

# **Influence of fertility on women participation in labour market and their wages.**

## **Alternative cost of having a child.**

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### Abstract

Children require not only financial expenditures but also expenditures of time. So the number of children and distribution of their births in time remains in conflict with the aspiration of parents after career and their quest for satisfactory work. Cost of child includes not only expenditures of parents on goods and services but also alternative costs of time devoted to bringing up children, resulting from a loss of the part or the whole of income due to having the child. This problem applies mainly to women, which despite social transformations and growing occupational activity remain to be main suppliers of time for children care. Maternity restrains woman possibilities on labour market not only through reduction of hours, which she can spend in work. She gets lower wages also because of disturbed career and smaller mobility than childless woman. Prolonging gap in occupational activity results as well in decrease of long-term ability of gaining income – diminishes total net income obtained during life-time (fewer years in work). This entails lower savings for retiring fund.

This paper consists of empirical estimations of models of women's participation in labour market taking into account endogeneity of fertility, which are subsequently employed as a selection equation in Heckman model of influence of having children on mothers wages. Thus we attempt to assess fraction of income lost by woman who decided to have children. We employ cross-sectional and panel data model on household budgets of Poland and Germany. Data used in estimation are taken from database created by Consortium of Household Panels for European Socio-economic Research (CHER) with exception of cross-sectional model for Poland, which is estimated on broader survey conducted by Polish Central Statistical Office.

## Introduction

Parents devote considerable resources to their children. Children affects the allocation of a given budget, the best known example is the observation that families with children have higher food budget share than families with the same income but no children. Other decisions made by household, like, e.g., concerning participation in labour market and amount of time intended to work, are also influenced by their presence.

Talking about „cost of children” in economics, usually we think about amount of money spend by parents on their children, in context of expenditure function used in demand analyses and applied welfare analyses, suitably extended to allow differences of demographic structure between households. But calculating the relative amounts of money two different types of households (with and without children) require in order to reach the same standard of living doesn't exhaust this subject. The other respect in which we talk of „cost of children” is that in which we use the expression in the context of microeconomic analyses of fertility decisions. The cost of children is defined then as a minimum net cost to the parent or parents of raising a certain number of children with certain characteristics in certain economic environment (represented, e.g., by the prices and income tax system). In other words, we can say that it is the opportunity-cost of having children. This problem is usually considered due to mother (especially of young or new-born child) and her behaviour on the labour market.

## Our research issue

Childbearing affects women's opportunities in the labour market. Motherhood reduced women's labour force participation, and their earnings, when employed, is lowered by taking the part time-jobs and by interrupted employment experience.

This study tries to quantify the cost of children in terms of impact of birth of a new child (and presence of preschool children) on both female earnings and labour supply behaviour.

Our main purpose was trying to find an answer to two questions:

- ▶ How strong is influence of decision of having a child on participation in labour market?
- ▶ How large part of her income a woman loses as a result of maternity?

## Econometric problems

- ▶ self-selection of working women
- ▶ endogeneity of fertility in participation equation

The purpose of our analysis was to calculate forgone earnings of women. But estimation of wage equation require prior estimation of selection equation, due to self-selection problem.

Female participation in the labour market for panel data is modelled by probit, where the outcomes are „employed” and „not employed”. The specification allows the presence of children in different age intervals, especially new born infants, to affect the participation decision. Fertility (and family structure) in such models is usually treated as exogenous determinants of female participation decisions. However, decisions concerning when and how much to work on one hand and having a baby on the other should be treated as jointly determined. Women’s decisions about labour participation, number and timing of children are made simultaneously and are affected by labour market conditions and government policies, as well as by personal preferences. Failure to account for the endogeneity of fertility may bias estimates of the effect of fertility and other (correlated exogenous regressors) on labour market participation. This problem has needed to be solved in our work. In case of cross-section data we have just estimated a binomial probit model, in which both equations are estimated together. In case of panel data the problem was more complicated. We attempted to estimate bivariate model for panel data, following Carrasco (Carrasco, 1998), unfortunately we have not succeeded to achieve convergence of the model. In an attempt to assess the severity of the problem of endogeneity we have decided to estimate multinomial logit for interaction of labour market participation and fertility.

## Data sources

We used the data for Poland and, as a comparison, data for Germany. Covered years and numbers of observations in every sample are presented below. The samples are limited to married women of age 18 to 55, with or without children, living in households without any other relatives. Three-generational households, as well as lone mothers, weren’t taken into account.

► Poland:

- panel data – CHER 1997-2000 – 980 women
- cross-sectional data – 1998 survey of Polish Central Statistical Office – 13.316 women

► Germany:

- panel data – CHER 1990-2000 – 950 women
- cross-sectional data – CHER 1998 (one wave from above panel) – 950 women

## Variables

The effect of fertility is specified by a dummy variable  $(d_{it})$  which equals 1 if there is in a household an additional child up to 11 months in case of Poland, or, in case of Germany, if age of the youngest child is 0 or 1 – that's because of lack of the data concerning month of birth. Apart

from this, we were also interested in considering the effect of older children, so we specified in our model by dummy variables as follows:

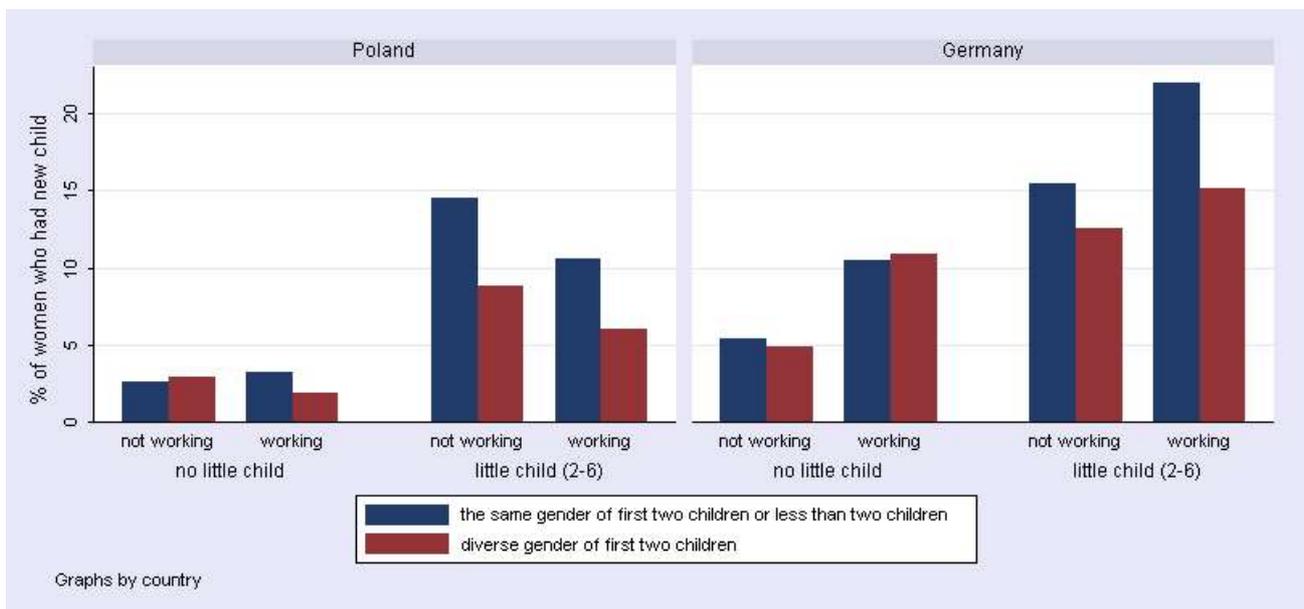
- children 1-2: this variable takes the value 1 if there are children at age 1-2 in the household;
- children 3-6: this variable takes the value 1 if there are children at age 3-6 in the household;
- children 6-16: this variable takes the value 1 if there are school-age children in the household;

Besides, we controlled also for socio-economic characteristic of woman – age, level of education, house ownership, residence (countryside, city, big city – only for Polish data), and presence the other source of income.

Labour market participation is represented also by a dummy ( $y_{it}$ ) which equals 1 for „working”.

We have to choose also an additional variable as an instrument for fertility. In this paper we use the sex of previous children as instrument. This follows from the finding, well-documented in the demography literature, that parents prefer „balanced” families in terms of the sex composition of their children, and are more likely to have an additional child if the previous ones are of the same sex. This instrument seems to be a good predictor of fertility, but not of participation, in the sense that sex of children does not influence directly this decision.

- instrument for fertility ( $z_{it}$ ) – whether the first two children are of the same gender (following, e.g., Angrist, Evans 1996)



## Estimated models for labour market participation

► cross-sectional

► with exogenous fertility

$$y_i = I(\alpha_0 + \alpha_1 d_i + \beta_0 x_i + \beta_1 x_i d_i + v_i > 0) \quad (1)$$

where  $(v_i | x_i, d_i) \sim N(0, 1)$

► with endogenous fertility – (1) and additionally

$$d_i = I(\lambda_0 + \lambda_1 x_i + \lambda_2 z_i + \varepsilon_i > 0) \quad (2)$$

where  $((v_i, \varepsilon_i) | (x_i, z_i)) \sim N(\mathbf{0}, \mathbf{I})$

## Estimated models for labour market participation

► longitudinal

► with exogenous fertility

$$y_{it} = I(\alpha_0 + \alpha_1 d_{it} + \beta_0 x_{it} + \beta_1 x_{it} d_{it} + \eta_i + v_{it} > 0) \quad (3)$$

► multinomial logit – trial to check for endogeneity

(4 categories for combinations of participation and fertility)

$$P(f) = \frac{\exp(V^f)}{\sum_{a=1}^4 \exp(V^a)} \quad (4)$$

where  $\exp(V^1) = 1$ ,  $V_{it}^a = \alpha^a + \beta^a x_{it} + \eta_i^a + v_{it}^a$

## Results of estimation – participation equations

As we expected, almost all children variables decrease the probability of woman's participation. Also general number of children is significant. Surprisingly, for Poland we can observe negative effect of living in urban areas. We think, that it's caused by methodology of collecting data – if the household is running a farm, all members are counted as „working”. This could be a reason that living in villages increases the probability for women of being employed.

**Table 1****Cross-sectional model for labour market participation with exogenous fertility**

<b>predictors</b>	<b>Poland</b>	<b>Germany</b>
newborn child	-0.2631 (0.0733)	-
children at 1-2	-0.6916 (0.0530)	-
children at 3-6	-0.3803 (0.0307)	-0.8216 (0.1369)
children at 6-16	-	-0.5348 (0.1105)
newborn child together with children at 1-6	0.1920 (0.1160)	-
age	-	-0.0295 (0.0092)
does husband work	-	0.3397 (0.1353)
husband's income from employment (per hour)	-0.0206 (0.0020)	-0.0073 (0.0023)
other household income	-0.0022 (0.0001)	-0.0007 (0.0001)
secondary education	0.5322 (0.0261)	0.3814 (0.1070)
university education	1.3092 (0.0539)	0.9938 (0.1273)
number of children	0.0895 (0.0112)	-
lives in a big city (more than 0.5 mln)	0.2011 (0.0397)	/
lives in the country	0.0907 (0.0299)	/
house ownership	0.1587 (0.0262)	-
intercept	-0.2314 (0.0309)	1.4851 (0.4536)

**Table 2a****Cross-sectional model for labour market participation with endogenous fertility – participation equation**

<b>predictors</b>	<b>Poland</b>	<b>Germany</b>
newborn child	-0.3370 (0.1210)	-1.5215 (0.4571)
children at 1-2	-0.7174 (0.0530)	-
children at 3-6	-0.3991 (0.0312)	-0.7495 (0.1325)
children at 6-16	-	-0.4775 (0.1062)
newborn child together with children at 1-6	0.2864 (0.1149)	-
age	-	-0.0305 (0.0089)
does husband work	0.2136 (0.0343)	0.3777 (0.1298)
husband's income from employment (per hour)	-0.0249 (0.0021)	-0.0051 (0.0023)
other household income	-0.0022 (0.0001)	-0.0006 (0.0001)
secondary education	0.5185 (0.0262)	-
university education	1.3015 (0.0540)	-
number of children	0.0805 (0.0114)	-
lives in a big city (more than 0.5 mln)	0.1979 (0.0397)	/
lives in the country	0.0825 (0.0301)	/

<b>predictors</b>	<b>Poland</b>	<b>Germany</b>
house ownership	0.1587 (0.0262)	-
intercept	0.1077 (0.0368)	1.8252 (0.4349)

**Table 2b**  
**Cross-sectional model for labour market participation with endogenous fertility – fertility equation**

<b>predictors</b>	<b>Poland</b>	<b>Germany</b>
the same gender of two first children	0.3058 (0.0504)	-
children at 1-2	-0.7074 (0.0939)	-
children at 3-6	-0.1890 (0.0495)	-0.7890 (0.3400)
children at 6-16	-	-1.1607 (0.3924)
age	-0.1054 (0.0042)	-0.1708 (0.0315)
husband's income from employment (per hour)	-	0.0161 (0.0048)
other household income	-0.0006 (0.0001)	-
university education	0.2635 (0.0713)	-
number of children	-	0.6875 (0.1643)
lives in the country	0.1594 (0.0492)	/
intercept	1.7026 (0.1373)	3.2231 (1.1338)

**Table 3**  
**Longitudinal model for labour market participation with exogenous fertility and random effects**

<b>predictors</b>	<b>Poland</b>	<b>Germany</b>
newborn child	-0.7526 (0.2885)	0.5412 (0.1022)
children at 1-2	-1.2414 (0.1856)	-0.3306 (0.0827)
children at 3-6	-0.5325 (0.1180)	-0.5036 (0.0518)
children at 6-16	-	-0.1752 (0.0583)
newborn child together with children at 1-6	0.9637 (0.2582)	-
age	0.06576 (0.0123)	-
does husband work	0.4710 (0.1686)	0.2846 (0.0651)
other household income	-0.0103 (0.0008)	-0.0014 (0.0001)
years of education	0.3667 (0.0408)	0.1755 (0.0191)
number of children	-	-0.1616 (0.0378)
lives in the country	-0.5433 (0.1846)	/
intercept	-6.2890 (0.7504)	-1.1551 (0.2481)

Outcomes for **multinomial logit** for interaction of labour market participation and fertility:

► **Poland**

- random individual effects are significant and very strongly correlated for all categories
- there is no reason to reject hypothesis of independence of both decisions
- neglect of endogeneity should not influence our results

► **Germany**

- random effects are insignificant
- prediction value of model is very poor (probabilities of choice of an alternative are almost equal for women who actually chose it and for those who did not)

## Estimated models for income from employment

In the second part of analysis women's incomes from employment were estimated as a function of age, education and „children” variables. Various models for labour market participation from previous section was used as selection equation for model of earnings. For comparison simple regressions was estimated as well.

**Table 4a**

**Women's wages – estimations on Polish cross-section**

predictors	model without self-selection	models with self-selection	
		exogenous fertility <sup>1)</sup>	endogenous fertility <sup>2)</sup>
birth of additional child	-232.1612 (28.855)	-123.713 (28.573)	-232.4511 (28.861)
child at 1-2	- 167.3779 (19.2547)	10.2814* (20.197)	-197.0536 (22.918)
child at 3-6	- 113.6078 (11.5827)	-39.8631 (11.729)	-121.2674 (12.0356)
birth of additional child with presence of child at 1-6	98.7558 (41.7652)	23.527* (40.976)	98.328 (41.775)
children at 6-16	- 60.1805 (10.0841)	- 70.5896 (9.878)	- 59.7669 (10.091)
age	55.3025 (5.1479)	34.6676 (5.111)	44.2801 (6.913)
age squared	- 0.7144 (0.0665)	- 0.4186 (0.0662)	- 0.5994 (0.0821)
secondary education	238.831 (8.9569)	126.6584 (9.933)	242.0663 (9.0672)
university	694.3609 (14.4367)	476.6976 (16.785)	707.4663 (15.547)
lives in the country	- 109.4891 (9.5995)	- 145.7014 (10.079)	- 104.175 (9.8991)

predictors	model without self-selection	models with self-selection	
		exogenous fertility <sup>1)</sup>	endogenous fertility <sup>2)</sup>
lives in big city	151.8131 (12.9161)	113.5337 (12.744)	153.1056 (12.9347)
house ownership	-	-35.798 (8.929)	-
self-selection factor	/	-1355.091 (54.958)	853.7299 (359.7365)
intercept	-676.1358 (94.825)	342.9668 (101.585)	-1098.14 (202.3322)
correlation of disturbances	/	-1.297	1.025

**Table 4b**  
**Women's wages – estimations on German cross-section**

predictors	model without self-selection	models with self-selection	
		exogenous fertility <sup>1)</sup>	endogenous fertility <sup>2)</sup>
child at 3-6	-922.2814 (186.5304)	-	-1008.92 (191.0927)
children at 6-16	-496.2088 (171.0347)	-	-623.7795 (182.041)
age	600.596 (128.2271)	455.8042 (123.886)	428.2408 (153.806)
age squared	-7.4962 (1.5640)	-5.2394 (1.5095)	-5.5954 (1.8227)
university	1221.089 (129.7607)	/	1212.399 (129.62)
years of education	/	158.9978 (26.1975)	/
number of children	-371.3976 (12.744)	-262.6593 (63.999)	-282.5879 (85.4942)
self-selection factor	/	-6589.153 (686.1457)	6943.084 (3434.19)
intercept	-9087.131 (2572.551)	-6086.995 (2501.416)	-10804.75 (2705.215)
correlation of disturbances	/	-1.3448	1.1973

The presence of newborn child in household decreases the mother's wage. Controlling for self-selectivity reduce, in the cross-section models with exogenous fertility, the influence of the presence of new-born child in household. But taking into account also endogeneity of fertility, makes the models more similar to a models without „self-selection” at all, especially for Poland.

**Table 5****Women's wages – estimation on panel sample**

predictors	Poland		Germany	
	model without self-selection	model with self-selection <sup>1)</sup>	model without self-selection	model with self-selection <sup>1)</sup>
birth of additional child	-150.7854 (33.4263)	-140.755 (33.015)	-116.5844 (61.3874)	-381.6922 (61.367)
child at 1-2	- 129.1284 (29.7905)	- 74.6578 (29.809)	-712.988 ( 50.633)	-557.4324 (50.05)
child at 3-6	-71.8473 (22.6875)	- 52.5992 (22.4148)	-410.848 (32.397)	-152.5629 (33.5523)
child at 6-16	-	-	-188.2611 (33.436)	-111.4277 (32.8783)
age	13.6758 (2.0688)	14.7937 (2.0232)	80.1691 (3.2001)	89.4048 (3.1558)
secondary education	209.148 (29.3139)	166.7355 (28.9175)	-	-
university	633.0296 (41.9732)	566.0023 (41.4772)	881.447 (85.8193)	655.5346 (84.948)
lives in the country	56.5005 (32.6131)	69.3422 (31.753)	/	/
number of children	-	-	-270.575 (24.4078)	-187.1588 ( 24.1445)
house ownership	-	-	153.6614 (41.586)	125.0175 (40.618)
self-selection factor	/	- 92.5983 (8.2929)	-	-979.3018 (41.732)
intercept	- 211.3625 (84.6358)	- 189.5332 (82.6684)	-1090.691 (136.7477)	-1082.136 (134.2193)
fraction of variance due to random effects	0.6262	0.6176	0.6299	0.63098
correlation of disturbances	/	-0.2955	/	-0.8607

<sup>1)</sup> “self-selection factor” was taken from probit model of women participation in a labour market with exogenous fertility

<sup>2)</sup> “self-selection factor” was taken from bivariate probit model

In case of models with self-selection for panel data (Table 5), only exogenous fertility was taken into consideration. However, on the base of the outcomes of multinomial logit for Poland, we can presume, that introducing endogeneity of fertility would not significantly change the evaluations – individual effect seem to be more important.

Comparing outcomes for Poland and Germany, it is interesting to observe, that in case of Germany presence of children exerts an influence on mother's wages longer than in Poland. It

means, that German women make the decision about re-entering the labour market much later.

Interesting part is also the impact of educational variables on earnings. It can be easily observed, that this impact is not linear. The effect of moving from middle to high level of education is much greater than in case of moving from basic to middle level. It's not surprising: better educated women can choose more jobs which suit their needs, they can achieve jobs with a higher status and income level. As a result this women forgo more income.

## **Final calculations of forgone earnings and conclusions**

It's generally accepted that the presence of children, especially young children, decreases the labour supply of the mother. Withdrawal from the labour force (or reduction in the intensity of work) impose a direct cost in terms of forgone earnings and an indirect cost in terms of reduction in human capital accumulation.

Our estimates indicate that a new birth has a strong impact on mother's labour force participation and their wages as well. This negative effect becomes smaller for older children, and for Poland even disappears when child achieves a school age.

Models estimated on panel data show, that unobserved personal preferences concerning having children and work seem to be important in evaluating „costs” of motherhood: introducing “individual effects” reduces the calculated loss of monthly income in comparison to cross-section estimates. By this we can partly take into account that presence of child generates not only costs – raising children and companionship of children increase utility.

The calculated loss of money income, expressed as a percent of childless woman, are greater in case of Germany. Of course, and it's not surprising, in both considered countries the biggest „gap” we can observe for women raising more children, especially in a pre-school age.

Self-selection with exogenous fertility always reduces evaluation of negative effect of „children” variables, but introducing endogeneity of fertility makes the parameters again significant and strongly negative. Taking into account self-selectivity is most important for the calculations of forgone earnings connected to the presence of child aged 1 or 2, but not for a new-born child.

Summing up, outcomes of our analysis are consistent with earlier expectations: influence of having children turned to be strongly negative.

**Table 6a****Estimation of loss of monthly income caused by decision of having children**

<b>Poland</b>	<b>without self-selection</b>		<b>with self selection</b>	
<b>cross-section</b>	<b>loss in PLN</b>	<b>% of childless woman income</b>	<b>loss in PLN</b>	<b>% of childless woman income</b>
woman with newborn child	232.16	25.50	232.45	25.54
woman with newborn child and child at 1-2	300.78	33.05	331.18	36.39
woman with newborn child and child at 3-6	247.01	27.14	255.39	28.06
woman with newborn child, child at 1-2 and child at 3-6	414.39	45.50	452.44	49.71

Average income of working childless woman (1998) – 910.20 PLN.

Exchange Rate: 1€ = approx. 4.7PLN

**Table 6b****Estimation of loss of monthly income caused by decision of having children**

<b>Poland</b>	<b>without self-selection</b>		<b>with self selection</b>	
<b>panel</b>	<b>loss in PLN</b>	<b>% of childless woman income</b>	<b>loss in PLN</b>	<b>% of childless woman income</b>
woman with newborn child	150.79	16.57	140.76	15.47
woman with newborn child and child at 1-2	279.91	30.75	215.41	23.67
woman with newborn child and child at 3-6	222.63	24.46	193.35	21.24
woman with newborn child, child at 1-2 and child at 3-6	351.76	38.65	268.01	29.45

Average income of working childless woman (1998) – 910.20 PLN.

Exchange Rate: 1€ = approx. 4.7PLN

**Table 7a****Estimation of loss of monthly income caused by decision of having children**

<b>Germany</b>	<b>without self-selection</b>		<b>with self selection</b>	
<b>cross-section</b>	<b>loss in €</b>	<b>% of childless woman income</b>	<b>loss in €</b>	<b>% of childless woman income</b>
woman with one child	371.31	11.38	282.59	6.13
woman with one child at 3-6	1293.59	39.64	1291.51	28.02
woman with two children	742.71	22.76	565.17	12.26
woman with two children, both at 3-6	2587.27	79.29	2583.01	56.05
woman with child at 3-6 and child at 6-16	2161.20	66.23	2197.87	47.69
woman with three children	1114.11	34.14	847.76	18.39

Average income of working childless woman (1998) – 2803.11 Euro.

**Table 7b****Estimation of loss of monthly income caused by decision of having children**

<b>Germany</b>	<b>without self-selection</b>		<b>with self selection</b>	
<b>panel</b>	<b>loss in €</b>	<b>% of childless woman income</b>	<b>loss in €</b>	<b>% of childless woman income</b>
woman with newborn child	387.16	16.78	586.45	36.32
woman with newborn child and child at 1-2	1370.72	59.42	1312.81	81.31
woman with newborn child and child at 3-6	1068.58	46.33	907.94	56.23
woman with newborn child, child at 1-2 and child at 3-6	1527.41	66.22	1206.52	74.72

Average income of working childless woman (1998) – 2803.11 Euro.