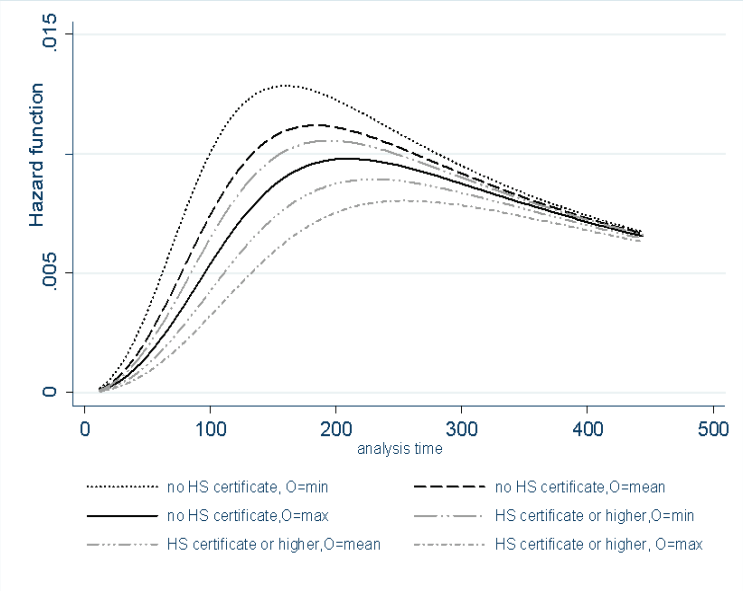

Figure 4: Estimated hazard functions by educational group and level of Openness

Besides showing that more educated women delay childbirth compared with 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).

[20] Given that the event is not certain to occur (a woman may remain forever childless) the survival time T can be undefined. For this reason we can not calculate the mean age at childbirth. However, we can calculate the median age at childbirth provided we define it as age at which half of the population has had a child (Rodriguez, 2008).

Estimates from separate regressions

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 the separate regressions.

Table 3 shows the results of the full model estimated separately for 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 effects of the personality traits that are significant in both groups are bigger, in absolute terms, in the more educated group.

Table 3: Estimates from separate regressions

	less educated		**more educated**	
	(1)	(2)	(1)	(2)
agreeableness	-0.043***	-0.052***	-0.054***	-0.048***
	(0.012)	(0.013)	(0.012)	(0.012)
conscientiousness	0.041***	0.041**	-0.014	-0.005
	(0.012)	(0.013)	(0.012)	(0.013)
extroversion	-0.025*	-0.030*	-0.030**	-0.053***
	(0.012)	(0.012)	(0.011)	(0.012)
neuroticism	-0.047***	-0.035**	-0.007	-0.007
	(0.011)	(0.012)	(0.011)	(0.011)
openness	0.041***	0.038**	0.093***	0.076***
	(0.012)	(0.013)	(0.012)	(0.012)
intact family		0.123***		0.072**
		(0.032)		(0.028)
sibs		-0.021***		-0.027***
		(0.005)		(0.006)
mother's education		0.086***		0.081***
		(0.018)		(0.011)
suburban area		ref		ref
inner city area		-0.076		-0.116**
		(0.043)		(0.043)
village, town, etc		-0.028		-0.131***
		(0.032)		(0.024)
born before 1960		ref		ref
cohort 1960-1970		-0.022		0.056*
		(0.030)		(0.024)
cohort 1971-1990		-0.161***		0.088**
		(0.036)		(0.027)
constant	4.950***	4.759***	5.225***	5.032***
	(0.012)	(0.062)	(0.010)	(0.048)
ln gamma	-1.046***	-1.097***	-1.108***	-1.143***
constant	(0.017)	(0.019)	(0.017)	(0.018)
Observations	2827	2408	3769	3270

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

In order to test the hypothesis that personality traits matter more for the highly educated women, we calculated a measure of explained variation for use with censored survival data for each of the groups - we will call it R-squared.[21] 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. [22]

As it can be seen in table 4, personality traits alone explain more variation in the timing of first child for the more educated women than for less educated women: the R's-squared are 2.0% and 1.3% respectively.[23] These results give support to the hypothesis that personality traits matter more for more educated women than for less educated women (in terms of childbearing timing).

Table 4: R-squared of the different models by educational group

set of covariates	less educated	more educated
personallity traits only	0.0129	0.0201
family background only	0.0197	0.0433
personallity traits and family background	0.0326	0.0594

These figures may come across as quite small and one could be tempted to 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 cannot be interpreted as a proper explained variation measure; and then, the R-squared of the model with personality traits only is not much smaller than the one with just the traditional background variables (4.3% and 2.0%, 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-

[21] This explained variation statistic, developed by Royston (2006), is calculated as $R^2 = \frac{V}{\pi^2/6+V}$, where $V = \frac{\rho_k^2}{1-\rho_k^2}$ and $\rho_k^2 = 1 - exp(-X^2/e)$. X^2 is the likelihood statistic for comparing the model with index $X\beta$ with the null $X\beta = 0$, which follows a χ^2 on $dim(\beta)$ degrees of freedom under the null that $\beta = 0$, and e is the number of events. The idea is to use ρ_k^2 to approximate other explained variation statistic for the proportional models which is very complex but correcting for the bias in this measure when there is a large amount of censoring.

[22] We also calculated this R-squared using a Cox-model specification and the results are qualitatively the same.

[23] A difference persists even when allowing for unobserved heterogeneity.

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.

DISCUSSION AND CONCLUSIONS

Using data from the British Household Panel Survey, this paper assesses the influence 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 literature on non-cognitive skills.

By interpreting personality traits as intrinsic preferences, 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 high levels of Agreeableness, Extroversion and Neuroticism "accelerate" childbirth, high levels of Conscientiousness and Openness are associated with childbirth postponement.

The results on Agreeableness and Openness are in line with Miller's (1992) results on the determinants of childbearing motivation. He finds that Nurturance[24] has a significant positive relation with women's positive childbearing motivation whereas for Autonomy[25] the relation is negative. This suggests 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 (sympathy for others), 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

[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 restraints, confinement, or restrictions; enjoys being unattached, free, not tied to people, places, or obligations; may be rebellious - a trait associated with Openness

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.

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 on 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 usually unobserved. Given that personality traits (usually unobserved) are correlated with both education and fertility decisions they are another potential source of endogeneity. So, 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 indeed some selection into education in terms of Openness but that is not the whole story. When education is added to the list of covariates the estimated coefficient of Openness goes down when compared to a baseline model where the set of covariates is composed of the personality traits only, but by no means is the effect of Openness washed away.

Another possible story is that there is substantial heterogeneity, traits-wise, among less *and* more educated women but these differences in personality 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 hypothesis. 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 group, women who have an average to high score on Openness have lower hazards of childbirth.

Summing up, our results show that personality traits contribute to the differences in fertility timing between more and less educated women in two different ways: first, personality traits influence both education and fertility decisions; and second, some highly educated women - the

more “open-minded” - severely postpone childbearing and therefore they push up the average age at first birth within the group of more educated women thereby creating a fertility timing gap between more and less educated women.

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APPENDIX

Table 5: Summary statistics

		Had a child	Childless
		71.4	28.6
highest qualifications (in %)			
no high school certificate	42.9	48.8	28.0
high school certificate or higher	57.1	51.2	72.0
birth cohorts (in %)			
born before1960	44.3	53.1	22.3
cohort 1960 to1970	24.7	29.1	13.6
cohort 1971 to 1990	31.0	17.8	64.1
intact family (in %)	(obs: 6069)		
no	19.6	18.8	22.2
yes	80.4	81.2	77.8
sibs (in %)	(obs: 6082)		
0	9.7	9.5	10.0
1	30.3	27.4	38.5
2	24.7	24.3	26.0
3 or more	35.4	38.9	25.5
mother's education (in %)	(obs: 5694)		
never went to school	0.9	1.1	0.3
left school with some qualifications	54.0	60.9	34.6
left school with no qualifications	23.6	20.8	31.6
got further education qualifications	17.2	14.2	25.4
got univerity or higher education degree	4.4	3.0	8.1
father's education (in %)	(obs: 5430)		
never went to school	1.1	1.3	0.7
left school with some qualifications	48.6	53.6	34.3
left school with no qualifications	15.9	13.7	22.3
got further education qualifications	27.4	26.0	31.2
got univerity or higher education degree	7.0	5.4	11.5
area lived in childhood (in %)	(obs: 6084)		
inner city	9.9	10.8	7.3
suburban area	21.9	20.9	24.6
village, town, rural or countryside, moved around	68.3	68.3	68.1
age at last interview			
min	18	18	18
25th percentile	32	37	22
median	43	47	28
75th percentile	56	58	43
max	75	75	75
age ended studies	(obs: 5954)		
min	5	5	13
25th percentile	16	16	17
median	18	18	19
75th percentile	23	24	22
max	75	75	70

Table 6: Summary statistics by women's educational level

	no high school certificate	high school certificate or higher
mother's sub-sample		
age at first childbirth		
min	14	14
25th percentile	20	22
median	23	25
75th percentile	26	29
max	42	46
mean age at first childbirth	23.4	25.7
child born in a union (in %)	(obs: 1637)	
no	21.5	16.9
yes	78.5	83.1
child conceived in a union (in %)	(obs: 1635)	
no	37.7	26.2
yes	62.3	73.9
childless women's sub-sample		
think will have children (in %)	(obs: 1976)	
no	24.2	17.7
varied over time	10.4	9.8
yes	65.5	72.5

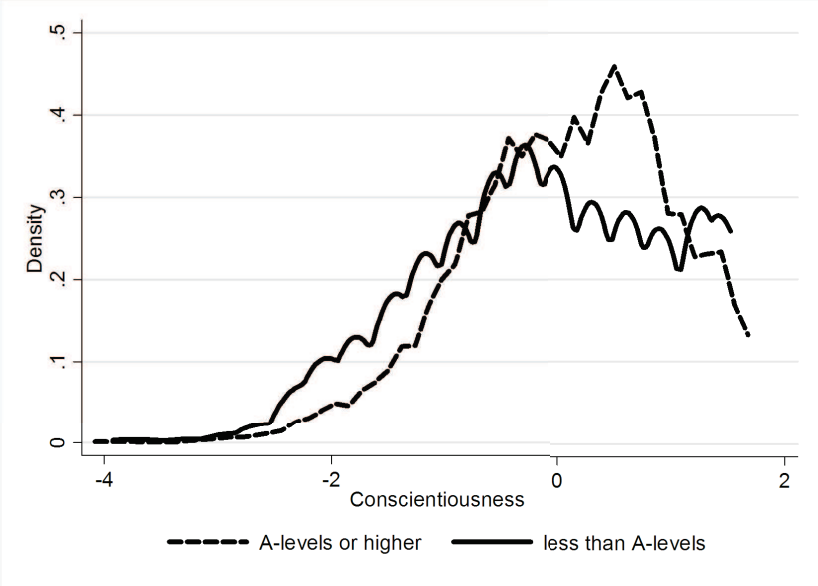

Figure 5: Distribution of 'Conscientiousness' by educational group

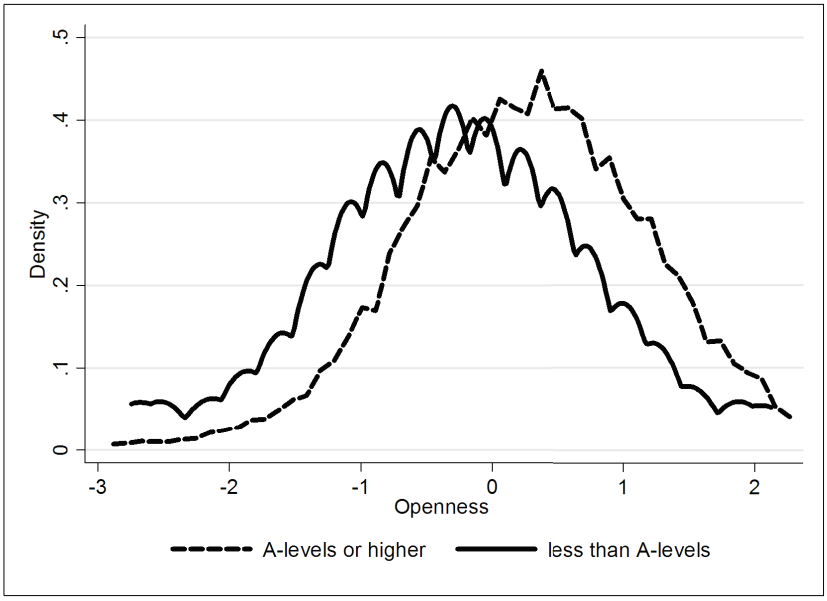

Figure 6: Distribution of 'Openness' by educational group

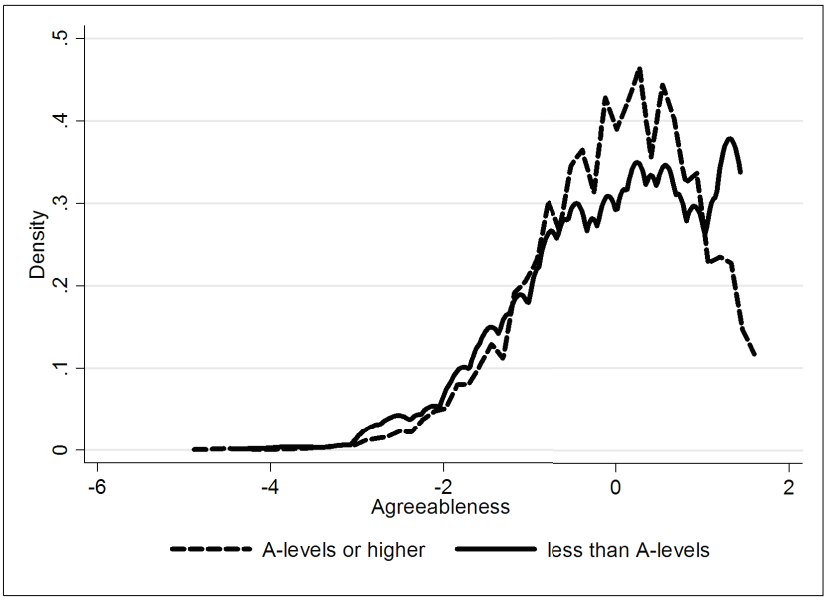

Figure 7: Distribution of 'Agreeableness' by educational group

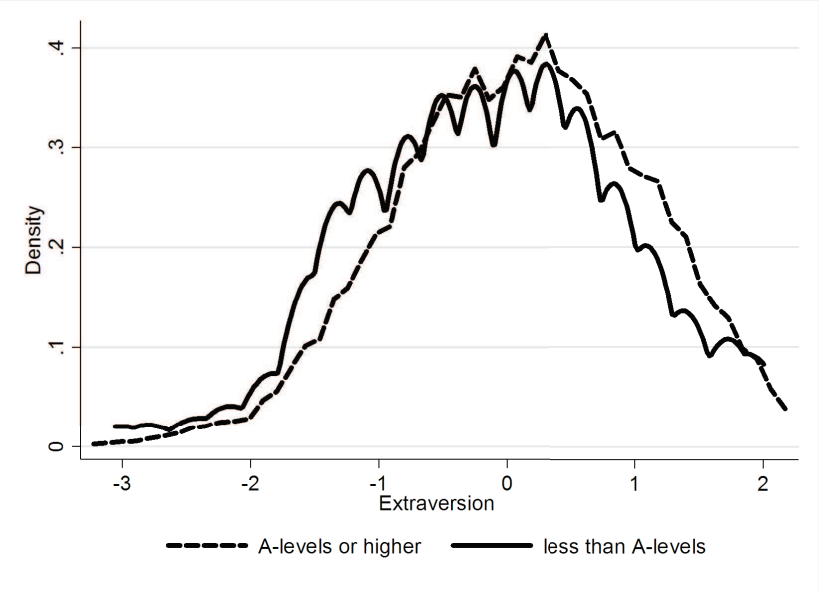

Figure 8: Distribution of 'Extraversion' by educational group

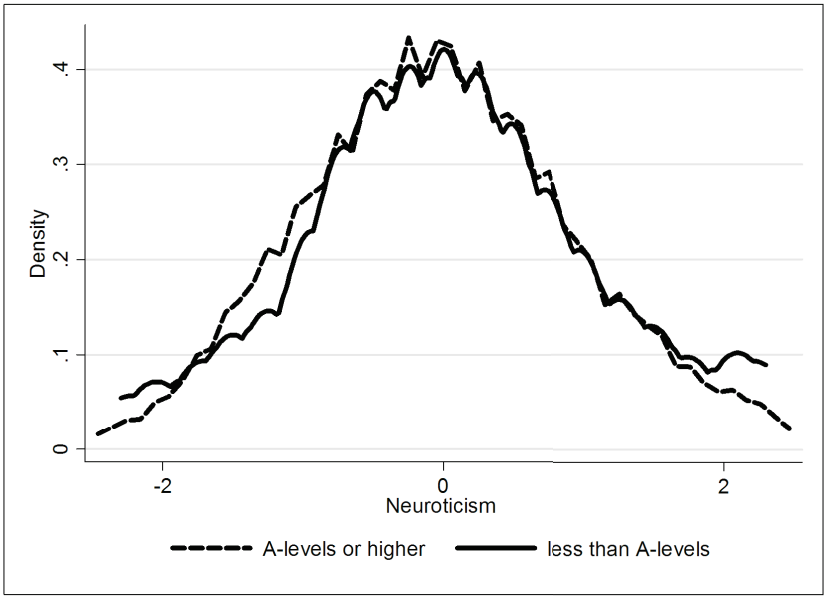

Figure 9: Distribution of 'Neuroticism' by educational group

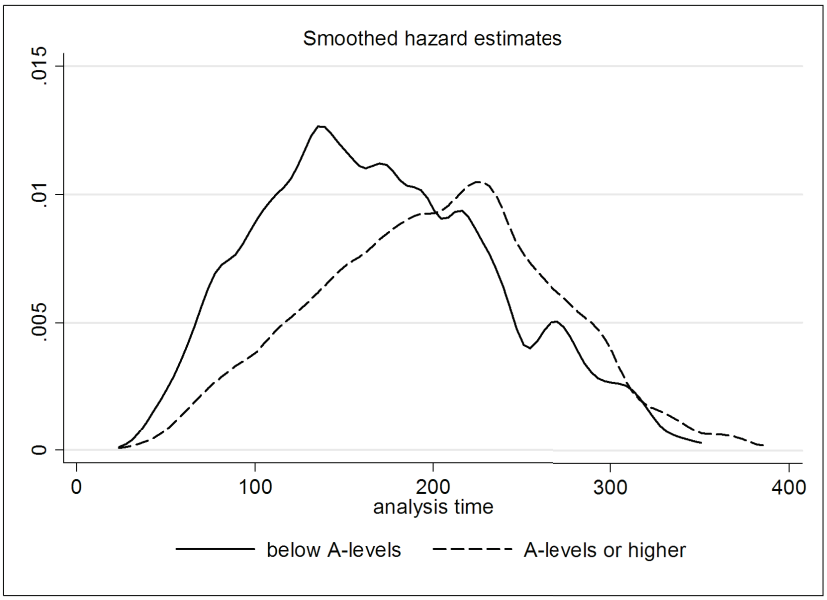

Figure 10: Non-parametric hazard functions by educational group