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Can fiscal policy spur fertility?

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Abstract

Research background: The decreasing fertility rate is a serious problem for policymakers as it affects the pension system as well as private consumption and savings. It seems reasonable to analyze whether fiscal policy may mitigate the low birthrate problem.

Purpose of the article: In this paper we strive to answer the question whether fiscal incentives spur fertility if parents are rational.

Methods: A theoretical economic model of utility maximization is applied to analyze the impact of fiscal policy on fertility. The conclusions are based on the analysis of comparative statics simulation calibrated for actual data from Poland.

Findings & Value added: The results indicate that a substantial fertility effect can be obtained by raising subsidies for children or general benefits for families.

Introduction

In most economically developed countries the average number of children born during the reproductive life of a woman (i.e. 15–49 years) is constantly diminishing over the recent decades and it does not support the simple

replacement of generations. For example, in Poland the total fertility rate amounted to 1.39 in 2016 (Eurostat, 2018), while to prevent low-mortality population from contracting the rate of 2.1 of a child per woman is necessary (Espenshede *et al.*, 2003). It is claimed that the decline in fertility is primarily due to the changes in households' time allocation decisions affected by:

- the trade-off parents face between the number of children and their *quality*;
- the increasing expected value of the opportunity cost for mothers (see Sommer, 2016);
- a higher bargaining power of women over their partners;
- intergenerational distribution effects of fiscal policies (see Werding, 2010).

In order to encourage procreation a number of different policies are recommended, including but not limited to, fiscal policy instruments, such as taxes and cash benefits for children. They reduce the costs of childbearing (positive incentive) or raise the costs of living for childless or people with low number of children (negative stimulus). In practice, the proposed fiscal incentives are too modest to fully cover the costs of raising children or to change the mind of the people who do not intend to have children. Hence, the question arises whether tax incentives can really stimulate fertility, assuming that parents are rational economic agents and fertility is endogenous (i.e. decided by the parents).

Since the initial work of Becker (1960), economists have postulated using economic incentives to affect parental decision making, and the idea has been empirically tested (e.g. Angrist *et al.*, 1998; Kögel, 2004). In Becker's view, children are a consumption good that gives utility, but comes at a cost. Thus, to study the procreation decision making process, it is suitable to use microeconomic analysis framework to examine the optimal pronatalistic policy. It is asserted that such a policy may counteract at least some of the causes of the declining fertility by lowering the opportunity cost of childcare and correcting for negative external effects (see e.g. Cigno, 1986; Zhang, 1997; Apps & Rees, 2004; Laroque & Salanié, 2004). Empirical evidence is affluent (Dilnot & McCrae, 2000; Smallwood, 2002; Cigno *et al.*, 2003; Baughman & Dickert-Conlin, 2009; Kearney, 2004; Ohinata, 2011; Kudła, 2014, pp. 13–24; Boldrin *et al.*, 2015). For example, the optimal tax-mix should consist of children-related tax allowances and higher taxes on goods consumed by adults (Yasuoka & Goto, 2015) accompanied by taxes imposed on capital gains (van Groezen & Meijdam, 2008). Such a policy should reduce the costs of having children and the consumption of adults' goods.

However, parents do not necessarily have to respond to the tax incentives. For example, the tax savings can increase parents' consumption or consumption of their living children instead of consumption of the prospected future children. As Becker and Lewis (1973), de Tray (1973) and Becker and Tomes (1976) point out, an increase in the number of children makes marginal human capital decline, i.e. the more children parents have the less attention they are able to pay for each one of them. This hampers their development and undermines their future productive capacity.

In the paper, it is assumed that pronatalistic fiscal policy is effective (it changes the parents' willingness to conceive more children), fertility is endogenous (fully controllable by parents), and fertility decisions stem from rational economic choices (see e.g. Cigno, 1986; Cigno, 2001; Cigno & Pettini, 2002). In order to design an optimal policy an economic model describing fertility response of a family is developed. Subsequently the model is applied to the numerical simulation of Polish household's fertility behavior with one child (family 2+1) and two children (family 2+2). The simulation results suggest that responses of these two types of families are similar, with a slightly higher sensitivity of the latter. The cost effectiveness criterion hints at the advantage of direct subsidies to families (with regard to the number of children currently brought up).

Model

It is assumed that parents maximize utility derived from consumption of parent's goods, $a > 0$, leisure, $l > 0$, and the number of children, n . Contrary to a life-cycle modeling approach, the parents do not value the children's quality (human capital). This stems from the assumption that the parents are able to estimate the costs of childrearing only for the first several years of the child's life. The time of childcare for young children, t , is roughly constant and is determined only by physiological needs of the child. The later period of a child's life is not taken into account when deciding to procreate due to the lack of information about future costs of childrearing (the parents are 'myopic'). The parents provide each of their children with child-specific goods (such as diapers, nutrition, clothing, etc.) which cost is equal to c . For simplicity, the child-specific goods are distinguishable from goods consumed by the parents, and therefore taxed with the preferential tax rate, $\tau_c > 1$, which is different from the net rate of the tax on the goods consumed by the parents, $\tau_a > 1$.

Furthermore, it is assumed that some amount of the specific goods is shared by children (e.g., a stroller can be used by all the children), so that

the total cost of children is the sum of each individual consumption minus a constant representing the savings in costs, $n\tau_c - b$, where $b > 0$, starting with the first child in the family (so $b = 0$ if $n = 1$).

The parents solve the constrained optimization problem:

$$U(a, l, n) - \lambda\{a\tau_a + n[w\tau_w t + c\tau_c] - b - w\tau_w(h - l) - \psi - n\varphi\}, \quad (1)$$

where:

$U(a, l, n)$ – the utility function assumed to be strictly concave, twice differentiable, and strictly increasing in a, l and n ;

τ_w – the rate of the tax imposed on the wage w ;

h – total time available for the parents in a time interval;

ψ – general subsidy to the family (independent of the number of children);

φ – children related cash benefit.

To derive an explicit analytical solution to the parents' problem we specify the utility function in the form of $U(a, l, n) = \ln(a) + \alpha \ln(l) + \beta \ln(n)$, $\alpha, \beta > 0$. The α and β are parameters reflecting the relative preferences for leisure and the number of children. By solving (1) with respect to a, l and n , one gets the optimal number of children:

$$n = A \frac{w\tau_w h + b + \psi}{w\tau_w t + c\tau_c - \varphi} \quad (2)$$

where:

$$1 > A = \frac{\beta}{1 + \alpha + \beta} > 0.$$

Comparative statics

By totally differentiating the first order conditions of (1) it is possible to determine what happens to the optimal number of the children when fiscal parameters: $\tau_a, \tau_w, \tau_c, \psi$, and φ are changing:

$$\frac{\partial n}{\partial \tau_a} = 0 \quad (3)$$

$$\frac{\partial n}{\partial \tau_w} = Aw \frac{c\tau_c h - bt - \varphi h - t\psi}{\nabla} \quad (4)$$

$$\frac{\partial n}{\partial \tau_c} = -Ac \frac{b + w\tau_w h + \psi}{\nabla} \quad (5)$$

$$\frac{\partial n}{\partial \psi} = A \frac{c\tau_c + w\tau_w h - \varphi}{\nabla} \quad (6)$$

$$\frac{\partial n}{\partial \varphi} = A \frac{b + w\tau_w h + \psi}{\nabla} \quad (7)$$

where:

$$\nabla = (c\tau_c + w\tau_w t - \varphi)^2 > 0 \text{ for } \varphi \neq c\tau_c + w\tau_w t.$$

Evidently, the derivative (5) is negative, while the derivative (7) is positive. Most likely $\varphi < c\tau_c + w\tau_w t$, so the derivative (6) should be positive too. The sign of (4) is ambiguous and depends on the sign of $h(c\tau_c - \varphi) - t(b + \psi)$. The parsimonious government (when φ and ψ are small enough) would increase the fertility rate by raising the tax on wages. It is because b is only a part of the total spending on the first child in the family and $h > t$. However, if the government was generous (high φ and ψ) then lowering the labor income tax would be beneficial to the development of the population. Summing up, the pronatalistic fiscal policy mix should consist of low taxes on children goods and labor income, paired with high family allowances. The program could be financed by higher taxation of adult goods which does not affect the fertility rate.

Data for simulation

The model has been used to find the optimal behavioral reaction of the two types of Polish families in the time span of one year: 2+1 (parents with one child) and 2+2 (parents with two children) using actual data for the year 2016. The scarcity of data does not allow for consideration of other types of families (e.g. 2+3 or 1+1).

Childcare time(t). On average, according to Bobrowicz (2007)¹, in families with children under the age of 3 parents spend together 37.5 hours per

¹ We had to use outdated data (from before 2007) as more current set of data is unavailable. However, we believe that childcare time did not change considerably by 2016 and

week on childcare (on average: 27.7 hours is spent by the mother and 9.6 hours by the father) which results in 1,940 total hours per year². In the case of children 4-6 years of age, the average weekly and yearly time of parents is slightly smaller: 30.7 and 1,596 hours, respectively. By averaging, the childcare time in the first six years of a child's life is approximately 1,768 hours per year. The *total time* at the disposal of each parent is about sixteen hours a day, which gives 11,680 hours per year for the family (*h*).

Children's consumption and tax rates. The children's consumption (*c*) is calculated as the difference between the average monthly gross consumption expenditures of the 2+1 family (3,651.69 PLN in 2016) and the average monthly gross consumption expenditures of the 2+0 family (2851.1 PLN in 2016) (GUS, 2017). It implies an annual increase in the expenditures induced by the first child in the family of 9,607,08 PLN. By analogous calculation, the increase in gross consumer spending of the average 2+2 family is estimated at 5394,12 PLN a year and *gross savings* (*b*) arising from the sharing of consumer durables at 4212.96 PLN. However, the consumption of children includes goods taxed with a reduced 8-percent VAT rate as well as goods levied with the standard VAT rate of 23% and, to a lesser extent, with other indirect taxes. Therefore, the *average tax rate* on goods consumed by children (τ_c) has to be weighted by the share of different types of goods increment in a consumer basket with respect to the tax rates applied to different categories of goods. Unfortunately, there is no data on the actual shares of consumption with different tax rates for adult and children goods. Therefore, the average gross tax rate on children consumption is assessed arbitrarily from the following shares of the expenditures increase: 20% of net expenditures on food, non-alcoholic beverages, clothing and footwear, housing equipment and maintenance; 33% of net expenditures on health and transportation; and 90% of net expenditures on education. The remaining part of the increase in families' spending is assigned to goods taxed with the standard rate. Finally, the average tax rate is estimated at 20% ($\tau_c=1.2$) and incremental net consumption (Δc) by the 2+1 and 2+2 families at 7990.31 PLN and 4507.19 PLN, respectively.

Wages (*w*). The average gross wage rate is calculated as the average yearly gross wage (48,626.28 PLN in 2016) (GUS, 2018) divided by the average yearly number of hours worked by employees (1996.8 hours) (GUS, 2018). The obtained gross wage (24.35 PLN per hour), allows for the calculation of average wage tax parameter (τ_w). It can be derived from the average tax wedge. For families with 2 children in 2016 the tax wedge

cannot significantly alter the estimation.

² The survey data.

varies from 30.8% for one-earner married couple at 100% of average earnings to 33.11% for two-earner married couple, one at 100% of average earnings and the other at 67% (OECD, 2017). As no more accurate data is available, we set the weighted average tax wedge at 32%. It implies the *net wage* of 18.45 PLN and $\tau_w = 0.75$

Family benefits. Taking into account their economic importance, family benefits split into two groups: *benefits depending on the number of children* in a family (φ) and *other social benefits* (ψ). Direct family benefits (φ) in Poland include: family allowances, welfare benefits, grants on the birth of a child and parental benefits. Additionally, there is a tax relief for children in the personal income tax. In general, it is supposed that in the first period of a child's life the main benefit received by the family (with one or two children) is the tax relief of 1112.04 PLN yearly per child³. This should be increased by the child birth benefit (1000 PLN) which is received by about 76% of Polish families and gives on average 167 PLN a year for the 2+1 family and 333 PLN a year for the 2+2 family. These calculations cover the first six years of a child's life. All other benefits are assumed to stay below 100 PLN yearly per child, because they are specific and may exclude each other because they depend on the financial situation of a household. For this reason, the children-related cash benefit φ is estimated at 1379 PLN⁴. Finally, the benefits unrelated to the number of children (ψ) have been assumed as the difference between the total family benefits received by a family in 2016, (2380.32 PLN for the 2+1 family and 5789.16 PLN for the 2+2 family) (GUS, 2017) and the children-related benefits (φ).

Table 1 summarizes the parameters' estimates used for the numerical simulation.

Results

For the presumed values of parameters, the optimal number of children is equal to 5.43A (5.336A for the 2+1 family and 5.523A for the 2+2 family⁵),

³ The tax relief does not apply to those who do not pay the general income tax (e.g. lump-sum taxpayers, farmers etc.) and individuals earning low incomes.

⁴ We omit the benefits received since the mid-2016, like the "Family 500+" social program and allowances applicable for mothers who were not entitled to the maternity leave allowance.

⁵ The slight difference between the two types of families is due to the family's economy of scale (b) and general family transfers (ψ). However, the 2+1 and 2+2 parents' responses to family benefits are similar (see Table 2). For small values of A the difference in their fertility behavior is negligible (see Figure 1).

where A is defined by (2). Figure 1 shows the impact of parents' preferences (represented by A) on the optimal number of children. The 2+1 family has one child which implies $A = 0.1874$, and for the 2+2 family $A = 0.3621$. To obtain the fertility rate of 2.1 (necessary to prevent a decrease in population) the value of A should be 0.394 and 0.38, respectively (the 2+1 family should increase the number of children by 1.1 while the 2+2 family by 0.1). However, A reports the relative value the parents place on their: children, consumption and leisure⁶, and as such it remains out of control of the policymakers. Nevertheless, the latter can apply the policy mix along the guideline based on the values from Table 2, to implement effective pronatalistic policy.

In order to increase the fertility rate in Poland to 2.1 (assuming A to be constant) the family benefits (either φ or ψ) have to be raised by about 11,000 PLN a year in 2+1 family and by about 850 PLN for 2+2 family. It does not preclude the different types of policies, for example, offering a greater subsidy for the 2+2 families and lower subsidy for 2+1 families. Starting from the average fertility (1.39) the amount of subsidies raising the fertility rate to 2.1 (which is equal to the increase by 0.71 of a child) should be about 7200 PLN (for 2+1) and 6000 (for 2+2). The required increase of wage taxation is too high to be feasible in 2+1 families and would require the abandonment of the wage tax in 2+2 families. Similarly, a decrease in taxation on children goods which elevates the number of children to the 2.1 level cannot be applied to 2+1 families, because it exceeds the value of consumption of children goods several times over. For 2+2 families the drop in taxes should reach 25.5% which requires the subsidization of children goods.

Obviously, the values resulting from the numerical simulation exhibit a considerable degree of ambiguity. The sensitivity analysis was performed to assess the stability of the outcomes for the value of parameters most prone to errors. By using extreme parameters in place of the original values the results of the simulation are altered, but for the majority of the parameters the difference is insignificant. Only fractions of changes reveal substantial effect on the number of children. For example, setting τ_c to 1 reduces the effect of τ_w by 17-21% and increases the effect of ψ and φ by 25-31%. By dividing c by *ten* the signs of the impact of ψ and φ reverse, the

⁶ For different values of A the relation between the scaling parameters: α and β is given by $\beta = \frac{A}{1-A}(1 + \alpha)$, as illustrated in Figure 2. The higher A (the higher probability of having greater number of children) the steeper the line and the further from the beginning is the point at which $\alpha = \beta$. For small values of A , as it probably takes in general, α is higher than β .

impact of τ_w decreases as many as 86% and the impact of τ_c decreases by as much as 63-86%. The effect on τ_c is as expected because lower spending on children diminishes the importance of the tax on goods they consume though the effect on τ_w is a surprise because child rearing is cheaper. On the other hand, cutting down family benefits to one tenth has only moderate effect on the fertility sensitiveness (-4 to -12% on the benefits side, 5-14% on the wage side and without changes on the taxation of children goods).

Conclusions

The results suggest that the optimal pronatalistic fiscal policy mix for Poland should consist of generous family benefits package financed through consumption taxes on goods consumed by adults. Wage taxes do not seem to be an effective and reliable means of fertility stimulation as they cannot be adjusted to the required fertility rate. Not without meaning is their sensitiveness to family factors (composition, consumption pattern, etc.).

The analysis is based on a model of fertility which substantially simplifies the process of procreation decision. For example, it assumes the rational parents maximizing their utility regardless of other factors relating to current composition of families. Several other limitations to the study should be mentioned.

Firstly, fertility behavior is not necessarily endogenous and may be driven by factors beyond the control of families. In this case, fiscal instruments to spur fertility would be futile.

Secondly, economic factors affecting fertility might be much less important than others, e.g. cultural ones. The economic model ignores them because they are hard to operationalize in a formal model. They refer to economic roles of parents and to social preferences over fertility rate.

Thirdly, the results depend on the form of the utility function. The one assumed in here is usually chosen for the analysis of consumer behavior but it discriminates against having children (because the latter take time of the parents). The limited ability of parents to earn money may also be the case (not considered in this paper). For example, according to Cukrowska-Torzewska (2016), women labor supply is a decreasing function of the number of children and their earnings dropping by 7.6% (for one child), 16.4% (for two children) and even by 32% (for three or more children). This can significantly disrupt the fertility choice of families.

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Annex

Table 1. The values of parameters

	family 2+1	family 2+2
τ_a	1.23	1.23
τ_c	1.20	1.20
τ_w	0.76	0.76
w	24.35	24.35
h	11680	11680
t	1768	1768
c	7990	7990
b	0	4213
φ	1379	1379
ψ	2380	5789

Source: own calculations based on GUS (2017, 2018) and OECD(2017).

Table 2. The impact of fiscal instruments on the optimal number of children

	2+1 family	2+2 family
A	0.1874	0.362129
$\frac{\partial n}{\partial \tau_w}$	0.251	0.414
$\frac{\partial n}{\partial \tau_c}$	-0.196	-0.391
$\frac{\partial n}{\partial \psi}$	0.0001002	0.0001175
$\frac{\partial n}{\partial \varphi}$	0.0000976	0.0001184

Figure 1. The optimal number of children as a function of A

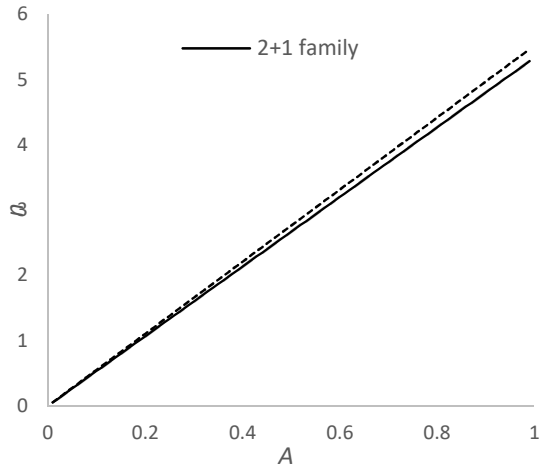


Figure 2. The relation between α and β for the 2+1 family (α range 0-1) and (α range 1-100).

