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Fertility Effects of Pensions and Family Benefits

Test on Hungarian Data

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1. Introduction

There is a discrepancy between the consumption path and income path of the life-cycle.[4] The elderly as well as the children have to consume, income, however, is produced in the active period. All societies exploit the occurrence of overlapping generations and use two-way flows of transfers, one from the active to children and another one from the active to the elderly, in order to smooth out the difference. In a traditional society the institution organizing this chain is usually the extended family. In modern societies such transfers flow among social generations rather than family generations. This historical shift creates a larger risk pool (a comparative efficiency of the family and the insurance market see in Kotlikoff and Spivak 1981), makes intergenerational transfers more easily enforceable and offers insurance against unintended infertility (Sinn 2004). However, if alternative vehicles of wealth accumulation, such as the capital market or social security, offer higher yields some generations may be tempted to desert from the family chain leaving their parents without old-age income and decreasing their fertility (Cigno 1993).

This mechanism roughly described above conceptualizes children as investment goods. If no other reasons than old-age security influenced fertility, voluntary childlessness would dominate modern societies. The alternative consumption good approach implies that couples decide to have children even for short-term returns. These simple demand models predicts fewer but better educated children, allowing for positive effects of public transfers directed to families on quantity of children. (e.g. Becker, 1981) Therefore, looking at birth order effects might lead to a better understanding of how couples decide over their family size.

Fertility effects of family benefits have been analyzed extensively. Gauthier and Hatzius (1997) and Sleebos (2003) review the empirical literature. In this field time series analysis on aggregate data is more frequent. Ermisch (1988) used aggregate time series data for Britain, Whittington, Alm and Peters (1990) for the United States, Zhang, Quan and Meerbergen (1994) for Canada, and Gábos (2003) for Hungary. Ekert-Jaffé (1986), as well as

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Gauthier and Hatzius (1997) analyze pulled time series aggregate data for several countries. Blau and Robins (1989) and Whittington (1992) use a household panel, Milligan (2002) examines a micro-database from the Canadian Census, while the analysis of Landais (2003) uses data from annual (1915-1998) income tabulations produced by the French income tax system. Laroque and Salanié (2005) estimate their model on individual data from the French Labor Force Survey. The common finding of the literature is a positive but modest effect of family benefits on fertility. The positive relationship is present in all of these analyses, while magnitudes of these effects vary across countries.

Looking at birth order effects is not a common practice in these analyses. Gauthier and Hatzius (1997) estimate higher elasticities for the first birth than for the subsequent ones. The paper of Ermisch (1988) is p*er se* an analysis of birth order effects. Unlike the previous study, the Ermisch's one concludes that more generous child allowances would increase the chances of third and fourth births. Other papers that deal with the effects of public programs on a specific birth order can be found in the review of Sleebos (2003). Oláh (1998) estimates a positive effect of non-cash maternity policies and of gender equity on the propensity of having a second child in Sweden and Hungay. Kravdal (1996) concludes that the availability of day care institutions increases the probability of having a third birth among women in Norway. The fertility effects of pensions were not yet analyzed in terms of birth order.

On the fertility effects of pensions Nugent (1985) and Nelissen and van den Akker (1988) offers detailed reviews. Most papers analyze cross-sections of different countries or regions within countries (e.g. Hohm, 1975 compares 67 countries, Nugent and Gillaspy, 1983 34 Mexican counties, Entwisle and Winegarden, 1984 48 and 52 middle and low income countries in two separate models). A notable exception is Jensen (1990), who, testing Cain's "lexicographic safety first" model on data of the Rand Malaysian Family Life Survey, uses household data. He finds that couples using contraceptives had significantly higher life insurance and expected external, non-family source of income for old age. Cigno and Rosati (1996) and Cigno, Casolaro and Rosati (2003) use macro data but in a time series, not in cross section. They explain savings and fertility by social security coverage in Italy, Germany, the UK and the US. Their study is unique in that child benefits appear as control variables in their models.

In this paper we jointly estimate the fertility effects of backward and forward flowing intergenerational transfers, using a time series of Hungarian data between 1950 and 2004. Two main reasons drove us to choose Hungary and only Hungary for analysis. First, significant variations in the time series of both fertility and intergenerational transfers make the country perfectly suitable for empirical testing. Second, we were able to collect detailed expenditure data on family benefit system for Hungary and not for other countries. We also analyze birth order effects, albeit for a shorter period (1961-2004) due to data availability problems. The remainder of the paper is organized as follows. In the second section we introduce the data, the institutional background, and show some qualitative evidence. We discuss econometric problems and introduce the measurement model(s) in the third section. Section four contains the main results, while section five show the results by birth order. The last section concludes.

2. Trends in fertility, pensions and family benefits in Hungary

We measure fertility with the total fertility rate. The *TFR* is the most commonly used indicators of fertility and is defined as sum of age-specific birth rates calculated for the reproductive period of women. It expresses the number of children a woman would have if she went through her reproductive ages with age-specific birth rates characterizing that calendar year. It must be highlighted however, that *TFR* does not represent the fertility behavior of a real cohort, but of a hypothetical one, since it describes the patterns of one particular year. This index filters out the effects of changes in gender and age composition on the number of births. Using the total fertility rate as a dependent variable in similar models is wide spread in international literature. (e.g. Ekert-Jaffé, 1986; Gauthier and Hatzius, 1997; Zhang, Quan and Meerbergen, 1994)

GDP is used for normalization in studies dealing with the fertility effects of pensions and using time series data, while analyses of family benefits relies on more sophisticated indices. In order to have the same content of our explanatory variables, pension and family benefit expenditures are expressed relative to the GDP.[5] They operationalize intergenerational transfers flowing forward and backward among overlapping generations. Data used to construct the explanatory variables are mainly of the Hungarian Central Statistical Office. While expenditures on pensions were easy to collect, we had to use alternative sources (as publications of Ministry of Finance for example) to have a complete picture of the complex family benefit system.

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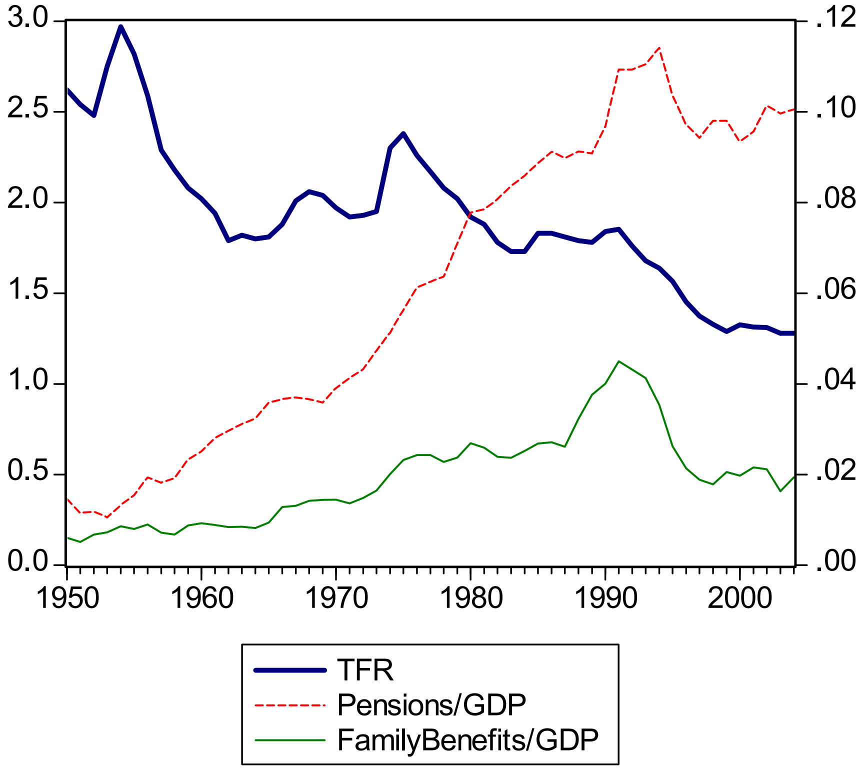
[5] Gábos (2003) used alternative specification of family benefits on Hungarian data.

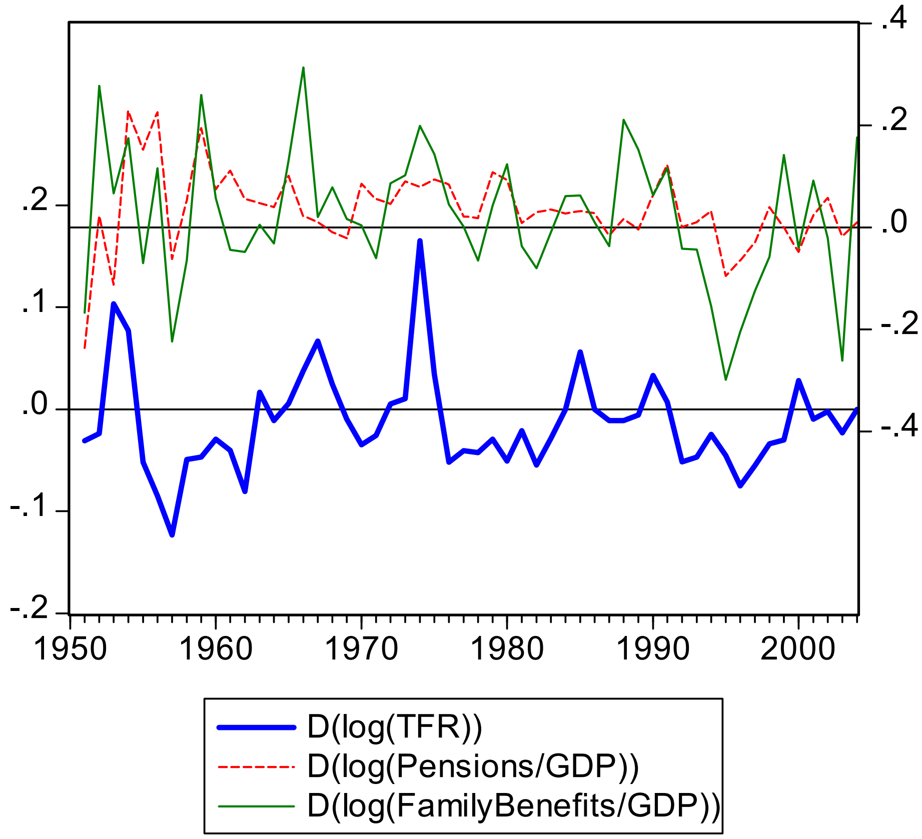
Figure 1.
Time series of Total Fertility Rate (TFR; left axis), Pensions/GDP and Family Benefits/GDP (right axis). Hungary. 1950-2004



Source: Hungarian Central Statistical Office.

Figure 1 shows the time series of fertility together with family benefits and pensions. The decline of Hungarian fertility in the second half of the 20th century has been more or less consistent. Besides the sheer slope of the trends, the most striking feature of Figure 1 is the opposite trends of fertility and pensions. Whether the two trends are linked in a causal way or not is probably impossible to tell. During our analysis, we shall concentrate on deviations from these trends. We can do so because another striking feature is the number of characteristic deviations in the series, some apparently temporary, others more persistent. In order to see those changes in a direct way, Figure 2 shows the same series in log differences.

Figure 2.
Log changes in Total Fertility Rate (TFR; left axis), Pensions/GDP and FamilyBenefits/GDP (right axis). Hungary. 1950-2004



Source: Hungarian Central Statistical Office.

The Hungarian funded pension scheme collapsed in World War II and in the inflation that followed. It was re-established in 1950 as a PAYG scheme. The pension rate basically stagnated from the re-start until the extension of eligibility in 1957 and it is only from then that stable growth began. The annual growth rate increased following the 1970 implementation of annual pension indexation. By the beginning of the 1980s the system has become mature and the growth of the pension rate slowed down. From the end of the 1980s, the beginning of the mass influx of those under retirement age, until the mid 1990s it again began to grow significantly. In 1995-1996 the pension rate fell sharply; since then it stagnates. Frequently, though not always, significant jumps in pensions coincide with drops in the total fertility rate.

Family benefits follow a weaker opposite trend before 1990 but not afterwards. The growth segments of the fertility series, five in number are linked to the important changes in the family benefit system. The first one, 1953-1955 coincides with strict abortion policies. The second stage, 1965-1969, contains the implementation of an extended childcare allowance in 1967. Stage three (1973-1975) coincided with the 1973 implementation of a complex population policy program, which contained yet another tightening of abortion practices. The package contained positive incentives such as significant housing support for couples with children and increasing the real value of cash family benefits. Stage four (1984-1985), although lasted only one year, more or less coincided with the introduction of yet another new form of support, the wages related child care fee in 1985. Compared to the previous stage, however, there is a significant difference. The growth period is not followed by an instant and relatively quick decrease, but rather by stagnation. Finally the last growth stage, 1988-1990, was preceded by a substantial increase of cash family related transfers, above all, child allowances.

Comparing growth periods of fertility and family policy suggests that family benefits may affect fertility. The picture is a bit less clear for pensions: the strong opposing trends may be connected in a causal way but the smaller changes in the pension system do not always coincide with significant changes in fertility. At least four reasons should make us cautious when interpreting these initial results. First, changes in family benefits and pensions are positively correlated: the correlation coefficient of log differences is 0.5. This is only in small part due to their common denominator as correlation of log differenced numerators is also at 0.4. In order to separate the effect of one, therefore, one obviously has to control for the other. Secondly, there are many variables that affect fertility and may be correlated with changes in either family benefits over GDP or pensions over GDP if only through their denominator. Disposable income and female employment are the most important but many others may be relevant as well. Third, changes in policy may be accompanied with elements not measured by our explanatory variables. One obvious example is the strict abortion regime of 1953-55 that also saw a slight increase in family benefits. But the 1973 policy package also included increased family benefits along with other elements that might have had a positive effect on fertility. Fourth, policy and fertility may be determined in a simultaneous way. Changes in family benefits may be results of policy reaction to recent changes in fertility. The measurement model to be presented below addresses all the above issues.

3. Measurement model

In this section, we outline the estimation strategy and the main results. According to Figure 1, all three variables are trending. Augmented Dickey-Fuller and Phillips-Perron tests cannot reject the null of unit root in each, indicating stochastic trends. The KPSS test also rejects the null of trend-stationarity in the case log pension over GDP and log family benefits over GDP, it cannot do so in case of log total fertility rate. There is no evidence for cointegration between the three variables (or any pair of two from tham).

Using log-differenced variables in the regressions is consistent with a model where families assume that expected pension and family allowance benefits follow a stochastic trend and deviations from trend are unpredictable. We shall run all of our models in log differences, but among the robustness checks, we also run everything on linearly detrended log fertility as a dependent variable.

We regress first difference of the log total fertility rate ($\Delta\ln TFR$) on its own lag(s), the lagged first difference of the rate of family benefits to GDP ($\Delta\ln FB$) and lagged first difference of the rate of pension expenditures to GDP ($\Delta\ln P$). Equation (1) shows the. As year t fertility is a result of decisions made at least 9 months earlier, only year t-1 or earlier changes in family benefit changes or pension can have a causal effect.

$$(1) \qquad \Delta \ln TFR_t = \alpha_0 + \sum_{s=1}^{S} \alpha_s \Delta \ln TFR_{t-s} + \sum_{s=1}^{S} \beta_s \Delta \ln FB_{t-s} + \sum_{s=1}^{S} \gamma_s \Delta \ln P_{t-s} + u_t$$

In our estimated models, at most first lags are going to be significant. Therefore, in practice, (1) simplifies to

$$(1a) \qquad \Delta \ln TFR_t = \alpha_0 + \alpha_1 \Delta \ln TFR_{t-1} + \beta_1 \Delta \ln FB_{t-1} + \gamma_1 \Delta \ln P_{t-1} + u_t$$

The interpretation of the coefficients is the following. A one per cent increase in family benefits is expected to lead to a β_1 per cent increase in fertility the next year. Similarly, one per cent increase in pensions is expected to lead to a γ_1 per cent increase in fertility the next year. Under the maintained assumption of unit root processes, the induced changes are permanent unless an opposite change in the right-hand side variables induces opposite effects. If changes in residual fertility are positively serially correlated, as they are in some of the estimated models, α_1 is significant positive. Long run effects of changes in family benefits and pensions may therefore be different from short-run effects. We therefore calculated long-run effects from each model in order to provide a better comparison across different models. Note that with α_1 close to or statistically indistinguishable from zero, long-run effects are very close to short-run effects. Based on model (1a), long-run effects of family benefits and pensions are the following:

$$(2) \qquad LE(FB) = \frac{\beta_1}{1-\alpha_1} \qquad LE(P) = \frac{\gamma_1}{1-\alpha_1}$$

Standard errors of the long-run effects can be estimated via the delta-method approximation:

$$(3) \qquad V\left[g\left(\hat{\boldsymbol{\theta}}\right)\right] \approx \nabla g\left(\boldsymbol{\theta}\right)'_{\boldsymbol{\theta}=\hat{\boldsymbol{\theta}}} V\left(\hat{\boldsymbol{\theta}}\right) \nabla g\left(\boldsymbol{\theta}\right)_{\boldsymbol{\theta}=\hat{\boldsymbol{\theta}}},$$

where $\hat{\boldsymbol{\theta}}$ is the vector of estimated coefficients, g is the function as defined in (2), ∇g its gradient (evaluated at the point estimates), and $V\left(\hat{\boldsymbol{\theta}}\right)$ is the variance-covariance matrix of the estimated coefficients.

As we already indicated, a major problem is whether we can give a causal interpretation to the estimated coefficients and the calculated long-run effects. We have no good instruments for either potentially endogenous right-hand side variable, but we have many proxies to account for potential omitted variables and even for simultaneity bias. In order to proxy for endogenous changes in policy, we can use year *t FB* and *P* variables as proxies for unobserved changes in fertility that might have occurred simultaneously with family benefit and pension changes:

$$(4) \quad \Delta \ln TFR_t = \alpha_0 + \alpha_1 \Delta \ln TFR_{t-1} + \beta_0 \Delta \ln FB_t + \beta_1 \Delta \ln FB_{t-1} + \gamma_0 \Delta \ln P_t + \gamma_1 \Delta \ln P_{t-1} + v_t$$

Since only lagged family benefit and pension changes can have causal effects, current changes are proxies for correlated unobservables. Therefore, the lagged effect estimates (β_1, β_2, etc, γ_1, γ_2, etc.) and the long-run effect estimates based on them are cleared of the endogeneity (provided current effects are perfect proxies). Even if they are imperfect proxies, including them in the equation reduces the potential bias from endogeneity. By looking at the differences of short-run and long-run effect estimates from models (3) versus (4), we can also get a sense of how severe simultaneity bias may be in the first place.

Omitted variables may induce bias in our estimates if they are correlated with our measures of family benefit or pension changes. One source of such a bias may stem from policy changes that included but were not restricted to family allowances. The periods of 1953-55 and 1973-75 experienced such policies as they included, among other measures, a tightening on abortion. We therefore also estimated our model with a dummy (ABORT) for the six years involved:

(5) $$\Delta \ln TFR_t = \alpha_0 + \alpha_1 \Delta \ln TFR_{t-1} + \beta_1 \Delta \ln FB_{t-1} + \gamma_1 \Delta \ln P_{t-1} + \lambda ABORT_t + w_t$$

There may other omitted variables that affect fertility and also the family benefit or the pension variables, either through their numerator or GDP. In order to proxy for omitted variables we use a set of potentially relevant control variables. The included controls are factors that may affect the fertility decision or GDP on their own rights, and therefore all correspond to year *t*-1. Moreover, since all controls are nonstationary themselves, they are entered in differences as well.

(6) $$\Delta \ln TFR_t = \alpha_0 + \alpha_1 \Delta \ln TFR_{t-1} + \beta_1 \Delta \ln FB_{t-1} + \gamma_1 \Delta \ln P_{t-1} + \lambda ABORT_t + \boldsymbol{\delta}' \Delta \mathbf{x}_{t-1} + \omega_t$$

The controls include disposable income, female employment rate and its squared value, infant mortality, and marriage rate. These variables are thought to have substantial effect on fertility, both on theoretical grounds and according to the previous empirical literature as we briefly reviewed in the introduction.

Finally, we also estimate a model with all proxies and other controls together:

(7)
$$\Delta \ln TFR_t = \alpha_0 + \alpha_1 \Delta \ln TFR_{t-1} + \beta_0 \Delta \ln FB_t + \beta_1 \Delta \ln FB_{t-1} + \gamma_0 \Delta \ln P_t + \gamma_1 \Delta \ln P_{t-1} + \lambda ABORT_t + \boldsymbol{\delta}' \Delta \mathbf{x}_{t-1} + \varepsilon_t$$

Recall that the time series in our sample run from 1950 to 2004. After differencing and taking into account that lags are used for the estimation, we are left with 53 observations. Given the relatively short time-series, the differenced nature of the series, and the relatively large number of parameters, any significant estimates indicate strong correlations. Small degrees of freedom are also likely to result in unstable results across specifications unless the underlying relationships are robust – or, in other words, finding robust estimates are a remarkable result given the relatively short time series.

4. Results for overall fertility

Table 1 shows the main results. It presents the estimated effect of family benefits and pensions for models (1) and (4) through (7). For comparison, it also shows estimates similar to (1) but family benefits and pensions entered separately. The estimates of the family benefits (*FB*) are positive significant at the 1% level in all specifications. Pension rate (*P*) has a significant negative effect in all specification, at 1% level except in specification (4) where it is significant at the 5% level. The magnitudes of long-run effects are also very similar in the different specifications. An exception is when we enter FB and P separately, which show the need for a joint estimation.

According to the point estimates, *one per cent increase in family benefits is associated with an approximate 0.2 per cent increase in total fertility in the long run*. At the same time, *one per cent increase in the pension rate is associated with an approximate 0.3 per cent decrease in total fertility in the long run*.

Table 1
Aggregate time-series estimates of the effect of family benefits over GDP (*FB*) and pensions (*P*) over GDP on the total fertility rate (*TFR*) next year.

	LHS: DlnTFR						
	specification						
	(1)	**(1')**	**(1")**	**(4)**	**(5)**	**(6)**	**(7)**
$DlnFB_{t-1}$	0.21	0.10		0.16	0.20	0.24	0.20
	[3.78]**	[1.94]+		[2.99]**	[3.88]**	[4.86]**	[4.06]**
$DlnP_{t-1}$	-0.29		-0.13	-0.21	-0.32	-0.37	-0.31
	[3.62]**		[1.68]+	[2.46]*	[4.10]**	[5.20]**	[4.10]**
Constant	Y	Y	Y	Y	Y	Y	Y
$DlnTFR_{t-1}$	Y	Y	Y	Y	Y	Y	Y
$DlnFB_t$ and $DlnP_t$				Y			Y
Special year dummies					Y	Y	Y
Other controls						Y	Y
Observations	53	53	53	53	53	53	53
R-squared	0.42	0.26	0.25	0.5	0.48	0.62	0.68
	Implied long-run effects						
DlnFB_1	0.26	0.15		0.20	0.22	0.22	0.18
DlnP_1	-0.37		-0.24	-0.26	-0.35	-0.34	-0.28

Absolute value of t statistics in brackets

+ significant at 10%; * significant at 5%; ** significant at 1%
Y – variable present in the equation

The model gives a relatively strong fit for a regression on first differences. The dynamic specification is also correct, as the tests indicate no remaining serial correlation after entering the once-lagged dependent variable. No further lags of the right-hand-side variables are significant either in any of the specifications. In fact, even the first lag of the *TFR* is insignificant except for the simplest models with family benefits and pensions entered separately. Long-run effects are therefore very close to the parameter estimates themselves. Looking at the long-run effects, we can see that the estimates slightly weaken when proxies are controlled for. The largest drops are due to controlling for contemporary changes in transfers (in order to proxy for simultaneity) or the 1953-56 and 1973-75 dummies (in order to control for more complex policy changes). But even these changes are weak.

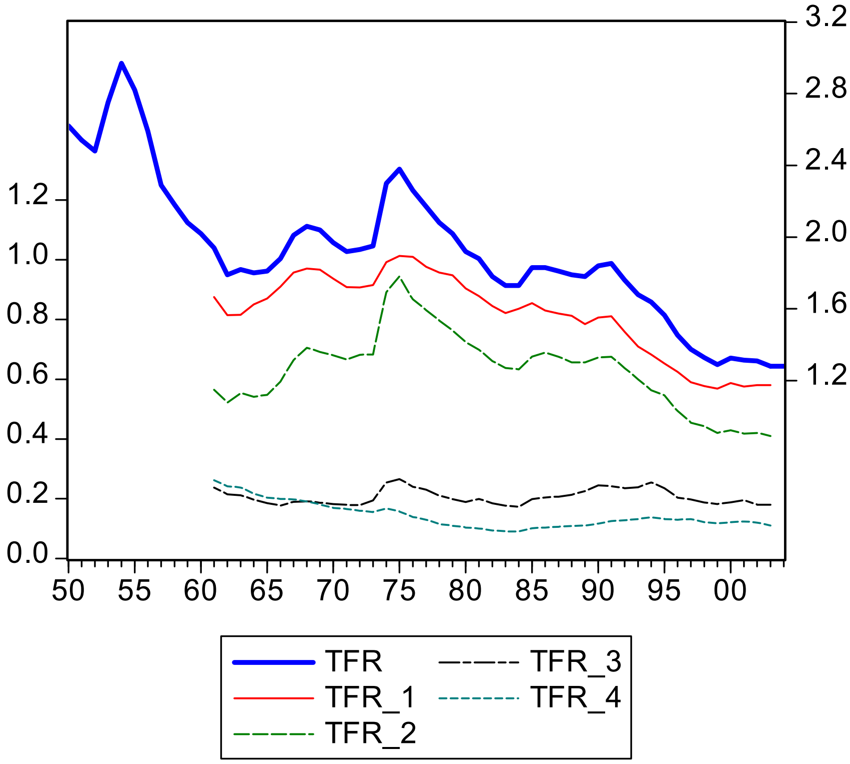
5. Results by birth order

Birth order total fertility rates exist by starting from year 1961 only. This way time series are not only shorter for these models, but they also exhibit less variation. Overall fertility trends are driven by the first and second births in Hungary during the period in analysis (Fig. 3.) More interestingly, third order TFR has a different pattern, showing fewer disturbances in the last four decades. After a pick in the middle of the 70's and a slight decrease during the next ten years, the third order TFR started to increase and reached similar values in the middle of 90's as twenty years earlier.

Estimation results for birth order effects are in Table 2. It presents the estimated effect of family benefits and pensions for models (1), (5) and (7). For comparison reasons, the model with the overall TFR as dependent variable was run for the same period. The estimates for family benefits (*FB*) belonging to model (1) are positive and significant at 1% level for all birth orders, excluding the fourth one. Controlling for complex policy changes (dummies for years 1953-55 and 1973-75) and for contemporary changes in transfers, results in weaker estimates for birth orders. However, estimated third birth effects are significant at 5% level in the last model as well. What is more striking, values of estimated coefficients increase from the first to the third birth for both models (5) and (7). While fourth birth effects of family benefits are present in the model (5) only, the pension system has negative effects for these births at 10% level and even at 5% level for specification (5). Due to this former model, pensions influenced third births as well during the period in analysis. Lower significance levels in birth order models compared to that analyzing overall fertility could be attributed partly to the relative shortness of these time series.

According to the point estimates of model (7), *the effects of both of family benefits and pensions tend to increase in magnitude by birth order. The increase seems to be smoother for family benefits, while the effect of pension to jumps after the second child. One per cent increase in family benefits is associated with an approximate 0.25 per cent increase in third order fertility rates*. At the same time, *one per cent increase in the pension rate is associated with an approximate 0.37 per cent decrease in fourth order fertility rates*.

Figure 3.
Total Fertility Rate (TFR; right axis) and TFR by birth order (left axis).
Hungary. 1962-2003



Source: Hungarian Central Statistical Office.

Table 2
Aggregate time-series estimates of the effect of family benefits over GDP (*FB*) and pensions (*P*) over GDP on birth order fertility rates (*TFR1_4+*) next year.

	DlnTFR (from 1962)	DlnTFR1	DlnTFR2	DlnTFR3	DlnTFR4+
$DlnFB_{t-1}$	0.16	0.16	0.29	0.35	0.13
	[2.69]*	[3.49]**	[3.21]**	[3.45]**	[1.57]
$DlnP_{t-1}$	-0.12	-0.10	-0.02	-0.27	-0.33
	[0.89]	[0.88]	[0.10]	[1.12]	[1.75]+
Constant	Y	Y	Y	Y	Y
$DlnFB_t$ and $DlnP_t$	Y	Y	Y	Y	Y
Observations	42	42	42	42	42
R-squared	0.4	0.25	0.25	0.24	0.09
$DlnFB_{t-1}$	0.16	0.10	0.21	0.26	0.14
	[2.98]**	[2.27]*	[2.42]*	[2.63]*	[1.70]+
$DlnP_{t-1}$	-0.13	-0.05	-0.04	-0.39	-0.42
	[1.07]	[0.55]	[0.19]	[1.87]+	[2.35]*
Constant	Y	Y	Y	Y	Y
53-55 & 73-75 dummies	Y	Y	Y	Y	Y
other controls	Y	Y	Y	Y	Y
Observations	42	42	42	42	42
R-squared	0.56	0.55	0.52	0.51	0.33
$DlnFB_{t-1}$	0.13	0.06	0.15	0.25	0.11
	[2.21]*	[1.47]	[1.72]+	[2.33]*	[1.25]
$DlnP_{t-1}$	-0.10	-0.05	0.02	-0.34	-0.37
	[0.80]	[0.51]	[0.10]	[1.50]	[1.98]+
Constant	Y	Y	Y	Y	Y
$DlnFB_t$ and $DlnP_t$	Y	Y	Y	Y	Y
53-55 & 73-75 dummies	Y	Y	Y	Y	Y
other controls	Y	Y	Y	Y	Y
Observations	42	42	42	42	42
R-squared	0.62	0.62	0.57	0.53	0.36

Absolute value of t statistics in brackets
+ significant at 10%; * significant at 5%; ** significant at 1%
Y – variable present in the equation

6. Conclusions

Building on a theoretical background of inter-linked intergenerational transfers, we tested the fertility effects of family benefits and pensions. GDP was used to normalize our explanatory variables. Both overall and birth order effects were analyzed.

We found a strong and robust effect of family benefits and pensions on overall fertility. Based on our estimates, changes in the expenditures on family benefits had a positive effect on the Hungarian fertility trends, while the expansion of pension system worked in the opposite direction. We also found that both type of intergenerational transfers affected, mostly (family benefits) or exclusively (pensions), the decisions on higher order births. Our results suggest that fertility behavior of Hungarians was not dominated by voluntary childlessness or by strong preferences towards one-child families during the last decades. The expansion of pension system resulted in the restriction of high order births, while this negative fertility effect was partly offset by maintaining a complex system of cash family benefits. As a final conclusion, we might state that our results are in line with the vast majority of findings presented in the related international literature.

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