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Keywords: labour supply, family size, female employment
JEL codes: J13, J22,

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1. Introduction

Wide spread entry of women into the labour force has been one of the most pronounced socio-economic developments in the 20th century, and high levels of female employment are crucial from the point of view of continued economic growth and financial stability of many welfare systems (Galor and Weil, 1996; Lagerlof, 2003; Klasen and Lamanna, 2009). Importantly though, the demographic developments play a vital role in the models, and these are in turn determined by current and future fertility levels. Given the potentially strong link between female employment and family size it seems that understanding the relationship between the two ought to be at the heart of the policy discussion, especially in the regimes that are characterized by both low fertility and low female employment. Furthermore, uncovering the causal link between number of children and female labour market outcomes is a key aspect behind the design of effective policies in these societies.[2]

Employment rates of women with children, in particular those with young kids, are generally lower in comparison to women who either never had children or whose children are older or no longer live with their parents (Gronau, 1973; Schultz, 1990; Leibowitz et al., 1992; Ahn and Mira, 2002; Adsera, 2005). On the one hand, the presence of children induces various constraints on labour market activity and may affect individual preferences over consumption and leisure.[3] On the other hand, women who have lower inclination to work may decide to have more children than those who are more strongly attached to the labour market, implying self-selection into larger families among women with weaker labour market attachment. This would result in lower rates of labour market participation among these mothers even without the causal link running from family size to lower employment. Such a potential selection means that a simple cross-sectional correlation between employment and the number of children would generally be biased (Killingsworth and Heckman, 1986; Blundell and Macurdy, 1999), and the OLS analysis would overstate the negative effect of family size on maternal labour market outcomes. Thus, the identification of the causal effects requires a more complex estimation method.

In this paper, we follow two canonical approaches to identify the causal effects of children on labour market outcomes. First, we use exogenous variation in the number of children driven

[2] Exogenous changes in policies have been used to identify changes in female labour supply. These include reforms that affect individuals' work incentives (Blundell et al., 2008) or tax reforms (Blundell et al., 1998). Blundell et al. (2005) provide theoretical collective framework for analyzing the labour supply in households with children.

[3] The presence of children in the family significantly affects female preferences for leisure and thus women's labour supply elasticities (Heckman, 1993; Joshi, 1998; Blau and Kahn, 2005).

by multiple births (Rosenzweig and Wolpin, 1980a; Rosenzweig and Wolpin, 1980b; Bronars and Grogger, 1994; Angrist and Evans, 1998; Jacobsen et al., 1999; Caceres-Delpiano, 2006; Vere, 2011). Second, we exploit parental gender preferences (Angrist and Evans, 1998; Chun and Oh, 2002; Cruces and Galiani, 2007; Daouli et al., 2009). In the former case parents expect to have a single offspring as a result of a pregnancy while in turn they get two (or more) kids. Thus, there is an exogenous variation in the size of the family that is independent from preferences related to the labour market.[4] The latter case relies on the finding that parents may exert skewed preferences towards child's gender or towards a gender mix of the siblings. Since gender of a child is virtually random, given such preferences the gender composition of children can be plausibly used as an instrument for subsequent family size choices.

The distinguishing feature of this study is that the analysis is conducted on data from a regime characterized by a combination of low levels of female employment and low fertility rate. Namely, for the purpose of the analysis we use the Household Budgets' Survey data from Poland for years 2003-2010. Poland has one of the lowest fertility and female employment rates in Europe, and partly as a result of that, faces one of the most severe demographic changes in the coming decades with old-age dependency ratios in 2050 at about 53.0. With fertility at 1.4 in 2009 Poland lags far behind countries such as Ireland (2.1), France (2.0), the UK (1.9) or Sweden (1.9). In addition to low fertility levels, Poland has one of the lowest rates of female employment in the European Union, far below those of such countries as the Netherlands, Germany or Sweden.[5] These stylized facts make Poland an interesting case for the analysis of the causal relationship between family size and employment in a low fertility – low female employment context, which has never been studied before to our knowledge.[6] This analysis may provide valuable insights for policy makers and shed light on the discussions in Poland and other countries of the region facing similar problems related to fertility, demographic change and employment. The combination of low female employment

[4] Note that twining rates may not be purely random. For example women with family history of twining have higher incidence of subsequent multiple births. Furthermore, twining rates increase with maternal age, being a twin, use of fertility drugs and specific nutritional aspects (Waterhouse, 1950; Bulmer, 1970; Lichtenstein et al., 1996; Westergaard et al., 1997). In the analysis we control for maternal age and treat the instrument as exogenous. The incidence of in-vitro fertilization is still very low in Poland. Although the official statistics are not maintained, NGOs reports from late 2000s suggest that around 1.5% of live births is due to IVF procedures.

[5] Data on fertility rates and old-age dependency ratios are taken from EUROSTAT. According to the OECD female employment in 2008 was at the level of 71.6, 69.6 and 79.2% in the Netherlands, Germany and Sweden respectively. At the same time it was 59.6% in Poland.

[6] There is a number of studies linking family size (fertility) and female employment based on data from the former Soviet bloc countries, yet to our knowledge these do not include a single causal: Hungary (Saget, 1999), Romania (Fong and Lokshin, 2000), Poland (Matysiak, 2009; Bardasi and Monfardini, 2009) and the former East Germany (Bonin and Euwals, 2002).

and low fertility is particularly challenging from the policy-making point of view when a strong negative causal relationship between family size and female employment exists. In such a case any potential increases in fertility would reduce the effects of policies aimed at higher female labour market participation. On the other hand, if the relationship between family size and employment is weak, the policies aimed at gains in both of these domains could operate without significant negative spillovers. Since this relationship may differ by family characteristics we also present detailed heterogeneity analysis.

The results confirm a negative relationship between number of children and female labour supply. In line with the endogeneity hypothesis, the simple OLS estimates overstate the negative effect of childbearing on female labour force participation, but in the overall sample this bias is small. In the sample of mothers with at least one child, we find that an additional child reduces the mother's probability of employment by 7.1 percentage points and it averages over all the subsequent children above the first one. Thus, the marginal effect of going from first to second child is larger in reality. The corresponding effect estimated for OLS is -8.3pp. The negative causal effect of additional children in the sample of mothers with at least two children is much smaller (-3.2pp) and statistically insignificant, while the OLS suggests a statistically significant correlation of -6.8pp. This suggests a high degree of endogeneity between fertility and labour market choices among families with more than two children. Naturally, given the estimation strategies we take, we can only examine the relationship between family size and labour market outcomes for families with at least one child and this limitation should be kept in mind throughout the discussion, i.e. we cannot explore the difference between having versus not having any children.

Heterogeneity analysis using the twining instrument shows significant variation in the nature of the family size – labour market attachment relationship in Poland. We find that the negative causal effect established in the full sample is driven primarily by women who are highly educated and who come from the younger cohorts. Of a particular interest should be the fact that in both of these subsamples we find a positive bias of the OLS estimates relative to 2SLS coefficients. Thus, it is women with the strongest labour market attachment and/or with most secure labour market position who select into higher family sizes. We attribute that to the fact that in low fertility and low employment societies only families with secured labour market position can afford to have children, and in particular more than one child (Brewster and Rindfuss, 2000). For women with less than higher education and for those from earlier cohorts (born before 1978) we find no causal effect of additional children on employment. Furthermore, we could not identify any significant causal effects of the number

of children on female employment in the sample in which we approximate complete fertility history by looking at women whose last birth was more than six years prior to the interview. For this sample, however, using the twinning instruments we find strong and significant negative effects of family size on maternal labour income, and - in the case of families with at least two children - also on the income of fathers.

The rest of the paper is organized as follows. In the next section we describe the data and provide a set of summary statistics. We then present and discuss the estimation strategy (Section 3), which is followed by the main results of the paper and heterogeneity analysis in Section 4. Section 5 concludes the paper.

2. Data and descriptive statistics

The analysis is based on a dataset from the Polish Household Budgets' Survey (PHBS) for years 2003–2010. The PHBS is a nationally representative dataset collected annually by the Polish Central Statistical Office. The data includes information on household demographic composition, labour market activity, as well as detailed income and expenditure data. In total, we have data on 286 379 households and 857 843 individuals over eight years. The dataset does not contain retrospective fertility information, and thus we can rely only on contemporaneous family composition. Individuals in the data are matched into families, defined as a single adult or a couple (married or cohabiting) with any dependent children, through available relationship information. Since we use contemporaneous family information we restrict the sample to families with a mother present in the household, where the child-mother relationship is clearly specified in the data. Following similar studies in the literature we limit the analysis to mothers aged between 18 and 40, who had their first child at the earliest at the age of 16, and whose oldest child was at most 15 years old at the time of the interview.[7] Additionally we impose the restriction that the youngest child is at least six months old to avoid potential bias due to lower labour market activity of mothers during the initial months following childbirth.[8]

The descriptive statistics are presented in Table 1 where we show information separately for families with at least one and at least two children. Statistics for the subsample of married or

[7] The dataset contains a very small number of families with children without a mother. We do not have precise information if the mother in the data is the biological mother, but the families we use are limited only to the cases where the mother-child relationship is specified in the data. There is a number of cases where the children fulfill our age criteria but where only the father is identified in the data – 235 families. Since these are very rare and special cases we exclude them from the analysis.

[8] We impose the restriction at the threshold corresponding to statutory maternal leave in Poland. This additional restriction does not have any substantial effect on the results.

cohabiting mothers (below referred to as "couples sample") differ very little from the full sample of mothers and we present them separately in the Appendix (Table A1). The sample size for families with at least one child is 60 253 (52 991 couples), and for families with two or more children is 33 012 (30 578 couples). Among families with at least one child the average number of children is 1.74. About 15% of mothers in the sample have three or more children. Among those with two or more children the number of children (at 2.35) and the proportion with three or more children (at about 26%) in the full and in the cohabiting sample are essentially the same. Both the number of children and the proportion of mothers with three or more children in the sample with two or more kids are lower compared to other studies in the literature (e.g. Angrist and Evans, 1998; Vere, 2011; Cruces and Galiani, 2007).[9] About 54% of mothers in the sample are working, and employment rates are very similar for the sample with at least one and at least two children. The same applies to husbands or partners of mothers (Table A1) for whom we find an employment rate of about 81% in both samples. In both samples the raw female employment rate falls for women with three or more children by about 4pp compared to mothers with either one or two children.

We use the number of children as our – potentially endogenous – family size variable in the analysis.[10] It is then instrumented by twins at first birth (*twins-1*; e.g. Rosenzweig and Woplin 1980a) for families with at least one child and by twins at second birth (*twins-2*; e.g. Angrist and Evans 1998) and two gender-related instruments for the sample with at least two children. The latter variables are an indicator for same sex of the first two children (*same sex*) and separate instruments for two girls or two boys born as the first two children (*two boys* and *two girls*).

We take a multiple birth as an observed case of twins in the family identified by month of birth of the children (in the sample we do not find any case of a multiple birth of higher order than two). The mean of the *twins-2* indicator (0.010) is slightly lower than the mean of the *twins-1* indicator (0.011), which might be related to the fact that the probability of having twins rises with mother's age at conception (Mittler, 1971). Since this could be an outcome of the mother's choice, and thus affects the exogenous nature of the instrument, we incorporate demographic characteristics of the mother in the analysis, which should provide consistent estimates. The *same sex* indicator variable equals to one if the first two children were either girls or boys (mean of 51%). The occurrence of two boys in a row is slightly higher (27%)

[9] The only causal study where we found even lower fraction of women having more than two kids is Greece, with about 21% (Daouli et al., 2009).
[10] Results using indicator variables for more than one child or more than two children give similar conclusions. These results are available from the authors upon request.

than the occurrence of two girls in a row (24%). Unlike in some Asian countries, this is likely to be due to natural reasons as there is no evidence of sex selective abortion in Poland.[11]

In Table A3 in the Appendix we present evidence on correlations between maternal education, several other characteristics and family size. These regressions suggest little endogeneity concern in the case of maternal education and cohorts in the full sample (Table A3, panels A and B). Therefore, our heterogeneity analysis presented in Section 4.2 focuses on these two dimensions. The correlations indicate, however, that heterogeneity analysis could not be trusted as much in the case of other potentially interesting variables such as fathers' education or income, as well as in the case of maternal education for the couple's sample (see Table A3, panels C-E).

Table 1. Descriptive statistics – all families with children

	With at least one child		**With at least two children**	
	Mean	Standard deviation	Mean	Standard deviation
Number of children	1.740	(0.846)	2.351	(0.694)
- one child	0.452	(0.498)	-	-
- two children	0.404	(0.491)	0.737	(0.441)
- three or more children	0.144	(0.352)	0.264	(0.441)
Twins at first birth (twins-1)	0.011	(0.102)	-	-
Twins at second birth (twins-2)	-	-	0.010	(0.099)
Same sex of first two born children	-	-	0.509	(0.500)
Two first born girls	-	-	0.237	(0.425)
Two first born boys	-	-	0.271	(0.445)
Age of mother	31.352	(4.844)	32.762	(4.127)
Age of mother at first birth	23.563	(3.662)	22.906	(3.254)
Mother's education:*				
- basic	0.385	(0.487)	0.457	(0.498)
- secondary	0.364	(0.481)	0.346	(0.476)
- higher	0.252	(0.434)	0.197	(0.398)
Mother works	0.539	(0.499)	0.538	(0.499)
- one child	0.541	(0.498)	-	-
- two children	0.548	(0.498)	0.548	(0.498)
- three or more children	0.508	(0.500)	0.508	(0.500)
Mother's labour income	677.57	(975.75)	603.83	(918.44)
- one child	766.93	(1033.97)	-	-
- two children	684.22	(959.22)	684.22	(959.22)
- three or more children	379.17	(749.06)	379.17	(749.06)
N	60253		33012	

Notes: The samples include families in which the mother is younger than 41 and older than 17 and had the first child at the earliest at the age of 16; children's age ranges from 6 months to 15 years; labour incomes are unconditional monthly net values indexed by CPI to June 2006.

* Education categories cover: "basic" – no formal education, primary education, gymnasium and vocational education; "secondary" – secondary academic and secondary vocational education; "higher education" – education degrees higher than secondary;

Source: authors' own calculations based on the PHBS data (2003-2010).

[11] Polish abortion legislation clearly states three cases when the procedure can be performed: when the pregnancy endangers mothers' life or health, when the fetus is malformed or when the pregnancy results from a criminal act. There exist an abortion underground and tourism but we could not find any evidence in either the pro-life or the pro-abortion movements' statistics that Polish mothers would perform sex selective abortion.

3. Estimation strategy

We use two sources of exogenous variation in family size in the form of twinning (*twins-1* and *twins-2*) and gender preferences (*same sex* and *two girls - two boys*), and examine the effects of family size measured as the number of children on employment and labour income. We thus consider the following linear model:

$$Y_i = X_i^{'}\alpha_1 + C_i^{'}\alpha_2 + \varepsilon_i \tag{1}$$

where Y_i is a measure of labour supply (employment or labour income) of mother or father *i,* X_i is a set of control variables with respect to fertility, such as age of the mother at first birth, a polynomial in mother's age at the time of interview, as well as time and regional (voivodship) effects; C_i is the endogenous family size variable and ε_i is the residual. We assume that $Cov(X_i, \varepsilon_i) = 0$ and $Cov(C_i, \varepsilon_i) \neq 0$. The first-stage equations (2) to (4) describe relationships for twinning at j^{th} parity, as well as the just identified and over-identified models using gender preferences.

$$C_i = X_i^{'}\beta_1 + (twins - j_i)^{'}\gamma_k + \upsilon_i \tag{2}$$

$$C_i = X_i^{'}\beta_1 + (\text{First gril}_i)^{'}\beta_2 + (\text{Second girl}_i)^{'}\beta_3 + (\text{Same sex}_i)^{'}\gamma_3 + \xi_i \tag{3}$$

$$C_i = X_i^{'}\beta_1 + (\text{First girl}_i)^{'}\beta_2 + (\text{Two girls}_i)^{'}\gamma_3 + (\text{Two boys}_i)^{'}\gamma_4 + \eta_i \tag{4}$$

where $Cov(twins - j_i, \upsilon_i) = Cov(\text{Same sex}_i, \xi_i) = Cov(\text{Two girls}_i, \eta_i) = Cov(\text{Two boys}_i, \eta_i) = 0$; $j=1,2$ is the indicator of twin birth parity and γ_k (k=1,2,3,4) are the first stage effects of the instruments.

In order for the instruments to be valid, in addition to their exogeneity with respect to labour market outcomes we also need a strong relationship between instruments and endogenous variables.[12] Table 2 presents the first stage results for the full sample of families linking the instruments to our family size variable. Using twins at either first or second birth is strongly correlated with the number of children in the family. The effects are highly significant with

[12] Ichino et al. (2011) suggests that gender of the first child has an independent effect on female labour supply decisions. If this is true, then the exclusion restriction in gender preferences instruments is violated, however, Karbownik and Myck (2011), using the same dataset as in current research, show that in Poland this phenomenon could not be identified.

large t- and F-statistics. First birth twinning effect is about 0.65, while twining at second birth naturally has a larger impact of around 0.86.[13]

Table 2. OLS estimates of first stage relationships - all families, with controls

	(1)	(2)	(3)	(4)
	Dependent variable: number of children			
Instruments for fertility:				
Twins at 1st birth	0.642***			
	(0.023)			
	[28.42]			
Twins at 2n birth		0.842***		
		(0.029)		
		[28.74]		
Same sex of 2 children			0.041***	
			(0.007)	
			[5.60]	
First child female			0.006	0.014
			(0.007)	(0.010)
Second child female			-0.008	
			(0.007)	
Two boys				0.049***
				(0.010)
				[4.79]
Two girls				0.033***
				(0.011)
				[3.16]
R-squared	0.266	0.096	0.082	0.082
F-statistics on excluded instruments	807.96	826.02	31.34	16.47
LM statistic on underidentification test	362.95	236.65	31.34	32.94
N	60,253	33,012	33,012	33,012

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1), t-statistics on the coefficients in square brackets. All regressions include time and voivodship specific effects. The additional covariates include age of mother at first birth, and a polynomial of mother's current age. Sample of mothers aged <18; 40> with oldest child younger than 16 years, who gave the first birth at the age of 16 at the earliest and whose last birth was 6 months prior to survey at the latest.
Source: authors' calculations based on BBGD data 2003-2010.

The gender preferences instruments are 5-6 times weaker than twinning and much weaker than those reported by Angrist and Evans (1998). However, their coefficients are statistically significant at 1% level and in each case the F-statistics on the excluded instruments are higher than 10, considered to be the rule of thumb threshold by Stock et al. (2002). Women with two first children of the same sex are estimated to be 4.2 percentage points more likely to have a third child suggesting mixed gender preferences, and there is a small difference in the number of children conditional on whether the woman had two boys or two girls, with a slightly larger family size in the case of two boys. The main results presented below use all of the examined sets of instruments. In the heterogeneity analysis, given the smaller sample sizes, we only show results using the strongest of instruments, i.e. twinning.

[13] The coefficients obtained for Poland are generally larger than those for the US reported in Vere (2011). This conforms with differences in family size/fertility between Poland and the US. If families on average decide to have fewer children, the effect of a twin birth on family size will be larger.

4. Results

Estimation results presented below are grouped into three sections. In Section 4.1 we show the baseline results estimated for the full and couples samples. Section 4.2 presents estimates of heterogeneity results using sub-samples split by characteristics which have been established to be uncorrelated with our instruments (see Table A3 in the Appendix), namely mother's education and birth cohort. Following this, we analyse the longer run effects of children on parental outcomes by focusing on samples that are likely to represent women with complete or close-to-complete fertility, which we take to be delineated by the time since the last birth to be higher than six years. While without either retrospective data on past or declarative data on future childbearing a strict complete fertility sample cannot be created, we take our definition to be its close approximation. The purpose of this analysis is, on the one hand, to look at a sample where future fertility considerations no longer affect current labour market situation, and, on the other, to examine if the number of children has longer run consequences on labour market outcomes for parents whose children are already of school age.

4.1 Baseline results

The baseline results are presented in Tables 3 and 4 for the full and the couples' samples respectively. In the former, we show the effects of the number of children on probability of observing a working mother in the household and her labour income, while in the latter we include also mother's partners' labour market outcomes. Columns (1) and (2) of the tables show results for families with at least one child, while columns (3) - (6) for the sample with at least two children. For this sample the IV estimations include both the *twins-2* instrument as well as the gender preferences instruments (*same sex* and *two boys – two girls*).

OLS estimates suggest a strong negative relationship between family size and maternal labour market outcomes. Mothers' probability of working is reduced with each child by 8.3 percentage points (pp) in the sample of all families with children (Table 3), and by 6.8pp in the sample of families with two or more children. These results suggest lower correlations than those found in Rosenzweig and Wolpin (1980b) and Caceres-Delpiano (2006). 2SLS results for maternal employment hold in the sample of mothers with at least one child, however the values of coefficients are lower. Namely, each additional child (second and subsequent children) reduces maternal employment by about 7.1pp, which is higher compared to the estimates found in the literature on US data (Bronars and Grogger, 1994; Jacobsen et al., 1999).

For families with at least two children the estimated 2SLS coefficients, in the case of specifications (4) and (6), are still negative but of much lower magnitude compared to OLS estimates (-3.3pp using the twining instrument, and -2.2pp in the case of using two boys/two girls instruments) and they are no longer statistically significant. In specification (5) the estimated coefficient turns positive (1.7pp), but it is also insignificant. No statistical significance in specification (4) results despite the acceptable strength of the twin instrument (see Table 2). All this suggests that family size in Poland reduces employment up to the second child, but the causal effects of the number of children disappear for higher parities irrespectively of the instrument used. Thus, increasing the number of children from two to three has no causal effect on female employment, and the observed lower employment rates of mothers with more than two children are due to the endogenous nature of fertility choices.

OLS estimates presented in Table 3 additionally point to a negative relationship between maternal labour income and the number of children in the magnitude of between 200 PLN and 212 PLN per month per child. This negative relationship between the number of children and labour income holds and is statistically significant in the 2SLS regressions using the twinning instrument, and thus, can be given a causal interpretation. The magnitudes in specifications (2) and (4) are lower compared to the OLS estimates at -179.50 PLN in the sample with at least one child and at -113.00 PLN for the sample with at least two children, but they represent substantial causal reductions in income given the average incomes of 677.60 PLN and 603.80 PLN, and median incomes of 189 PLN and 0 PLN in the two investigated samples respectively. The strong and statistically significant causal effect of the number of children on labour incomes suggests "penalties" on the labour market for women on the intensive margin, which affect also those women with two or more children.

In the cases of specifications (5) and (6) in Table 3, where we use the instruments based on children's gender, as in the case of the extensive margin we could not identify any significant effects of children on female labour income. It is worth noting, however, that as in the case of the estimated effect of the number of children on employment in specification (5), in both cases using gender preference instruments the estimated coefficients on labour income, while insignificant, are positive. This may relate to the different nature of the instruments and potentially to different interpretations of the identified local average treatment effects. While the twinning instrument reflects the effect of unplanned increases in family size, the gender instruments reflect effects of planed increases in family size. As we shall see below, in

Section 4.3, in some specific cases estimates using these instruments are not only positive, but also statistically significant.[14]

Table 3. OLS and 2SLS estimates of labour supply models – all families

	(1)	(2)	(3)	(4)	(5)	(6)
	With at least one child		With at least two children			
	OLS	2SLS twins-1	OLS	2SLS twins-2	2SLS same sex	2SLS two boys two girls
	Dependent variable: mother works					
Fertility measure: number of children	-0.083***	-0.071***	-0.068***	-0.033	0.017	-0.022
	(0.002)	(0.027)	(0.004)	(0.030)	(0.118)	(0.115)
	Dependent variable: mother's labour income					
	-211.598***	-179.490***	-199.857***	-113.016**	287.117	292.685
	(4.627)	(53.190)	(5.871)	(54.652)	(248.470)	(244.148)
N	60,253	60,253	33,012	33,012	33,012	33,012

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Sample of all families - for selection criteria see Table 1. Columns (1) and (2) – families with at least one child; columns (3)-(6) – families with at least two children. All regressions include following covariates: age of mother at first birth, a polynomial of mother's current age as well as time and voivodship specific effects.
Source: authors' calculations based on BBGD data 2003-2010.

Table 4. OLS and 2SLS estimates of labour supply models

	(1)	(2)	(3)	(4)	(5)	(6)
	At least one child		At least two children			
	OLS	2SLS twins-1	OLS	2SLS twins-2	2SLS same sex	2SLS two boys two girls
	Dependent variable: mother works					
	-0.082***	-0.068**	-0.065***	-0.033	0.067	0.039
	(0.003)	(0.030)	(0.004)	(0.030)	(0.113)	(0.111)
	Dependent variable: mother's labour income					
Fertility measure: number of children	-209.507***	-166.642***	-199.458***	-103.571*	344.840	363.029
	(4.979)	(61.052)	(6.132)	(56.151)	(241.017)	(238.761)
	Dependent variable: father works					
	0.001	0.021	-0.005*	0.019	-0.048	-0.051
	(0.002)	(0.015)	(0.002)	(0.014)	(0.063)	(0.062)
	Dependent variable: father's labour income					
	-94.465***	223.534*	-176.250***	-107.503	-149.195	-219.700
	(8.231)	(133.573)	(10.446)	(94.664)	(375.208)	(370.340)
N	52,991	52,991	30,578	30,578	30,578	30,578

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Sample of couples – for sample selection criteria see Table A1 in the Appendix. Columns (1) and (2) – families with at least one child; columns (3)-(6) – families with at least two children. All regressions include following covariates: age of mother at first birth, a polynomial of mother's current age as well as time and voivodship specific effects.
Source: authors' calculations based on BBGD data 2003-2010.

The nature of family size decisions may be different among single mothers and those living in couples, and the investigation of couples enables us to estimate also the family size effects for fathers or to be precise for partners of mothers as in the case of couples we do not impose the restriction of the mother's partner to be identified in the data as the child's father.

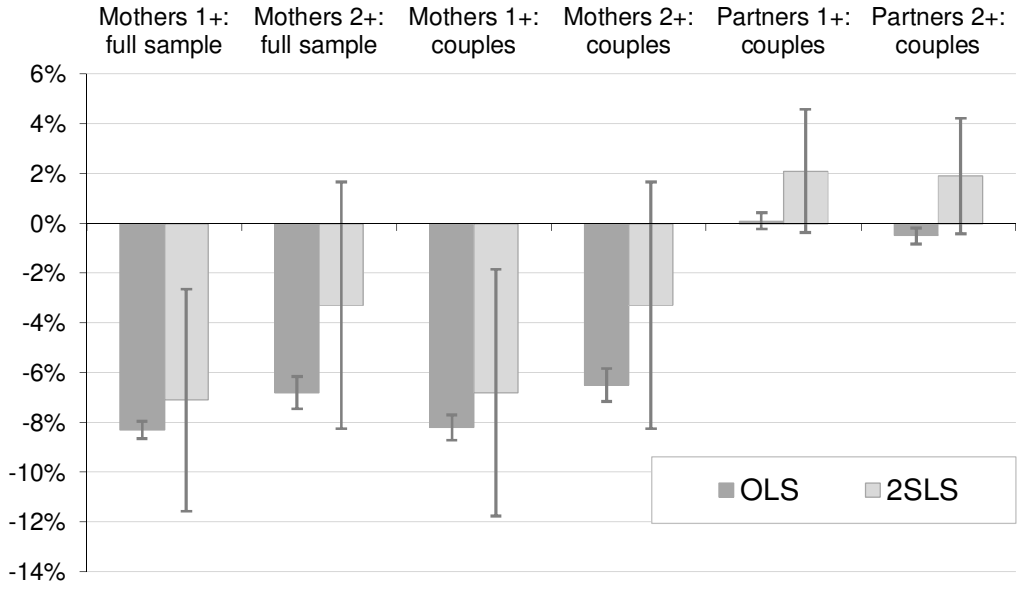
[14] See Browning (1992) for a discussion of gender-based instruments. Our results seem to be in line with those of Daouli et al. (2009) for Greece.

In Table 4 we re-estimate the specifications from Table 3 for couples (summary of first stage equations are given in Table A2). Neither the OLS nor the 2SLS estimates for mothers in couples deviate much in magnitude from the results in the full sample of mothers. For paternal labour market outcomes the OLS results indicate negative correlations between the number of children and labour income. The OLS estimates in the sample of families with at least two children also pick up a correlation between the number of children and father's labour supply on the extensive margin with a small statistically significant negative coefficient (-0.5pp). In the causal estimates, however, the negative effects on the intensive margin are no longer significant in the sample with at least two children, and turn positive and statistically significant (at 10%) in the sample with at least one child. Incomes of fathers (or partners) grow with every additional child by about 223.50 PLN per month, i.e. by about 14% of the sample average (see Table A1). This is a substantial effect and confirms earlier findings of the effect of children on paternal labour market outcomes (Lundberg and Rose, 2002).[15] Thus, our results provide no causal evidence on the effect of number of children on fathers' extensive margin of labour supply decisions, but suggest positive effects of children on the intensive margin for the smaller families.

The summary of the baseline results for specifications 1 - 4 in Tables 3 and 4 are presented in Figures 1 and 2 for the estimates of the effect of children on the extensive and the intensive margin of labour supply respectively. The vertical lines represent 10% confidence intervals of the estimates. As we can see in most cases the OLS and 2SLS coefficients are not significantly different from each other, given the relatively large standard errors on the IV estimates. The only exception is the estimate of the effect of children on partners' labour income in the sample with at least one child, where the OLS suggests a statistically significant negative correlation, while the causal estimates suggests a strong positive effect.

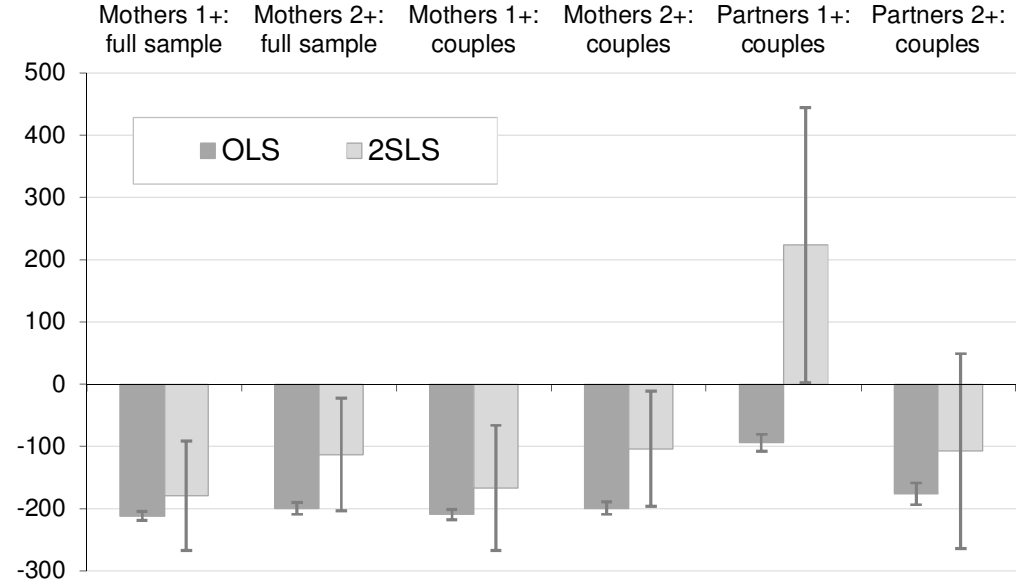
[15] Angrist and Evans (1998) using the *twin-2* instrument also find positive relationship but their coefficients are insignificant.

Figure 1. OLS and 2SLS estimates of the relationship between work and number of children



Notes: Values of coefficients on the number of children from Tables 3 for "full sample" and from Table 4 for the sample of "couples". Sub-samples of families with at least one child labelled as "1+", while those with at least two children as "2+". Vertical lines represent 10% confidence intervals.
Source: authors' calculations based on BBGD data 2003-2010.

Figure 2. OLS and 2SLS estimates of the relationship between labour income and number of children



Notes: Values of coefficients on the number of children from Tables 3 for "full sample" and from Table 4 for the sample of "couples". Sub-samples of families with at least one child labelled as "1+", while those with at least two children as "2+". Vertical lines represent 10% confidence intervals. Effects in PLN per month (in June 2006 values).
Source: authors' calculations based on BBGD data 2003-2010.

4.2 Heterogeneity analysis

The relationship between labour supply and childbearing is likely to differ by women's education (Gronau, 1986), which affects labour market opportunities (Psacharopoulos, 1985;

Altonji and Blank, 1999; Card, 1999) and marital matching (Becker, 1973; Becker, 1974; Chiappori et al., 2009), all of which in turn may affect household income, labour market activity and the family size. Furthermore, it seems crucial from the policy point of view to understand if and how the effects of the number of children on labour market outcomes differ in specific population subgroups, in particular in relation to incomes or income-related characteristics. If there are significant differences between groups then clear identification of those in most need of policy intervention could potentially help in the choice a particular policy, e.g. between benefit increases and tax reductions for families. Additionally, it seems important to understand if the relationships are stable across different cohorts of families and try to identify any observable trends. Therefore, in this Section, we present the analyses conducted for the full sample of mothers, which is split conditional on:

- mother's education (below high school, high school, above high school);
- mother's cohort (born before 1973, between 1973-1977 and after 1977).[16]

Results of heterogeneity analyses are presented in Tables 5 and 6 in which we compare OLS and the causal estimates using the approach based on the stronger of the instruments, i.e. twin births.[17]

As we can see in Table 5, the negative correlation between the number of children and mothers' work and income is most negative for the lower educated mothers. All OLS estimates, however suggest a negative relationship between the number of children and the two labour market outcomes. Once we look at the causal estimates, however, the strongest effects are found for the sample with at least one child among the most educated mothers. One child among these mothers reduces maternal employment by as much as 14.8pp and labour income by 309.50 PLN per month. Both of these are higher in magnitude than OLS estimates for this sample, although the difference is not statistically significant. It suggests an unexpected direction of the endogeneity bias, pointing towards the interpretation that in this group of mothers it is those with the highest labour market attachment who decide to have more children, which results in the downward bias of the OLS estimates.

[16] In Table A3 in the Appendix we demonstrate the validity of the choice of the two conditioning variables by which we split the sample. The Table also demonstrates that although it seems desirable and interesting from the policy point of view to analyze the relationship between fertility and labour market outcomes also by such characteristics as father's income or education, the exogeneity of these characteristics with respect to our instruments could easily be questioned.

[17] Results using gender preferences instruments are available upon request. These instruments are much weaker than twinning and they do not yield significant results except for two boys two girls instrument for extensive margin of labour supply of highest educated mothers, where the coefficient is barely significant at 10% level.

Table 5. Heterogeneity analysis by mother's education

		(1) "1+ children" OLS	(2) "2+ children" OLS	(3) "1+ children" 2SLS	(4) "2+ children" 2SLS
Above high school		Dependent variable: mother works			
	Number of children	-0.081***	-0.087***	-0.148***	-0.088
		(0.005)	(0.011)	(0.045)	(0.054)
		Dependent variable: mother's labour income			
	Number of children	-203.943***	-212.681***	-309.481**	48.411
		(19.462)	(38.687)	(132.170)	(188.873)
	N	15,154	6,510	15,154	6,510
High school		Dependent variable: mother works			
	Number of children	-0.081***	-0.039***	0.009	-0.041
		(0.005)	(0.008)	(0.041)	(0.052)
		Dependent variable: mother's labour income			
	Number of children	-215.926***	-196.010***	-50.894	-117.278*
		(6.889)	(10.450)	(62.015)	(64.657)
	N	21,901	11,427	21,901	11,427
Below high school		Dependent variable: mother works			
	Number of children	-0.057***	-0.054***	-0.072	0.018
		(0.003)	(0.005)	(0.054)	(0.046)
		Dependent variable: mother's labour income			
	Number of children	-113.630***	-104.035***	-106.251**	-117.831***
		(3.289)	(4.079)	(50.729)	(37.805)
	N	23,198	15,075	23,198	15,075

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Based on the full sample of families. For sample restrictions see Table 1. All regressions include the following covariates: age of mother at first birth, a polynomial of mother's current age as well as time and voivodship specific effects.
"1+ children" – families with at least one child; "2+ children" – families with at least two children.
Source: authors' calculations based on BBGD data 2003-2010.

The relationship between probability of working and family size found in the OLS regression for low and middle educated women confirms the expected direction of endogeneity, namely that the lower employment among those with higher number of children is – at least partially – driven by the fertility choices of women with lowest labour market attachment. All 2SLS estimates for the two lower educated groups are statistically insignificant, which suggests no causal effect of children on female employment. In particular in the case of middle educated mothers the magnitude of the causal estimates is an insignificant +0.1pp and it changes from the statistically significant OLS estimate of -8.1pp per additional child. For both samples of mothers with lowest education and for those with at least two children in the middle education group we identify negative causal effects of children on labour income in the range of around 110-120 PLN per month. Results for the middle educated group confirm the upward bias of the OLS, while those for the lowest educated mothers are closely in line with OLS estimates.

Table 6. Heterogeneity analysis by mothers' cohort

		(1) "1+ children" OLS	(2) "2+ children" OLS	(3) "1+ children" 2SLS	(4) "2+ children" 2SLS
		Dependent variable: mother works			
Mothers born after 1977	Number of children	-0.120***	-0.065***	-0.158***	-0.016
		(0.006)	(0.010)	(0.041)	(0.061)
		Dependent variable: mother's labour income			
	Number of children	-235.996***	-178.653***	-117.848	101.092
		(9.039)	(13.229)	(75.260)	(130.850)
	N	17,982	6,010	17,982	6,010
		Dependent variable: mother works			
Mothers born between 1973 and 1977	Number of children	-0.092***	-0.068***	-0.042	-0.019
		(0.004)	(0.006)	(0.045)	(0.051)
		Dependent variable: mother's labour income			
	Number of children	-216.602***	-187.638***	-113.277	-128.649
		(7.404)	(9.069)	(87.775)	(88.263)
	N	20,840	12,112	20,840	12,112
		Dependent variable: mother works			
Mothers born before 1973	Number of children	-0.066***	-0.070***	-0.021	-0.054
		(0.004)	(0.005)	(0.052)	(0.047)
		Dependent variable: mother's labour income			
	Number of children	-201.598***	-210.840***	-336.822***	-210.528**
		(7.335)	(8.648)	(108.776)	(83.988)
	N	21,431	14,890	21,431	14,890

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Based on the full sample of families. For sample restrictions see Table 1. All regressions include the following covariates: age of mother at first birth, a polynomial of mother's current age as well as time and voivodship specific effects.
"1+ children" – families with at least one child; "2+ children" – families with at least two children.
Source: authors' calculations based on BBGD data 2003-2010.

We also confirm a degree of heterogeneity in the relationship between family size and labour market outcomes in the analysis by mothers' birth cohorts (Table 6). We set the cohort thresholds at birth years, which allow the division of the main sample of mothers with at least one child into three subsamples of similar size. This implies thresholds set at birth years before 1973, between 1973 and 1977, and after 1977. OLS estimates for the sample with at least one child show an increasing negative influence of an additional child on maternal employment for younger cohorts. For the oldest cohorts, the coefficient on the number of children suggests a reduction in employment by 6.6pp for each additional child. This effect for the middle and latest cohort is respectively -9.2pp and -12.0pp. We find no such heterogeneity in the estimates for the sample of mothers with two or more children, where the coefficients are all in the range from -6.5pp to -7.0pp per child.

In the sample of mothers with at least one child we cannot identify any statistically significant causal effect of the number of children on maternal employment for women in the two elder cohorts. For the youngest cohorts, however, the causal effect of the number of children is strongly negative (-15.8pp) and statistically significant. Moreover, it once again suggests selection into fertility among women with higher labour market attachment, and thus, a downward OLS bias. For this cohort, the causal negative effect of additional children on

maternal employment is about 30% higher when compared to the OLS estimate, although, as in the case of highest educated mothers, the difference is not statistically significant.

It is also worth noting here the pattern of the results identified for the oldest cohort. Causal estimates for mothers born before 1973 suggest no effect of children on the probability of work, and large and statistically significant negative causal effects of the number of children on labour incomes. It points to a potentially important medium or long term consequence of children on the intensive margin of the female labour market outcomes, which we investigate further below by looking at a sample of families with the last recorded birth at least six years prior to the survey. This, on the one hand, approximates a selection of families with close to or complete fertility histories and focuses the analysis on parents with children beyond pre-school. On the other hand it also allows us to look at the nature of long-term effects of children on labour market outcomes.

4.3. Long-term effects of the number of children

Results in this section focus on the samples of families in which the time since the birth of the youngest child is more than six years, meaning they naturally focus on a sample of older mothers (mean age of 34.2 and 34.8 in the two investigated samples) and approximate complete fertility histories, as well as examine the situation of mothers in families where all children are already of school age but still in the household. The results, presented in Tables 7 and 8 for the full and the couples' samples respectively, are broadly in line with those for the oldest cohort from Table 6. We still find negative correlations between female labour market outcomes in the OLS regressions. The causal nature of these effects holds, however, only for maternal labour incomes in the 2SLS estimates with the exception of the estimate for the couples' sample with at least one child. The estimates suggest that mothers' labour incomes are reduced by 154.60 PLN and 194.00 PLN per month for each child in the samples with at least one and at least two children respectively. Like in the results in Table 4, the causal effect of children on paternal incomes in the sample with at least one child is positive, although it is not statistically significant. The 2SLS estimates in the case of the sample with at least two children suggest a negative effect of children on the income of fathers/partners in the range of 247.00 PLN per month. This suggests that among larger families in the longer run not only mother's but also father's income is reduced as a result of a higher number of children.

Table 7. OLS and 2SLS estimates of labour supply models – all families. Time since last birth more than 6 years.

	(1)	(2)	(3)	(4)	(5)	(6)
	With at least one child		With at least two children			
	OLS	2SLS twins-1	OLS	2SLS twins-2	2SLS same sex	2SLS two boys two girls
	Dependent variable: mother works					
Fertility measure: number of children	-0.044***	-0.039	-0.047***	-0.037	-0.068	-0.039
	(0.004)	(0.035)	(0.007)	(0.040)	(0.176)	(0.168)
	Dependent variable: mother's labour income					
	-214.836***	-154.560**	-222.805***	-193.966***	870.784**	644.117*
	(8.306)	(71.211)	(11.007)	(58.638)	(423.297)	(378.032)
N	24,624	24,624	13,795	13,795	13,795	13,795

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Families in which the mother is younger than 41 and older than 17 and had the first child at the earliest at the age of 16 and the last birth more than 6 years prior to interview; children's age from 6 to 15 years; Columns (1) and (2) – families with at least one child; columns (3)-(6) – families with at least two children. All regressions include following covariates: age of mother at first birth, a polynomial of mother's current age as well as time and voivodship specific effects.
Source: authors' calculations based on BBGD data 2003-2010.

Table 8. OLS and 2SLS estimates of labour supply models. Time since last birth more than 6 years.

	(1)	(2)	(3)	(4)	(5)	(6)
	At least one child		At least two children			
	OLS	2SLS twins-1	OLS	2SLS twins-2	2SLS same sex	2SLS two boys two girls
	Dependent variable: mother works					
Fertility measure: number of children	-0.043***	-0.039	-0.045***	-0.035	0.015	0.010
	(0.004)	(0.040)	(0.007)	(0.041)	(0.170)	(0.163)
	Dependent variable: mother's labour income					
	-213.181***	-130.763	-230.884***	-177.287***	1,112.026**	814.946**
	(8.981)	(84.643)	(11.170)	(60.643)	(443.439)	(388.731)
	Dependent variable: father works					
	0.003	0.033	0.001	-0.014	-0.072	-0.092
	(0.003)	(0.021)	(0.004)	(0.026)	(0.107)	(0.104)
	Dependent variable: father's labour income					
	-157.684***	205.078	-234.294***	-247.045**	43.530	83.956
	(14.542)	(154.061)	(19.439)	(109.621)	(544.963)	(525.298)
N	21,112	21,112	12,575	12,575	12,575	12,575

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Sample of couples; families in which the mother is younger than 41 and older than 17 and had the first child at the earliest at the age of 16 and the last birth more than 6 years prior to interview; children's age from 6 to 15 years; Columns (1) and (2) – families with at least one child; columns (3)-(6) – families with at least two children. All regressions include following covariates: age of mother at first birth, a polynomial of mother's current age as well as time and voivodship specific effects.
Source: authors' calculations based on BBGD data 2003-2010.

A notable result which we find for this sample are significantly different estimates of the causal effect of children on maternal labour incomes in the sample with at least two children depending on the choice of the instrument (Tables 7 and 8, columns 4-6). As mentioned earlier, when estimating the effect using the incidence of twinning (column 4) we find a statistically significant negative relationship. Yet when we use gender preferences instruments, both in the full sample of mothers and in the couples sample we find strongly positive and statistically significant effects in the range of 644.10 PLN to 1,112.00 PLN. As

we noted in Section 4.1, since in each case we identify the LATE, the most likely interpretation of this result is the different local nature of the instruments we use. The fact that in the case of twinning the instrument reflects the effect of an unplanned increase in the number of children, while in the case of gender preferences is a reflection of a conscious decision, may result in identification of the effects for different types of families i.e. the supports of the distributions of families who comply with the instrument might not overlap. We leave a more detailed analysis of this finding for future research.

5 Conclusions

The analysis in this paper focuses on identification of causal estimates of the effects of family size on labour market outcomes using data from the Polish Household Budget Surveys for years 2003-2010. We applied 2SLS estimations using twining and sibling gender composition as the sources of exogenous variation in the family size. To our knowledge this is the first set of causal estimates for a regime where both fertility and female employment are low and for any of the countries of Central and Eastern Europe.

Results using the twinning instrument are consistent with the literature (Rosenzweig and Wolpin, 1980a; Vere, 2011) and confirm the negative effect of an additional child on female employment of about 7.1pp in the sample of mothers with at least one child. This is though only slightly less negative compared to OLS estimates of about 8.3pp. These causal effects apply, however, only up to the parity of two. While OLS estimates for families with at least two children are still negative and statistically significant (-6.8pp) we could not identify any causal effect of the number of children on female employment for families with two or more children. Thus, lower employment among mothers with more than two children seems to be a result of fertility choices among mothers with lower labour market attachment. Relative to other findings in the literature, our twinning results are generally larger for families with more than one child. Furthermore, these results seem to be quite similar irrespectively whether we use OLS or IV, whereas in the US studies the OLS were severely downward biased. We also do not find robust causal effects with respect to the extensive margin of female labour supply for mothers with more than two children. Finally, unlike other authors (Daouli et al. (2009) is a notable exception here) we find gender preferences instruments virtually useless in case of Poland.

In most cases, OLS estimates exaggerate the negative effects of children on maternal labour supply on the extensive and the intensive margin but once we differentiate the analysis by maternal education and cohort we demonstrate that for some groups the effect of endogeneity

may actually be reversed. Thus, the OLS may in some cases *underestimate* the negative causal effects of children. It is the case for mothers with higher education and those from the cohort born after 1977. In both these cases we find the negative causal effect of an additional child to be in the range of 15pp, compared to the OLS estimates of -8.1pp and -12.0pp. To our knowledge such an effect has not been found in earlier studies, and it points towards the hypothesis that in these groups it is the stable employment and good career outlooks that determine choices concerning a higher number of children. Therefore, it is women with greater labour market attachment that decide to have a higher number of children. At the same time, for mothers with less than higher education and for those from earlier cohorts we find no evidence of the causal effect of children on employment. These estimates are generally lower when compared to the OLS results and statistically insignificant.

In almost all cases where we find a negative causal effect of family size on employment of mothers we also confirm the negative influence of the number of children on female labour incomes. Such negative effects on the intensive margin of labour supply are also found for mothers with low and medium education and for those in the oldest cohort where we could not identify any causal effect on employment. Furthermore, we could find very little evidence on the negative effect of the number of children on fathers' labour outcomes. The only exception is the sample of families in which we approximate full fertility history by limiting the sample to mothers whose youngest child was born at least six years before the survey. For this sample using twinning instruments we identify negative effects of children on the intensive margin of labour supply in the case of mothers with at least one and at least two children, and for fathers with at least two children. In the couples' sample with at least one child we actually find a positive and statistically significant effect of family size on fathers' labour incomes.

The findings suggest several important policy conclusions and new directions for further research. From the analysis it is clear that mothers, but not fathers, suffer the negative labour market consequences of childbearing in Poland. These effects are particularly strong for well-educated women and for women from younger cohorts, and they apply principally up to parity two. While mothers with more than two children are less likely to work, it is due to the fertility choices of women with weaker labour market attachment rather than the causal effect of the higher number of children. In almost all subsamples of women, however, we find negative consequences of children in terms of lower labour incomes. These effects also extend beyond the time of early childhood.

The strong effects of family size on employment and labour income among highest educated mothers and those belonging to the youngest cohorts suggest that policies to relax the family related constraints ought to focus particularly on these groups. In the case of other groups distinguished in the paper, since we find no causal effects of children on employment, the government ought to concentrate on supply side policies to provide stronger labour market incentives to mothers. Childbearing does have significant and large effects of children on labour incomes of mothers. This has direct consequences for the financial position of mothers, but it also implies lower financial incentives to work and in the long run will translate into lower pensions. While policies to compensate these losses may be difficult to implement at the time of tight government budgets, encouraging higher fertility may require attempts to reduce the financial loss of mothers related to the family size.

Our results also suggest interesting avenues for further analysis. As we saw, the relationship between fertility and maternal labour market outcomes differ significantly by a number of exogenous characteristics. For different groups not only does the OLS bias go in different directions, but effects for some subsamples occasionally turn positive and statistically significant when we use the gender instruments. More in depth analysis of the identified effects using different instruments is left for future research.

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Appendix

Table A1. Descriptive statistics – the couples sample

	With at least one child		With at least two children	
	Mean	Standard deviation	Mean	Standard deviation
Number of children	1.780	(0.852)	2.352	(0.695)
- one child	0.423	(0.494)	-	-
- two children	0.425	(0.494)	0.736	(0.441)
- three or more children	0.153	(0.360)	0.264	(0.441)
Twins at first birth (twins-1)	0.011	(0.103)	-	-
Twins at second birth (twins-2)	-	-	0.010	(0.101)
Same sex of first two born children	-	-	0.508	(0.500)
Two first born girls	-	-	0.236	(0.424)
Two first born boys	-	-	0.273	(0.445)
Age of mother	31.517	(4.724)	32.797	(4.094)
Age of mother at first birth	23.682	(3.639)	22.982	(3.253)
Mother's education:*				
- basic	0.377	(0.485)	0.449	(0.497)
- secondary	0.363	(0.481)	0.348	(0.476)
- higher	0.260	(0.438)	0.203	(0.402)
Mother works	0.547	(0.498)	0.542	(0.498)
- one child	0.552	(0.497)	-	-
- two children	0.552	(0.497)	0.552	(0.497)
- three or more children	0.516	(0.500)	0.516	(0.500)
Mother's labour income	681.81	(986.56)	605.50	(923.83)
- one child	785.91	(1057.38)	-	-
- two children	687.75	(966.08)	687.75	(966.08)
- three or more children	376.60	(748.40)	376.60	(748.40)
Father works	0.806	(0.396)	0.812	(0.391)
- one child	0.80	(0.402)	-	-
- two children	0.81	(0.393)	0.810	(0.393)
- three or more children	0.82	(0.386)	0.818	(0.386)
Father's labour income	1574.372	(1579.488)	1528.973	1541.814
- one child	1636.31	(1627.48)	-	-
- two children	1630.63	(1591.66)	1630.63	(1591.66)
- three or more children	1246.05	(1354.22)	1246.05	(1354.22)
N	52991		30578	

Notes: The samples include families in which the mother is younger than 41 and older than 17 and had the first child at the earliest at the age of 16; children's age from 0-15; labour incomes are unconditional monthly net values indexed by CPI to June 2006.

* Education categories cover: "basic" – no formal education, primary education, gymnasium and vocational education; "secondary" – secondary academic and secondary vocational education; "higher education" – education degree higher than secondary;

Source: authors' own calculations based on the PHBS data (2003-2010).

Table A2. OLS first stage relationships and the strength of the instruments

	(1)	(2)	(3)	(4)
	Dependent variable: number of children			
	- **twins at 1st birth**	- **twins at 2nd birth**	- **same sex of 2 kids**, - first kid girl, - second kid girl	- first kid girl, - **two boys**, - **two girls**
Married and cohabiting mothers				
t-statistic on the instrument	24.79	28.02	5.88	4.90; 3.45
R-squared	0.274	0.098	0.084	0.084
F-statistic on excluded instrumetns	614.60	785.38	34.61	18.01
LM statistic on underidentification test	299.04	227.76	34.60	36.00
N	52,991	30,578	30,578	30,578
All families, time since last birth more than 6 years				
t-statistic on the instrument	24.03	21.32	4.58	2.18; 4.29
R-squared	0.242	0.090	0.062	0.062
F-statistic on excluded instrumetns	577.39	454.34	20.95	11.55
LM statistic on underidentification test	207.14	106.98	20.95	23.10
N	24,624	13,795	13,795	13,795
Married and cohabiting mothers, time since last birth more than 6 years				
t-statistic on the instrument	20.50	20.58	4.72	2.30; 4.36
R-squared	0.247	0.093	0.063	0.063
F-statistic on excluded instrumetns	420.06	423.58	22.24	12.13
LM statistic on underidentification test	168.67	101.23	22.25	24.26
N	21,112	12,575	12,575	12,575

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). All regressions include time and voivodship specific effects. The additional covariates include age of mother at first birth, and a polynomial of mother's current age. Sample of mothers aged <18; 40> with oldest child younger than 16 years old who gave the first birth at the age of 16 at the earliest and whose last birth was 6 months prior to survey at the earliest.
Source: authors' calculations based on BBGD data 2003-2010.

Table A3. Validity of heterogeneity analyses.

	(1)	(2)	(3)	(4)	(5)	(6)
	With covariates			Raw correlations		
	Twins-1	Twins-2	Same sex	Twins-1	Twins-2	Same sex
Panel A: Maternal education, full sample						
Secondary school	-0.001	0.001	0.006	-0.001	0.001	0.006
	(0.001)	(0.001)	(0.008)	(0.001)	(0.002)	(0.008)
	0.186	0.393	0.414	0.180	0.469	0.405
Below secondary school	-0.001	0.001	-0.012	-0.001	0.001	-0.011
	(0.001)	(0.001)	(0.007)	(0.001)	(0.001)	(0.007)
	0.260	0.472	0.117	0.264	0.564	0.121
R-squared	0.001	0.001	0.001	0.000	0.000	0.000
N	60,253	33,012	33,012	60,253	33,012	33,012
Panel B: Maternal cohorts (no year fixed effects), full sample						
Middle age group	0.002	0.000	-0.011*	0.002*	0.000	-0.011*
	(0.001)	(0.001)	(0.006)	(0.001)	(0.001)	(0.006)
	0.102	0.702	0.069	0.092	0.707	0.072
Youngest	-0.002	0.001	-0.002	-0.001	0.001	-0.002
	(0.001)	(0.002)	(0.008)	(0.001)	(0.002)	(0.008)
	0.116	0.689	0.747	0.129	0.686	0.802
R-squared	0.001	0.001	0.001	0.000	0.000	0.000
N	60,253	33,012	33,012	60,253	33,012	33,012
Panel C: Maternal education, married sample						
Secondary school	-0.002**	0.001	0.003	-0.002**	0.001	0.003
	(0.001)	(0.002)	(0.008)	(0.001)	(0.002)	(0.008)
	0.046	0.386	0.714	0.042	0.483	0.728
Below secondary school	-0.002	0.001	-0.017**	-0.002	0.001	-0.017**
	(0.001)	(0.001)	(0.008)	(0.001)	(0.002)	(0.008)
	0.124	0.496	0.024	0.115	0.606	0.024
R-squared	0.001	0.001	0.001	0.000	0.000	0.000
N	52,991	30,578	30,578	52,991	30,578	30,578
Panel D: Father's education, married sample						
Secondary school	-0.002	0.002	0.005	-0.002	0.002	0.004
	(0.001)	(0.002)	(0.010)	(0.001)	(0.002)	(0.010)
	0.198	0.367	0.582	0.181	0.403	0.715
Below secondary school	-0.003**	0.002	-0.008	-0.004***	0.002	-0.009
	(0.001)	(0.002)	(0.009)	(0.001)	(0.002)	(0.009)
	0.011	0.314	0.396	0.010	0.343	0.309
R-squared	0.001	0.001	0.001	0.000	0.000	0.000
N	52,991	30,578	30,578	52,991	30,578	30,578
Panel E: Father's income, married sample						
Middle third	-0.000	-0.003*	-0.003	0.000	-0.002*	-0.003
	(0.001)	(0.001)	(0.007)	(0.001)	(0.001)	(0.007)
	0.962	0.083	0.688	0.939	0.087	0.685
Bottom third	0.004***	-0.002	-0.002	0.004***	-0.002	-0.001
	(0.001)	(0.002)	(0.007)	(0.001)	(0.001)	(0.007)
	0.001	0.138	0.787	0.001	0.197	0.905
R-squared	0.001	0.002	0.001	0.000	0.000	0.000
N	52,991	30,578	30,578	52,991	30,578	30,578

Notes: Covariates in columns (1)-(3) include: year and regional (voivoidship) fixed effects. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).
Source: authors' calculations based on BBGD data 2003-2010.