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SOCIAL SECURITY, SAVING AND FERTILITY[1]*

MIKKO PUHAKKA

Department of Economics, University of Oulu,
P.O. Box 4600, FIN-90014 Oulu, Finland;
email: mikko.puhakka@oulu.fi

and

MATTI VIREN

Department of Economics and the Public Choice Research Centre,
University of Turku, FIN-20014 Turku, Finland,
and
Bank of Finland, Box 160, FIN-00101 Helsinki, Finland;
email: matvir@utu.fi

We investigate the effect of government policies on fertility in a model where children are mainly seen as investment goods. To illustrate this effect we construct a simple overlapping generations economy in which households (parents) can invest both in children and financial assets. An introduction of the public social security system lowers the incentive to have children, i.e. fertility will be lower. This is an important negative externality. We test some of the model's basic implications using unique long historical panel data from 11 countries for the period 1750–2000. In addition, we use two additional, more recent, data sets to reinforce the empirical results obtained with historical data. These analyses show that there is a positive relationship between ageing and fertility if we control for the key determinants of fertility. By contrast, there is a strong negative relationship between (various indicators of) social security and fertility. Empirical evidence is found for the notion that child support increases fertility. (JEL: E21, E32)

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1. Introduction

The demographic structure in many Western economies are changing rapidly and quite substantially. Low fertility and longer expected lifetimes are causing these fundamental changes. In fact, ageing and fertility decline are currently considered to be important problems in Europe and many other industrialized economies. Moreover, the fact that they are usually regarded as "problems" may sound somewhat surprising because an increase in life-span should increase individual's lifetime utility and well-being.[2]

Typically, fertility is taken as given – at least from the point of view of government policies. The exogeneity assumption might be more accurate when it comes to ageing, but definitely not when it comes to fertility as we argue below. But how does fertility change? Obviously, changes in institutions and other variables such as incentives to have children affect fertility. Both historical data and cross-country comparisons show that there are, and have been, huge differences in fertility behavior.

To support our empirical work, we construct a simple two-period overlapping generations model with perfect foresight. This model is used to study the fertility behavior of households: whether to invest in children and/or in financial assets for the sake of old-age income. We construct our model along the lines developed first by Cigno (1993). It is worth emphasizing that we do not assume the number of children to be an argument in the utility function as some of the relevant literature does.[3] Our model is especially suitable for an analysis with long time series, and lets us see the fertility effects of publicly and privately provided social security. Consumers live for three periods, but take part in economic activity only when they are middle-aged and old.

We are assuming, as e.g. Ehrlich and Lui (1991), that there is a social compact between parents and children, i.e. children donate a private pension to their parents. Children are thus partly viewed as a vehicle for old age support. To what extent will the publicly provided social security system replace children as such a mechanism? An important theoretical issue in these models is, how to determine the intergenerational transfers between generations, more precisely, how to solve the level of private pension given by children to their parents without altruism. We do not address this issue in our model. Cigno (2006) develops this theme thoroughly.[4]

Cigno (1993) and Rosati (1996) argue that the public pension system reduces incentives to have children. Interestingly, Rosati ties his result to the degree of risk aversion of consumers. The negative effect is obtained with a high degree of risk aversion. Ehrlich and Lui (1998) also contend that social security system diminishes fertility. The same conclusion is drawn by Ehrlich and Kim (2005). Boldrin, De Nardi, and Jones (2005) demonstrate the effect of old-age pensions on fertility in two types of calibrated models. In a model based on Boldrin and Jones (2002) they show that the effect is quite large, but in a model based on Barro and Becker (1989) it actually is very small. Leroux and Pestieau (2011) build a model, where the public pension system emerges endogenously via a political system in a society, where traditional family ties are looser than before (a switch from traditional society to a modern world). In our model and empirical analysis we consider a direct causal link from public pensions to fertility.

In the empirical section, we test the basic implications of the theoretical model. In particular, we focus on the relationship between fertility and the pension system using several alternative measures for the pension/social security system. Unlike most studies, we have constructed long historical time series that covers several generations of the population. We try to control the

[2] *In Puhakka and Viren (2006) we provide a more descriptive and policy oriented view of these questions.*

[3] *This is not to say that the utility function approach is completely false. Rather, we want to emphasize the investment motive. For practical reasons, we do not incorporate both approaches into our model.*

[4] *If the middle-aged person's utility depends on his parents' utility, the optimum level of donation is quite straightforward to derive. This approach is followed e.g. by Boldrin and Jones (2002) and Boldrin, De Nardi and Jones (2005). Ehrlich and Lui (1991, 1998), and Ehrlich and Kim (2005) assume in turn that there is a social compact between children and parents in such a way that the level of transfers received by the old from their offspring is proportional to the offspring's labor earnings.*

other determinants (background variables) of fertility, such as income level, infant mortality and life expectancy. Obviously, the growth of the pension system is just a part of the growth of the welfare state. Thus, the results of the empirical analysis cannot fully discriminate between the effects of the pension system in the strict sense or the welfare state in general. Interestingly for our results, Sinn (2004) argues that public pay-as-you-go pension system may reduce parents' investment on their children's human capital. Although his model has exogenous population growth, this effect is quite similar to our result, where public pension system directly lowers fertility. He also demonstrates that the pay-as-you-go system always decreases welfare.

The analysis is additionally complicated by the fact that at least some indicators of the welfare state also include expenditures on various child support systems which influence fertility in quite a different way (and we are not always able to control various expenditure categories). In one of our data sets this distinction can be done. Nevertheless, our evidence might help in designing policies, which could have less harmful effects on labor supply (retirement age) and fertility. If our thesis is correct, it would be dangerous for governments to try to solve the ageing-related fiscal problems simply by raising taxes, since fertility decline might still accelerate further.

Using the German data Cigno, Casolaro and Rosati (2002/2003) have tested the effect of social security system on fertility. There is a negative effect, but they also point out that this effect jeopardizes the system's future by eroding the base of future contributions. Similarly, Galasso, Gatti and Profeta (2009) use cross-country data to find that the generosity of the public pensions system decreases fertility. They also show that fertility crucially depends on (some rather crude proxies of) the development of financial markets and thus availability of alternative ways of saving for the old age. Billari and Galasso (2010) use Italian data from pension reforms to evaluate the effect of pensions on fertility and also find sizeable negative effect.

We proceed as follows. In section 2 we describe our model and explore the effects of the social security on fertility. In section 3 we delve deeper into the determinants of fertility by studying empirically the effects of a set of variables on fertility. Finally, some conclusions are provided in section 4.

2. *Private Pensions and Social Security*

We consider an overlapping generations exchange economy with perfect foresight. In this economy consumers live for three periods, but they are economically active only in the middle and the last period of their lives: there are young, middle-aged and old people. Our model rules out the longevity issue, which is not a trivial one as seen later in the empirical applications. Due to endogenous fertility population growth rate is endogenous. Consumers born in period $t-1$ are able to reproduce at t. They choose the number of children (N_t^y). We denote by n_t the number of children per the total number of middle-aged persons, i.e. $n_t N_t^m = N_t^y$. We assume that everybody survives from the childhood to the middle age, and all the middle-aged will survive to the old age.

We compute the gross rate of population growth (N_t / N_{t-1}) as follows. The total number of people at t is

$$(1) \qquad N_t = N_t^y + N_t^m + N_t^o .$$

Given the assumptions above we have the following expressions: $N_t^y = n_t N_t^m$, $N_t^o = N_{t-1}^m$, and $N_t^m = n_{t-1} N_{t-1}^m$. Using these expressions the gross population growth rate is

$$(2) \qquad \frac{N_t}{N_{t-1}} = \frac{\left[1 + n_t + \frac{1}{n_{t-1}}\right] N_t^m}{\left[1 + n_{t-1} + \frac{1}{n_{t-2}}\right] N_{t-1}^m} .$$

Rearranging we get

$$(3) \qquad \frac{N_t}{N_{t-1}} = \frac{\left[(1 + n_t) n_{t-1} + 1\right] n_{t-2}}{\left[(1 + n_{t-1}) n_{t-2} + 1\right]} .$$

In the steady state (or in the balanced growth path) $N_t / N_{t-1} = n$.

The middle-aged person supplies a fraction of his time endowment for work and earns wage w_t per unit of time worked. The other fraction of person's time is used for rearing the children. Consumers are active for two periods. Their lifetime utility function is $u(c_1^t) + \beta\, u(c_2^t)$. $u(c)$ is assumed to be a strictly concave increasing function which fulfills the following Inada conditions: $\lim_{c\to 0} u'(c) = \infty$ and $\lim_{c\to\infty} u'(c) = 0$. $\beta = (1+\rho)^{-1}$, where ρ is the rate of time preference.

As e.g. in Ehrlich and Lui (1991) we assume that there exists a given family compact (or a family insurance arrangement) between the parents and their children. The amount given by the middle-aged to their elders is denoted by α. The cost of rearing and educating children is the following function: $v(n)$ with the assumptions: $v'(n) > 0$ and $v''(n) > 0$. The average cost of rearing children is $ac(n) \equiv v(n)/n$. Since $v(n)$ is a strictly convex function, the average cost is also an increasing function of n. From the point of view of the subsequent analysis this assumption is crucial. If we assumed that function $v(n)$ is linear, the rate of return from investment in children would be constant – as it is with investment in financial assets, and we would end up with a corner solution either in terms of n or s which does not accord well with empirical evidence. Hence, we have to adopt a more general formulation, but the problem is that we cannot easily say whether $v(n)$ is convex or concave. From the point of view of conventional time-allocation model it would be tempting to assume that it is concave. It is easy to see that in this case (in the same way as with the linear cost function) we would end up with the corner solution where the optimal family size is "infinite". That could be the case in some circumstances but it cannot really be considered a general solution.[5] Moreover, if $v(n)$ is concave we would end up with an implausible result that wages (income) increase fertility while the size of the private donation from children to parents decreases fertility!

An obvious solution for this dilemma would be to consider a case where the cost per child can be U-shaped. This shape could be motivated by arguing that there are either some fixed costs in raising children or there is a learning aspect in rearing and educating children, and hence "increasing returns to scale" with few children. But if the number of children is high, the average cost tends to increase because children may become an obstacle for accumulation of skills and full-time production work.[6]

We also assume that there is a pay-as-you-go social security system such that the benefit received in old age is financed by the lump-sum tax levied in the middle age. The system is thus balanced, and there is no need for government to float debt. τ_t is the tax on the middle-aged, and b_t the benefit received by the old in that period. The budget constraint for the social security system is thus

(4) $$N_t^m \tau_t = N_t^o b_t.$$

Since $N_t^o = N_{t-1}^m$, and $N_t^m = n_{t-1} N_{t-1}^m$, it follows that per old benefit can be expressed as

(5) $$b_t = \frac{N_t^m}{N_t^o}\tau_t = \frac{N_t^m}{N_{t-1}^m}\tau_t = \frac{n_{t-1}N_{t-1}^m}{N_{t-1}^m}\tau_t = n_{t-1}\tau_t.$$

With stationary policies we have $b = n\tau$. In addition to investment in children there is a possibility to invest in a private asset denoted by s_t.

We now consider the following decision problem

(P1) $$\max_{\{c_1^t, c_2^t, n_t, s_t\}} u(c_1^t) + \beta\, u(c_2^t)$$

s.t.

(i) $$c_1^t + s_t + \alpha = w_t\left[1 - v(n_t)\right] - \tau$$

(ii) $$c_2^t = \pi\alpha n_t + R_{t+1}s_t + b.$$

Note that leisure is discarded here, i.e. the time, which is not allocated to work, is allocated

[5] *If n goes to infinity all time is used in producing children which would bring consumption to zero (in the absence of credit markets). In such a case, one possible solution would be child-labor that would generate income in the first period and thus guarantee nonzero consumption.*

[6] *Keep in mind that here we have to interpret v from the point of view of an OG model, not from the point of view of simple time-allocation model. Although it may be true that $v''(n) < 0$, it may well be that the derivative of w with respect to n is indeed negative.*

to rearing children.[7] The first-order conditions are

$$\text{(6i)} \quad w_t v'(n_t) u'[w_t[1 - v(n_t)] - \alpha - s_t - \tau] = \alpha\beta u'[\alpha n_t + R_{t+1} s_t + b]$$

$$\text{(6ii)} \quad u'[w_t[1 - v(n_t)] - \alpha - s_t - \tau] = R_{t+1}\beta\, u'[\alpha n_t + R_{t+1} s_t + b].$$

These first-order conditions boil down to the arbitrage condition

$$\text{(7)} \quad \frac{\alpha}{w_t v'(n_t)} = R_{t+1}.$$

Note that this is the condition, which directly determines the choice of the optimal number of children. A straightforward total differentiation (without time subscripts) yields

$$\text{(8)} \quad v''(n)dn = \frac{d\alpha}{wR} - \frac{\alpha}{wR^2} dR - \frac{\alpha}{w^2 R} dw.$$

Thus we have $n_\alpha > 0$, $n_R < 0$, and $n_w < 0$. An increase in the private donation raises fertility, and increases in the interest factor and the wage rate decrease fertility.

The number of children is also affected by taxes and public pensions. Totally differentiating (6ii) we first get

$$\text{(9)} \quad [-wv'(n)u''(c_1) - \alpha R\beta u''(c_2)]dn = u''(c_1)d\tau + R\beta u''(c_2)db.$$

We denote $D = -wv'(n)u''(c_1) - \alpha R\beta u''(c_2) > 0$. We want to keep the budget, $b = n\tau$, balanced. Hence, we then need to have

$$\text{(10)} \quad db = \tau dn + nd\tau.$$

Using (10) in (9) we finally have

$$\text{(11)} \quad [D - \tau R\beta u''(c_2)]dn = [u''(c_1) + R\beta n u''(c_2)]d\tau.$$

Thus it can be easily seen that under balanced budget policy we have $n_\tau < 0$. Thus an increase in taxes, but keeping the budget balanced at the same time, will decrease fertility.

[7] *This assumption is not completely innocent e.g. from the point of view of empirical evidence. It is only that we do not want to introduce a separate labor supply (hours of work) decision to the model.*

3. The Empirical Effects of Some Key Variables on Fertility

In our empirical analysis, we want to see whether the data are consistent with the predictions of the effects of the perceived determinants of fertility discussed above. In particular, we test the notion that the growth of pensions, or more generally, social security depresses fertility. For that purpose we estimate simple linear models in which pension/social security is proxied with some alternative ways. The size of government is the first proxy. We also use the GDP share of government pension or social security expenditures as a measure of the social security variable. The most sophisticated variable is constructed by computing a "replacement ratio of pension benefits". On the basis of the theoretical analysis, we expect that social security has a negative effect on fertility. The role of social security is controlled by other determinants of fertility (income, education, infant mortality, structure of the economy and life expectancy). Thus, the estimating equation is of the form:

$$\text{(12)} \quad FER_{it} = a_{i0} + a_1 SS_{it} + a_2 EDU_{it} + a_3 IMR_{it} + a_4 OLD_{it} + a_5 GDP_{it} + u_{it}.$$

FER denotes fertility, *SS* a proxy for social security, *EDU* the level of education, *IMR* the infant mortality, *OLD* the share of old people (or alternatively a measure of life expectancy, *LIFE*) and *GDP* the level of per capita GDP, and u is the error term. In a sense, the decision variable n could be thought as the "effective" number of children who have been born and survived the birth. Hence, the higher is the expected infant mortality, the higher must the "nominal" birth rate be.

There might be some ambiguity with the control variables determining fertility. We already discussed the role of income or productivity on wages and found that the effect could in principle be positive or negative although – given our assumptions on $v(n)$ – we would expect that the sign of the effect ought to be negative. Similarly, we expect that education depresses investment in children basically because education provides an alternative investment mechanism comparable to investment in financial assets.[8] Intuitively, we might expect that longer life-expectancy makes the support that is provided by children more valuable. Thus, investment in children would give a higher rate of return. Therefore, ceteris paribus, there ought to be a positive relationship between life-expectancy and fertility. In the raw data, the relationship is just the opposite, but the reason is obvious. Life expectancy is highly correlated with income and all other indicators of economic development which in turn affect fertility. What we really need is the conditional effect of life-expectancy on fertility. That may be obtained only by using a proper multivariate model.

It is quite clear that the list of control variables could be more extensive. Such variables as religion, child labor and contraceptives, would be obvious candidates to a more extensive list of variables in the estimating equation. It is only that they represent quite difficult data problems especially for our long time series model. Moreover, previous studies suggest that their role has not been very robust over time.[9]

In our empirical analyses we have used three data sets. First, we use historical data from 11 countries for the period 1860–2000. These data have a lot of variation in all the basic determinants of fertility (social security, education, life expectancy, infant mortality and income). In this respect the data are "better" than the more recent data where – at least in the developed countries – relatively little time-variation can be found in these variables. It is also clear that fertility decisions represent long-run investments in which the relevant period is much longer than one quarter or one year. Obviously, the quality of the old data may be poor and sample sizes small (the historical data represent five – in some cases ten-year – intervals). The main data source is Mitchell (2007), although several national data sources are also utilized.[10]

In addition to these historical data we also use two other data sets mainly to get more data coverage and more precise measures of the pension and child support variables. In the first place, we use the World Development Indicators (WDI) data that cover the period 1960–2004. The data include practically all the countries in the world and the number of data points is up to 3,500. Finally, we use the MZES (Mannheimer Zentrum fur Europäische Sozialforschung) data on social security expenditures which include separately pension expenditures and child support expenditures. The MZES data cover the period 1949–1993 for 21 European countries.[11] One advantage of the data is the fact that various social security expenditure categories can be distinguished so that we could, for instance, compare the effect of pension expenditures and total social security expenditures. Both variables are expressed in per capita terms: the respective expenditures are divided by the number of beneficiaries and GDP by mid-year population. Thus they reflect some sort of replacement rates. They are used in the context of equation (12) to facilitate comparison with relationships between fertility and cruder proxies of pensions and social security.

The results are reported below in the following fashion. The relationship between fertility and its potential determinants are illustrated with subsequent scatter diagrams (Figures 1). The estimation results with the alternative data sets are reported in Tables 1–4. All reported estimation results represent models in which all the coefficients are restricted to be equal for all countries in the panel (for a test of this restriction, see footnote 12).

[8] *In the theoretical model we did not consider education explicitly because it would complicate the model a lot. On the other hand, education is to a large extent a choice variable for the household. At least it is closer to social security than investment in children or investment in financial assets.*

[9] *It would be useful to have data on children's donations to parents but these data are typically not collected. We have only some data on children who engage in full-time nursing of their parents (and get some compensation for that). In Finland, the number of those cases is about 10,000 (Care by close relatives in Finland, 2008).*

[10] *The long time series of the fertility rate have been constructed by dividing the number of births with the female age cohorts of 15–49. With the WDI and MZES data, the usual fertility measure is used.*

[11] *The data base also includes two countries (Slovakia and Czech Republic) which are not included in our sample because they have only 3 observations (including those would not, however, make any difference). Total number of observations is 796.*

In general, the results are well in accordance with the predictions of the theoretical model. In particular, this is true with the pension/social security variables. Starting from Table 1, we see that income and education have a negative effect on fertility as predicted. Infant mortality, in turn, has a positive effect. As pointed out earlier, this means that higher values of infant mortality reduce the "effective" fertility rate and the "target levels" of fertility can be achieved only with higher "nominal" fertility rates. The role of life expectancy (or the share of old people, OLD) is somewhat ambiguous. In fact, the relationship appears to be nonlinear (see the squared term of OLD in equations 1–5) so that with very large values of this variable the fertility effect is positive. By contrast, the role of the government size (or social security) looks quite systematically negative: the bigger the government, the lower the fertility rate. Obviously, the size of government is a very rough measure of pensions but we have to keep in mind that the relevant variable does not only include pensions in the form of cash but also all health care and nursing services that are provided to pensioners. One may assume that the growth of government (the welfare state) to a large extent reflects just expenses from these activities. The general flavor of the empirical results does not change if we carry out stability analysis by reducing the sample period (see equations 6' and 6" in Table 1). Thus, we find again that the coefficient of government size is negative, the coefficient of infant mortality positive and the coefficient of life expectancy somewhat ambiguous. In a linear model, the sign is negative if other control variables are not introduced, but positive otherwise.

Obviously, there are measurement problems with the government size and the social security variables. Bigger government might just reflect more bureaucracy or more government interventions in the economy. It might also simply reflect wars or other similar events and not just better social security. Finally, social security may also have some conflicting effects on fertility. Higher benefits may encourage people to get married and have children because of easier access to supported housing, child care and other social benefits. Thus, it is useful to revisit the analyses with more precise measures of the pension system.

The much larger, but also much shorter, data from the World Bank WDI data bank (Table 2), point to the same direction as the long historical data. With the shorter data we can experiment with different indicators of the government size and a larger set of control variables. Thus, we use taxes, expenditures or public consumption as proxies for the size of government. The WDI data bank also includes some data on pensions but these data only cover a few years/countries. Nevertheless, the three alternative measures of government size are negatively related to fertility irrespective of the inclusion of different control variables. The gross tax rate seems to have most explanatory power. That might follow from the fact that total expenditures include military expenditures which may have a quite different – although negative – effect on fertility (cf. equation 7 in Table 3). The role of per capita GDP becomes somewhat ambiguous if more control variables (like life expectancy and the literacy rate) are included. Obviously, this reflects the close relationship of these variables in global cross-country data.

Finally, we turn to the results with the MZES data (Tables 3). The data, even though smaller than the WDI data, have the advantage of containing more precise indicators for pension and social security expenditures and containing also data on child support.[12] Therefore, it is useful to find out that the results again point to the same direction as the data sets with much cruder measures of pension benefits. With the MZES data, we have constructed replacement ratio measures for pension and child support expenditures. That was done by using expenditures from the MZES data and dividing these by the respective number of pensioners and children, and finally, dividing these per capita numbers by per capita GDP. The data are illustrated in Figure 2. A dominant feature in the figure is the great fall in the fertility rate in the 1970s and an almost simultaneous increase in the relative level of pension benefits. With child care expenditures, changes have been much smaller and they do not seem to provide an immediate expla-

[12] *Unfortunately, the data have not been updated.*

nation for changes in the fertility rates. One has also to keep in mind that child support expenditures also reflect changes in fertility (most likely with a lag). Thus, large drops in fertility rates – such that took place in the 1970s – put pressure on child allowances and other child support expenditures.

It is not surprising that the Granger causality tests between the fertility rate and the child support replacement rate are not significant. By contrast, we can clearly reject the hypothesis that pension expenditures (pension replacement rate) do not Granger cause fertility (the marginal significance level p = 0.004) while the opposite hypothesis cannot be rejected (p = 0.334). This does not, of course, rule out the "reverse causality" possibility because we cannot control expectations and government plans, for instance. One caveat should, however, be put forward here. The individual country coefficients of the pension variable appear to be somewhat different (the null hypothesis of equal coefficients can be rejected at the 5 per cent level even though the difference in explanatory power is quite marginal). The results of the bi-variate causality tests do not exclude the possibility that changes in social security and fertility are determined by some other variables like attitudes or cultural factors.

Results from empirical analyses with these new values are reported in Table 3. The message of the table is quite clear: higher pensions lower fertility. The coefficient of the corresponding variable PENSION/Y is always negative and it can be estimated quite precisely. A change in the general income level (GDP per capita) has also a negative effect while child support expenditures (CHILD/Y) have an opposite effect. With the latter result we have a caveat due to relative large confidence intervals so that we can only be pretty sure of the sign of the effect but not of the exact magnitude. The important thing is that the results are quite similar to those in Tables 1 and 2 suggesting that our cruder measures point to the right direction.

Finally, we made an attempt to test the substitutability of fertility (or, in more precise terms, investment in children) and saving in the national accounts' sense. The test is done simply by introducing the household saving rate to our basic specification (presented in Table 3). Alternatively, we introduce the real interest rate as a proxy for the rate of return from alternative investments (alternatives to investment in children). The saving rate is obviously endogenous and estimation may only be done by the IV (or GMM) estimator. The whole idea is to see whether saving does indeed have an offsetting effect on fertility. The estimating results using the MZES data for other variables are reported in Table 4. These results seem to support the notion that investment in children and investment in financial assets are indeed substitutes. Thus, household saving has negative effect on fertility and similarly the (real) interest rate tends to depress fertility.[13]

There are some caveats, however, which may stem from the fact that the coefficients of the replacement ratios cannot be precisely estimated. This might reflect the fact that the simultaneity problem cannot be solved completely. In some cases, the coefficient of the child support variable even has the wrong sign. We find that even in this "testing equation" fertility seems to react as expected to relevant economic variables.

4. Concluding remarks

Our paper is based on the view that fertility behavior is analogous to investment in human capital and physical assets. Although the planning horizon of investors is quite long, fertility behavior is not exogenous. Quite clearly it depends on the menu of investment alternatives and the respective returns. Government expenditures on social security constitute the key element, which affects the rate of return on investment in children. Increased tax-financed social security lowers the rate of return from investment in children by diminishing the need from old-age support from children. Empirical evidence seems to be consistent with this conclusion. This result has potentially powerful policy implications. Attempts to improve old-age sup-

[13] *These results are in accordance with Galasso, Gatti and Profeta (2009), even though they do not use rates of return, but instead use domestic credit as the indicator for credit market opportunities.*

port may lead to a deterioration of fertility and in turn to worsening of the dependency ratios (and hence also the "demographic dividend") and government finances unless some balancing actions are made in terms of child support or, more generally, profitability of investment in children. Due to this fertility externality public pension programs are more expensive than generally understood and would require accompanying elements of e.g. boosting labor supply. A more immediate implication of the analysis is the conclusion that analyses which focus on the various long-term issues such as fiscal sustainability should not be carried out with the assumption of exogenous fertility.

If investment in human capital (children) were included in aggregate investment and saving, the result would greatly deviate from the System of National Accounts (SNA) values. The problem is that, opposite to financial saving, no official data are available on this form of saving. One may only guess that the magnitude of saving in the form of children is far from trivial. In many countries saving and fertility seem to behave in a similar way which re-enforces the total effect.[14] Thus, recent developments in developed countries have produced an intolerable combination of high pension expenditures and low saving and low fertility.

[14] *See Figure 3 which illustrates the case of Finland. In the 1950's Finland used to have an exceptionally high saving rate, but more recently the saving rates have been close to zero. Similarly, fertility has decreased quite a lot since the 1950's. Obviously, the social security effect could explain the fall in both saving and fertility (cf. e.g. the classic paper of Feldstein (1974)).*

Table 1. Results with the historical data for 1860–2000

	1	2	3	4	5	6	6'	6"	7
GDP	–.009	–.007	–.009	–.016	–.014	–.007	–.006	–.010	–.007
	(3.24)	(2.82	(3.24)	(6.23)	(7.12)	(2.93)	(1.75)	(3.66)	(2.75)
GOV	–.035	–.024	–.030	–.070	–.031	–.025	–.050	–.045	–.048
	(1.72)	(1.90)	(1.55)	(4.54)	(1.94)	(1.18)	(1.62)	(2.22)	(2.43)
EDU	–.029	–.010	–.029			–.033	–.049	–.048	–.035
	(2.50)	(1.17)	(2.51)			(3.10)	(3.25)	(3.94)	(3.25)
IMR	.018	.012	.018			.023	.025	.019	–..019
	(3.48)	(3.31)	(3.48)			(5.36)	(3.50)	(3.83)	(4.36)
OLD	–.005	–.010	–.005	–.0.11	–.013	–.037	–.032	.080	–.013
	(1.99)	(5.10)	(2.08)	(6.46)	(6.83)	(0.52)	(2.51)	(0.88)	(0.18)
OLD^2	.017	.032	.018	.045	.048				
	(1.87)	(3.77)	(1.90)	(6.34)	(6.03)				
WAR			–.005						
			(0.88)						
N	181	181	181	194	194	181	104	148	168
R^2	0.825	0.792	0.844	0.834	0.788	0.873	0.712	0.8126	0.842
SEE	0.023	0.013	0.013	0.014	0.014	0.13	0.015	0.014	0.012
Test	1.98	17.02	1.96	2.16	..	2.98	3.75	3.23	2.64
	(0.039)	(0.009)	(0.041)	(0.022)		(0.001)	(0.000)	(0.001)	(0.007)
Effects	FE	RE	FE	FE	RE	FE	FE	FE	FE
Sample	2000	2000	2000	2000	2000	2000	1965	1985	2000

Notes: Corrected t-ratios are in parentheses. All estimates are panel GLS estimates. Equation 7 excludes Japan. Sample indicates the last year of the sample period; the first year is always 1850. FE indicates the (cross-section) fixed effects model and RE the (cross-section) random effects model. Tests denote the corresponding fixed effects test (implying that all cross-section effects are zero) or the Hausman specification test for the orthogonality of cross-section error terms and the RHS variables. GDP denotes (log) per capita GDP in fixed US dollars and IMR infant mortality rate. Government size (GOV) is measured by government expenditures/GDP and EDU by participation to primary education. OLD denotes the share of old (more than 65 years of age) people out of total population and WAR is a dummy for war years.

Table 2. Results with the WDI data

	1	2	3	4	5	6	7	8
GDP	–.835	–.720	–.780	–1.191	–1.068	.202	.257	.176
	(103.08)	(77.20)	(68.49)	(26.79)	(30.25	(3.85)	(2.18)	(6.16)
GOV	–.005	–.022	–.010	–.019	–.018	–.020	–.008	–.027
	(2.69)	(21.49)	(12.93)	(4.75)	(4.62)	(5.39)	(4.69)	(8.64)
LIFE						–.114	–.080	–.073
						(13.16)	(5.15)	(10.37)
LIT						–.036	–.071	–.019
						(11.15)	(7.68)	(6.99)
IMR								.012
								(7.41)
MIL								–.152
								(9.19)
R^2	0.801	0.844	0.801	0.871	0.381	0.793	0.962	0.984
SEE	1.290	1.455	1.290	0.692	0.703	0.917	0.392	0.642
Test	..			37.56	30.97	..	31.17	
				(0.000)	(0.000)		(0.000)	
N	2523	1534	1528	2523	2533	685	685	135
Estimator	GLS	GLS	GLS	GLS	GLS	GLS	OLS	GLS
Effects	none	none	none	FE	RE	none	FE	none
GOV	GQ	TAX	EXP	GQ	GQ	TAX	TAX	TAX

Notes: GQ denotes public consumption/GDP, EXP total government expenditure/GDP and TAX gross tax returns/GDP. LIT denotes adult literacy rate, LIFE life expectancy at birth, IMR the infant mortality rate and MIL military expenditures/GDP. Otherwise, the notation is the same as in Table 1. The number of countries is 150 and the number of data points 1,525.

Table 3. Estimation results with MZES data

	1	2	3	4	5	6	7
GDP	–.451	–.002	–.002	–.002	–.002	–.002	–.020
	(23.14)	(2.90)	(3.04)	(2.63)	(2.90)	(1.82)	(2.09)
CHILD/Y	.047	.001	.001	.002	.001	.001	–.005
	(4.12)	(0.87)	(0.16)	(1.80)	(0.62)	(0.68)	(0.69)
PENSION/Y	–.099	–.013	–.018	–.016	–.012	–.011	–.014
	(5.30)	(3.59)	(3.54)	(4.70)	(2.87)	(2.11)	(1.70)
FER_{-1}		.976	.952	.977	.976	.976	.984
		(162.01)	(101.10)	(175.17)	(162.11)	(120.49)	(90.18)
R^2	0.730	0.980	0.981	0.982	.979	0.888	
SEE	0.136	0.037	0.036	0.037	0.037	0.037	0.040
N	746	732	732	732	732		
Estimator	LS	LS	LS	GLS	GLS	LAD	GMM
Effects	FE	none	FE	FE	RE	none	differences
Test	..		1.75	2.61			20.05
			(0.02)	(0.00)			(21.00)
DW	0.10	1.20	1.24	1.20	1.21	..	..

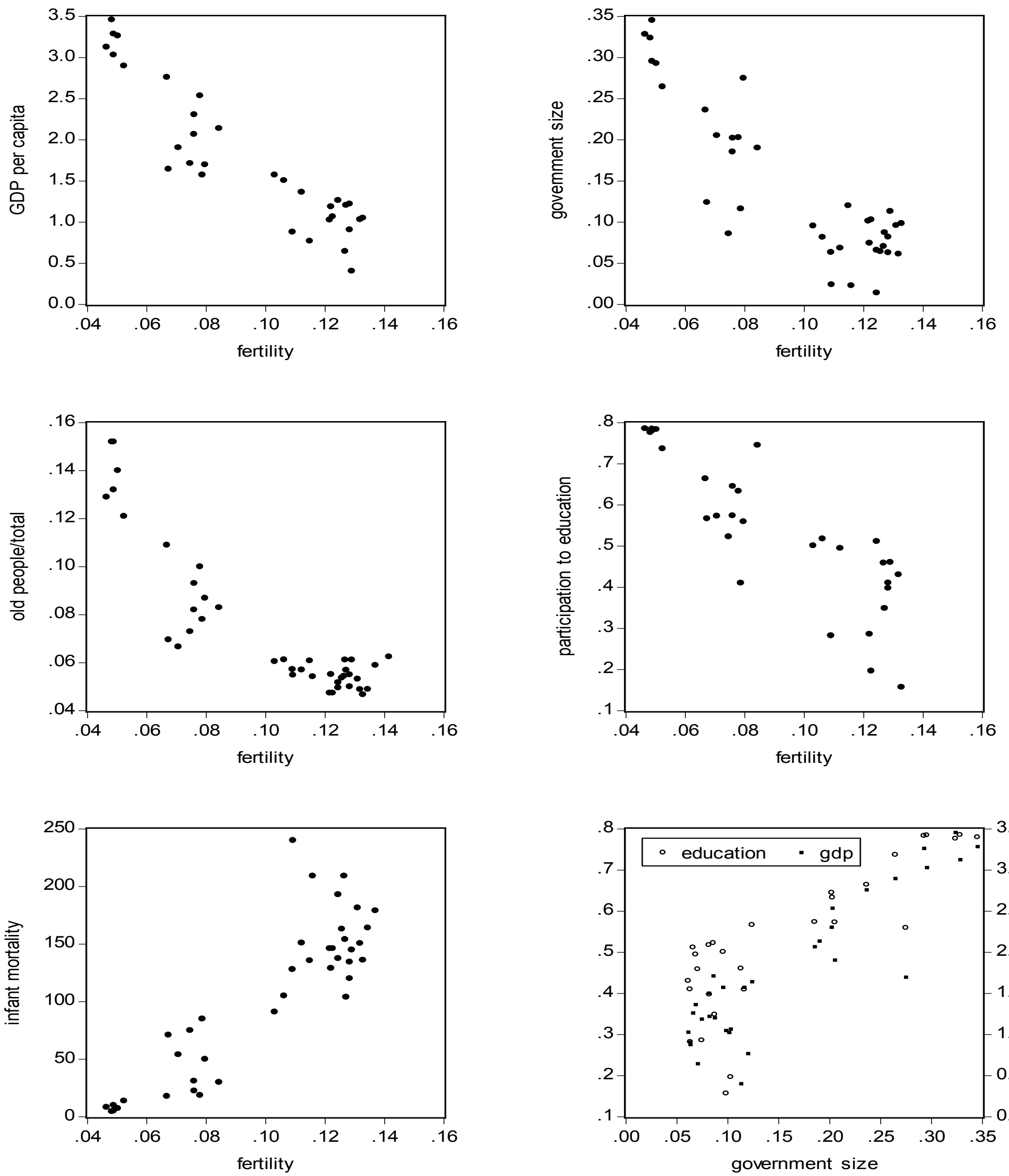
Notes: GDP denotes the Gross Domestic Product in constant per capita terms. CHILD/Y denotes the (government) expenditures on children (per capita) in relation to per capital GDP. Similarly, PENSION/Y denotes a "replacement ratio" in terms of government pension expenditures. Test indicates the test for fixed effects, or in the case of GMM, the J-test for overidentifying restriction(s). All variables are expressed in logarithms.

Table 4. Testing the substitutability of saving and fertility

	1	2	3	4	5	6
GDP	–.003	–.004	–.074	–.004	–.001	–.001
	(2.71)	(2.66)	(1.37)	(0.80)	(0.22)	(0.30)
CHILD/Y	–.020	–.030	.256	.254	.367	.346
	(1.69)	(0.92)	(3.16)	(3.16)	(4.36)	(3.89)
PENSION/Y	–.029	–.025	–.157	–.043	–.050	-.070
	(1.01)	(0.96)	(1.20)	(0.32)	(0.41)	(0.57)
HSR	–.285	–.340	–.421	–.772		
	(4.05)	(4.34)	(1.77)	(2.65)		
inf			.749	.808		.040
			(2.03)	(2.12)		(2.95)
r						–.012
						(3.87)
rr					–.010	
					(3.86)	
FER_{-1}	.955	.956				
	(69.43)	(67.43)				
R^2	0.991	0.991	0.889	.895	0.885	0.885
SEE	0.060	0.060	0.209	0.208	0.217	0.217
Estimator	LS	IV	OLS	IV	LS	LS

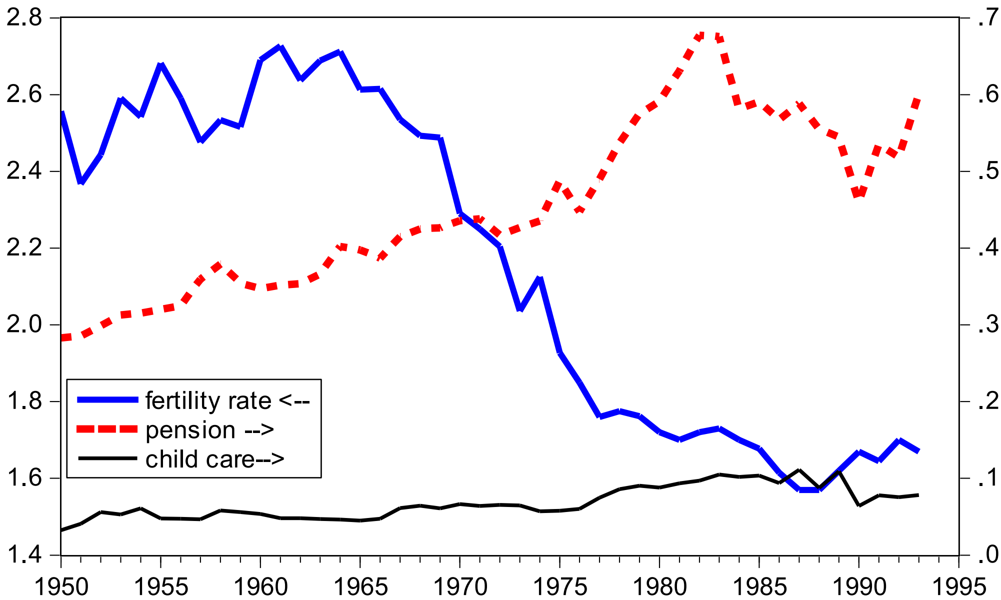
Notes: inf denotes the rate of inflation, r the nominal interest rate, rr the real (ex post) interest rate and HSR the household saving rate. Otherwise the notation is the same as in Table 3. Here all equations include both cross-section and period fixed effects. In the IV estimation, the set of additional instruments includes the lagged saving rate, the real interest rate and the growth rate of GDP.

Figure 1. Relationship between fertility and its determinants from the historical data



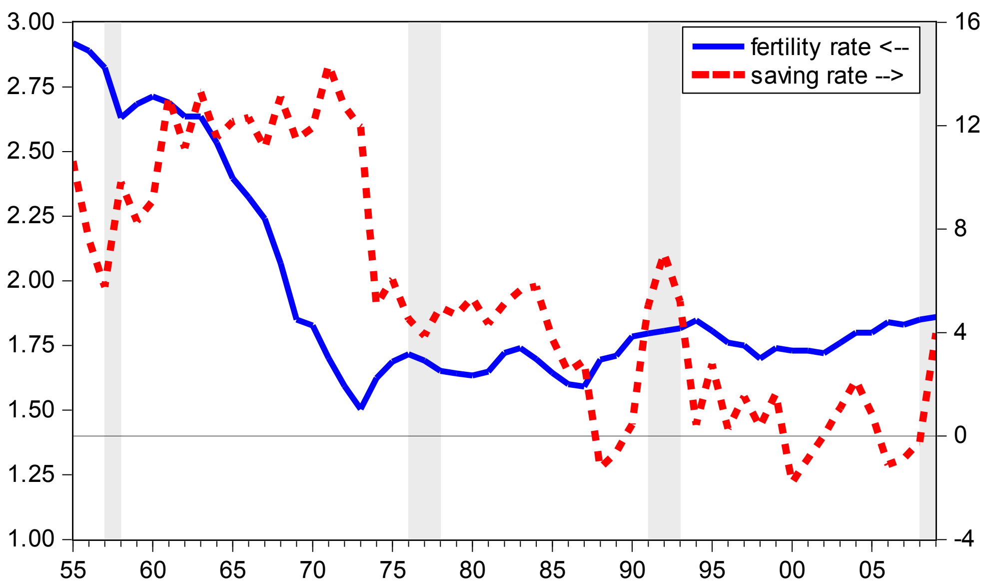
Notes: Numbers are median values of countries for 1860–2000. In the last graph, we compare government size with education, on the one hand, and GDP per capita, on the other hand.

Figure 2. Median values of fertility, pensions and child care



Note: Pensions and child support expenditures are expressed as respective replacement ratios.

Figure 3. Fertility and saving in Finland



Notes: Shaded areas are depressions. Saving rate data prior to 1975 represent the OLD SNA which is fully comparable to current ESA95 numbers.

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