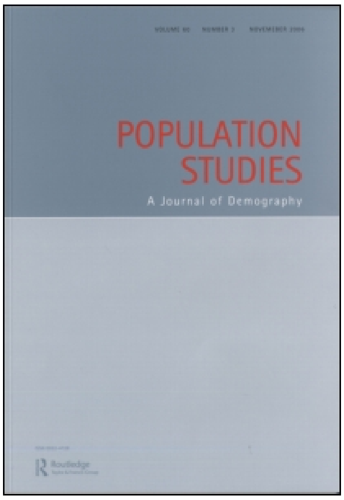

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The effects of child-related benefits and pensions on fertility by birth order: A test on Hungarian data

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The effects of child-related benefits and pensions on fertility by birth order: A test on Hungarian data

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Using aggregate time-series data from post-war Hungary, we investigated the effect of child-related benefits and pensions on overall fertility and fertility by birth order. The results indicate moderate effects that are robust across a wide range of specifications. According to our estimates, a 1-per-cent increase in child-related benefits would increase total fertility by 0.2 per cent, while the same increase in pensions would decrease fertility by 0.2 per cent. The magnitude of both effects increases by birth order; this is more robust for child-related benefits.

Keywords: fertility; birth order; child-related benefits; pensions; Hungary

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Introduction

There is a discrepancy between the consumption path and the income path of the life cycle. Whereas both the elderly and children—that is, people in the inactive period of the life cycle—consume goods and services, income is produced only in the active period. All societies reallocate resources across overlapping generations, from the active to children and the elderly (Lee 1994). In a traditional society, the institution organizing this chain is usually the extended family. In modern societies, extra-familial institutions take over many of the reallocating roles (Lee 2000). This historical shift creates a larger risk pool (Kotlikoff and Spivak 1981), facilitates the enforcement of intergenerational transfers, and offers insurance against unintended infertility (Sinn 2004). At the same time, different institutions for intergenerational transfers may provide different incentives for childbearing (see, for example, Cigno 1993; Sinn 2004).

In this paper, we contribute to the empirical evidence on the role of these incentives by presenting an investigation of the effects of extra-family institutions. Using time-series data from post-war Hungary, we jointly estimated the fertility effects of government-financed child-related benefits and pay-as-you-go (PAYG) pensions. We estimated the effects for fertility overall and by birth order. Before presenting results, we present the simple standard model of fertility that guided our enquiry. According to this model: (i) fertility is positively affected by child-related benefits and negatively affected by an expansion of the PAYG pension scheme; and (ii) the higher the number of children, the stronger the effects of both child-related benefits and pensions. In other words, the fertility response is predicted to increase with birth order.

Our empirical results show that child-related benefits do indeed positively affect fertility, and that pensions have a negative effect of a similar magnitude. A 1-per-cent increase in child-related benefits is estimated to increase total fertility by 0.2 per cent. The same increase in pensions is estimated to decrease fertility by 0.2 per cent. While the effect of pensions may seem somewhat surprising, our results are also robust to the inclusion of various proxies. The magnitude of both effects tends to increase with birth order, but this finding is more robust for child-related benefits. The effects by birth order provide additional support for our causal interpretation of the estimates.

The estimated effect of child-related benefits on total fertility is consistent with the findings of existing studies (for excellent reviews, see Gauthier and Hatzius 1997; Sleebos 2003; Björklund 2007). The finding that child-related benefits have stronger effects at higher birth orders is consistent with the results of Ermisch 1988, Kravdal 1996, and Oláh 1998. However, these results contradict those of Gauthier

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and Hatzius 1997, who find stronger estimated effects for the first birth than for subsequent ones.

Studies of the fertility effects of pensions are more fragmented. (For excellent reviews, see Nugent 1985; Nelissen and van den Akker 1988; Boldrin et al. 2005.) Most researchers analyse cross sections of different countries or regions within countries (see, for example, Hohm 1975; Nugent and Gillaspy 1983; Entwisle and Winegarden 1984; Galasso et al. 2008), although Jensen 1990 uses household data. Aggregate time-series studies include those of Cigno and Rosati 1996 and Cigno et al. 2003. These studies obtain results that are in line with ours. As far as we are aware, the fertility effects of pensions have not yet been analysed in terms of birth order.

Most empirical studies capture one-way intergenerational transfers, either child-related benefits or pensions, but there are well-established theoretical reasons for a joint investigation. The self-enforcing intergenerational constitutions proposed by Rangel 2003 and Cigno 2005 render fertility choices and the choice over forward-flowing transfers endogenous. Intergenerational constitutions are sets of rules that ensure the sustainability of the chain of intergenerational transfers by dictating the amount transferred from one generation to the other or by making $t+1$-period pensions depend on t-period transfers flowing to children. Van Groezen et al. 2003 and Fenge and Meier 2005 compare the effects of extending the PAYG pension system by incorporating a fertility-related component into the effects of introducing family allowances. Abío et al. 2004 make declining fertility endogenous by distinguishing between the labour of men and women. They show that a pension reform linking pensions to the number of children functions as a corrective tax and is able to restore both the optimal capital stock and the optimal rate of population growth.

The remainder of the paper is organized as follows. In Section 2, we present a simple theoretical model of the demand for children. In Section 3, we describe the data, the institutional background, trends in fertility and child-related benefits and pensions, and discuss the econometric issues arising from the use of time-series data. In Section 4, we report our regression results, first in relation to overall fertility, and then in relation to fertility by birth order.

Theoretical considerations

In this section we describe the simple theoretical model of the demand for children that guided our study. Using an established framework from the literature, we show that the fertility effect of an increase in child-related benefits is positive, that the effect of an expansion of the PAYG pension scheme is negative, and that the higher the number of children, the stronger are both effects. While the effect on the number of first births applies to families with low or high total demands for children, only families with high overall demands for children experience higher birth orders. Therefore, demand elasticities are larger at higher birth orders if these elasticities increase with the demand for children.

Our theoretical framework represents an extension of the model of Sinn 2004. Further extensions and alternatives are discussed briefly at the end of the section. In this model, a household of parents makes a forward-looking decision over two periods. In the first period, parents work and possibly raise children. In the second period, parents do not work, but their children do. Parents' consumption in the second period can be financed by savings from first-period earnings, by transfers from grown-up children raised in their household, or by PAYG pension benefits financed by all children (not only those raised in their own household). For a convenient normalization, Sinn 2004 used period-2 goods as the numeraire. This means that the price of first-period goods is R, which represents $1+$the interest rate on one unit of capital-market investment.

Raising children incurs an investment of H in the aggregate human capital of all the children in the family, which generates an overall return of $f(H)$. Children enjoy this return by working in the second period. It is assumed that returns are positive but decreasing ($f' > 0$, $f'' < 0$), and that they exceed returns on financial investments ($f'(H) > 1$) for a sufficiently low H. The model determines the level of investment in children in order for them to achieve an optimal combined level of earnings, with optimality being viewed from the parents' perspective. Both investment and children's earnings are defined in terms of aggregates, that is, as investment and earnings per child, respectively, multiplied by the number of children. Our empirical analysis focused on the number of children and ignored investment per child. Under reasonable assumptions, the number of children and total investment are positively related, and thus anything that increases the latter increases fertility. The intuition behind this result can be strengthened by assuming fixed investment requirements per child. However, this assumption is not consistent with the important trade-off between the quality and quantity of children; this trade-off is central to the human-capital-based literature on fertility (for standard references, see Becker 1960; Becker and Lewis 1973). While explicit modelling of the quality–quantity trade-off is beyond the scope of this paper, we note that the derived effects on human capital investment may overestimate the effects on fertility.

Parents are assumed to be altruistic in the sense that they care for their children's (combined) consumption as well as their own consumption. Making standard assumptions about the utility function implies a separation of the intertemporal decision (about how to allocate total parental consumption across two periods) and the decision about how much to invest in children's human capital H (and how much to leave for total parental consumption). We did not analyse the intertemporal decision and focused instead on the latter decision. Hence, the parents' joint utility function is $U(C_p, C_c)$: parents care about their own consumption (C_p) as well as their children's combined consumption (C_c).

Children's consumption is financed by their own earnings $f(H)$, net of the within-family transfer that children give to their parents (T). In a PAYG pension system, children's earnings are taxed, at the rate τ, to finance pensions provided to all old households:

$$C_c = (1-\tau)f(H) - T. \tag{1}$$

Parents face the following budget constraint:

$$C_p = W - H(1-b) + T + P \tag{2}$$

where W is total parents' earnings (net of taxes and including other endowments), b is government-financed child benefits, T represents transfers to parents from their own children, and P is PAYG pensions, all measured in period-2 prices. Child-related benefits are defined as a proportion of total investment in children. Empirically, such benefits are normally paid per child. In our framework, this applies only if per-child investments are fixed. Hence, our formulation represents a useful simplification.

Parents maximize their utility subject to constraints (1) and (2). The result of optimization is

$$f'(H)\frac{1-\tau}{1-b} = \frac{\partial U/\partial C_p}{\partial U/\partial C_c} = 1 \tag{3}$$

where the last equality follows from the fact that in this model, the marginal rate of investment in children equals the marginal rate of return on capital (with all values measured in period-2 prices). The optimal level of investment is determined by (3). It is instructive to express the demand for investment explicitly, as follows:

$$H^* = f'^{-1}\left(\frac{1-b}{1-\tau}\right) \equiv g\left(\frac{1-b}{1-\tau}\right) \tag{4}$$

where g is the inverse of the first derivative of f, in which case, $g > 0$ and $g' < 0$. Clearly, optimal investment is increasing in child benefits (b) and decreasing in the PAYG tax levied on grown-up children (τ). The intuition for the effect of child benefits is straightforward: these benefits lower the unit cost of investing in children. In this model, PAYG pensions reduce investment in children: PAYG pensions lower the returns on investing in children because children are taxed to finance parents' pensions. One can view this negative effect as being caused by the externalities arising from raising children who will then finance everyone's second-period consumption (Nugent 1985; Cigno and Rosati 1996); this introduces the effect of a moral hazard into insurance against involuntary childlessness (Sinn 2004).

An important purpose of our theoretical investigation was to derive implications by the number of children. In our model, the fertility effect depends on whether the effects of b and τ increase in magnitude with H^*. Given b and τ, heterogeneity in H^* can result from heterogeneity in the production function f: from the same level of investment, households may produce different numbers of children or exhibit differences in earnings per child.

It is instructive to consider the following simple parameterization of the production function f:

$$f(H) = aH^{\alpha} \tag{5}$$

with the technology parameters $a \geq a_{\min} > 0$ and $0 < \alpha < 1$ being heterogeneous across households. Clearly, this parameterization results in the required $f' > 0$ and $f'' < 0$. Moreover, an appropriate choice of $a_{\min}$ ensures that $f'(H) > 1$ for low levels of H.

Under this parameterization, households with higher values of a and α are more efficient in raising children and endowing them with the appropriate human capital, and for given values of b and τ, they will choose higher levels of investment. The easily derived optimal level of investment is

$$H^* = \left(a\alpha\frac{1-\tau}{1-b}\right)^{1/(1-\alpha)}$$

which is increasing in a, α, and b and decreasing in τ. Given the functional form of (5), the demand elasticities simplify to

$$\varepsilon_b \equiv \frac{\partial H}{\partial b}\frac{b}{H} = \frac{1}{1-\alpha}\frac{b}{1-b} > 0 \quad \text{and}$$

$$\varepsilon_\tau \equiv \frac{\partial H}{\partial \tau}\frac{\tau}{H} = -\frac{1}{1-\alpha}\frac{\tau}{1-\tau} < 0. \tag{6}$$

The higher is α, the stronger are the demand elasticities: the elasticity for child-related benefits is a positive function of α, whereas the elasticity for PAYG pensions is a negative function of α. Because higher levels of α correspond to higher levels of H, (6) implies that the increase in optimal investment induced by an increase in child-related benefits is greater for households in which investment is already high (because of their efficient child-raising technology). Analogously, the decrease in optimal investment induced by an expansion of the PAYG system is greater for households with higher investments. Because an increase (decrease) in optimal investment also means an increase (decrease) in the number of children by assumption, these results imply that the fertility effects are stronger for households with higher levels of fertility. As a result, from the above argument, at higher birth orders, one would expect the fertility effects of child benefits to be more positive and the fertility effects of an expansion of the PAYG system to be more negative.

In our model, which draws heavily on that of Sinn 2004, all effects operate through the decreasing returns to investment in children. The heterogeneity of the effects on the number of children is driven by heterogeneity in the decreasing returns. The combined earnings capacity of children affects parental decisions in two ways. The first operates through parental altruism, defined as a preference for children's consumption, and the second operates through the effect on parental consumption of enforceable transfers from children. If parental altruism were defined in terms of the number of children (as it is, for example, by Greenwood et al. 2005), or if there were no parental altruism (as assumed by Cigno 1993), taxes levied on children could affect parental decisions only through within-family transfers. Not only do PAYG pension taxes reduce children's budgetary scope for financing family transfers but also any expansion of the PAYG pension scheme may have a direct negative effect on the transfers themselves, given the size of the budget set. Such a mechanism is outlined by Cigno 1993. A sustainable family constitution requires children to transfer resources to their parents so that, when the children are old, they will be eligible to receive such transfers from their own children. When contributions to a PAYG pension system increase, grown-up children may decide to pay the same total amount but to increase the share of indirect payments. In this case, parents can expect a reduction in direct transfers from their children, which reduces the value of investing in children. With fertility effects operating through these alternative channels, and with a standard parameterization of the utility function, the fertility elasticities for child-related benefits and PAYG pension taxes can be expected to have the signs given in (6). Moreover, the elasticities can be expected to be larger in absolute magnitude for parents with higher fertility, also as in (6).

Trends in fertility, pensions, and child-related benefits in Hungary

We used aggregate time-series data on total fertility for Hungary from 1950 to 2006. Total fertility, which is the most commonly used indicator of fertility, is the sum of age-specific birth rates calculated for the reproductive period of women and thus filters out the effects of sex and age composition. Although variations in total fertility arise partly because of timing effects, analysing the effects of policy on completed fertility would require even longer time series (without structural breaks). For this reason, total fertility is most often used as the dependent variable (see, for example, Ekert-Jaffé 1986; Zhang et al. 1994; Gauthier and Hatzius 1997).

Figure 1 shows the time series of total fertility from 1950 to 2006, as well as the time series of total fertility by birth order. (Trends in fertility behaviour in Hungary have been analysed recently by Spéder and Kamarás 2008.) Total fertility in Hungary declined significantly from 2.6 in 1950 to 1.3 by 2006. Data on Hungary's fertility by birth order are available from 1961. The birth-order series indicates that during the period under analysis, Hungary's overall fertility trends were driven by first and second births, although third births followed similar trends. After peaking in the middle of the 1970s, fertility decreased slightly over the next 10 years. Third-order total fertility then increased, and by the middle of the 1990s, it had almost reached its level of 20 years earlier.

All fertility series exhibit trends. Because we used our regression models to estimate elasticities, we generated the natural logarithm of the total-fertility series. Unit root tests show that the fertility trends are stochastic (see the first two panels of Table A1 in the Appendix). The last panel of Table A1 in the Appendix shows that the log-differenced fertility series are stationary. Figure 2 displays the log-difference series. According to the figure, year-by-year relative changes in overall fertility are influenced by third-order and higher order birth rates as well. This justifies our analysis of the effects of policy changes on fertility by birth order.

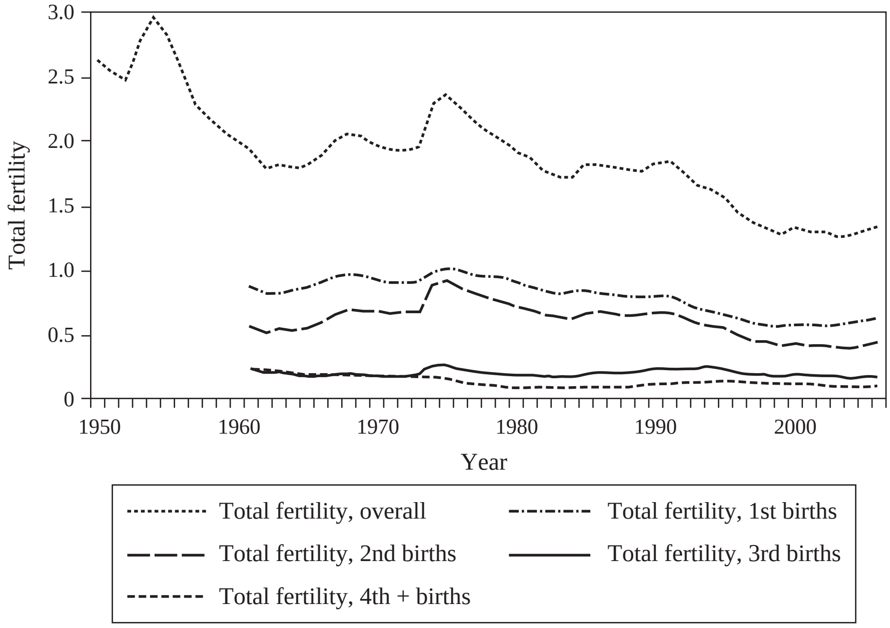

Figure 1 Total fertility, overall and by birth order, Hungary 1950/1961–2006
Source: Central Statistical Office

We constructed child-related benefit and pension series using data from the Central Statistical Office (CSO) and the Central Administration of the National Pension Insurance (CANPI) (Jurth 1987; CSO 1996, CSO various years; CANPI various years). Our explanatory variable for child-related benefits includes only cash transfers. This variable has a number of components. It includes family allowance (for the whole period) and tax relief (from 1989 to 1995 and since 1999), for which all children under the age of 16 and those older but still studying in secondary education are eligible. Several types of maternity benefits are also included. These comprise maternity allowance (effective for the whole period) and childcare fee (from 1985 to 1996 and since 2000), both of which are wage-related transfers. The former is given for the first 6 months after birth, and is followed by the latter paid until the child's second birthday. In addition, we included the following: childcare allowance (a fixed benefit for non-working women paid, from 1967, during the child's first 3 years); maternity grant (a lump-sum support that parents receive immediately after birth); and a special child-raising support (from 1993) for families with at least three children after the youngest child has reached age 3.

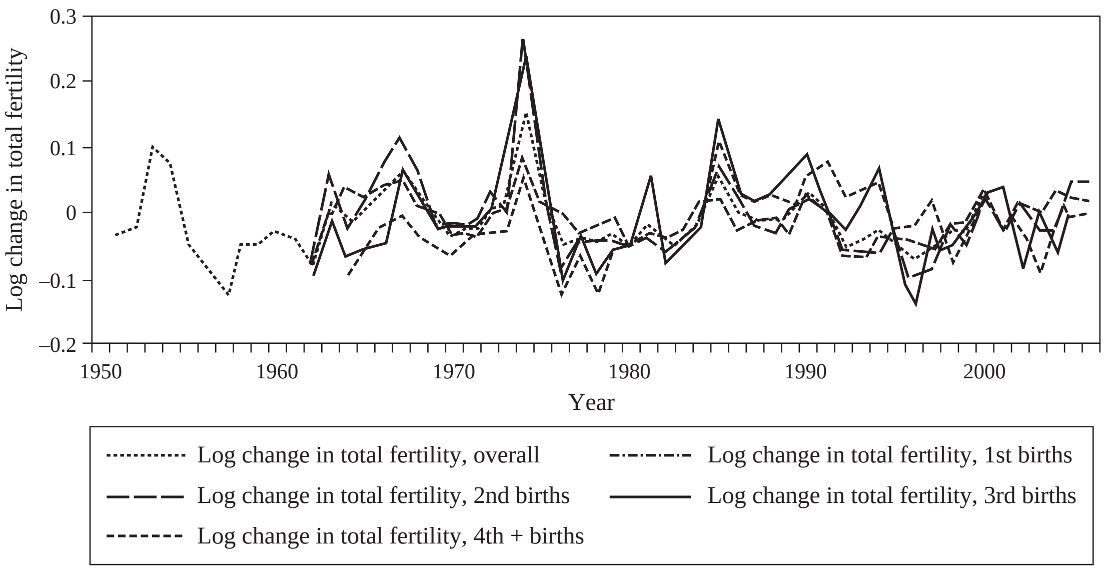

Figure 2 Log difference of total fertility, overall and by birth order, Hungary 1950/1961–2006
Source: As for Figure 1

Hungary's first funded national pension scheme collapsed in the period of the Second World War and the subsequent hyperinflation. By 1950 it had been re-established as a PAYG scheme. Relative pension expenditures stagnated from its inception until 1957, when eligibility was extended. The annual growth rate increased after 1970, when annual pension indexation was introduced. By the beginning of the 1980s the system had reached a high degree of maturity, and the growth of public pension expenditures relative to gross domestic product (GDP) (the pension rate) had slowed. Total pension expenditures stabilized during the transitional recession of the early 1990s. The pension rate fell sharply following the budget reforms of 1995–96, since when it has stagnated. To ensure consistency over time, our measures of pension benefits covered all pensions and other public retirement expenses financed by the national Pension Insurance Fund, including provisions by the fund for collective farmers, which was a separate entity until 1975. Thus, our time series covered all old-age benefits, disability benefits, and survivors' benefits.

For child-related benefits and pensions, we normalized the series by the population in the relevant age range: 0–18 for child-related benefits and, for pensions, above the retirement age. Retirement ages for women and men, respectively, were 55 and 60 years until 1998, and subsequently increased gradually to reach 62 years for men (in 2001) and 61 for women (in 2006). Both variables are defined in real terms, deflated by the consumer price index. Figure 3 shows the two series alongside the total-fertility series (also in logarithm). To facilitate comparisons, the series on child-related benefits and pensions were normalized to natural logs, the 1950 value of which was further normalized to zero.

Comparing trends in fertility and child-related benefit expenditure reveals two distinct subperiods. In the first, between 1950 and 1991, there were opposing trends: a decrease in fertility and a continuous expansion of the child-related benefit system. The downward trend in fertility was interrupted by two important, albeit short, growth periods—1953–55, 1973–76—both related to strict anti-abortion policies. The 1973 benefits package also incorporated positive incentives for childbearing, such as the provision of significant housing support and an increase in the real value of child-related cash benefits. Similar trends were evident in the second part of the period for both fertility and expenditure on child-related benefits. The mid-1990s saw a dramatic reduction in these benefits, followed by an accelerated decline in fertility. Since then, both child-related benefits and fertility have levelled off.

Like total fertility, child-related benefits and pensions follow stochastic trends. (The unit root test results are in Table A1 in the Appendix.) Our regression models include percentage deviations from these (stochastic) trends in the form of log differences (as is the case for total fertility). Figure 4 shows the series themselves together with the log-differenced fertility series.

The figures show substantial variations in year-to-year log changes. The tentative conclusions drawn from Figure 3 seem to be reinforced: many (but not all) jumps in fertility were preceded by similar jumps in child-related benefits, and some (but not all) decreases in fertility occurred around periods of increasing pension benefits. The 1950s experienced such episodes, as did later periods. The purpose of our regression analysis was to establish whether there were systematic relationships and whether such relationships were causal.

For our robustness checks, we controlled for infant mortality, the marriage rate, and the employment of women. For completeness, Table A1 in the Appendix shows the results of unit root tests on these variables, against the alternative of a deterministic trend. Whether these variables have unit roots is less clear than it is for our main variables. We also tested for co-integrating relationships among all forms of the dependent variable and child-related benefits and pensions, all in logs. The upper panel of Table A2 in the Appendix presents the results. We found evidence of a co-integrating relationship in one case only. We also carried out the co-integration test for all six variables used in the regressions. The results reported in the bottom panel of Table A2 indicate that there is a stationary linear combination among the six variables. Such a relationship calls for an alternative estimation strategy, which we discuss subsequently along with robustness checks on our main results.

Regression estimates

To capture the effects of child-related benefits and pensions on fertility, we estimated a series of regression models. In each of these models, the log change in total fertility is the left-hand-side variable. The right-hand-side variables are log changes in child-related benefits and pensions, both in real terms and normalized by the relevant population. Given the log–log specification, the estimated

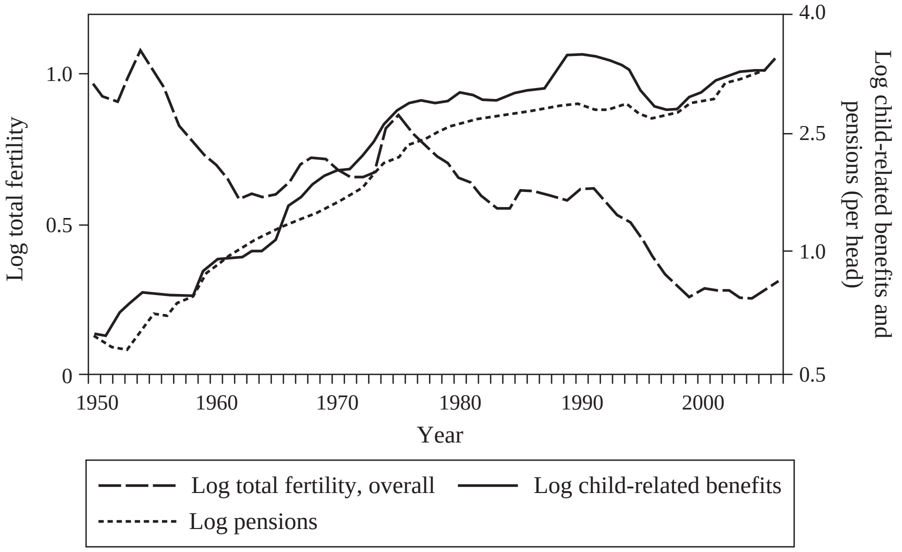

Figure 3 Child-related benefits and pensions, and total fertility, Hungary 1950–2006
Source: Central Statistical Office and Central Administration of National Pension Insurance

coefficients are elasticities. Many models include additional controls.

For our baseline model, we regressed the first difference of the log of total fertility ($\Delta\ln TFR$) on the lagged first difference of (logged) child-related benefits ($\Delta\ln B$) and pension benefits ($\Delta\ln P$). Lags were introduced because fertility in year t is the result of decisions made at least 9 months earlier; therefore, only changes in year $t-1$ or earlier in child-related benefits and pensions can have causal effects. Thus, our baseline model is

$$\Delta\ln TFR_t = \alpha + \beta\Delta\ln B_{t-1} + \gamma\Delta\ln P_{t-1} + u_t. \qquad (7)$$

In (7), because the slope coefficients represent elasticities, a 1-per-cent increase in child-related benefits is followed by a β-per-cent change in fertility in the subsequent year, on average; similarly, a 1-per-cent increase in pensions is followed by a γ-per-cent increase in fertility in the subsequent year. The log–log specification in differences is not only convenient for estimating elasticities, but it is also useful for generating normally distributed residuals.

All effects are identified as year-to-year changes in fertility in response to year-to-year changes in policy variables. Under the maintained assumption of unit root processes, both the observed policy changes and the induced fertility changes are permanent. The identification is therefore consistent with our theoretical model that incorporates rational and forward-looking parents. At the same time, for

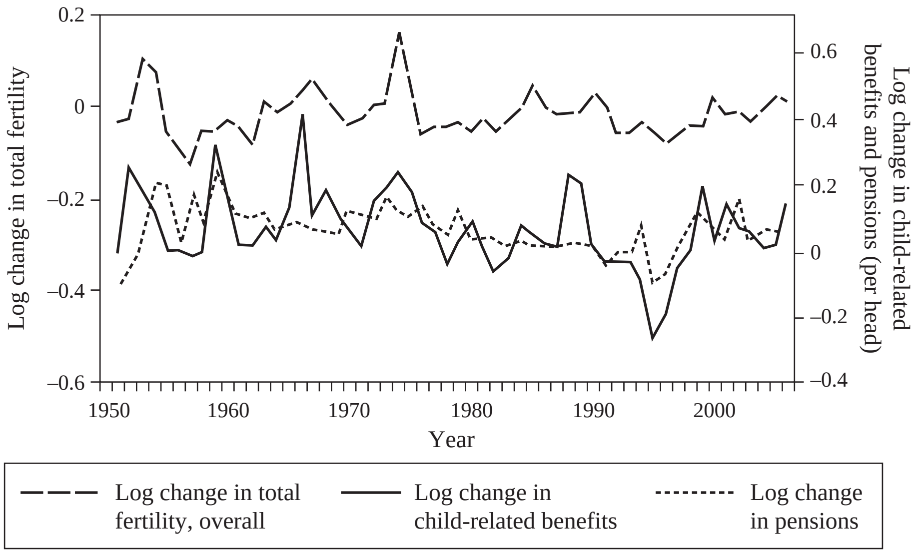

Figure 4 Log differences of child-related benefits and pensions, together with total fertility, Hungary 1950–2006
Source: As for Figure 3

current changes in the pension system to have effects on current fertility, parents need to be forward-looking to a greater extent than is required for changes in child-related benefits to have similar effects. Our results with respect to pensions should therefore be interpreted with more caution.

A potentially important problem with regression (7) is the possibility that policy and fertility may be simultaneously determined. In particular, changes in child-related benefits could represent policy responses to recent changes in fertility. They may be also caused by omitted variables that are also correlated with our policy variables. In the absence of good instruments for the potentially endogenous right-hand-side variables, we used B_{t+1} and P_{t+1} to proxy for potential omitted variables and simultaneity bias. Thus, our second regression takes the following form:

$$\Delta \ln TFR_t = \alpha + \beta \Delta \ln B_{t-1} + \gamma \Delta \ln P_{t-1} + \delta_1 \Delta \ln B_{t+1} + \delta_2 \Delta \ln P_{t+1} + v_t. \tag{8}$$

If future change in child-related benefits and pensions cannot have causal effects on current fertility, $\Delta \ln B_{t+1}$ and $\Delta \ln P_{t+1}$ can serve as proxy variables for correlated unobservables. While these proxies are likely to be imperfect, their inclusion reduces the bias in the causal estimates. If the estimates of β and γ from regressions (7) and (8) are similar, this would support a causal interpretation of these parameters. By the same argument, current changes in B and P may also serve as proxies. Treating the lead and contemporaneous policy variables as proxies for unobservables has an alternative. Since policy changes are typically known in advance, current and lead policy changes may themselves have a causal effect. In addition, current coefficients can capture some of the immediate fertility reaction that occurs within the same calendar year. We chose the more conservative approach and interpret only lagged coefficients as causal effects. To check for robustness, we present estimates based on t-dated proxies later in this section.

Another potential problem is that changes in child-related benefits (and perhaps pensions) may be accompanied by other policy changes excluded from our regressions. One obvious example is the abortion restrictions of 1953–55, which were accompanied by an increase in child-related benefits. Although the 1973 policy package did increase child-related benefits, it also introduced other changes that might have had a positive effect on fertility. Therefore, we also estimated a model that incorporated two dummy variables (D_{5355} and D_{7476}) to represent these two periods:

$$\Delta \ln TFR_t = \alpha + \beta \Delta \ln B_{t-1} + \gamma \Delta \ln P_{t-1} + \delta_1 \Delta \ln B_{t+1} + \delta_2 \Delta \ln P_{t+1} + \delta_3 D_{5355} + \delta_4 D_{7476} + w_t. \tag{9}$$

The results from the three regressions are presented in Table 1. Recall that our sample covers the period 1950–2006. First differencing and incorporating lags reduces the sample size to 54 annual observations.

Our first-difference models fit the data reasonably well. Our dynamic specification is supported by tests that indicate no residual serial correlation. The estimated effect of child-related benefits (B) is similar across the three models, decreasing from 0.27 in model (7) to 0.22 in model (9), and is significant at the 1-per-cent level. In addition, the estimated effect of pensions (P) is similar across specifications, ranging from -0.21 to -0.19, and being significant at the 5-per-cent level.

The coefficients for the proxy variables $\Delta \ln B_{t+1}$ and $\Delta \ln P_{t+1}$ indicate no evidence of systematic policy responses to recent changes in fertility. (For this, the coefficient for the former should be negative and that on the latter positive.) If anything, these coefficients suggest that fertility responds to expected policy changes, perhaps because policy changes were, to some extent, anticipated 2 years in advance. Therefore, the main coefficients of interest (those on $\Delta \ln B_{t-1}$ and $\Delta \ln P_{t-1}$) are likely to represent conservative estimates of the overall causal effects.

Our preferred regression is represented by model (9). These estimates are based on excluding changes in child-related benefits and pensions that occurred in the periods 1953–55 and 1974–76. Model (9) yields an elasticity of 0.2 for child-related benefits and one of -0.2 for PAYG pensions. For child benefits, the small standard error implies a 95-per-cent confidence interval of (0.12, 0.32). The effect of pensions is less precisely estimated, with a wider 95-per-cent confidence interval of (-0.35, -0.03). As already noted, behaviour must be extremely forward-looking for pensions to have an effect on fertility. Therefore, it is somewhat surprising that the estimated pension effects are similar in absolute magnitude to the estimated child-related benefit effects.

Our estimates from model (9) imply that of the fertility increases within the 1953–55 and 1974–76 periods (6 and 7 per cent, respectively), two-thirds remain unexplained by our policy variables (point estimates of 4 and 5 per cent, respectively). This

Table 1 Estimates of the effect of child-related benefits (B) and pensions (P) in a year on total fertility in the following year, Hungary 1950–2006. Aggregate time-series regressions estimated on log differences

	Model (7)	Model (8)	Model (9)
$\Delta \ln B_{t-1}$	0.27	0.26	0.22
	[0.05]***	[0.05]***	[0.05]***
$\Delta \ln P_{t-1}$	−0.21	−0.21	−0.19
	[0.08]**	[0.09]**	[0.08]**
$\Delta \ln B_{t+1}$		0.11	0.13
		[0.05]**	[0.05]**
$\Delta \ln P_{t+1}$		−0.05	−0.12
		[0.10]	[0.10]
D5355			0.04
			[0.02]*
D7476			0.05
			[0.02]**
Constant	−0.02	−0.02	−0.02
	[0.01]**	[0.01]**	[0.01]**
Observations	54	54	54
R-squared	0.37	0.43	0.50
Breusch–Godfrey Serial Correlation LM test			
Chi-squared	1.40	0.33	0.48
p-value	0.24	0.57	0.49

Notes: Aggregate Hungarian time series from 1950 to 2006. The data were compiled by the authors, with additional assistance from the Ministry of Finance of Hungary.
Left-hand-side variable: log difference of total fertility. B and P are government expenditures on child-related benefits and pensions, respectively, both normalized by the relevant population. Index $t-1$ denotes values in year $t-1$. Index $t+1$ denotes values in year $t+1$. D5355 and D7476 are dummies for years 1953 through 1955 and 1974 through 1976, respectively.
Standard errors in brackets. * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.
Source: Central Statistical Office and Central Administration of National Pension Insurance.

suggests that although increased cash transfers are not the only effective component of the complex policies adopted in these periods, they are nevertheless important.

Table 2 shows the results of additional robustness checks. The results in the first column indicate the effect of including infant mortality, the marriage rate, and the employment rate of women (all in lagged log differences). The results in the second column indicate the effect of allowing for feedback effects by including the first and second lags of (log-differenced) total fertility. Interestingly, the coefficient on the first lag indicates a weak (statistically insignificant) positive feedback, whereas that on the second lag indicates a modest but statistically significant negative feedback. At the bottom of each column of Table 2, we report point estimates of the long-run effects, which factor in the estimated feedback effects. In the third column, $\Delta \ln B_t$ and $\Delta \ln P_t$ are included (in addition to $\Delta \ln B_{t+1}$ and $\Delta \ln P_{t+1}$) to proxy endogenous effects. As we noted earlier, coefficients for the contemporaneous and lead coefficients may also represent causal effects because some of the immediate fertility reaction may show an effect within the same calendar year, and because the examined policy changes may have been anticipated.

In the first column, the additional control variables have plausible signs, but their inclusion does not greatly affect the main estimates. The second column shows that the long-run point estimates are only marginally smaller than the original estimates. The results in the third column show that including contemporaneous changes in child-related benefits and pensions does not materially affect the estimated coefficients of family benefits, but it does decrease the estimated pension effect. Note that the contemporaneous proxies are not statistically significant (the p-value of their F-test is 0.15), and their sign is more consistent with the causal interpretation. Within that interpretation, the overall effect of pensions remains significant since the coefficients of the lagged and contemporaneous pension variables are jointly significant (the p-value of their F-test is 0.03). In summary, the robustness checks largely reinforce our causal interpretation of the coefficients reported in Table 1.

As we indicated in the previous section, the six variables (those included in Table 2 except for the time dummies) may be co-integrated. If such a

Table 2 Additional regression estimates of the effect of child-related benefits (B) and pensions (P) in a year on total fertility in the following year, Hungary 1950–2006

	Additional controls	Feedback effects	Contemporaneous proxies
$\Delta\ln B_{t-1}$	0.23	0.21	0.19
	[0.05]***	[0.05]***	[0.05]***
$\Delta\ln P_{t-1}$	−0.18	−0.20	−0.11
	[0.09]*	[0.08]*	[0.09]
$\Delta\ln B_{t+1}$	0.13	0.14	0.1
	[0.05]**	[0.05]***	[0.05]*
$\Delta\ln P_{t+1}$	−0.13	−0.17	−0.11
	[0.11]	[0.10]	[0.10]
D5355	0.06	0.05	0.06
	[0.03]**	[0.03]*	[0.02]**
D7476	0.04	0.06	0.05
	[0.02]	[0.02]**	[0.02]**
$\Delta\ln infm_{t-1}$	0.18		
	[0.09]**		
$\Delta\ln marr_{t-1}$	0.11		
	[0.11]		
$\Delta\ln femp_{t-1}$	−0.26		
	[0.27]		
$\Delta\ln TFR_{t-1}$		0.16	
		[0.14]	
$\Delta\ln TFR_{t-2}$		−0.3	
		[0.12]**	
$\Delta\ln B_t$			0.09
			[0.06]
$\Delta\ln P_t$			−0.16
			[0.10]
Constant	−0.01	−0.02	−0.02
	[0.01]	[0.01]**	[0.01]**
Observations	54	53	54
R-squared	0.56	0.58	0.54
Long-run effects, $\Delta\ln B_{t-1}$		0.18	
Long-run effects, $\Delta\ln P_{t-1}$		−0.18	
Breusch–Godfrey Serial Correlation LM test			
Chi-squared	0.24	3.37	0.39
p-value	0.66	0.07	0.53

Notes: See Table 1.
Standard errors in brackets. * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.
Source: As for Table 1.

relationship exists, regressions on differenced variables are misspecified. Therefore, we re-estimated the baseline models including the appropriate error-correction term. Table A4 in the Appendix shows the results from two vector error-correction models (VECMs), one with one lag and another one with two lags. For each model, we report the results of the regressions in which fertility is the dependent variable. Because the first model might be dynamically misspecified (it barely passes the serial correlation test), we need to examine the results from the second (that is, two-lag) model as well. In the first VECM, the coefficients of child-related benefits and pensions are similar to those reported in Tables 1 and 2. In the two-lag model, it is the long-run effects that should be compared. The long-run effect of pensions is very similar to the previous result, and the effect of child-related benefits is only marginally weaker.

Besides the effects on overall fertility, we estimated the effects on fertility by birth order. The prediction of the model was that higher-order births should be more responsive to changes in child-related benefits and pensions. Table 3 reports the results for the baseline model (7). (The results from model (9) are practically the same.) Recall that because of data limitations, our analysis of fertility by birth order was limited to a shorter period (1961–2006). The first column of Table 3 reports the results for overall fertility for the same period.

Table 3 Aggregate time-series estimates of the effect of child-related benefits (B) and pensions (P) in a year on total fertility by birth order in the following year, Hungary 1961–2006

		Estimates by birth order			
	Estimates on overall fertility	1st	2nd	3rd	4th or higher
Δln *B*_1	0.21	0.15	0.26	0.32	0.14
	[0.05]***	[0.04]***	[0.08]***	[0.10]***	[0.07]*
Δln *P*_1	−0.20	0.09	0.17	−0.15	−0.58
	[0.08]**	[0.10]	[0.18]	[0.22]	[0.16]***
Constant	−0.02	−0.02	−0.03	−0.02	0.00
	[0.01]**	[0.01]***	[0.01]**	[0.01]	[0.01]
Observations	44	44	44	44	44
R-squared	0.58	0.34	0.33	0.22	0.24

Notes: See Table 1.
Standard errors in brackets. * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.
Source: As for Table 1.

The results in the first column suggest that although the overall effects of child benefits before and after 1961 are similar, the overall effects of pensions are weak after 1961. More importantly, however, the estimated elasticities by birth order are broadly consistent with our expectations. The fertility effect of child-related benefits is estimated to be 0.15 for the first birth, 0.25 for the second, 0.30 for the third, and 0.15 for fourth and higher order births. The results for pensions are more complicated. The estimated pension elasticities are insignificant for the first, second, and third births, whereas the elasticity for fourth and higher order births is −0.60.

The point estimates tend to increase in absolute magnitude by birth order. This finding is broadly consistent with the theoretical comparative static results by birth order from Section 2 and supportive of our causal interpretation of the main estimates. The increase seems to be smoother for child-related benefits; for pensions, the effect jumps after the third child.

Conclusions

In the study reported in this paper, we used Hungarian data to test the fertility effects of two opposing intergenerational transfer flows: government-financed child-related benefits and pay-as-you-go pensions. Our main explanatory variables were total public expenditure on child-related benefits and pensions, each measured in real values and normalized by the population of the affected age group. We estimated effects on overall fertility and by birth order.

We found evidence of moderate effects of child-related benefits and pensions on overall fertility. Our estimates indicate that changes in expenditure on child-related benefits have a positive effect on Hungarian fertility, whereas expansion of the pension system had the opposite effect. Our preferred estimates indicate that a 1-per-cent increase in child-related benefits would increase total fertility by 0.2 per cent, whereas a 1-per-cent increase in pensions would decrease fertility by 0.2 per cent. For pensions to have such an effect, couples would need to be forward-looking to a great extent. It is therefore somewhat surprising that pensions have an effect of similar magnitude to that of child benefit estimates. However, our estimates are robust to various changes in specification. They are also consistent with results reported in both the theoretical and empirical literature.

We also found that the estimated effects tend to be stronger for higher-order births. The effect of child-related benefits increases gradually until the fourth birth, after which its magnitude drops to the effect on first births. Pensions do not significantly affect the first three births but do so strongly thereafter. Our simple theoretical model implies that the elasticities with respect to child-related benefits and pensions should be stronger the more children a family already has. Our estimated effects by birth order are broadly consistent with this expectation and therefore support our causal interpretation of the estimates.

Our results are relevant to policy considerations but should be interpreted carefully. To illustrate the magnitude of the estimated effects, one can make the following back-of-the-envelope calculations. Total fertility in Hungary was 1.35 in 2006. In order to reach the replacement rate of 2.1 in that year, our estimates suggest that child-related benefits would need to increase by an implausibly large 280 per cent from 2004 to 2005, *ceteris paribus*. Even reaching the more modest rate of 1.6 (the demographic projections for 2025) would require an increase as large as 93 per cent. In addition, our estimates do not allow for the effect of optimizing the institutional arrangements for the Hungarian child benefit system, nor do they allow a comparison between the effectiveness of cash benefits and in-kind transfers.

Our results highlight the moderate, but important, role of child-related benefits in providing positive incentives for fertility. They also suggest that pay-as-you-go pensions have negative, albeit moderate, effects on fertility. Taken together, these results provide further evidence that different institutional arrangements for intergenerational transfers provide different incentives for fertility behaviour and that people do respond to such differences.

Notes

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Appendix

Table A1 Results of unit root tests for the stationarity of total-fertility series, Hungary 1950/1961–2006

	Levels			Logs			Log differences		
	Phillips–Perron[1]		KPSS[2]	Phillips–Perron[1]		KPSS[2]	Phillips–Perron[3]		KPSS[4]
	Test stat	*p*-value	Test stat	Test stat	*p*-value	Test stat	Test stat	*p*-value	Test stat
Total fertility (*TFR*)	−2.40	0.40	0.17	−2.20	0.49	0.17	−4.32	0.00	0.06
TFR, 1st birth order	−1.95	0.62	0.41	−1.89	0.66	0.30	−4.28	0.00	0.24
TFR, 2nd birth order	−1.84	0.69	0.44	−1.75	0.73	0.33	−4.78	0.00	0.31
TFR, 3rd birth order	−2.48	0.34	0.16	−2.44	0.36	0.12	−4.68	0.00	0.07
TFR, 4th birth order	−2.44	0.36	0.52	−1.70	0.75	0.34	−4.33	0.00	0.46
B (child-related benefits)	−2.17	0.51	0.27	−1.13	0.92	0.45	−4.76	0.00	0.45
P (pensions)	−1.38	0.87	0.17	−0.84	0.96	0.47	−5.14	0.00	0.57
Infant mortality	−3.78	0.02	0.52	−2.05	0.57	0.32	−9.14	0.00	0.09
Marriage rate	−3.45	0.05	0.36	−1.77	0.72	0.36	−9.96	0.00	0.12
Women's employment rate	−4.18	0.00	0.64	−2.19	0.49	0.44	−3.92	0.01	0.69

Notes: See Table 1.
[1]Phillips–Perron tests. *H0*: Random Walk with drift, *H1*: stationary process around linear trend. Lag order determined by the Newey–West selection process.
[2]Kwiatkowski–Phillips–Schmidt–Shin test for stationarity. *H0*: stationary process around linear trend, one lag allowed. Critical value at 5 per cent is 0.15; test statistics larger (smaller) than 0.15 are evidence against (for) trend-stationarity.
[3]Phillips–Perron tests. *H0*: Random Walk, *H1*: stationary process. Lag order determined by the Newey–West selection process.
[4]Kwiatkowski–Phillips–Schmidt–Shin test for stationarity. *H0*: stationary process, one lag allowed. Critical value at 5 per cent is 0.46; test statistics larger (smaller) than 0.46 are evidence against (for) stationarity.
Source: As for Table 1.

Table A2 Results of the Johansen co-integration tests, Hungary 1950/1961–2006

	Test statistics of different models[1]					
Maximum rank of the co-integration vector	*TFR* overall	*TFR* 1st order	*TFR* 2nd order	*TFR* 3rd order	*TFR* 4th+order	Critical value
3-variable model[2]						
0	31.6*	39.1	32.1*	23.2*	22.0*	34.6
1	13.6	17.5*	13.7	12.5	11.9	18.2
2	3.0	2.5	3.0	2.7	2.9	3.8
6-variable model[3]						
0	114.1	131.9	120.8	114.1	116.3	104.9
1	75.9*	83.8	82.1	75.2*	76.9*	77.7
2	45.2	50.7*	48.1*	49.1	49.6	77.7
3	26.6	24.9	23.2	24.7	24.1	54.6
4	14.0	9.2	9.7	13.6	12.7	34.5
5	4.4	1.9	1.7	6.2	5.0	3.7

[1]Each column corresponds to a model with a different fertility measure: overall *TFR* and *TFR* by birth order (see Section 3 for the details).
[2]The 3-variable model includes log(total fertility), log(child-related benefits), and log(pensions). Child-related benefits and pensions are normalized by the relevant population, see Section 3. The co-integration test allows for trend and two lags.
[3]The 6-variable model includes log(total fertility), log(child-related benefits), and log(pensions) (latter two normalized by the relevant population, see Section 3), log(infant mortality), log(marriage rate), and log(female employment rate). The co-integration test allows for trend and two lags.
*The implied rank of the co-integration vector. A rank of 0 implies no co-integrating relationship; a positive rank implies the existence of a co-integration relationship. A rank higher than one implies more than one linearly independent co-integration relationship.
Source: As for Table 1.

Table A3 Summary statistics for all variables used for analyses, Hungary 1950/1961–2006

	Levels			Log differences		
	Mean	Std	Obs	Mean	Std	Obs
Total fertility (*TFR*)	1.90	0.41	57	−0.011	0.048	55
TFR, 1st birth order	0.80	0.14	46	−0.008	0.034	45
TFR, 2nd birth order	0.62	0.14	46	−0.006	0.063	45
TFR, 3rd birth order	0.20	0.03	46	−0.007	0.071	45
TFR, 4th birth order	0.14	0.04	46	−0.019	0.051	45
Child-related benefits	0.0019	0.0013	57	0.063	0.117	55
Pensions	0.0075	0.0053	57	0.062	0.065	55
D5355	0.05	0.23	57	0.055	0.229	55
D7476	0.05	0.23	57	0.055	0.229	55
Infant mortality	30.5	20.7	57	−0.048	0.062	55
Marriage rate	7.61	2.16	57	−0.017	0.054	55
Women's employment rate	0.87	0.12	57	0.009	0.024	55

Notes: See Table 1.
Source: As for Table 1.

Table A4 Results of the error correction models. Left-hand side: total fertility; right-hand side: child-related benefits, pensions, infant mortality, marriage rate, and women's employment rate. Hungary 1950–2006

	One lag	Two lags
$\Delta \ln TFR_{t-1}$	0.17	0.13
	[0.12]	[0.14]
$\Delta \ln B_{t-1}$	0.23	0.23
	[0.06]***	[0.06]***
$\Delta \ln P_{t-1}$	−0.22	−0.06
	[0.09]***	[0.10]
$\Delta \ln infm_{t-1}$	0.14	0.04
	[0.09]*	[0.09]
$\Delta \ln marr_{t-1}$	0.20	0.37
	[0.11]*	[0.12]***
$\Delta \ln femp_{t-1}$	−0.06	−0.10
	[0.25]	[0.30]
$\Delta \ln TFR_{t-2}$		−0.34
		[0.12]***
$\Delta \ln B_{t-2}$		−0.01
		[0.07]
$\Delta \ln P_{t-2}$		−0.24
		[0.09]***
$\Delta \ln infm_{t-2}$		−0.01
		[0.08]
$\Delta \ln marr_{t-2}$		0.39
		[0.12]***
$\Delta \ln femp_{t-2}$		−0.08
		[0.27]
Error correction term$_{t-1}$	0.01	−0.02
	[0.4]	[0.5]
Constant	−0.00	0.00
	[0.01]	[0.01]
Observations	55	54
Long-run effects of $\Delta \ln B$[1]	0.27	0.16
Long-run effects of $\Delta \ln P$[2]	−0.26	−0.25
Lagrange-multiplier tests for serial correlation (*p*-values)		
Lag 1	0.06	0.28
Lag 2	0.55	0.31

Notes: See Table 1. All variables (except the error correction term) are entered as log differences. Standard errors in brackets. *significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.

[1]Calculated from the point estimates of the coefficients on $\Delta \ln B_{t-1}$ and $\Delta \ln TFR_{t-1}$ for the one-lag model and $\Delta \ln B_{t-1}$, $\Delta \ln B_{t-2}$, $\Delta \ln TFR_{t-1}$, and $\Delta \ln TFR_{t-2}$ for the two-lag model.

[2]Calculated from the point estimates of the coefficients on $\Delta \ln P_{t-1}$ and $\Delta \ln TFR_{t-1}$ for the one-lag model and $\Delta \ln P_{t-1}$, $\Delta \ln P_{t-2}$, $\Delta \ln TFR_{t-1}$, and $\Delta \ln TFR_{t-2}$ for the two-lag model.

Source: As for Table 1.