ISSN 2042-4116

ESRC Centre for Population Change • Working Paper 62 • May 2015

CPC

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Couple socioeconomic gender equality and fertility: A Bayesian analysis

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E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

ABSTRACT

Connections between couples' socioeconomic status and fertility have recently attracted noticeable attention, especially in the context of ongoing changes in gender roles and a growing variety of family models. Although gender differences have been examined quite deeply, couples' procreative behaviour treated as a mutual result of male and female socioeconomic characteristics remains under-researched. Previous studies have suggested that the proper inference about procreative behaviour of a couple should be performed not only by analysing the characteristics of both parents, but also by, at the same time, considering the childless population. Therefore, the aim of this study is to investigate couples' procreative behaviour with regard to the gender socioeconomic (in)equality between partners, taking into account that the behavioural drivers could differ among parents and childless couples. The Bayesian Zero-Inflated Poisson framework, which allows considering two states (childlessness and parenthood) within one statistical model, is applied. The empirical illustration is based on the Generations and Gender Survey (GGS) dataset. The results show that including characteristics of both partners significantly improved the ability to describe fertility behaviour. Additionally, using other couple socioeconomic characteristics besides level of education, such as educational field and occupation, provided greater detail and gave greater explanatory power to couple's reproductive behaviour. In particular, the overall level of socioeconomic status was found to have a negative influence on fertility timing, but a U-shape relationship with completed family size.

KEYWORDS

Couples' fertility; couples' reproductive behaviour; socioeconomic status; gender equality; Bayesian methods in demography; Zero-Inflated Poisson.

EDITORIAL NOTE

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ACKNOWLEDGEMENTS

The study is a part of the PhD project "Bezdzietność i rodzicielstwo par a ich status społeczno-ekonomiczny w wybranych krajach europejskich – analiza bayesowska" ("Couples' childlessness and parenthood as a result of both partners' socioeconomic status in selected European countries – Bayesian analysis"), no. DEC-2013/11/N/HS4/03144, financed by a National Science Centre, Poland.

The study was presented at the CPC Seminar on 8 Jan 2015. The Author is highly grateful to colleagues for all comments and suggestions which arose during the meeting.

ESRC Centre for Population Change

The ESRC Centre for Population Change (CPC) is a joint initiative between the Universities of Southampton, St Andrews, Edinburgh, Stirling, Strathclyde, in partnership with the Office for National Statistics (ONS) and the National Records of Scotland (NRS). The Centre is funded by the Economic and Social Research Council (ESRC) grant numbers RES-625-28-0001 and ES/K007394/1.

This working paper series publishes independent research, not always funded through the Centre. The views and opinions expressed by authors do not necessarily reflect those of the CPC, ESRC, ONS or NRS.

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COUPLE SOCIOECONOMIC GENDER EQUALITY AND FERTILITY: A BAYESIAN ANALYSIS

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1. INTRODUCTION

Scientific interest in the association between socioeconomic status and fertility has so far focused mainly on women, while little is known about men and even less about couples. The common view is that increased female socioeconomic resources are negatively correlated with childbearing, while social and economic success may positively influence fertility among men. The empirical findings, however, are more complicated and inconsistent. Among others, Barthold et al. (2012) pointed out that these opposite effects of socioeconomic prospects on procreative behaviour are caused by socioeconomic sex-specific associations with childlessness, namely, the subpopulation of childless men with low socioeconomic status have a high risk of being childless, while the opposite is true for women. Excluding childless men from the analyses and investigating only fathers, led to the same association as found among women i.e. negative correlation. In turn, the results obtained for women were the same among a subpopulation of childless females as among mothers (Fieder and Huber 2007, Barthold et al. 2012). These findings suggest that the childless make fertility decisions based on different incentives than parents and therefore should be treated separately.

An important limitation of previous studies of the socioeconomic determinants of fertility is that they have mainly concentrated on the effect of educational level. Although education very often seems to be an efficient proxy of the socioeconomic status of an individual (especially in historical populations), in recent years, with the increase in the proportion of highly educated people, this feature is no longer a guarantee of a high economic status, and vice versa (van Bavel 2012). Therefore, expanding analyses by using other social and economic characteristics, such as educational field or occupation, could shed light on the complexity of results (see, e.g., Begall and Mills 2013, Gayle et al. 2015).

Furthermore, there has been a lack of studies that investigate the association between couple fertility and the socioeconomic characteristics of *both* partners together (with a few exceptions, see; Jalovaara and Miettinen 2013 on first birth; Andersson and Scott 2007 on second and third births). Since in modern societies fertility decisions are not taken solely by men or women, but they are the result of

mutual preferences and compromises between both potential parents (considering the individual opportunity costs of both sides), taking a couple perspective in fertility analyses seems to be crucial (Bauer and Kneip 2013). Whose characteristics are more influential? Are the male and female effects gendered or similar? Do partners' characteristics interact with each other? What would happen with fertility of a couple in which a woman has higher socioeconomic status than a man? Which types of couples are more likely to stay childless? Adopting a couple perspective could help in answering these questions.

In view of an insufficient quantity of studies on the relationship between the actual number of children and socioeconomic gender (in)equality between partners this paper will contribute to the current knowledge by attempting to fill this gap. The study aims to investigate couples' procreative behaviour with regard to the gender socioeconomic (in)equality between partners, taking into account that behavioural drivers could differ among parents and childless couples. The socioeconomic resources of both partners will be measured by educational level, educational field and occupation. Childless couples and parents will be treated separately, but still both groups will be connected with each other by the probability of childlessness/parenthood. This will be possible thanks to the attribute of the chosen model, which combines two regressions (for *zero* and *count* states) under one statistical distribution. Our aim is to analyse the pattern of fertility according to couple's socioeconomic profiles in contemporary European populations. As well as absolute socioeconomic characteristics, relative (within partnership) socioeconomic characteristics could also impact couples reproductive behaviour (see, e.g., Jalovaara and Miettinen 2013). Thus relative values will be also taken into consideration in this study.

2. THEORETICAL BACKGROUND AND PREVIOUS FINDINGS

In the literature devoted to various determinants of reproductive behaviour a special place is owed to the micro-economic theory by Gary Becker (Becker 1960). This theory is based on the assumption that the decision to have a child is a rational decision regarding the use of limited resources. If we assume that the child is a

consumer good, it follows that the growth in economic resources should lead to an increase in demand for children ("income" effect). However, Becker emphasizes that, in the case of women, economic success, due to growing alternative costs of having children, can lead to the opposite situation. For educated and working women time costs and opportunity costs of being a mother are high (Becker 1960, 1991). Therefore Becker linked the decrease in the fertility level in developed societies with an improvement in socioeconomic status of women, known as the "substitution" effect.

Changes in modern demographic behaviours observed in developed, particularly European, societies were described and explained by the Second Demographic Transition Theory (see Van de Kaa 1987, 1997, 1999, Lesthaeghe 1983, Lesthaeghe and Moors 1996). The authors of the concept claim that the contemporary family model was preceded by: 1) co-occurrence of marriages and other widely spreading family forms e.g. cohabitation and Living Apart-Together, 2) depriving a child a central place in the family which was given to the couple, 3) replacing preventive contraception by conscious decisions about the number of offspring and their timing 4) replacing a single model of the family (parents and children) by various forms of family life (Van de Kaa 1987). The observed changes are realized in the three layers: structural (society's urbanization, increase in welfare), technological (effective contraception) and cultural (the ideas of equality, freedom, self-fulfilment). Under these conditions, a need to reconcile women's and men's different careers is particularly important. These careers have occurred as a result of different social and parenting roles and growing partner independence and freedom of choice.

Changes in the social and economic roles of women and men, together with their impact on the reproductive behaviours in modern society have been included in the gender equity theory created by McDonald (McDonald 2000a, 2000b, 2006). The author emphasized that in contemporary populations, because of changes in attitudes and beliefs, the traditional family model with the males as breadwinner has been rejected. The roles of a man and a woman in a relationship started to intertwine and became equivalent in terms of socioeconomic conditions. Unfortunately, changes in social institutions often do not match the needs of a new mentality. While institutions that are focused on the individual such as education, labour market treat the roles of

women and men more equally, institutions that work on behalf of the family such as social insurance, taxes and employment conditions have often lagged behind. Therefore, while women now have increasingly similar access to the same opportunities as men, they still bare proportionally more of the costs of childbearing/rearing. This leads to a reduction of fertility level, particularly in those countries in which the family system is highly traditional, e.g. Eastern or Southern European countries.

With the presence of more symmetric gender roles that is observed nowadays in many European countries (see, e.g., Oppenheimer 1994, McDonald 2006, Lesthaeghe and Iñaki Permanyer 2014) the assumption of Becker's theory that the opportunity cost of having children applies only to women seems to be unfitting in today's society. Nevertheless, Mills and Blossfeld (2005) suggest the economic characteristics of the man, who is often treated as the primary breadwinner, impacts the family formation process to a greater extent than the economic characteristics of the woman. However, in more gender-egalitarian societies it has been found that the effects of economic characteristics are of similar importance regardless of gender (see Jalovaara and Miettinen 2013 on Finland).

The socioeconomic status of a couple will be characterized by educational level, educational field and occupational status of both partners. Educational level, as shown in previous researches, is usually negatively correlated with fertility of women (as assumed by Becker 1960, see also Kreyenfeld 2004, Weeden et al. 2006, Bauer and Jacob 2009, Barthold et al. 2012), while among men the connection seems to be equivocal i.e. negative among fathers (Barthold et al. 2012) and positive among childless men (Fieder and Huber 2007). However, recent studies have also shown a positive effect of education on the likelihood of having a first child (see Lappegård and Rønsen 2005 on women; Jalovaara and Miettinen 2013 on both sexes). A U-shaped relationship between education and fertility has also been reported, with medium educated individuals having the lowest risk of the first births (Winkler-Dworak and Toulemon 2007).

The field of education is expected to shape values and preferences of an individual as well as provide social norms typical for the certain field. Being part of

the specific social environment characterised by the field of study, may have an impact on a (usually) young person's values and could influence future fertility decisions (Hoem et al. 2006a, 2006b, van Bavel 2010). What is more, the literature also describes a sex segregation effect caused by the field of study, namely, it has been shown that women's fertility seems to be higher among female-dominated fields (see Hoem et al. 2006b). However, no such association was revealed among men.

Finally, occupation is the third measure of socioeconomic status taken into account in this analysis. Occupation is expected to be a reflection of job content and prospects, job security and potential skill deprivation caused by child-related leaves and gender dominance (Andersson and Neyer 2012). Regarding the latter, in previous studies among women, higher rates of first birth were found in female dominated occupations as well as highly male dominated jobs, while for men higher childbearing risk was observed only in occupation's dominated by males (Begall and Mills 2013, Andersson and Neyer 2012). These findings suggest the existence of the same-gender-environment effect rather than the female-dominated occupational effect. Additionally, regardless of sex, a lower risk of childbearing was reported in personal service, media and higher education jobs.

3. HYPOTHESES

In this study, since it concentrates on the possible effect of gender equality or inequality between partners on their fertility, considered hypotheses are connected with different socioeconomic profiles of a couple.

1) The first hypothesis assumes that couples with high socioeconomic status postpone having the first child, while those with low socioeconomic resources have the first child sooner than couples with medium level of social and economic prospects. These effects are also expected to be true for subsequent children (postponing childbearing by high status couples; expanding families sooner by low status couples). Thus, a negative influence of socioeconomic status on fertility timing (in general) is expected.

2) Secondly, both couples with low and high socioeconomic statuses have a lower probability of definite childlessness and higher completed number of children than those with medium socioeconomic prospects. Couples with low socioeconomic status incur a low opportunity cost of having a(nother) child, while those with high socioeconomic status have more resources and better conditions to rear children. Therefore we expect a U-shaped relationship between socioeconomic status and the completed fertility of a couple.

3) We also expect that the effect of educational hypo-[1] and hyper-gamy[2] on fertility is strongly dependent also on educational field and occupational status of both partners.

4) Socioeconomic hypogamy could result in postponing childbearing and limited fertility, especially when female occupational status is high.

5) On the other hand, socioeconomic hypergamy and attachment to the traditional family model leads to clear rules between partners and could encourage couples to become parents sooner and to have higher number of children, especially when male occupational status is high.

4. DATA

The data used in this study comes from the first wave of Generations and Gender Survey (GGS, www.ggp-i.org). The following four countries were used: Bulgaria (survey taken in 2004), France (data from 2005), Norway (2007-2008) and Poland (2011). These countries were chosen to represent four regions of Europe: the East, the West, the North and Central[3]. In this study analysis is performed on a combined dataset (with possible country-specific effects considered), but separate analyses for each country are also available and will be characterised in further research.

The GGS is conducted in the framework of the international Generations and Gender Programme (www.ggp-i.org). The program was initiated in the 2000 with the

[1] Socioeconomic hypogamy – women in a couple has higher socioeconomic status than a man
[2] Socioeconomic hypergamy – women in a couple has lower socioeconomic status than a man
[3] The representative of South Europe, which based on GGS dataset could be Italy, was not considered in the analyses due to the lack of information on educational field.

aim of implementing panel surveys in different countries participating in the study. The survey is carried out at every 3 years and consists of at least 3 rounds. The survey is based on a large, representative random sample in each country, the first round engaged approximately 10 000 people aged 18 to 79. In every round the same group of respondents is interviewed. Questionnaires consist of several modules that include a wide range of social, economic and cultural characteristics.

From the original dataset only respondents aged 25 or more, who were in a heterosexual relationships and gave information about their current partners (also aged 25 or more), were analysed. The age restriction is assumed to consider only respondents with (usually) finished educational career. Couples who biologically were not able to have children were excluded from the sample. The selected group was then divided into two subsamples: the first in which the woman in a union is aged 25 to 39 (8889 couples); and the second that consists of couples in which the woman is aged 40 or more (18591 partnerships). Based on the first group, in which fertility cannot yet be treated as completed, we can measure any tempo effect of socioeconomic characteristics on procreative behaviour. The observed changes in gender roles and in the division of socioeconomic status between partners are relatively fresh, taking place from about 1950-60 in Western Europe (as a part of the Second Demographic Transition), spreading to other countries in the subsequent decades and gaining intensity until these days (Lesthaeghe 2014). Thus, the possible associations between gender (in)equality and fertility could be particularly noticed among younger cohorts. The second group, on the other hand, has passed their most fertile reproductive ages and their actual number of children can generally be treated as completed (see for example Bailey et al. 2014). Therefore, it will be possible to consider also the quantum effect of fertility due to socioeconomic characteristics of a couple.

The response variable in this analysis is the *actual number of children* that a couple already have. This variable includes mutual children and children from previous partnerships, our analysis controls for the latter[4]. The structure of the number of children by age group is presented in Figure 1. Clearly the typical number of

[4] The analysis was also performed on a sample of couples that do not have children from previous partnership (about 80% of current sample). Since the results were generally consistent between samples we decided to work on the bigger dataset.

children in both groups is two. The share of childless couples is 10% in the younger age group and about half as much in the older age group.

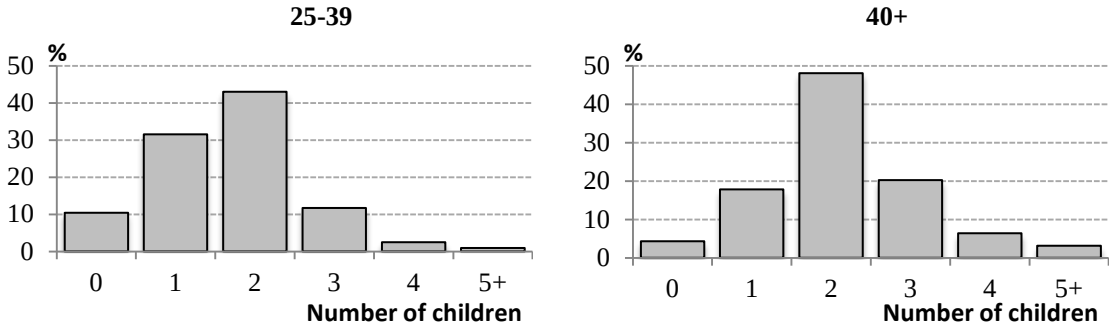

Figure 1: The structure of number of children by age groups

Source: Author's own elaboration based on GGS sample

The main explanatory variables in this analysis, representing couple socioeconomic status are: *educational level, educational field* and *occupation*. The *educational level* of each partner in GGS dataset is given in ISCED-97[5] codes (from 0 – pre-primary to 6 – 2nd stage of tertiary education). For the purpose of these analyses the highest completed educational level of each individual was first grouped into 3 classes: primary (codes 0 to 2), secondary (3-4) and tertiary (5-6). Then the couple's educational status was assigned to one of the seven classes: LL – both partners with primary (low) education; MM – both partners with secondary (medium) education or one partner medium and one low educated (reference level); HH – both partners with tertiary (high) education; LH – a woman in a couple is low educated, while a man has completed higher education; MH – a medium educated woman and a highly educated man; HL – a woman is highly educated and a man has low education and HM – a highly educated woman and a man with medium education. Approximately half of couples, regardless of age group, consist of partners that both completed medium educational level or one has medium and one low education (see Figure 2 type MM). Clearly the increase in educational level overall is visible – at younger age group there are more highly educated couples (type HH) than among older age group. Among educationally heterogamous couples (type LH, HL, MH, HM) the most popular is

[5] Further details of International Standard Classification of Education (ISCED-97) are available at: http://www.uis.unesco.org/Education/Pages/international-standard-classification-of-education.aspx

hypogamous union in which a woman is highly educated and a man has medium educational level (HM). This profile is also the third most popular type among younger age group and the fourth among the older ages. The significant increase in the share of educationally hypogamous unions (HM, HL) and small decrease in the share of hypergamous partnerships (MH, LH) is also observed.

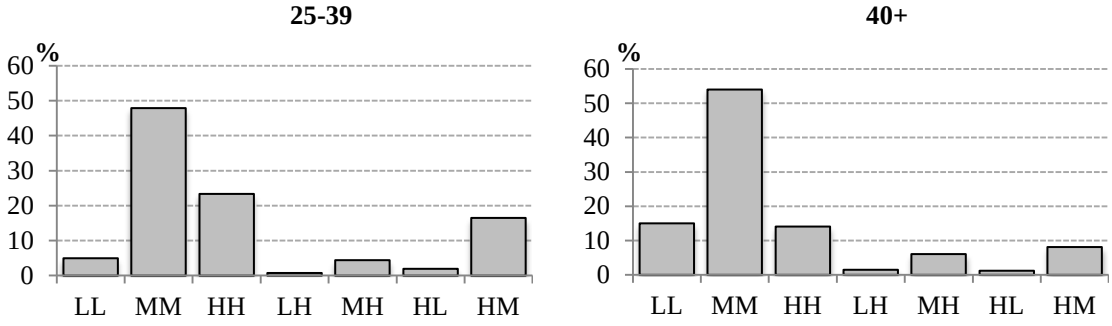

Figure 2: The structure of couples' educational profiles by age groups

Source: Author's own elaboration based on GGS sample

Note: LL – Both partners have primary (low) education;
MM – both have secondary (medium) education or one has medium and one low education;
HH – both have tertiary (high) education;
LH – woman has low education, man is highly educated;
MH – woman is medium educated, man is highly educated;
HL – woman is highly educated, man has low education;
HM – woman is highly educated, man has medium education.

Data on *educational field* in the original dataset are divided into nine (or more) main categories (this varies by country). To harmonize answers and to keep reasonable amount of cases in each class, after preliminary analysis, four groups were distinguished[6]: Humanities and Art (1); Social Sciences, business and law, Health and Welfare (2); Science, Engineering, manufacturing and construction (3); Basic programmes, Agriculture, Services and other (reference level – 4). The structure of educational field of each partner by considered age groups is presented in Figure 3. Among men, regardless of the age group, the most common field is science and engineering. This group became even more popular among younger men. The second field (social sciences, business and law together with health and welfare) gain some popularity among younger males. In turn, among women the most popular in both

[6] The educational field and occupation of both partners were (after preliminary investigation) included into the model as absolute values, and not relative to the other partner in the couple as in the case of educational level. Such a model gives more clear and consistent results.

groups is the 'basic' field (basic programmes, agriculture, services and other), but a substantial turn to social sciences and health is observed among younger women.

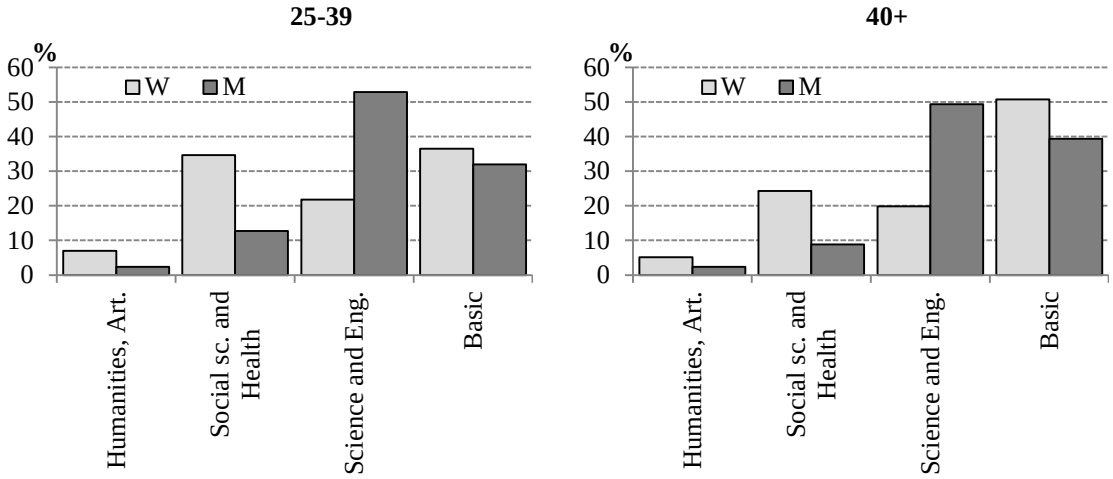

Figure 3: The structure of partners' educational field by age groups

Source: Author's own elaboration based on GGS sample

Finally, data on *occupation* are given in 1-digit ISCO-88[7] codes and in this analysis they were grouped into five classes: *Professionals* – legislators senior officials and managers, professionals (1); *Technicians and Clerks* - technicians and associate professionals, clerks (2); *Service and Trade workers* – service workers and shop and market sales workers, craft and related trades workers, plant and machine operators and assemblers (3); *Agriculture* – agricultural, forestry and fishery workers (4); *Basic* - elementary occupations (reference level – 5). If an individual (respondent or her/his partner) is on maternity or parental leave, is unemployed or retired the last occupation stated in the questionnaire was included. The most popular occupation among men and women in both considered age groups is the third occupational group (Service workers and shop and market sales workers, Craft and related trades workers, Plant and machine operators and assemblers) but also high share of women work as technicians, associate professionals or clerks (see Figure 4). The structure of occupations is generally consistent over the age groups, with a small recent reverse from agriculture, forestry and fishery as well as elementary occupations.

[7] Further details of the International Standard Classification of Occupations (ISCO) are available at: http://www.ilo.org/public/english/bureau/stat/isco/

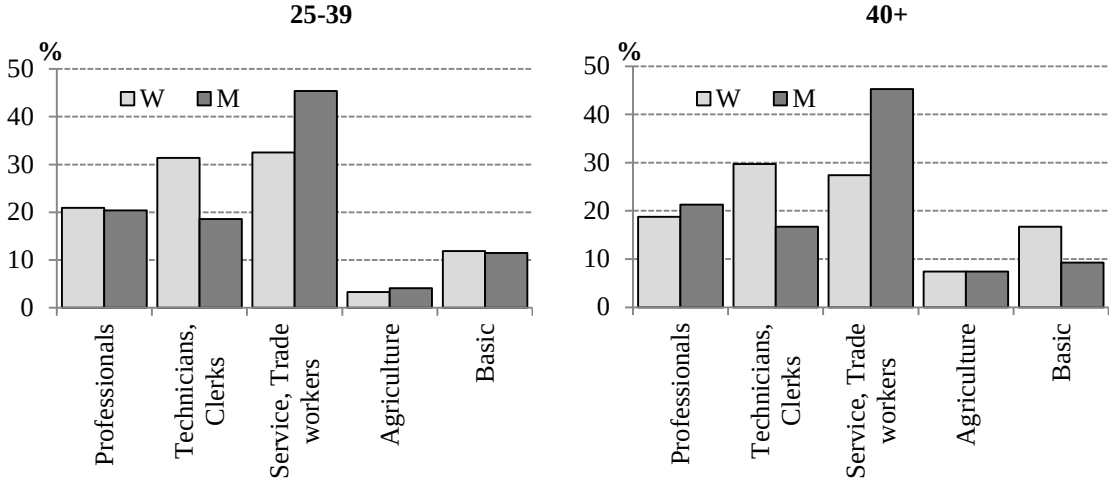

Figure 4: The structure of partners' occupation by age groups

Source: Author's own elaboration based on GGS sample

Besides the measures of couple's socioeconomic status mentioned above, several control covariates will be included. These are: *age of woman* (standardized), *age of man* (standardized), *type of settlement* (0 – rural, 1 – urban), *cohabitation* (0 – married; 1 – cohabiting), *previously married* (0 – not previously married; 1 – previously married), *union duration* (in years; standardized) and three binary covariates for countries: *BG* – Bulgaria, *FR* – France and NO – Norway (Poland as the reference level). Additionally for the parenthood status (as mentioned before): *woman's children from previous partnerships* and *man's children from previous partnerships* (0 – no children from previous partnerships; 1 – have children from previous partnerships). The structure of all control covariates is presented in Appendix A.

5. METHOD

5.1. ZERO-INFLATED POISSON MODEL WITH BAYESIAN APPROACH

To analyse reproductive behaviour and to distinguish childlessness and parenthood as two separate states, Zero Inflated Poisson model (ZIP) will be used (see, e.g., Lambert 1992, Osiewalska 2013). The considered model has two states: *zero*, which in fertility analysis can be interpreted as childlessness and is occurring with a probability p (probability of childlessness); and *count* – that relates to the

values greater than zero (1,2, ...), represents parenthood and is characterized by a probability that is analogous to the standard Poisson distribution (with parameter λ), but is additionally scaled by the probability of parenthood (1-*p*). Thus, the idea behind ZIP model is to combine two different statistical distributions: the Poisson and the binomial distribution.

It is important that the specification of model allows treating childlessness as a different state than having children and gives the opportunity to consider different determinants of childlessness and parenthood. Simultaneously, both states are tied with each other, as they are under the same statistical model. ZIP distribution can be represented as follows:

$$P(Y_i = y_i) = \begin{cases} p_i, & y_i = 0 \\ \dfrac{1-p_i}{1-\exp(-\lambda_i)} \exp(-\lambda_i) \dfrac{\lambda_i{}^{y_i}}{y_i!}, & y_i = 1,2,..., \end{cases} \quad p_i \in [0,1] \qquad p_i = \frac{\exp(x_i\gamma)}{1+\exp(x_i\gamma)} \qquad \lambda_i = \exp(w_i\delta)$$

where x_i and w_i are vectors of covariates and γ and δ are vectors of parameters. The coefficients estimated in the zero state are interpreted as in a logistic regression, while the coefficients for the count state have the same interpretation as in a standard Poisson regression.

In order to make formal inference about uncertainty of covariates and nonlinear function of the model parameters (such as probability of childlessness or expected number of children) as well as to incorporate our prior knowledge, Bayesian approach will be applied (see, e.g., Koop 2003). Intuitively, a good prior should fulfil two following conditions. First, it should enable all reasonable values, e.g., in modelling the number of children we can expect that the plausible values are in the range from 0 to 15 (or even to 10 in contemporary societies), therefore a prior distribution should attribute positive probability to all these values and very small or none probability to the remaining cases. Second, the prior should remain coherent with the common knowledge, so in the case of fertility of a couple it should propose an acceptable solution, e.g., by setting the highest probability to the values from 0 to

3-4 and much lower to bigger values. Such an initial knowledge is reflected by the prior distribution for a randomly chosen couple presented in Figure 5.

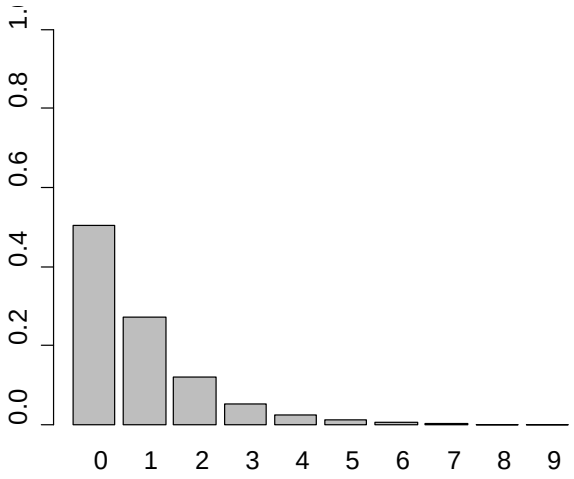

Figure 5: The prior distribution (density) of number of children for a selected couple

Source: Author's own elaboration based on GGS sample

Use of Bayesian methods in Demography is becoming more and more popular, especially in studies on population projections and migration (see, e.g., Bijak 2011, Raftery et al. 2012: 13915–13921, Bryant and Graham 2013), while fertility is, so far, left behind. However, more details about Bayesian Zero-Inflated Poisson model and its application in fertility modelling can be found in Osiewalska 2013.

6. POSTERIOR RESULTS

To specify the impact of socioeconomic status on couples' procreative behaviour the a posteriori expected values of selected coefficients were calculated and are shown in Table 1. The full posterior distributions for all considered covariates are presented in Appendix B.

To interpret the obtained results let us briefly remind ourselves that the reference level is a couple in which both partners have medium education, are educated in the field of basic programmes and both work in elementary occupations. It is also important to notice that all variables marked with grey colour have no meaningful impact on the response variable and, since posterior distributions turned

out to be generally unimodal, for readers' convenience, the cases, where zero does not lie between certain quantiles were marked with asterisks.

First, let us focus on the zero-state regression that models the probability of **childlessness** (temporary – at younger age group or definite – at older ages). Based on the coefficients for education of a couple, it occurred that both: a homogamous highly educated couple (type HH) and a hypogamous couple in which a woman is highly educated and a man has completed medium education (HM) clearly postpone parenthood (age group 25-39). The expected value of coefficient for type HH is positive and equal 0.621, the odds ratio is equal 1.86, meaning highly educated couples have almost twice as much chance of postponing parenthood than medium educated partners (MM). Similarly, a hypogamous couple type HM has 1.48 higher chance of being still childless than a reference union. Among the older age group it was revealed that educational level of partners does not influence the probability of definite childlessness. Both groups consists of different generations, so it is important to remember that the postponing effect visible among younger generations could, in future, result in higher probability of being permanently childless, even though this effect is not visible among current older cohorts.

Woman's educational field, in contrast to men's, was found to have an impact on the transition to parenthood and the probability of definite childlessness. Couples with women educated in social science, health or welfare have a child sooner (expected value of coefficient equals -0.319, odd ratio equals 0.73) and also have lower probability of definite childlessness than a reference couple (-0.207, odds ratio equals 0.81). In turn, when a woman is educated in humanities or art, a couple has 1.34 higher chance of being childless than partnerships with women having basic educational field (0.293).

Regarding the third measure of socioeconomic status - occupation, a woman's characteristics played a role in a couple's probability of childlessness, while a man's occupation is more important in the transition to parenthood. Couples with women working as technicians, associate professionals or clerks have about 23% lower odds of childlessness (expected value of coefficient equals -0.258) and women in agricultural, forestry and fishery sections have about 36% lower odds (0.444). In turn,

couples where the man is working as legislator, senior official, manager or professional (the professionals group) as well as technicians, associate professionals or clerks tend to postpone childbearing (odds equals 1.35 and 1.40, respectively).

Count state regression reflects **parenthood** and modelled the average number of children among parents. Starting with the education of a couple, it was revealed that homogamous low educated couples (type LL) tend to expand their families sooner (expected value equals 0.188, the average number of children is 1.2 times higher), while hypogamous union of a highly educated woman and a medium educated man (HM) tend to postpone having a second or subsequent child (-0.127, the average number of children is 0.88 times lower) compared to medium educated partners (type MM). Among the older age group it occurred that the relationship between completed family size and education of a couple is clearly U-shaped. Low educated partners together with those unions in which both partners finished tertiary education have, respectively, 10% and 6% higher number of children than medium educated couples.

Although couples in the lower age group with women educated in social science, health or welfare tend to have a first child sooner than other groups (as discussed above), they surprisingly postpone extending families (expected value of coefficient equals -0.085). Similarly, in the older age group, such couples are characterised by a lower probability of childlessness, but at the same time they have approximately 4% lower number of children on average (expected value of coefficient equals -0.044). Amongst the younger age group it also occurred that partnerships in which women are educated in the field of science or engineering postpone having higher order children (expected value of coefficient equal to -0.068). What is more, in the age group 40+, these types of unions have on average 4% smaller completed family size (expected value of coefficient equals -0.036). Regarding man's educational field, the results suggest that a couple with a man educated in science or engineering has approximately 3% lower number of children than a reference union (basic educational field).

Finally, the analysis has revealed that among parents there is a strong influence of both partners occupation on average number of children. All women's

occupations, besides agriculture, have negative impact on fertility. First, as shown for the first age group, couples with women working as professionals (1), technicians or clerks (2), service or trade workers (3) tend to postpone having an additional child (in comparison to the baseline, which is a couple with a woman working in basic occupations). The intensity of the postponing effect goes along with the prestige of occupation: from the lowest for the 3rd occupational group (expected value of coefficient equals -0.131) to the highest for the 1st class of occupation (-0.192). Similar negative effect of these occupational classes on completed family size was revealed for the older age group, the smallest number of children was found for couples with women working in the most prestigious occupations (18% lower number than for a reference couple) and the effect weakens with subsequent occupational groups (17% lower number for the 2nd class and 7% lower for the 3rd class as compared to a reference couple). The only one positive influence of woman's occupation on the total number of a couple's children was found for agriculture (8% bigger average family size as compared to a couple with a woman working in elementary occupations). Man's occupation, on the other hand, showed no relation to the tempo of expanding a family (see age group 25-39), but negative effects were found on completed family size (age group 40+). The relationship between occupational prestige and the number of children seems to be U-shaped, with the smallest number indicated for the 2nd occupational class (technicians, associate professionals and clerks; expected value of coefficients equals -0.130, average number of children lower of about 12%). Couples with male partners working as professionals or service and trade workers also have on average smaller families than a reference union (respectively, 9% and 7% lower average number of children).

	Probability of childlessness (p)		Parenthood (λ)	
Variable	Age group 25-39	Age group 40+	Age group 25-39	Age group 40+
Education of a couple:				
LL	0.131	-0.180	0.188**	0.091**
HH	0.621**	-0.181	-0.037	0.057*
LH	0.201	-0.271	0.111	0.035
HL	-0.005	-0.030	-0.008	0.056
MH	-0.292	0.034	-0.004	0.012
HM	0.393**	-0.205	-0.127*	0.043
Woman's educational field:				
Humanities, Art	-0.145	0.293.	0.039	0.016
Social sc., Health and Welfare	-0.319*	-0.207*	-0.085*	-0.044.
Science and Engineering	-0.097	-0.094	-0.068.	-0.036.
Man's educational field:				
Humanities, Art	0.090	0.008	0.033	0.026
Social sc., Health and Welfare	-0.079	-0.229	0.006	-0.007
Science and Engineering	-0.045	-0.067	0.035	-0.033.
Woman's occupation:				
Professionals	0.287	-0.021	-0.192**	-0.198***
Technicians and Clerks	0.172	-0.258.	-0.186**	-0.188***
Service and Trade workers	0.119	-0.014	-0.131**	-0.077**
Agriculture	-0.273	-0.444.	0.067	0.078*
Man's occupation:				
Professionals	0.302.	0.013	-0.077	-0.095*
Technicians and Clerks	0.335.	0.045	-0.062	-0.130**
Service and Trade workers	0.137	-0.079	-0.029	-0.068*
Agriculture	-0.426	0.173	-0.004	-0.003
Total number of couples	**924**	**808**	**7965**	**17783**

Table 1: The a posteriori expected values of selected coefficients within zero- and count-state regressions.

Source: Author's own elaboration based on GGS sample

Note: 1. Highest Posterior Density (HPD) quantiles: '***' – 0.001; '**' – 0.01; '*' – 0.05; '.' – 0.1
2. When zero lies between 5% and 95% quantiles the value was marked with grey
3. The model controlled for: a) zero and count state: age of a woman, age of a man, type of settlement, cohabitation, previously married, union duration, BG, FR, NO; b) only for parenthood: woman's/ man's children from previous partnerships

7. HOW SOCIOECONOMIC GENDER (IN)EQUALITY INFLUENCE COUPLE'S FERTILITY?

Based on the posterior results discussed in the previous section, socioeconomic characteristics of both partners occurred to have a meaningful impact on couples' procreative behaviour. To analyse deeper how socioeconomic gender equality or inequality between partners shapes their fertility, five different couples' profiles will be considered. These are:

1. High socioeconomic status profile (*high SES*) – both partners highly educated in science or engineering, working as professionals.
2. Medium socioeconomic status profile (*medium SES*) – both partners completed medium education or one partner has medium and one low education, the woman specialized in social sciences, health or welfare, the man educated in basic programmes, agriculture, services or other, both working as technicians, associate professionals or clerks.
3. Low socioeconomic status profile (*low SES*) – both partners having low educational level, educated in basic programmes, working in elementary occupations.
4. Hypogamous socioeconomic status profile (*hypogamous SES*) – a woman in a couple has higher socioeconomic status than a man.
5. Hypergamous socioeconomic status profile (*hypergamous SES*) – female partner has lower socioeconomic status than a man.

For each of these profiles posterior distributions of probability of childlessness (temporary or definite) as well as distributions of expected number of children (mean number calculated with the use of p and λ, both states are considered) is presented. The age of both partners assumed for the distributions are: 35 years for the first and 55 years for the second age group. The younger partners are in their active reproductive ages, they (in general) have already arranged their personal and professional careers and are eager to turn to parenthood or have additional children. They could give an insight on the "middle-stage" reproductive career. Partners at the age of 55 with high probability have finished their reproduction and the chance of having an additional child is almost zero, therefore they could shed light on completed reproductive behaviour.

7.1. TEMPO EFFECT

Starting with the younger age group (25-39), the posterior distributions of probability of being childless for considered profiles are shown in Figure 6. The upper plot contains the distributions for the first three profiles that represent the socioeconomically homogamous partners (socioeconomic equality) with the differences in the overall level of socioeconomic status, while the plot at the bottom shows heterogamous profiles (socioeconomic inequality) with similar overall level of socioeconomic status but different distribution of that status between partners. Based on the plot for homogamous profiles (upper one), we can clearly see that couples with high socioeconomic status postpone childbearing with much higher intensity than any other profile, the *a posteriori* expected probability of being childless for a 35 year old partners equals 0.09, while for medium SES profile it is about 0.04. Medium and low status profiles showed no difference in their transition to parenthood. In turn, hypogamous and hypergamous couples (lower plot) have similar behaviour regarding the time of the first childbearing and they also seem to postpone parenthood as compared to medium or low SES profile.

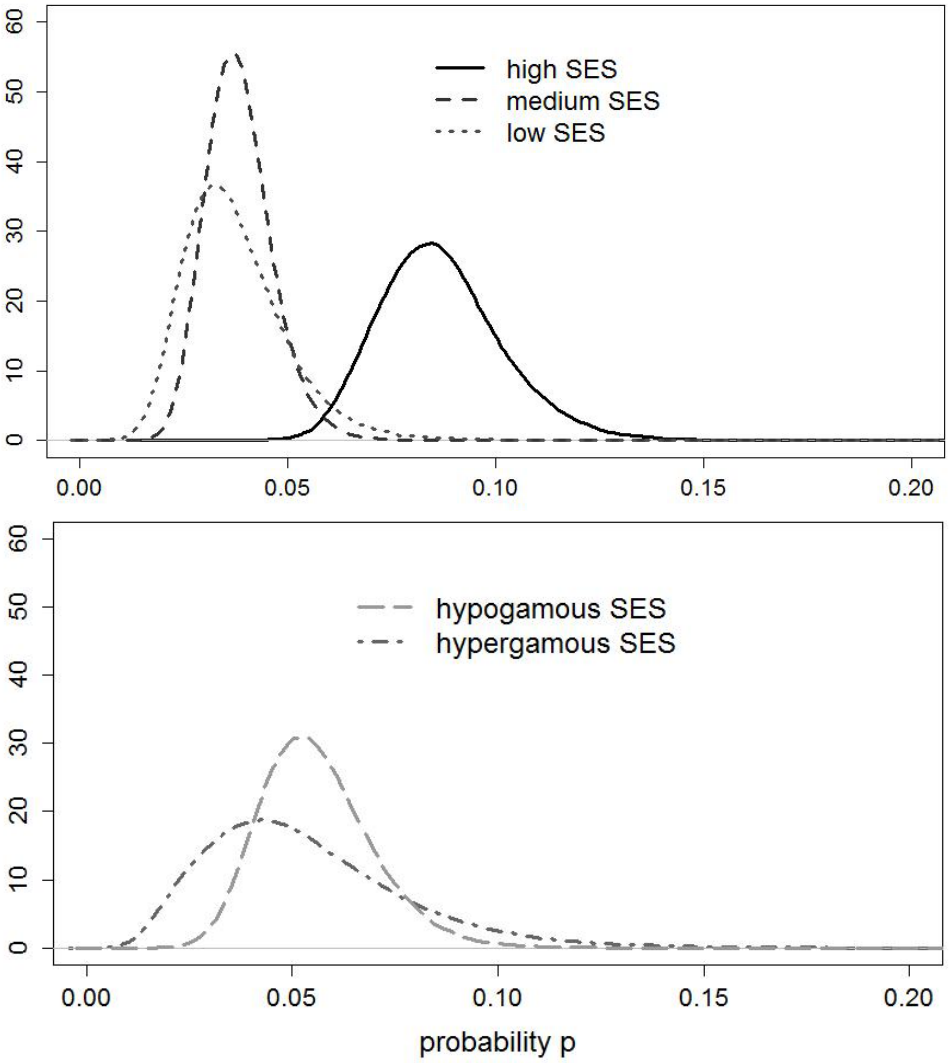

Figure 6: The posterior distribution of probability of childlessness (p) for selected couples' profiles. Age group 25-39

Source: Author's own elaboration based on GGS sample

For the purpose of analysing the expected number of children for the younger age group corresponding posterior distributions are shown in Figure 7. Couples with low socioeconomic status decide to have second child sooner than other types of unions. For 35 year old partners with low SES the *a posteriori* expected number of children is already two, while for high status couples it is still more often just one child (1.45 on average). Hypogamous couples behave similar to high SES profile unions, they postpone having the second child and at the age of 35 half of them still are expected to have only one offspring (1.47 on average). In turn, hypergamous couples seem to have second child sooner and at the age of 35 they are expected to have already 1.85 children on average, however, this group is also characterised by

higher diversity (the distribution of expected number of children for a hypergamous SES profile is more spread).

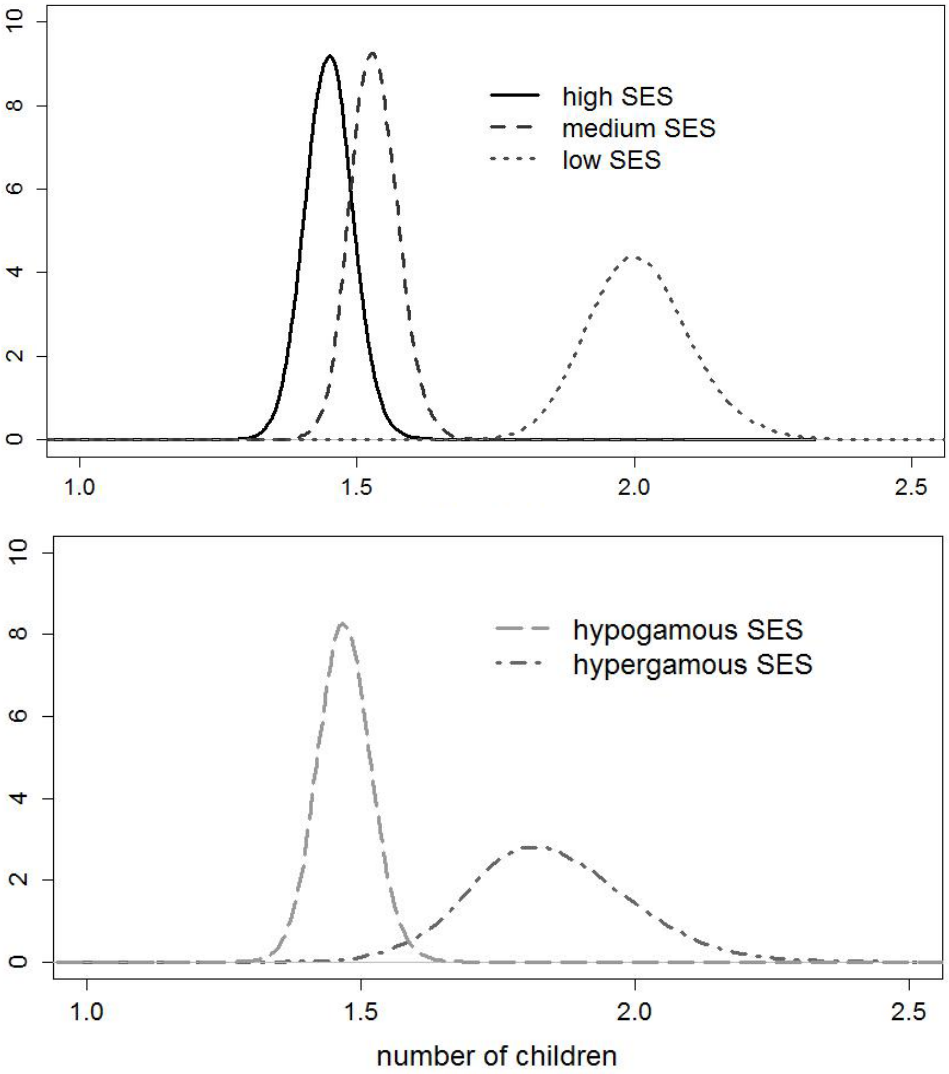

Figure 7: The posterior distribution of the expected number of children for selected couples' profiles. Age group 25-39

Source: Author's own elaboration based on GGS sample

7.2. QUANTUM EFFECT

Based on the posterior distribution for the second age group (presented for 55 year old partners) we are able to determine the impact of socioeconomic gender (in)equality between partners on definite childlessness and completed family size. First, the posterior distribution of probability of childlessness is presented in Figure 8. The highest probability of having no children is reported for couples with low

socioeconomic status (the *a posteriori* expected probability equals 0.13), while the lowest for medium SES profile (0.11), but observed differences are very small and not significant. Hypogamous and hypergamous couples have similar probability of childlessness which lies between the values stated for medium and low SES profiles, but their posterior distributions are slightly more spread than for other profiles, so the uncertainty of the results is also bigger. In general, no clear differences regarding the probability of childlessness among five considered profiles were found.

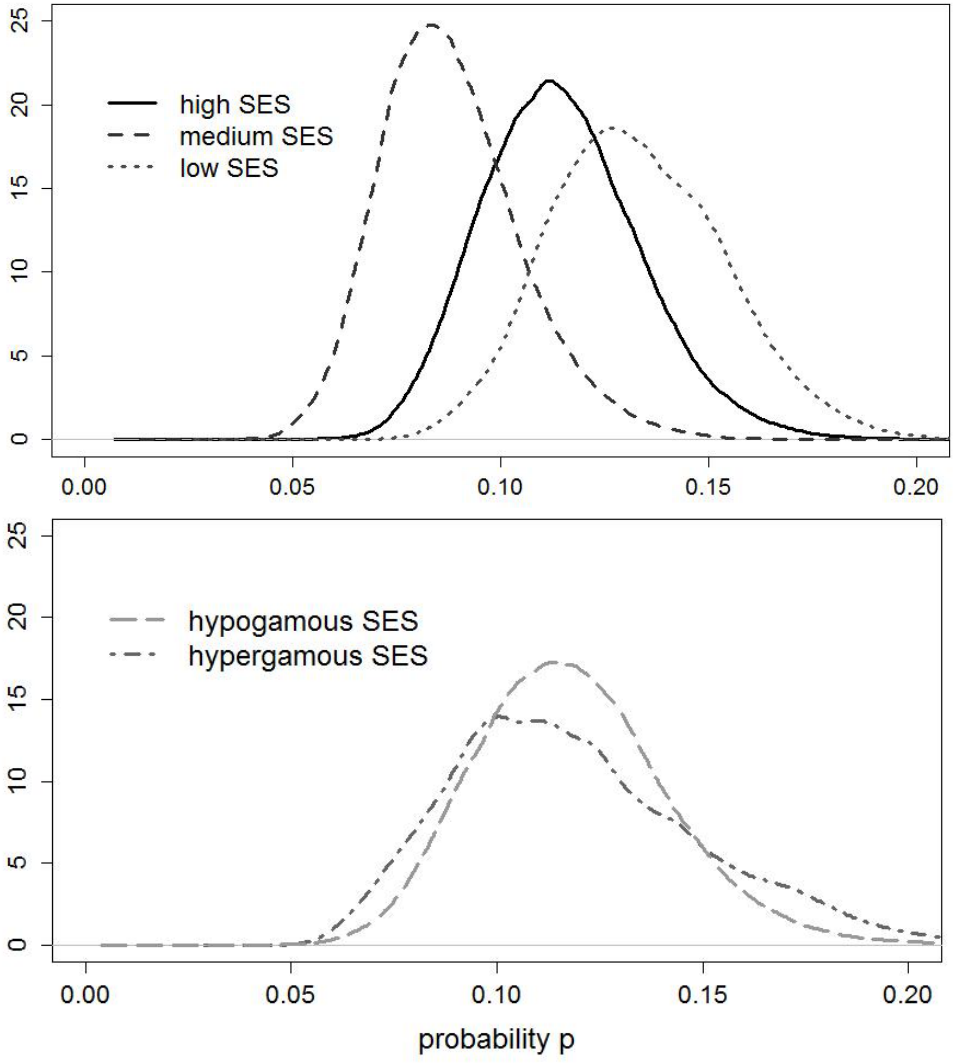

Figure 8: The posterior distribution of probability of childlessness (p) for selected couples' profiles. Age group 40+

Source: Author's own elaboration based on GGS sample

Expected completed family size also tends to vary due to couples' socioeconomic profiles. Partners with low SES, although they seem to have the

highest probability of childlessness (as shown in Figure 8), also have the highest *a posteriori* expected number of children. Nevertheless, these couples in general stop expanding their families after the birth of the second child. Comparing this picture with the same profile of younger cohorts (shown in Figure 7), it is tempting to assume that couples with low socioeconomic status will usually finish their fertility before the age of 35. However, we have to remember that these results come from different generations, so the completed family size of younger cohorts could still exceed the number stated for the older generations in forthcoming years. In turn, the completed family size of a high SES profile has very slightly (but not significantly) exceeded the number of children typical for a couple with medium SES (1.60 and 1.56 on average, respectively). Heterogamous SES profiles, again, placed themselves between the highest and the lowest values. Almost three out of four couples with hypogamous SES have two children, while the rest limit their families to only one child (1.70 on average). The hypergamous couples seem to go slightly further and they are expected to have 1.8 children on average.

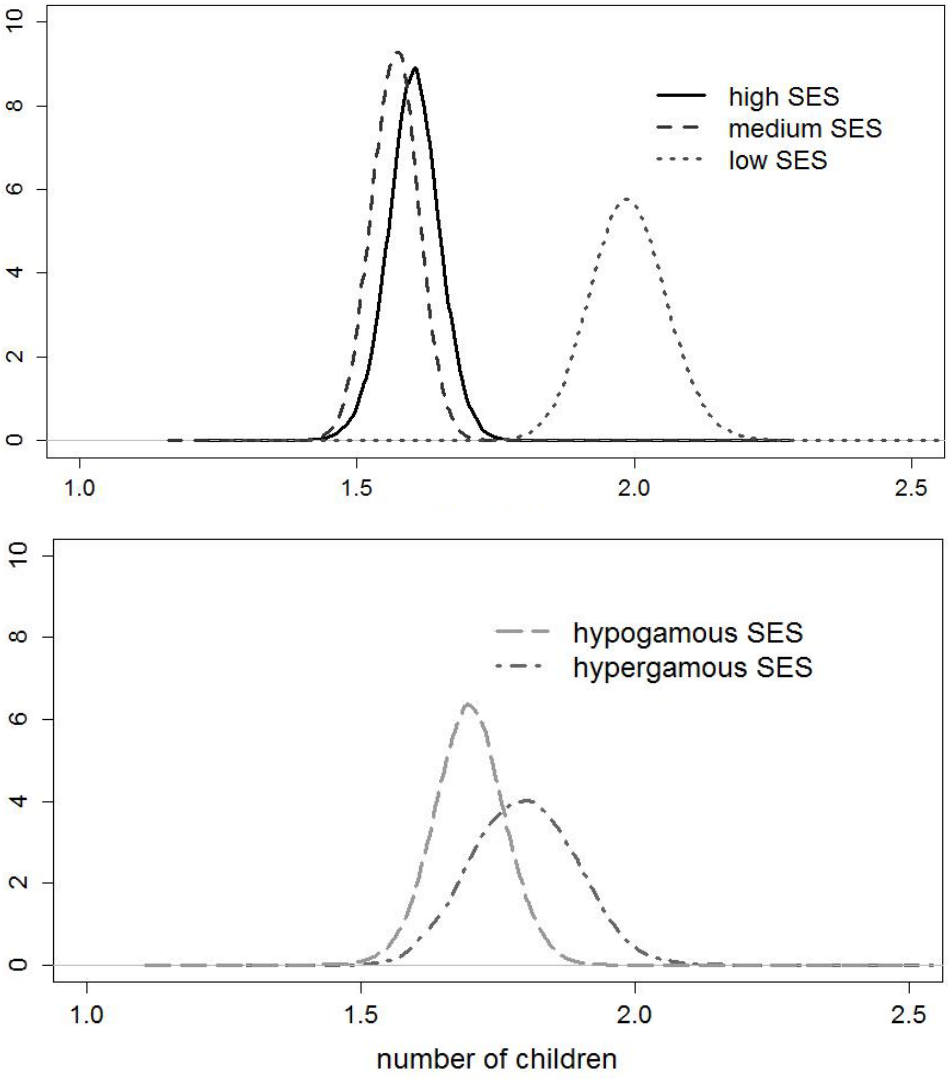

Figure 9: The posterior distribution of the expected number of children for selected couples' profiles. Age group 40+

Source: Author's own elaboration based on GGS sample

8. CONCLUSIONS

In this article we analysed the effect of both partners' socioeconomic characteristics on their procreative behaviour. Childlessness and parenthood were discussed separately. The possible postponing (tempo) effect as well as the impact on the completed family size (quantum effect), were also considered. The socioeconomic characteristics of both partners, which in this study are educational level, educational field and occupation, were taken into account in the model relative to other partner's resources (educational level) or in absolute values (educational field, occupation). Our findings should provide deeper insights on how socioeconomic gender equality or

inequality between partners as well as the overall level of socioeconomic status of couples shape their behaviour regarding family.

At first, it is worth to mention that including characteristics of both partners significantly improved the ability to describe fertility behaviour. The results showed that as well as using educational level additional characteristics describing socioeconomic status of a couple, such as educational field and occupation of both partners, provided wider view of considered relations and occurred to determine couple's reproductive behaviour in a great manner. To analyse the effects caused by the level and the distribution of socioeconomic status between partners, five couples' profiles were constructed and discussed.

The first three socioeconomically homogamous profiles presented the effects of the level of couples' status (low, medium and high). Consequently, regarding the postponing effect, it was shown that unions of partners with high socioeconomic status (on average) postpone having the first or subsequent child (as expected), while couples with low socioeconomic status of both partners (surprisingly) do not become parents sooner but they indeed expand families earlier than their counterparts. Therefore, the overall level of socioeconomic status seems to have negative influence on fertility timing. In turn, when it comes to completed fertility, it was proved that both low and high couple's socioeconomic status implicate bigger families than medium socioeconomic status. These findings confirmed the U-shape relation between the socioeconomic status of couples and their fertility. However, expected low probability of childlessness for high and low socioeconomic profiles was not confirmed by the obtained results and, what is more, a couple with low socioeconomic status seems to have the highest risk of being childless.

The last two profiles represented couples' heterogamy and showed the effects of similar level but different distributions of socioeconomic status between partners. First, a hypogamous couple in which a woman has high socioeconomic status and a man holds low socioeconomic resources was proved to postpone having the first or subsequent child (as compared to a medium SES profile). However, when it comes to completed fertility, these couples are expected to have (on average) bigger families than a homogamous medium SES union. In turn, socioeconomic hypergamy does not

increase the chances of becoming a parent, but is connected with having a subsequent child sooner than a medium SES profile. What is more, also the completed family of a hypergamous couple is bigger than a family of medium SES partners.

Beyond that, the results showed that the overall level of socioeconomic status differentiates the procreative behaviour of a couple more than the distribution of this status between partners, yet it is necessary to include both dimensions to fully describe possible relations.

Finally, the results presented in this paper are promising and encouraging for deeper studies on the impact of gender socioeconomic (in)equality on couples' fertility. Further analyses are carried out by the author to explore possible connections also in a country-specific context.

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APPENDIX A

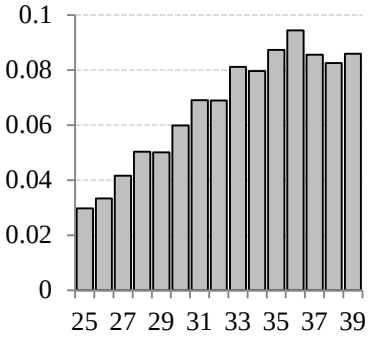
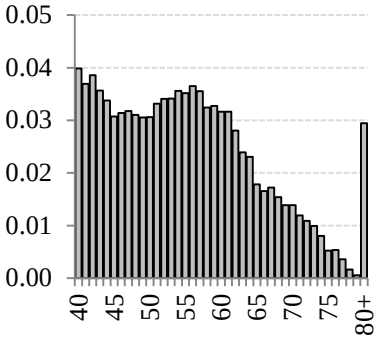
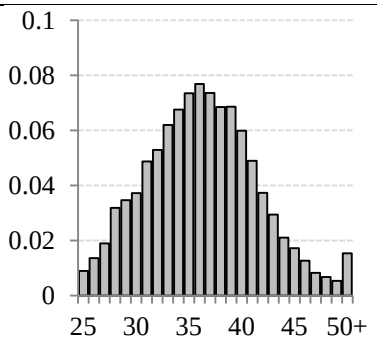
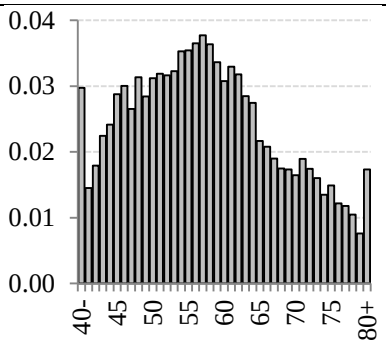
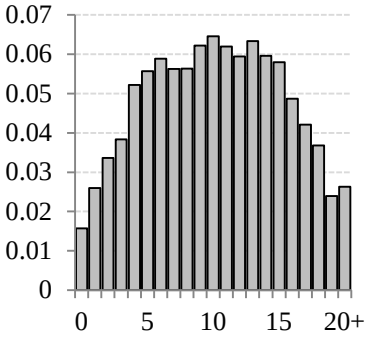
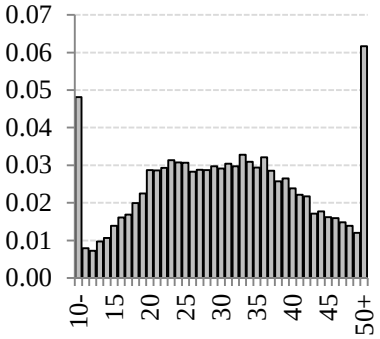
Covariate	Age group 25-39		Age group 40+	
	0	1	0	1
Type of settlement (0-rural; 1-urban)	0.358758	0.641242	0.391749	0.608251
Cohabiting	0.800765	0.199235	0.947824	0.052176
Previously married	0.953988	0.046012	0.913022	0.086978
A woman has children from previous partnerships	0.966588	0.033412	0.947017	0.052983
A man has children from previous partnerships	0.955901	0.044099	0.94691	0.05309
Bulgaria	0.712679	0.287321	0.77828	0.22172
France	0.818652	0.181348	0.815126	0.184874
Norway	0.793228	0.206772	0.796407	0.203593
Age of women				
Age of men				
Union duration				

Table A1: Structure of control covariates by age groups

Source: Own elaboration based on GGS sample

APPENDIX B

The dotted lines in Figures 1-4 in Appendix A represent the corresponding priors in order to compare the two distributions (posterior vs. prior) and illustrate the strength of inference about the selected marginal parameter distribution. The red dots mark 5.0% and 95.0% quantiles, which are helpful in determining the parameter impact's strength on the modelled variable. If a zero value (marked with a green dot) lies outside the interval set by the quantiles (so-called the highest posterior density interval - HPD), then the covariate can be assumed to have a significant impact on the analysed phenomenon. However, if there is a substantial probability that the parameter can be equal zero (so zero belongs to the HPD interval) then its effect is treated as neutral or negligible.

The covariates presented in the figures are:

const – intercept
educ11 – both partners having low education
educ33 – both partners having high education
educ13 – a woman has low education and a man has high education
educ31 – a woman has high education and a man has low education
educ23 – a woman has medium education and a man has high education
educ32 – a woman has high education and a man has medium education
studHumW – a woman educated in Humanities and Art
studSocialW – a woman educated in Social sc., business and law, Health and Welfare
studMathW – a woman educated in Science, Engineering
studHumM – a man educated in Humanities and Art
studSocialM – a man educated in Social sc., business and law, Health and Welfare
studMathM – a man educated in Science, Engineering
WoccupHigh – a woman works as *Professionals*
WoccupMed – a woman works as *Technicians, Clerks*
WoccupWorker – a woman works as *Service, Trade worker*
WoccupAgri – a woman works as *Agricultural, forestry, fishery worker*
MoccupHigh – a man works as *Professionals*
MoccupMed – a man works as *Technicians, Clerks*
MoccupWorker – a man works as *Service, Trade worker*
MoccupAgri – a man works as *Agricultural, forestry, fishery worker*

ageW – woman's age
ageM – man's age
typeSet – type of settlement (0-rural; 1-urban)
cohab – partners are cohabiting
prevMarr – respondent was previously married
unDur – union duration
BG – Bulgaria
FR – France
NO – Norway

Additional for parenthood:
WprevChild – a woman has children from previous partnerships
MprevChild – a man has children from previous partnerships

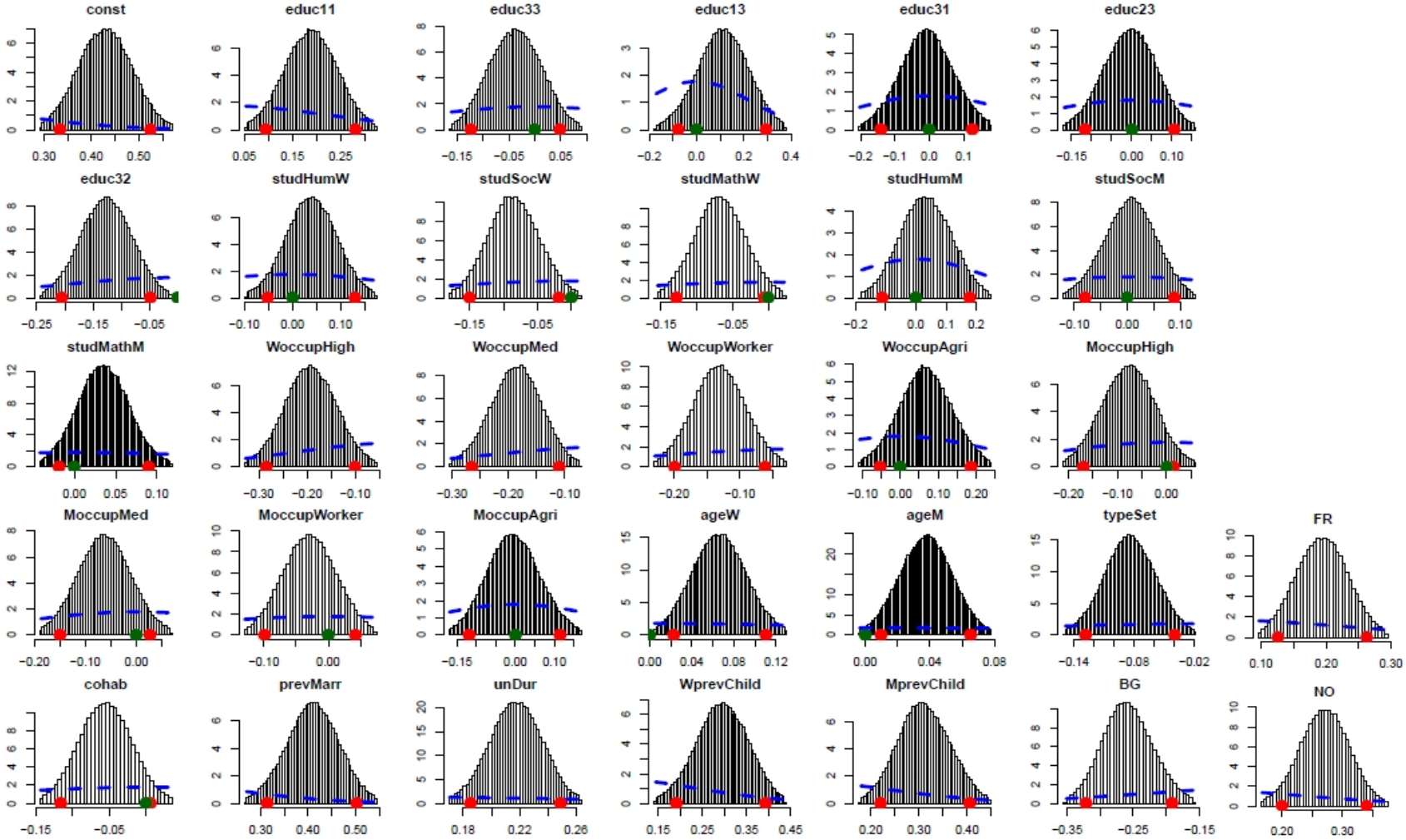


Figure A1: The posterior distributions for count state. Age group 25-39.

Source: Own elaboration based on GGS sample

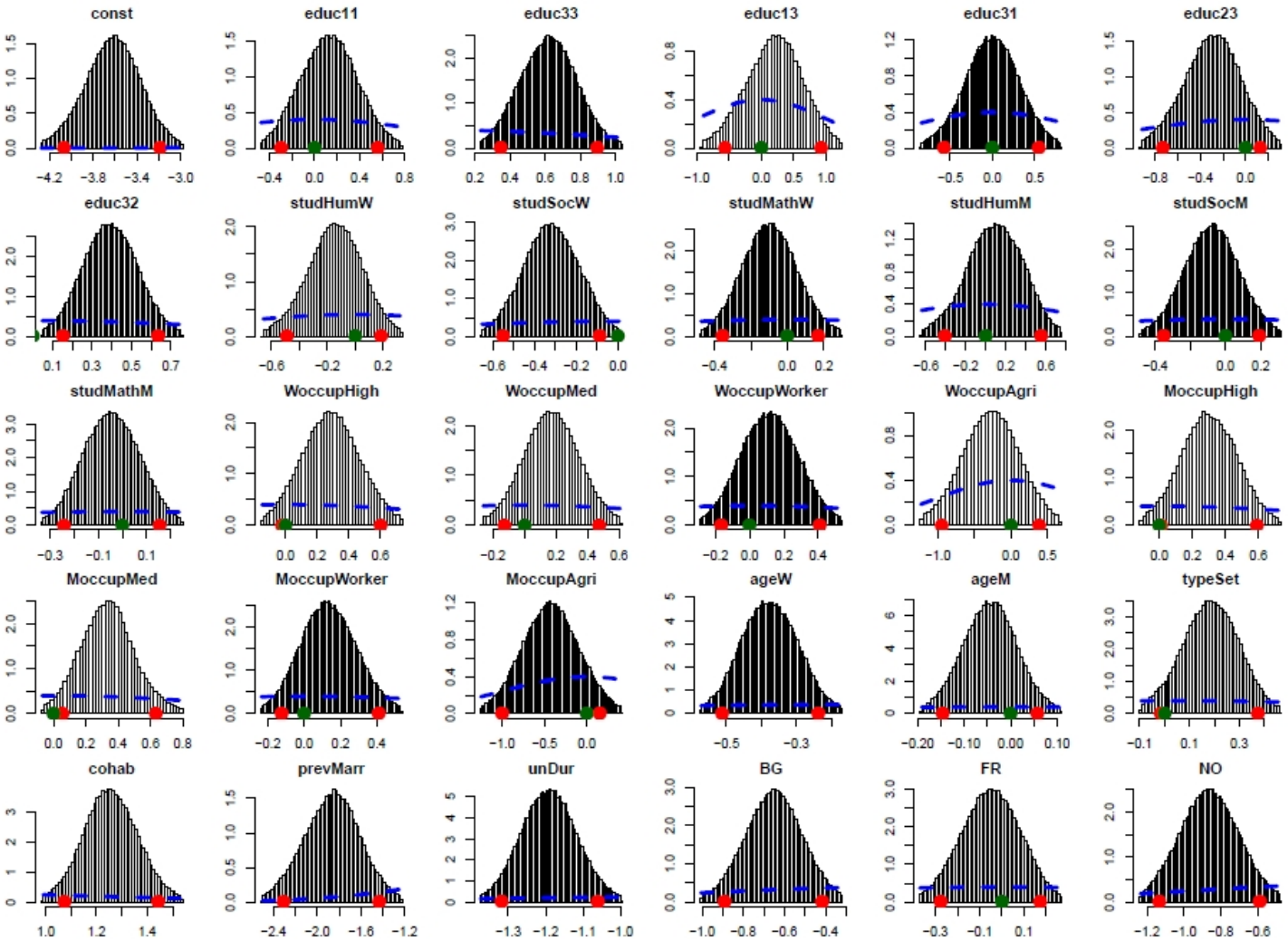


Figure A2: The posterior distributions for zero state. Age group 25-39

Source: Own elaboration based on GGS sample

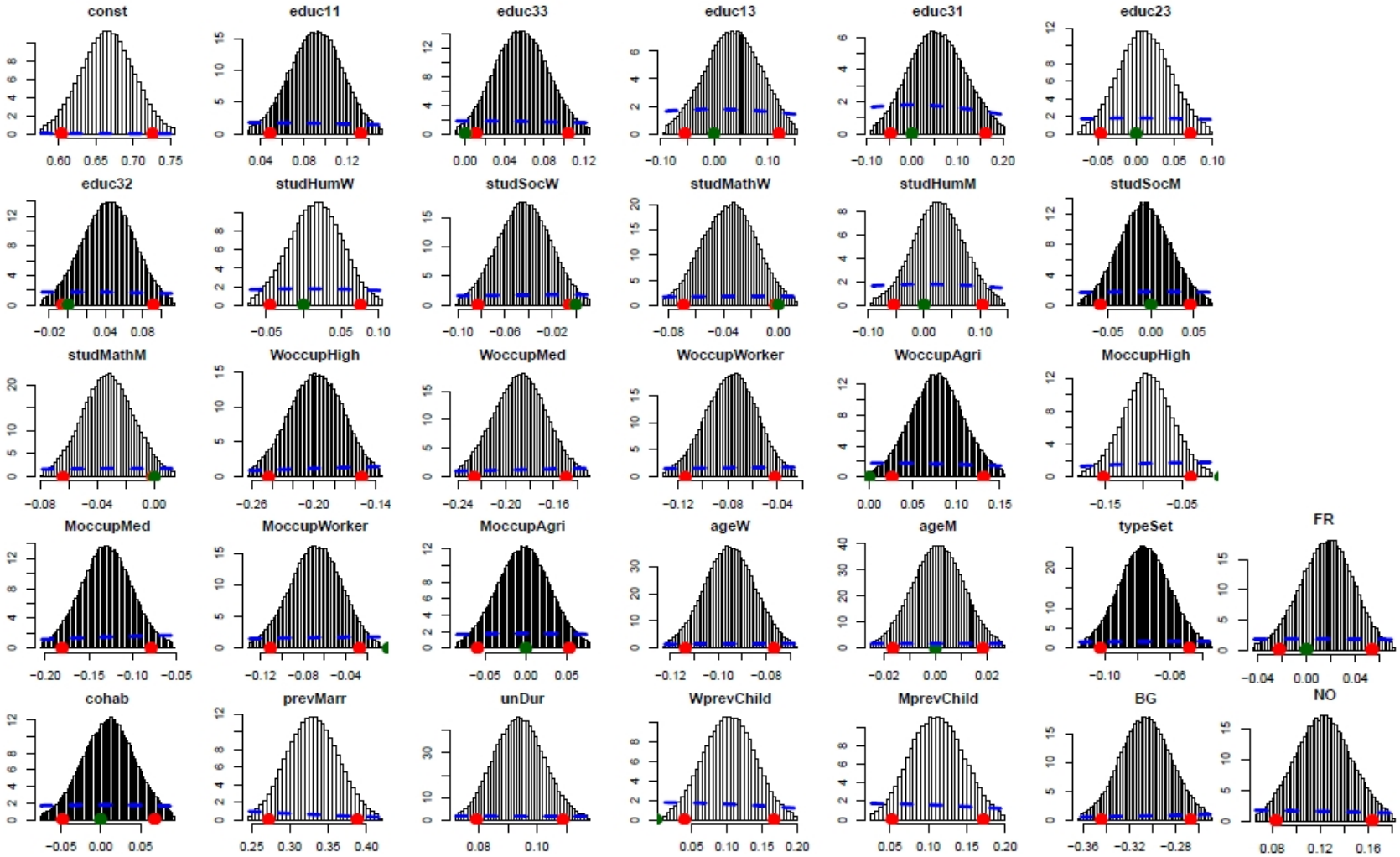


Figure A3: The posterior distributions for count state. Age group 40+

Source: Own elaboration based on GGS sample

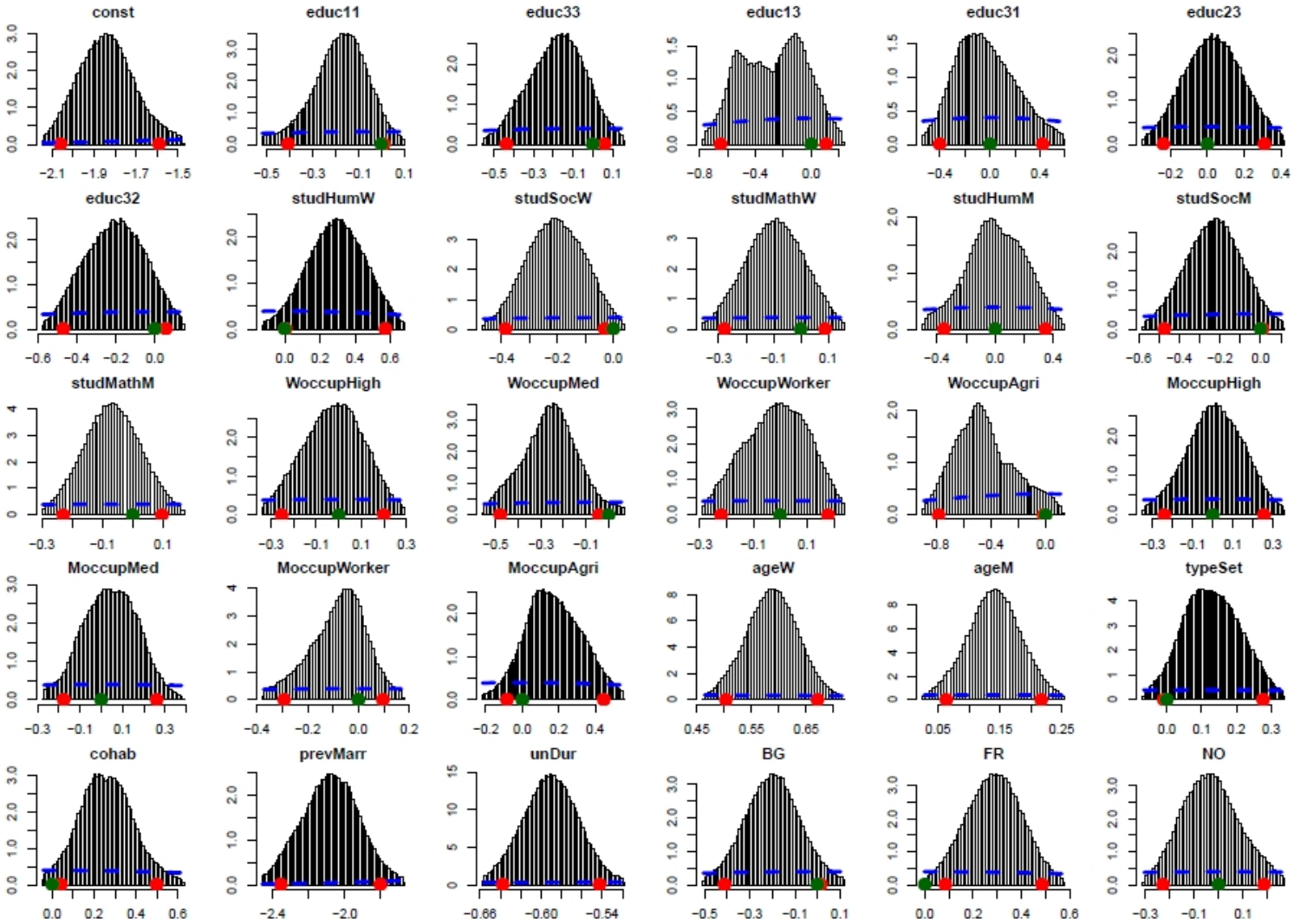


Figure A4: The posterior distributions for zero state. Age group 40+.

Source: Own elaboration based on GGS sample

	Probability of childlessness (p)		Parenthood (λ)	
Variable	Age group 25-39	Age group 40+	Age group 25-39	Age group 40+
Age of a woman	-0.376***	0.588***	0.066*	-0.095***
Age of a man	-0.044	0.141**	0.038*	0.001
Type of settlement	0.185	0.131	-0.083**	-0.076***
Cohabiting	1.257***	0.261.	-0.055	0.010
Previously married	-1.864***	-2.079***	0.410***	0.330***
Union duration	-1.191***	-0.590***	0.217***	0.094***
W's children from prev. unions	x	x	0.294***	0.103**
M's children from prev. unions	x	x	0.311***	0.111**
Bulgaria	-0.652***	-0.199	-0.258***	-0.306***
France	-0.049	0.287*	0.194***	0.016
Norway	-0.862***	-0.031	0.271***	0.123***
Total number of couples	**924**	**808**	**7965**	**17783**

Table A2: The a posteriori expected values of control coefficients within zero- and count-state regressions.

Note: 1. Highest Posterior Density (HPD) quantiles: '***' – 0.001; '**' – 0.01; '*' – 0.05; '.' – 0.1
2. When zero lies between 5% and 95% quantiles the value was marked with grey

Source: Own elaboration based on GGS sample

ISSN 2042-4116

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