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COUPLES' SOCIOECONOMIC RESOURCES AND COMPLETED FERTILITY IN POLAND[1]

INTRODUCTION

A remarkable increase in the formally-achieved levels of education, preceded by an improvement in educational attainment, and followed by expansion of labour market participation, especially among women, are considered as the most important drivers of fertility decline in industrialized countries (Oppenheimer 1994, Kohler et al. 2006, van Bavel 2012). Since the most significant changes in these areas have been achieved by women, the majority of studies used to concentrate on the possible connections between fertility and female socioeconomic status, while male characteristics were commonly neglected and the perspective of couples was almost never considered. Recently, however, a growing attention has been given to the impact of educational level and educational enrolment on childbearing behaviour both for women and men, and the general conclusion of this line of research is that a higher completed level of education, and a longer enrolment in education result in postponing childbearing and lead to smaller completed family sizes (see, e.g., Hoem 2000, Kohler et al. 2006, Winkler-Dworak and Toulemon 2007). However, other socioeconomic characteristics, such as employment, field of education or occupation are usually omitted or, if included, focus only on women (Hoem et al. 2006a, 2006b, Matysiak 2009, van Bavel 2010).

The measures of socioeconomic status in the previous work have been mainly based on the highest completed level of education, which seemed to be an efficient proxy of socioeconomic resources, especially in historical societies. However, the

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recent increase in educational enrolment, and the significant growth in the share of people who completed higher education has apparently changed the matter, so that a high level of education does not guarantee a high socioeconomic status of an individual any more. It is therefore necessary to consider other characteristics that describe the socioeconomic status more unambiguously, in order to analyse the possible impact of socioeconomic resources on reproductive behaviour (Gayle 2015). These other characteristics include, for instance, the area of education and occupation; both of them, accompanied by the level of education, could be treated as an adequate reflection of the social and economic status of an individual (Hoem et al. 2006b, Andersson and Neyer 2012, Begall and Mills 2013).

Previous studies have pointed out that the pattern revealed in the relationship between socioeconomic resources and childbearing behaviour could differ between parents and childless people (Hoem et al. 2006a, 2006b, Barthold et al. 2012). As a consequence, the proper inference about fertility should be therefore performed by a simultaneous analysis of both subpopulations. Usually, such an approach has been so far followed by the separate analyses of childless people and of parents. However, in such cases, the natural link between childlessness and parenthood, as two complementary states of one fertility process, was fully neglected. Therefore, using a model that allows including both states combined under one statistical model seems to be a natural solution.

Taking a perspective of a couple in analysing the relationship between fertility and socioeconomic resources, described not only by educational level, but also by educational field, occupation and other social or economic characteristics of both partners, still remains under-researched. To this author's best knowledge, there are only several studies that deal with this topic, but concentrate mainly on the gender-egalitarian welfare societies (see Jalovaara and Miettinen 2013 on first births in Finland, Andersson and Scott 2007 on second and third births in Sweden), South European countries (Vignoli et al. 2012 on first births in Italy) or analyse general European patterns (Osiewalska 2015 on fertility timing and completed family size in selected European countries). The case study of Poland could add new information on considered relationship in the formerly socialist European countries.

In the light of the existing considerations, the studies that examine the possible connection between fertility and couple socioeconomic status are insufficient. This study aims at analysing how socioeconomic resources of both partners in a couple affect their reproductive behaviour regarding completed family size in a relatively gender-conservative society. In particular, our aim is to examine the pattern revealed in reproductive behaviour in Poland, as a representative of the post-socialist European countries. The populations of childless couples and of parents are linked within a single model by the probability of childlessness/parenthood. Socioeconomic resources of a couple are described by educational level, educational field and occupation of both partners. Additionally, the employment sector (public, private, self-employed) is also included.

THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

Couples' reproductive behaviour in developed societies is usually an effect of rational and conscious decision, that is based on considering advantages and possible disadvantages of having a(nother) child. Within this decision-making process partners try to assess their readiness to rear children, relative to their both emotional and economic resources, as well as the expected impact of childbearing on their wellbeing and future life and careers (educational, professional, etc.). As a consequence, fertility decisions in modern societies are the result of mutual preferences and compromises between both potential parents, but still the perception of whether or not they are ready to have a child could differ between partners.

The theoretical discussion on how socioeconomic resources of both partners could influence this complex process at a micro level is provided by the economic theory by Becker (1960, 1991). The general assumption is that partners adjust their demand for children to match the limited resources they possess. Since more resources open up more possibilities, the demand for children increases with wealth, and a positive influence of socioeconomic status on couples' fertility can be expected (the "income effect"). However, Becker also emphasized that among women the effect of higher earnings on childbearing could be mixed. On the one hand, a woman's economic resources contribute to the overall household status, and therefore lead to the increase in demand for children and higher couple's fertility (due to the "income effect"). On the other hand, the opportunity costs of having a child for a high-status woman, such as potential losses in professional career, could dominate the childbearing desire and result in the negative effect of female socioeconomic resources on fertility (the "substitution effect"). It was suggested that the negative effect caused by the opportunity cost for women usually prevails over the positive influence of the income effect; therefore, a higher female socioeconomic status is linked with a lower level of fertility.

As stipulated by microeconomic theory, the effect of socioeconomic resources on fertility differs by sex. Simultaneously, Becker's assumption on the prevailing gender roles within a couple was traditional, based on the family model with a man as a main breadwinner and a woman taking care of children and household. Therefore, in this model, the opportunity cost of childbearing concerns only females. Recent changes in the perception and acceptance of very different gender roles could undermine the assumption made previously by Becker. According to the gender equity theory proposed by McDonald (2000, 2006), modern societies, with Nordic countries regarded as forerunners, tend to reject the traditional family model. This rejection might be voluntary, but it might also be forced by external factors, since only one working family member is usually not capable of providing enough financial resources to maintain the desired lifestyle.

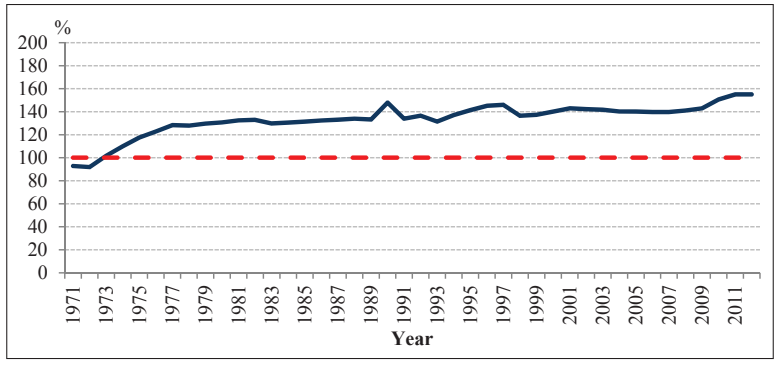
Changes in individual attitudes have led to a new model in which female and male roles regarding paid work and household duties are more equal. Women get

involved in their professional careers; men, in turn, take part in housework and childcare. Ideally, an opportunity cost of having a child should be divided by two, and concern a woman and a man in equal measure. The reality is, however, more complex. Although institutions that focus on individuals (education, labour market) have already shifted toward higher level of gender equity, family-oriented institutions (social insurance, employment conditions) are still linked to the old pattern in which a women usually devote herself to take care of children (at least in their early childhood). Thus, women can profit from the same educational and professional opportunities as men, but, if a child is born, her prospects are strongly limited by the unfitting family institutions. As a consequence, the opportunity cost of motherhood grows rapidly, and the level of fertility reduces. This effect is particularly significant in countries with still traditional family system, as, for instance, Poland and other Eastern or Southern European countries (see, e.g., Muszyńska 2007).

Poland, as one of the post-socialist countries, provides a possibility to analyse how the gender-specific socioeconomic resources are connected with couples' fertility under the relatively peculiar conditions. Women in the former socialist countries were expected to join education and then labour market with the same rights and under the same conditions as men. Therefore, the equality in gender roles regarding educational and professional careers was achieved sooner than in other European countries (van Bavel 2012). In Poland the reversal of the gender gap in education (the number of female students exceeding the number of men enrolled in tertiary education) was firstly noticed in the early 1970s (see Figure 1). After the disintegration of Eastern bloc, the previously observed trend continued to hold, and in 2012 there were already 1.55 female students in higher education per 1.00 males.

However, the equality in gender roles in education and labour marker in Poland does not correspond to the equality in housework and childcare duties. Still women, are usually expected to do both work and rear children (Muszyńska 2007, Kocot-Górecka

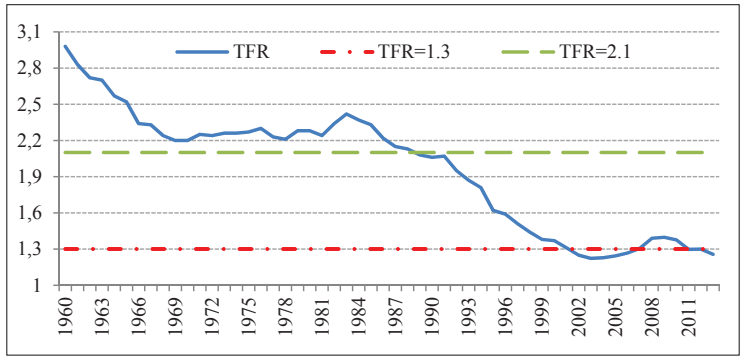
Figure 1. Ratio of female to male tertiary enrolment (%) in Poland, 1971–2012



Source: Author's own elaboration based on World Development Indicators (http://data.worldbank.org/indicator/).

2014). Given such discrepancies between the perception of labour market duties and childcare responsibilities, the fertility level in Poland is nowadays one of the lowest in Europe. Poland has belonged to the so called "lowest-low" fertility countries (with the TFRs below 1.3; see Kohler et al. 2002) for more than a decade, starting from 2002 with the TFR equal 1.249, slightly up to 1.256 in 2013 (Figure 2). The reduction in completed family size is accompanied by the increase in the share of childless couples. In 2002, as many as 28.8% of total number of marriages in Poland and 43.9% of cohabiting couples (all ages included) were childless, and till 2011 these shares have increased to 33.1% and 45.9%, respectively (Central Statistical Office of Poland 2014: 205).

Figure 2. Total fertility rate in Poland, 1971–2012



Source: Author's own elaboration based on World Development Indicators (http://data.worldbank.org/indicator/) and Local Data Bank, Central Statistical Office of Poland (http://stat.gov.pl/bdl/app/strona.html?p_name=indeks).

Many previous studies provide evidence of the negative effect of educational level on both woman's and man's childbearing behaviour (Kreyenfeld 2004 on German women, Lappegård and Rønsen 2005 on women in Norway, Winkler-Dworak and Toulemon 2007 on both sexes in France, Barthold et al. 2012 on both sexes across Europe). However, there are also several studies showing that the risk of having a first child is higher for individuals that completed tertiary education (Lappegård and Rønsen 2005 on women in Norway, Jalovaara and Miettinen 2013 on both sexes in Finland). The U-shaped impact has been also found in some studies (Winkler-Dworak and Toulemon 2007 on France). Finally, also the positive influence of educational level on fertility was reported for childless men (Fieder and Huber 2007 on Sweden). In Poland the strongly negative educational gradient in completed fertility of women was identified by Brzozowska (2014). Other studies have found that the higher female educational level, the lower risk of first, second and third birth (Soja 2005, Osiewalski and Zając 2011). The relationship between men's educational level and the risk of having the first child tends to be reversed U-shaped, with the highest likelihood reported

for individuals who completed medium education, while no effect was found for the second-order births (Matysiak 2014).

The impact of other socioeconomic characteristics, such as the field of education and occupation, on reproductive behaviour has not been widely analysed. Regarding the field of education, the majority of studies concentrates mainly on women (Hoem et al. 2006a, 2006b on Sweden, Neyer and Hoem 2008 on Austria and Sweden, Bagavos 2010 on Greece, van Bavel 2010 on European countries, Begall and Mills 2013 on the Netherlands). The choice of an area of education is assumed to have an impact on the process of shaping values and preferences of an individual, but it also influences the future labour market career. The results for women indicate the positive association between reproductive behaviour and "traditional" female fields of education (the so-called *sex-segregation effect*). In other words, higher fertility and lower probability of childlessness are usually observed in female-dominated fields, such as teaching or healthcare (see, e.g, Lappegård and Rønsen 2005, Hoem et al. 2006a, 2006b). In Poland, the female educational field occurred to have no significant impact on the risk of having the first and second child (Matysiak 2014). No studies, to Author's knowledge, have investigated the field of study of men.

Studies that examine the possible influence of occupation on fertility usually use the educational level and educational field as a proxy for individual's occupation (Lappegård and Rønsen 2005, Hoem et al. 2006a, 2006b, Neyer and Hoem 2008). Direct connection between childbearing behaviour and occupation are rare (Martin-Garcia 2009 on Spanish women, Andersson and Neyer 2012 on both sexes in Denmark, Begall and Mills 2013 on women in the Netherlands). The general picture that emerges from these studies is that both female-dominated and highly male-dominated occupations promote childbearing among women. In turn, men occurred to have higher risk of having the first child in jobs dominated by males. Therefore the "gender-homogenous" effect of occupation was suggested (Andersson and Neyer 2012). What is more, it was mentioned that in reproductive behaviour a job sector could also matter and a part of the positive effect of female-dominated fields might be explained by the fact that these jobs are very often located in the public sector providing more stable employment and more family-friendly practices (Hoem et al. 2006a, 2006b). Among Polish women, a higher risk of motherhood was reported in jobs connected with healthcare, teaching and social sciences (Matysiak 2014). Marriages in which a man works as a highly qualified specialist have the lowest risk of having the first, second and third child, as compared to marriages with a lower qualified male partners, and with farmers (Soja 2005).

This study concentrates mainly on the effect of socioeconomic resources of a couple, described by educational level, educational field and occupation (together with a job sector) of both partners on their completed family size. The following hypotheses are formulated. Firstly, we expect the negative impact of **educational level** of both partners on couple's completed fertility. Thus, homogamous unions with high education are expected to have smaller families as compared to their counterparts. On the

other hand, partners with high educational level are usually more prone to adapting new attitudes. Hence, the gender equality regarding housework and childcare among these couples could be relatively high and, therefore, fertility-enhancing. However, in Poland changes in the perception of gender roles are relatively new (Kocot-Górecka 2014), thus the effect of the equality between partners might not be revealed among older generations that already completed their reproductive careers. Secondly, since hypogamy in educational level has been present in Poland already for decades and female educational advantage do not necessarily correspond to economic advantage within a couple (see, e.g., van Bavel 2012), the effect of educational hypogamy on fertility is expected to be negligible.

Regarding the **field of education**, we expect that couples with female partner educated in health and welfare care or pedagogics (female-dominated[2] fields) have higher completed family size and lower probability of childlessness. Additionally, when a woman in a union is educated in fields typical for men (such as, e.g., engineering), the fertility-enhancing effect can be also expected. A similar positive effect is assumed for male partners educated in female-dominated fields.

Finally, the **occupational status** of both partners is expected to have a substantial effect on couples' reproductive behaviour. Based on previous findings of Soja (2005), we assume that together with the increase in occupational status the fertility declines for both sexes. Since family-oriented institutions in Poland are not yet entirely adjusted to the need of families and stay far behind those existing in the European frontrunner countries, such as in the Nordic Europe (Matysiak and Węziak-Białowolska 2013), the opportunity costs of having children are prominent and, therefore, could lead to limited number of children. Additionally, the effect of **business sector** (public or private) might also affect childbearing. We assume that partnerships with female partner working in public sector have higher number of children and lower probability of childlessness than other couples.

DATA AND MODEL

DATA

The empirical illustration of this study is based on the data from the first wave of the Polish Generations and Gender Survey (GGS, www.ggp-i.org). The GGS is an international survey that aims at collecting information on social, economic and cultural characteristics included in the questionnaire in several modules. Panels consist of at least three rounds carried out every three years in different countries

[2] The female to male ratio among students in Poland in 2013 was equal, respectively, 4.0 in pedagogics, 3.0 in medicine, 6.4 in social care (source: Author's own calculations based on Local Data Bank, CSO of Poland, http://stat.gov.pl/bdl/app/dane_podgrup.display?p_id=907474&p_token=0.7500256844062027).

participating in the study. In the context of this study, it is essential that the survey provides information on the creation, development and disintegration of families, relationships between the generations, change in the social roles of men and women, labour market, health, and prosperity status.

The Polish original dataset consist of 19,987 adult individuals. The first wave was conducted in 2011. For the purpose of this study only heterosexual partnerships (co-residing), in which female partners were aged 40 or more, were included in the sample. These restrictions cause a selection effect. All respondents who were single at the moment of interview, regardless of their previous partnership history, have been excluded due to the insufficient information provided in the survey on previous partnerships. This selection could have an impact on the results, especially among older ages, when the ratio of widowed people significantly increases. All re-partnered respondents were included in the analysis and the results were controlled for the presence of children from previous unions. The other selection bias is connected with the restriction on the age of the women. It should be noted that only those women who survived until the age of 40 or more are included in this study.

Additionally, incomplete information on socioeconomic characteristics or fertility of any partner caused an exclusion from the analysis. Consequently, the final sample includes 7,247 couples. The age restriction for women (40 years or more) ensured that, with a high probability, the fertility of a couple is already completed (Bailey et al. 2014).

VARIABLE DESCRIPTION

The structure of all analysed variables is presented in Table 1. Completed fertility of a couple (response variable) is measured by the number of children that a couple already have, including children from previous partnerships (approx. 5% of all children in the sample). The partners usually have two children (45.3% of the total sample) and the level of childlessness is relatively low (3.5%).

The main explanatory variables considered in the model are the level of education, the field of education, occupation and job sector, all for both partners. After preliminary analysis, to examine the possible effect of educational hypogamy that is typical in Poland for decades, **educational level** was included in the final model in relative values created for each couple (as a result of a combination of individuals' highest completed educational levels), while remaining variables were taken in absolute values. Consequently, there are five types of couples by educational level: *edu11* – both partners in a couple have completed at most lower (primary) education, *edu22* – both partners have completed medium (secondary) education (reference level), *edu33* – both partners are highly educated (tertiary education), *eduLH* – female partner is lower educated than male partner and *eduHL* – a woman is higher educated than a man. The majority of partners are in educationally homogamous unions, with a clear dominance of medium-educated couples (52.2%). Although

on a macro level female educational hypogamy has been observed in Poland since 1970s, this relation does not hold at the micro level in the generations under study. Still, among educationally heterogamous couples hypergamy is slightly more popular (14.6%) than hypogamy (13.6%).

Educational field of each partner was classified into the following six groups: (1) *Teaching, Health and Welfare* (including teacher training and education science, health and veterinary, personal services); (2) *Humanities and Art*, (3) *Social sciences, business and law* (social and behavioural science, journalism and information, business, administration and law), (4) *Science* (life sciences, physical sciences, mathematics and statistics, computing), (5) *Engineering* (engineering and engineering trades, manufacturing and processing, architecture and building) and (6) *General education* (reference level; agriculture, forestry and fishery, social services, elementary education and other). Among women, the most popular is *General education* (39.2%) and the smallest interest is given to *Science* (2.3%). In turn, the majority of men choose *Engineering* (55.9%), while the least popular are *Humanities and Arts* (1.1%).

Regarding **occupation** (present or the last one reported), the following five classes have been selected for both sexes: (1) *Professionals* (Armed Forces, legislators, senior officials and managers, professionals), (2) *Associate professionals* (technicians and associate professionals, clerks), (3) *Service and trade workers* (service workers, shop and market sales workers, craft and related trades workers, plant and machine operators and assemblers), (4) *Agriculture* (agricultural, forestry and fishery workers) and (5) *Basic occupations* (sales and services elementary occupations, labourers in mining, construction, manufacturing and transport; reference level[3]). The most popular occupational class among both sexes is *Service and trade workers* (25.1% for women, 52.7% for men). Additionally, 39.0% of women and 29.1% of men work in **public sector**.

Regarding remaining control variables, we include in the model the *type of settlement* (rural, urban), *union status* (cohabitation, marriage), *having children from previous partnerships* (included only for respondents in parenthood state), *age of a woman* (standardized), *age of a man* (standardized), and *union duration* (standardized). Based on the structure of considered covariates (Table 1), the majority of couples live in urban areas (62.7%) and only small share of unions are cohabiting (2.4%). Also very few respondents had been previously married (6.7%) and only 2.2% partners have children from previous partnerships. In the analysed sample women are aged 40 and more (up to 89), while men are from 30 to 91 years old. Thus, the women were born between 1921 and 1971; and the men between 1920 and 1980. Finally, the majority of unions have been in relationships already for more than 20 years (88.1%).

[3] Although in statistical modeling the reference level of a covariate should be based on the most popular level, which in case of occupation is *Service and trade workers* for both sexes, for the purpose of this study, to compare each class with the basic one, it has been decided to keep *Basic occupations* as the reference level for occupational groups.

Table 1. Structure of variables included in the model

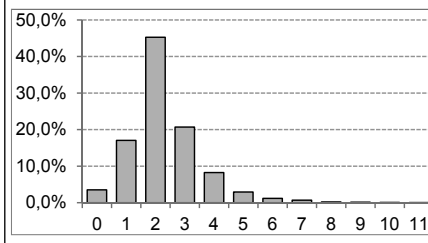
Response variable	Distribution
Number of children	
Main explanatory variables	**Structure**
Educational level	
edu11	11.2%
edu22 (ref.)	52.2%
edu33	8.3%
eduHL	13.7%
eduLH	14.6%
Educational field of a woman	
Teaching, Health and welfare	18.8%
Humanities and art	2.5%
Social science, business and law	17.8%
Science	2.3%
Engineering	19.4%
General education (ref.)	39.2%
Educational field of a man	
Teaching, Health and welfare	6.8%
Humanities and art	1.1%
Social science, business and law	4.3%
Science	1.6%
Engineering	55.9%
Elementary education (ref.)	30.3%
Occupation of a woman	
Professionals	18.7%
Associate professionals	21.4%
Service and trade workers	25.1%
Agriculture	12.9%
Basic occupations (ref.)	21.9%

Table 1 continued

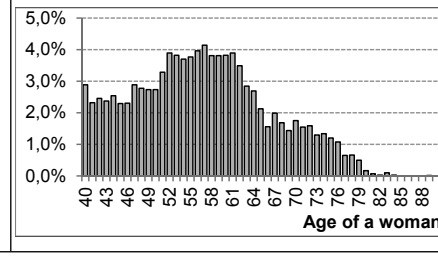
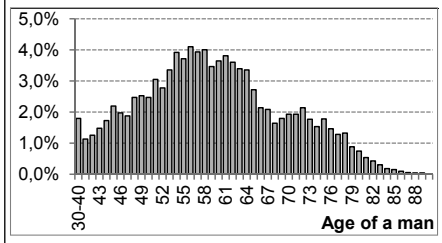
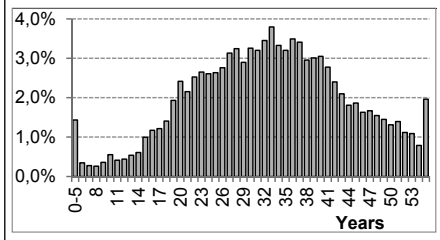
Main explanatory variables	Structure
Occupation of a man	
Professionals	13.7%
Associate professionals	9.1%
Service and trade workers	52.7%
Agriculture	10.9%
Basic occupations (ref.)	13.5%
Female job sector	
0 – other (ref.)	61.0%
1 – public	39.0%
Male job sector	
0 –other (ref.)	70.9%
1 – public	29.1%
Control variables	**Structure**
Type of settlement	
0 – Urban (ref.)	62.7%
1 – Rural	37.3%
Union status	
0 – marriage (ref.)	97.6%
1 – cohabitation	2.4%
Respondent previously married	
0 – no (ref.)	93.3%
1 – yes	6.7%
Having children from prev. partnerships (included only in parenthood state)	
0 – no (ref.)	97.8%
1 – yes	2.2%
Age of women	

Table 1 continued

Control variables	Structure
Age of men	
Union duration (in years)	
Total sample size	7247

Source: Own elaboration based on Polish GGS sample.

Correlations between all explanatory variables have been checked and no substantial values have been revealed. The highest value is observed between male and female occupations in *Agriculture* (0.6), but to keep similar occupational classes for each partner, after preliminary analysis, both covariates have been included in the model. The correlation matrix for main explanatory variables is presented in Appendix A.

MODEL

Since behavioural drivers can differ among childless couples and parents, there is a need to distinguish both groups. The proper analysis should be performed with a model that "reconciles" childlessness and parenthood, allows including corresponding explanatory variables for each state and keeps both states under one statistical model standing of the fertility process. All the above postulates are fulfilled by the **Zero-Inflated Poisson (ZIP) model** (see Lambert 1992). The model consists of two parts. The first one, called *zero state*, occurs with the probability p measured by a binomial logistic regression; in fertility this part stands for childlessness and p is corresponding probability of being childless. The second one is *count state* that takes integer values and uses the standard Poisson distribution with mean λ. This state corresponds to parenthood. Both *zero* and *count* states are combined with each other by applying the probability p. The formula for the model is therefore as follows:

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

$$p_i = \frac{\exp(x_i \gamma)}{1+\exp(x_i \gamma)}; \ \lambda_i = \exp(w_i \delta),$$

where x_i and w_i are vectors of covariates for i-th observation, and γ and δ are the vectors of hyperparameters. This formula corresponds to the hurdle specification of the ZIP models (see Pohlmeier and Ulrich 1995). The ZIP model was originally used to analyse the occurrences of defects in manufacturing process (see Lambert 1992). In demography the model has been used so far to examine fertility behaviour (see, e.g., Osiewalska 2013) and fertility intentions (Bordone et al. 2013).

In this study the Bayesian methods are used. The main idea behind this approach is very intuitive. Estimation of model's parameters is based on determining the conditional density of parameters given the observations vector $P(\gamma, \delta \mid Y)$, the so-called *posterior* distribution, from the join density of parameters and observations. The posterior distribution is than proportional to the likelihood function multiplied by the *prior* distribution of parameters, $P(\gamma, \delta)$:

$$P(\gamma, \delta \mid Y) \propto P(\gamma, \delta) P(Y \mid \gamma, \delta) = P(\gamma) P(\delta) \prod_i P(Y_i = y_i \mid \gamma, \delta) \tag{2}$$

Thus, both data and prior knowledge are included in the statistical model with the same level of importance.

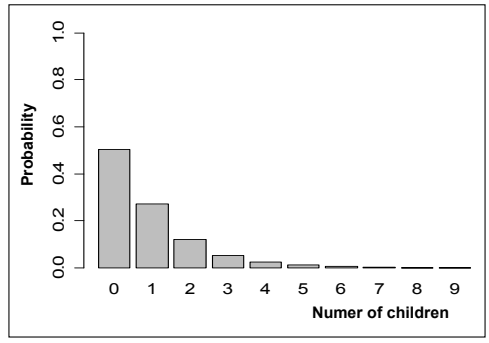
Recently Bayesian methods in demography have gained more popularity, especially in the area of migration (e.g., Bijak 2011, Abel et al. 2013) and population projections (Raftery et al. 2012, Bryant and Graham 2013, Billari et al. 2014, Wiśniowski et al. 2015). In fertility studies, examples of the use of these methods include forecasting (Alkema et al. 2011, Schmertmann et al. 2014) and modelling (Osiewalski and Zając 2011, Osiewalska 2015).

Application of the Bayesian methodology in this study is justified mainly by the ability to formulate fully probabilistic conclusions, based on distributions for all estimated values, as well as for their linear and nonlinear functions (see, e.g., Zellner 1971). It is particularly relevant for the ZIP models, in which nonlinear functions (such as the probability of childlessness) are of key interest. What is more, within the Bayesian framework there is no longer a need to rely on the asymptotic properties of estimators, such as asymptotic normality[4], which can never be sure to be satisfied and

[4] Asymptotic normality of an estimator means that the estimator's distribution approaches a normal distribution as the sample size grows. It is the main assumption of classical approach (see, e.g., Rao 1973).

which are under serious doubt in case of a small sample sizes. Another advantage of the Bayesian inference is the possibility of inclusion in the statistical model the prior knowledge – in our study it is the knowledge about probability of childlessness and the average expected family size. Our initial knowledge of completed fertility consists of two main elements. Firstly, we are almost sure that a randomly chosen contemporary couple would have less than 10 children (so there is no need to give any positive probabilities to values bigger than 10). Secondly, we would grant higher chances for the numbers of children between 0 to 3, and smaller chances for the remaining cases (4 to 10). Thus, in this study the initial knowledge of the number of children for a chosen couple is reflected by the prior distribution assumed in the model (see Figure 3, compare Osiewalska 2015). Details on ZIP model together with Bayesian framework used in fertility modelling as well as the Bayesian comparison between standard Poisson regression model and ZIP model can be found in Osiewalska (2013).

Figure 3. Prior distribution of the number of children for a chosen couple



Source: Author's own elaboration based on Polish GGS sample.

MODELLING RESULTS

The effects of partners' socioeconomic resources on becoming parents and having subsequent children are summarized by the *a posteriori* distributions of coefficients under study. All the marginal *a posteriori* distributions are presented in Appendix B. The measure of variable's significance (*MS*) is the marginal *a posteriori* probability that the corresponding parameter is equal to zero, which for a given parameter θ_i can be written as $P(\theta_i < 0 \mid Y)$ when $E(\theta_i \mid Y) \geq 0$, or $P(\theta_i > 0 \mid Y)$ otherwise. Here, values lower than 0.05 are assumed to indicate a significant impact of the corresponding covariate on the response variable. Otherwise, when there is a high probability that the parameter equals to zero, the corresponding covariate is assumed to be negligible. The expected values and measures of significance are presented in Table 2. When the variable is insignificant, the values have been marked with grey.

Table 2. The *a posteriori* expected values of coefficients and measures of significance (*MS*) within the zero state (childlessness) and the count state (parenthood) regressions

Main explanatory covariates	Probability of childlessness (p)		Parenthood (λ)	
	$E(\gamma_i \mid Y)$	$MS(\gamma_i)$	$E(\delta_i \mid Y)$	$MS(\delta_i)$
Education of a couple:				
edu11	0.143	0.289	0.098	0.010
edu33	–0.186	0.283	–0.105	0.033
eduHL	0.199	0.215	–0.009	0.394
eduLH	0.148	0.242	0.042	0.108
Woman's educational field:				
Teaching, Health and welfare	–0.213	0.156	–0.001	0.488
Humanities and art	0.039	0.442	–0.090	0.130
Social science, business and law	–0.053	0.394	–0.036	0.158
Science	–0.127	0.404	–0.114	0.078
Engineering	–0.549	0.012	–0.026	0.227
Man's educational field:				
Teaching, Health and welfare	–0.044	0.463	–0.038	0.216
Humanities and art	0.211	0.342	–0.057	0.303
Social science, business and law	–0.423	0.096	–0.182	0.007
Science	–0.255	0.332	–0.184	0.033
Engineering	0.112	0.285	–0.059	0.030
Woman's occupation:				
Professionals	–0.310	0.178	–0.164	0.001
Associate professionals	–0.177	0.222	–0.150	0.000
Service and trade workers	–0.045	0.422	–0.073	0.012
Agriculture	–0.412	0.078	0.019	0.322
Man's occupation:				
Professionals	–0.150	0.303	–0.099	0.028
Associate professionals	0.455	0.031	–0.064	0.096
Service and trade workers	–0.201	0.141	0.001	0.486
Agriculture	0.059	0.424	–0.013	0.388
Woman's job in public sector	–0.461	0.006	–0.002	0.469
Man's job in public sector	–0.058	0.375	–0.024	0.180

Table 2 continued

Control covariates	Probability of childlessness (p)		Parenthood (λ)	
	$E(\gamma_i \mid Y)$	$MS(\gamma_i)$	$E(\delta_i \mid Y)$	$MS(\delta_i)$
Intercept	–1.782	0.000	0.698	0.000
Age of a woman	0.524	0.000	–0.052	0.001
Age of a man	0.091	0.144	0.045	0.002
Type of settlement	–0.372	0.032	0.191	0.000
Union status	–0.308	0.248	0.027	0.331
Previously married	–2.601	0.000	0.451	0.000
Union duration	–0.506	0.000	0.021	0.029
Children from prev. partnerships	——		0.119	0.027
Total number of couples	256		6991	

Source: Author's own elaboration based on Polish GGS sample.

In addition, Figures 4–9 summarise the results by presenting the posterior distributions of the probability of childlessness and the expected number of children by significant main explanatory covariates. Table 3 reports the mean values of the respective posterior distributions.

As for the **educational level** of a couple, the analysis reveals the occurrence of negative impact of partner's education on fertility among parents. The expected value of coefficient for type *edu11* is positive (0.098), thus a homogamous union of low educated individuals (who had already become parents) is expected to have larger average family size than a medium-educated couple (reference level). In turn, highly educated parents have the lowest average family size (the expected value of the coefficient equals −0.105). No significant effect can be reported for hypogamous and hypergamous couples. Regarding childlessness, the impact of educational level on the probability of becoming parents occurred to be also insignificant.

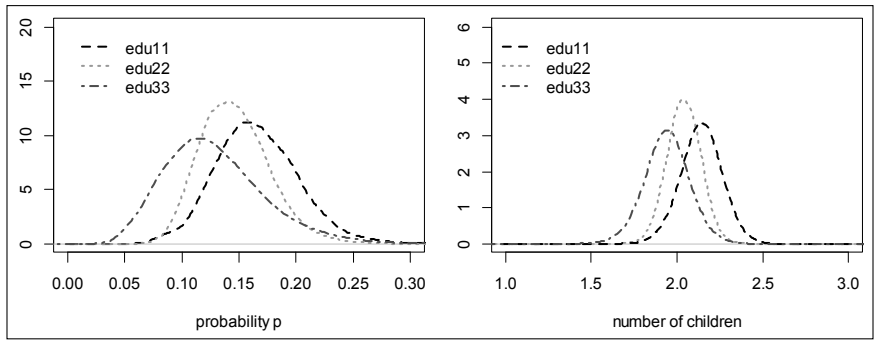
The posterior distributions of estimated probability of childlessness (p) and the expected family size[5] by educational level are shown in Figure 4. All the remaining covariates are at their reference levels; besides, both partners are assumed to be 55 years old and to have been in the relationship for 30 years. Only educational levels for which coefficients turned out to be significant are presented. Firstly, a homogamous low educated couple seems to have slightly (but not significantly) higher probability of being childless than a medium educated partners (the graph at

[5] Expected family size – the expected value of the ZIP distribution, equal to the product of probability of parenthood $(1 - p)$ and the expected value of the Poisson part (λ), scaled by $(1 - \exp(-\lambda))^{-1}$ – see eq. (1).

the left-hand side), while highly educated partners are characterised by the lowest risk of childlessness. The mean *a posteriori* expected probability of childlessness equals to 0.166 for *edu11*, 0.129 for *edu33* and 0.147 for *edu22* (Table 3). Additionally, the posterior distribution for highly educated couples is skewed to the right, so the majority of these unions have even lower probabilities of childlessness than the reported mean.

However, the average expected family size for homogamous couples with low levels of education, which takes into account also the corresponding probability of childlessness, tends to exceed the number estimated for high and medium educated unions. For the first group, the *a posteriori* expected mean of 2.142, while highly-educated partners are expected to have 1.940 children on average and a medium educated union is located in-between, with the mean of 2.041 (Table 3). Thus, a negative impact of partners' educational levels on their expected family size can be confirmed.

Figure 4. Posterior distributions of the probability of childlessness (*p*) and expected family size by couple's selected educational levels – homogamous couples

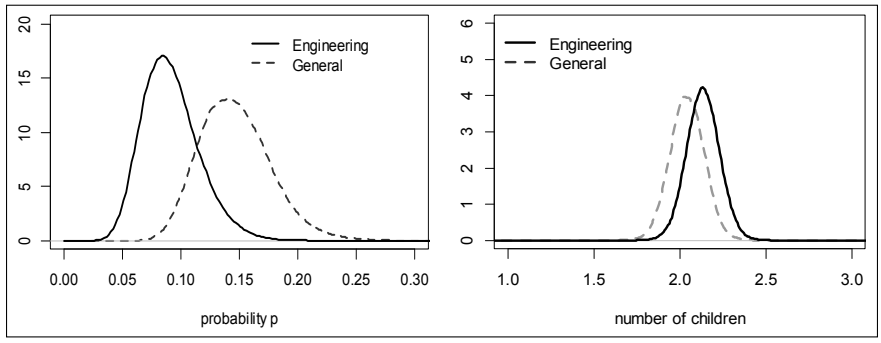


Source: Author's own elaboration based on the Polish GGS sample.

The **field of woman's education** has typically a negligible impact on couple reproductive behaviour. The only one exception has been revealed in the childlessness state. Namely, when a woman in a couple is educated in *Engineering*, the chance of being childless clearly declines and is equal almost half of the chances reported for union in which a woman is educated in *General education* (reference level; see Figure 5). As a consequence, the mean expected number of children for unions in which a woman is educated in *Engineering* exceeds the mean reported for *General education* (Table 3).

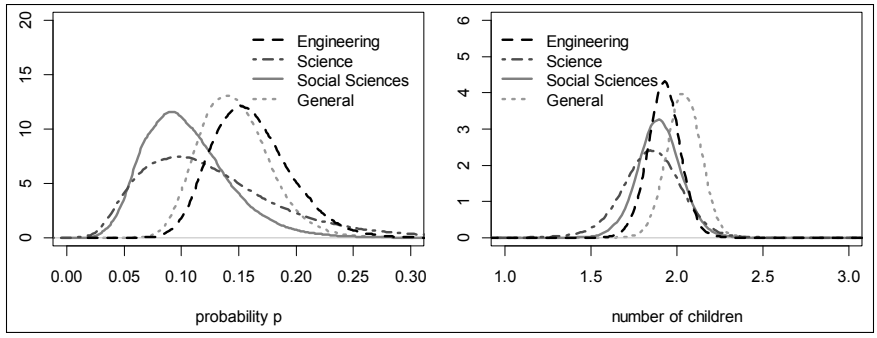
In turn, **male field of education** occurred to significantly determine fertility among parents. Couples in which a man is educated in *Social science, business and law*, *Science* or *Engineering* tend to have lower average number of children than their counterparts (Figure 6, Table 3).

Figure 5. Posterior distributions of the probability of childlessness (p) and expected family size by selected woman's educational field



Source: Author's own elaboration based on the Polish GGS sample.

Figure 6. Posterior distributions of the probability of childlessness (p) and expected family size by selected man's educational field

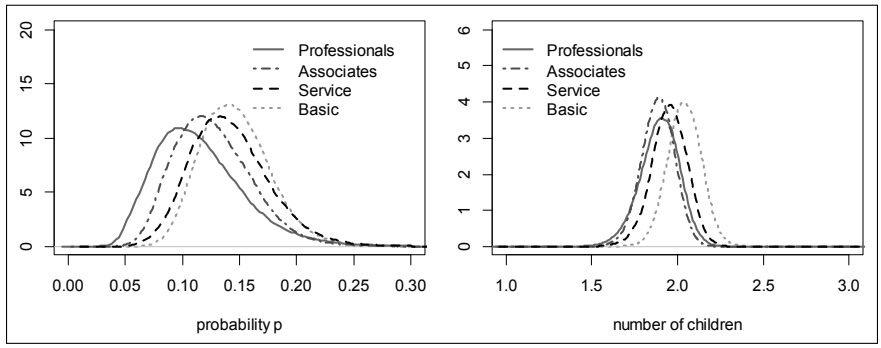


Source: Author's own elaboration based on the Polish GGS sample.

Female occupational status is negatively correlated with the completed family size. Couples with female partners working as *Professionals* or *Associate professionals* tend to have the lowest number of children. Slightly higher family sizes are observed for the *Service and trade workers* and the highest number is reported for *Basic occupations* (Figure 7).

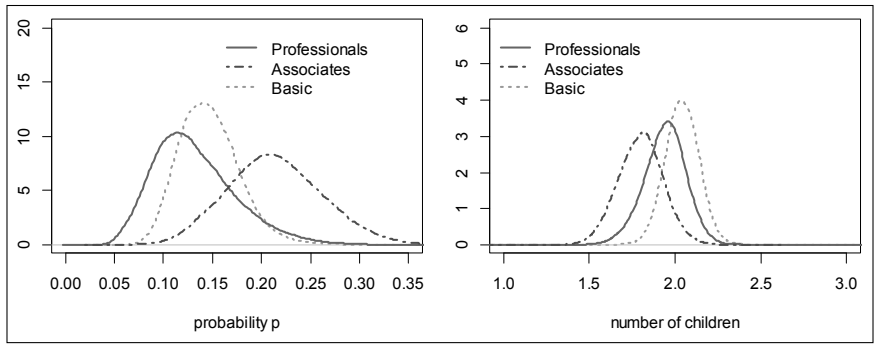
The selected **occupational groups of the male partner** determine both childlessness and parenthood states. When a male partner works as an *Associate professional* the probability of a couple being childless is higher than for other unions and the U-shaped relationships between male occupational prestige and couple's chances of becoming parents is observed (see Figure 8, left-hand side and Table 3). On the other hand, fathers having jobs as *Professionals* tend to limit the average family size. As a consequence of these two relationships, the couple's *a posteriori* expected number of children is also U-shaped related to male occupational status, with the lowest number reported for *Associate professionals* (Figure 8, right-hand side).

Figure 7. Posterior distributions of the probability of childlessness (p) and expected family size by selected woman's occupation



Source: Author's own elaboration based on the Polish GGS sample.

Figure 8. Posterior distributions of the probability of childlessness (p) and expected family size by selected man's occupation

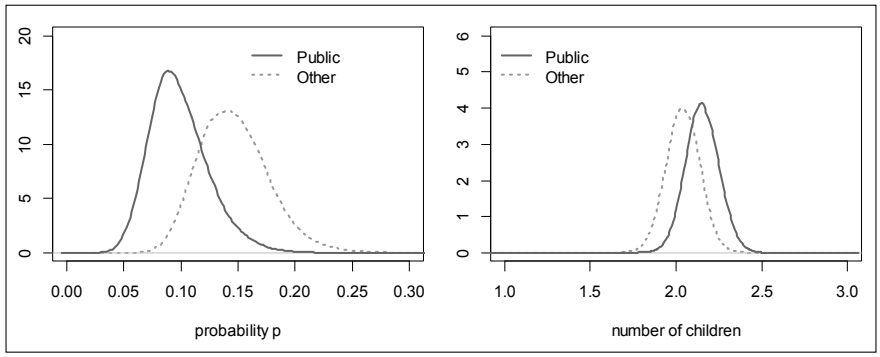


Source: Author's own elaboration based on the Polish GGS sample.

Finally, the effect of a **job sector** has been found to be substantial only for women. Namely, when the female partner works in a public sector, the probability of childlessness for a couple decreases and, as a consequence, the *a posteriori* expected number of children increases as compared to the reference level (see Figure 9).

Among the **control covariates**, a negative effect of female partner's age on couple's chance to become parents has been identified. Amongst parents, the older a woman and the younger a man, the lower their average family size is. Living in rural areas decreases the probability of childlessness and increases the average family size among parents. Also when respondent had been previously married, chances of becoming a parent and average number of children are higher than for other couples. Union duration also occurs to have positive influence on partner's reproductive behaviour. Finally, having children from previous partnerships naturally increases the average family size among parents.

Figure 9. Posterior distributions of the probability of childlessness (p) and expected family size by woman's employment sector



Source: Author's own elaboration based on the Polish GGS sample.

Table 3. The *a posteriori* expected values of probability of childlessness and average number of children by couples' socioeconomic characteristics

Socioeconomic characteristic	The *a posteriori* expected value	
	Probability of childlessness	Average number of children
Education of a couple:		
edu11	0.166	2.142
edu33	0.129	1.940
Woman's educational field:		
Engineering	0.092	2.134
Man's educational field:		
Social science, business and law	0.105	1.898
Science	0.128	1.851
Engineering	0.161	1.924
Woman's occupation:		
Professionals	0.116	1.895
Associate professionals	0.127	1.886
Service and trade workers	0.142	1.951
Man's occupation:		
Professionals	0.132	1.941
Associate professionals	0.214	1.799
Woman's job in public sector	0.099	2.152
REFERENCE LEVEL	0.147	2.041

Source: Author's own elaboration based on Polish GGS sample.

CONCLUSIONS

This study has aimed at analysing the impact of partners' socioeconomic resources on their completed fertility. The case study of Poland, a post-socialist country with a wide prevalence of *dual earner* family model, but relatively low level of gender equality in housework and childcare, has been considered. Socioeconomic status of a couple has been measured by educational level, educational field, occupation and job sector of each partner, in relative (in case of educational level) and absolute (for the remaining characteristics) values. Childless couples and parents have been considered together. The analysis has been performed with the use of Zero-Inflated Poisson model with Bayesian inferential framework.

The main conclusion of this study is that including both partners' socioeconomic resources increases our ability to characterise couples' childbearing behaviour. Besides educational level, additional socioeconomic characteristics of a woman and a man in a union, allow for examining couples' completed fertility from a wider perspective.

The results confirm that the negative influence of educational level holds also among couples. The homogamous highly-educated couples have the lowest completed family size, while the largest expected number of children *a posteriori* is typical for unions in which both women and men have low levels of education. Educationally hypergamous and hypogamous partnerships are located between low and high educated unions and have, on average, similar family size to homogamous medium-educated couples.

Although it might be expected that female-dominated educational fields, such as health and welfare or pedagogics, have fertility-enhancing effect among both sexes, these expectations are not supported by the model. However, the results reveal that the probability of childlessness is lower for couples with a woman educated in *Engineering*. This effect is coherent with previous findings on the positive influence of highly male-dominated educational field of women on childbearing (see, e.g., Hoem et al. 2006a). In turn, couples in which the man is educated in *Social science, business and law* (female-dominated), *Science* or *Engineering* (male-dominated) tend to have lower average number of children than their counterparts. Therefore, among men the sex-segregation effect has not been proved.

Regarding occupational branches the results confirm that female occupational prestige is negatively correlated with couple's completed family size. However, in the case of male occupation the effect is not straightforward. On the one hand, it has been shown that working as a *Professional* limits the average family size of a couple. On the other hand, probability of being childless significantly increases for couples in which a man works as an *Associate professional* and, because of high risk of childlessness, the average family size also declines. Finally, the expected number of children *a posteriori* for these couples is even lower than for *Professionals*. Therefore, a U-shaped relationship between male occupational prestige and couple's

fertility is suggested. Additionally, it has been shown that, indeed, working in the public sector has a fertility-enhancing effect, but only in case of female partner.

This study provides deeper insight on the relationship between partners' socioeconomic resources and completed fertility in Poland. However, it has also two data-driven limitations. Firstly, selection effects should be taken into account and, secondly, the occupational level is treated as fixed, although it might change over the life time. The first one is connected with the selection of couples that are still in relationships and in which female partners are at the age of 40 or more. All divorced unions, single parents and widowed have been omitted due to the insufficient information provided in the survey on previous partnerships. In turn, regarding the occupational classes, again there is lack of required information about the professional career and previous jobs, especially of the respondent's partner. Thus, only the effect of current (for employed individuals) or previous occupation (for the unemployed or inactive) can be measured. These occupations sometimes might differ from the occupation held during "active" past reproductive ages. However, it is also assumed that people behave in a way that could be described as family- or job-oriented, usually from their early adulthood. These attitudes shape their future family behaviour and professional careers, but they cannot be quantitatively measured until the late reproductive ages. In other words, we assume that, in general, a person who at the age of 45 holds a high level occupation has been job-oriented also in younger ages even when working on less prestigious jobs. Thus, on the other hand, including the occupation from the advanced stages of professional career could provide also the information about individual family-work attitude and seems to be also worth considering.

The results presented in this study encourage for deeper analysis of the impact of couple's socioeconomic status on fertility. The further steps might include a detail insight on the effect of socioeconomic gender equality or inequality between partners on their reproductive behaviours, regarding both the quantum and tempo effect, in Poland as well as in other countries providing different welfare regimes. From the methodological point of view, the next step would be performing the formal sensitivity analysis of results provided by the Bayesian Zero-Inflated Poisson model, given the choice of *a priori* distributions.

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COUPLES' SOCIOECONOMIC RESOURCES AND COMPLETED FERTILITY IN POLAND

ABSTRACT

Recently, a growing number of studies have examined the impact of educational level and educational enrolment on the childbearing behaviour of both sexes. At the same time, other socioeconomic characteristics, such as educational field or occupation, are usually neglected or, if included, focus only on women. This study aims at analysing how socioeconomic resources of both partners in a couple affect their completed fertility in a relatively gender-conservative country – Poland. As a representative of the post-socialist European countries, Poland is an interesting case study, in which women are often *double burdened* and the conditions to develop a family are more difficult. Since behavioural drivers could differ between parents and childless couples, the Bayesian Zero-Inflated Poisson model consisting of two states (childlessness and parenthood) is applied. The first-wave Generations and Gender Survey (GGS) data for Poland from 2011 are used. The results confirm that including both partners' socioeconomic resources in the model increases the ability to characterise couples' childbearing behaviour. In particular, the occupation of both partners occurs to have a substantial influence on their completed family size.

Keywords: Poland, socioeconomic status, completed fertility, childlessness, Bayesian demography, Zero-Inflated Poisson model

APPENDIX A

Table A1. Correlation matrix of the main explanatory variables

	edu11	edu33	eduHL	eduLH	studHealthW	studHumW	studLawW	studScienceW	studEnghW	studHealthM	studHumM	studLawM	studScienceM	studEnghM	WoccupHigh	WoccupMed	WoccupWorker	WoccupAgri	MoccupHigh	MoccupMed	MoccupWorker	MoccupAgri	publicJobW	publicJobM
edu11	1,00	-0,11	-0,14	-0,15	-0,17	-0,06	-0,16	-0,05	-0,17	-0,09	-0,04	-0,08	-0,05	-0,40	-0,17	-0,17	-0,03	0,30	-0,14	-0,09	-0,04	0,22	-0,09	-0,06
edu33		1,00	-0,12	-0,12	0,10	0,24	0,06	0,15	-0,07	0,13	0,21	0,19	0,23	-0,13	0,45	-0,06	-0,16	-0,11	0,48	0,00	-0,27	-0,10	0,09	0,10
eduHL			1,00	-0,16	0,15	0,09	0,07	0,05	-0,04	-0,07	-0,04	-0,05	-0,03	-0,14	0,23	-0,03	-0,07	-0,03	-0,10	0,03	0,03	0,01	0,09	-0,01
eduLH				1,00	-0,09	-0,05	-0,08	-0,03	-0,14	0,05	0,01	0,10	0,01	0,05	-0,10	0,02	-0,02	-0,01	0,17	-0,01	-0,07	-0,03	-0,02	0,04
studHealthW					1,00	-0,08	-0,22	-0,07	-0,24	0,12	0,01	0,02	0,02	0,03	0,38	-0,13	-0,03	-0,11	0,09	0,03	-0,04	-0,06	0,13	0,06
studHumW						1,00	-0,07	-0,02	-0,08	0,01	0,24	0,04	0,06	-0,04	0,22	-0,03	-0,07	-0,06	0,13	0,03	-0,08	-0,05	0,05	0,04
studLawW							1,00	-0,07	-0,23	-0,01	0,00	0,11	0,01	0,07	-0,01	0,24	-0,02	-0,12	0,06	0,04	0,01	-0,11	0,04	0,03
studScienceW								1,00	-0,08	0,01	0,02	0,02	0,17	0,00	0,15	0,01	-0,06	-0,04	0,10	0,01	-0,05	-0,03	0,03	0,01
studEnghW									1,00	-0,03	-0,03	-0,04	-0,03	0,14	-0,14	-0,05	0,13	-0,05	-0,05	-0,03	0,07	-0,03	-0,07	-0,02
studHealthM										1,00	-0,03	-0,06	-0,03	-0,30	0,09	-0,01	0,00	-0,05	0,11	-0,01	-0,04	-0,05	0,02	0,06
studHumM											1,00	-0,02	-0,01	-0,12	0,12	0,00	-0,04	-0,04	0,15	0,00	-0,09	-0,04	0,02	0,04
studLawM												1,00	-0,03	-0,24	0,11	0,08	-0,06	-0,07	0,19	0,12	-0,14	-0,07	0,04	0,07
studScienceM													1,00	-0,14	0,10	0,01	-0,04	-0,05	0,16	0,02	-0,10	-0,04	-0,01	0,06
studEnghM														1,00	-0,01	0,08	0,06	-0,20	-0,09	-0,01	0,23	-0,21	0,05	-0,03
WoccupHigh															1,00	-0,25	-0,28	-0,18	0,31	0,08	-0,17	-0,13	0,20	0,08
WoccupMed																1,00	-0,30	-0,20	0,07	0,09	0,00	-0,13	0,10	0,07
WoccupWorker																	1,00	-0,22	-0,15	-0,04	0,20	-0,13	-0,15	0,02
WoccupAgri																		1,00	-0,14	-0,10	-0,20	0,60	-0,29	-0,14
MoccupHigh																			1,00	-0,13	-0,42	-0,14	0,05	0,11
MoccupMed																				1,00	-0,33	-0,11	0,06	0,06
MoccupWorker																					1,00	-0,37	0,05	-0,04
MoccupAgri																						1,00	-0,18	-0,20
publicJobW																							1,00	-0,14
publicJobM																								1,00

Note: 1) The absolute values greater or equal 0.3 have been shaded
2) All variables' names are explained in Appendix B

Source: Author's own elaboration based on the Polish GGS sample.

APPENDIX B

THE COVARIATES PRESENTED IN THE FIGURES ARE:

const – intercept (constant)
educ11 – both partners have low education
educ33 – both partners have high education
educHL – a woman has higher education than a man
educLH – a woman has lower education than a man
studHealthW – a woman educated in Teaching or Health and Welfare
studHumW – a woman educated in Humanities and Arts
studLawW – a woman educated in Social sc., business and law,
studScienceW – a woman educated in Science
studEngW – a woman educated in Engineering
studHealthM – a man educated in Teaching or Health and Welfare
studHumM – a man educated in Humanities and Arts
studLawM – a man educated in Social sc., business and law
studScienceM – a man educated in Science
studEngM – a man educated in Engineering
WoccupHigh – a woman works as a *Professional*
WoccupMed – a woman works as an *Associate professional*
WoccupWorker – a woman works as a *Service or trade worker*
WoccupAgri – a woman works as an *Agricultural, forestry, fishery worker*
MoccupHigh – a man works as a *Professional*
MoccupMed – a man works as an *Associate professional*
MoccupWorker – a man works as a *Service or trade worker*
MoccupAgri – a man works as an *Agricultural, forestry, fishery worker*
pubJobW – a woman works in public sector
pubJobM – a man works in public sector

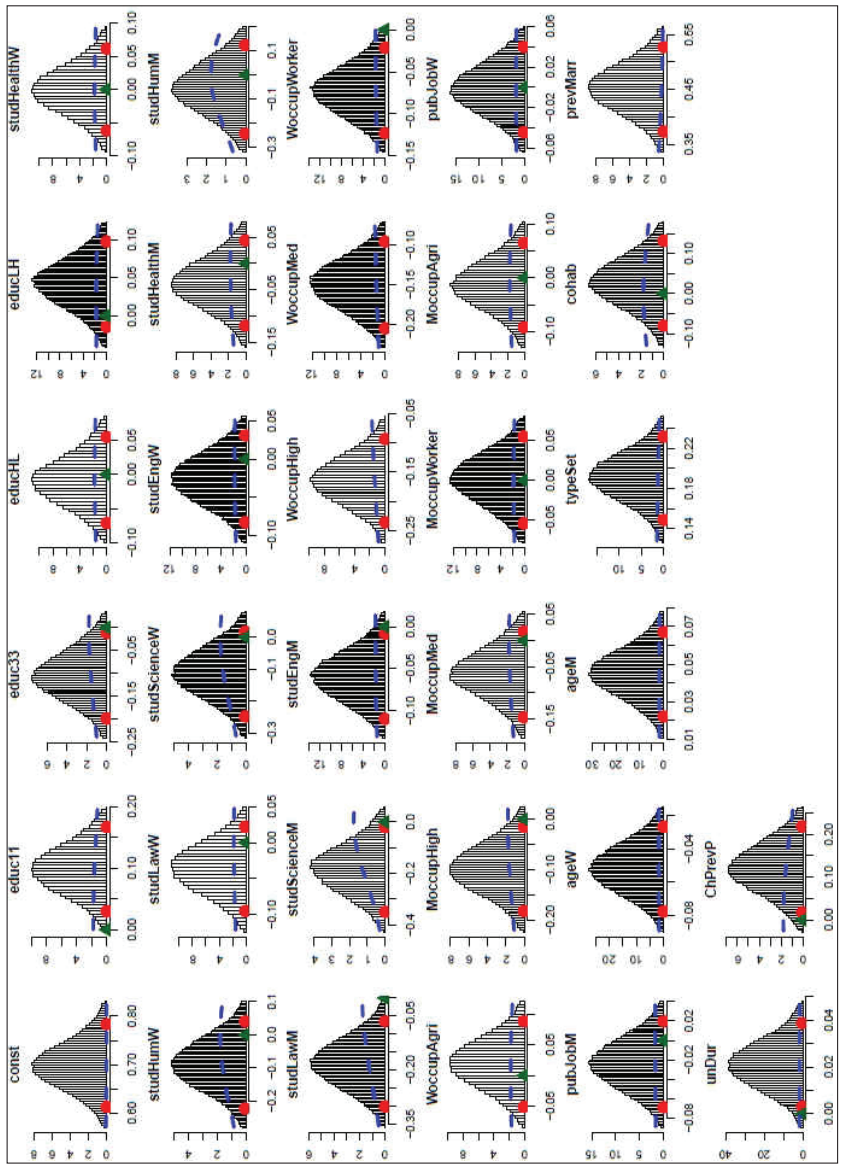
ageW – a woman's age
ageM – a man's age
typeSet – type of settlement (0-urban; 1-rural)
cohab – partners are cohabiting
prevMarr – respondent was previously married
unDur – union duration

ADDITIONAL FOR PARENTHOOD:

ChPrevP – at least one partner has children from previous partnerships

The dashed lines in Figures B1–B2 in Appendix B represent the corresponding prior densities, in order to compare the two distributions (posterior vs. prior) and illustrate the strength of inference about the selected marginal parameter distribution. The dots mark the 5.0% and 95.0% quantiles, which are helpful in determining the parameter impact on the modelled variable. If a zero value (marked with a triangle) lies outside the interval set by the quantiles (the so-called *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 (and zero belongs to the HPD interval), then its effect can be treated as neutral or negligible.

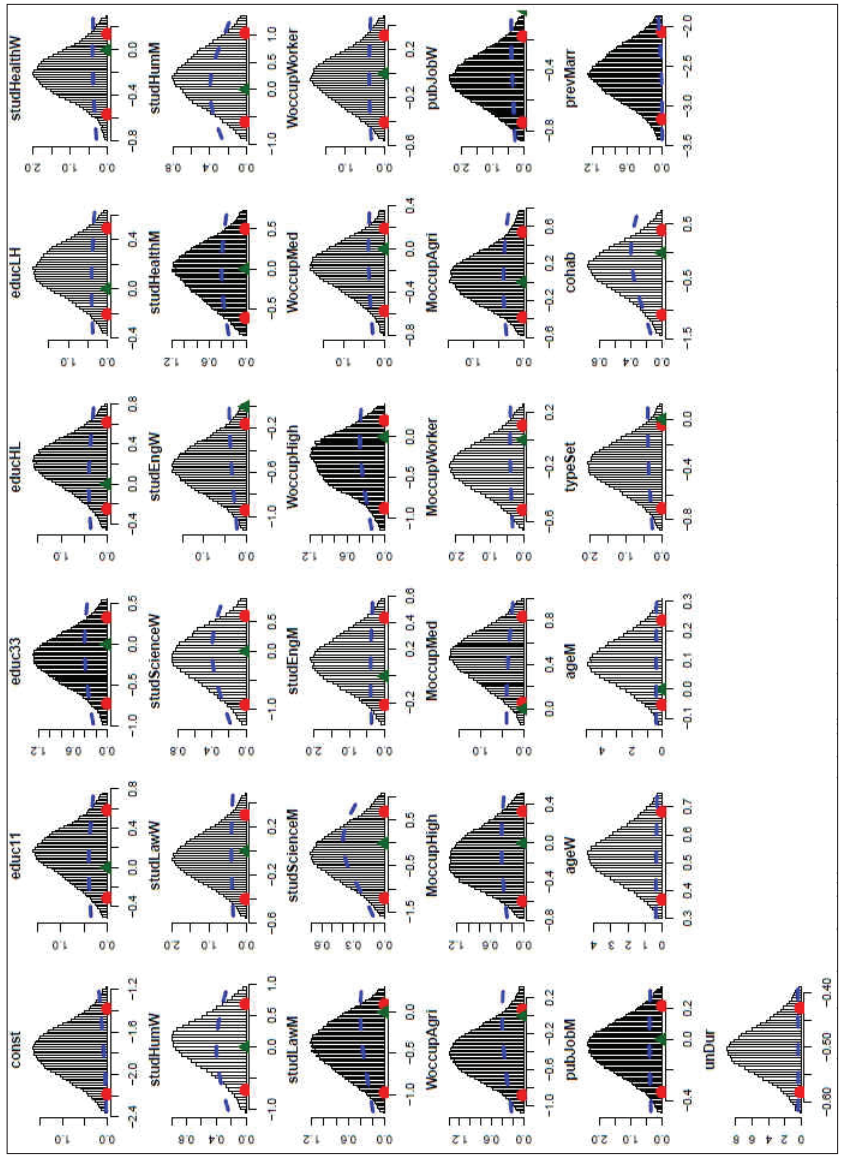
Figure B1. The marginal posterior distributions for the count state (parenthood) part of the model



Note: For the explanation of variables' names, dashed lines, dots and triangles see the introduction of Appendix B

Source: Author's own elaboration based on the Polish GGS sample.

Figure B2. The marginal posterior distributions for the zero state (childlessness) part of the model



Note: For the explanation of variables' names, dashed lines, dots and triangles see the introduction of Appendix B

Source: Author's own elaboration based on the Polish GGS sample.