Given that people live longer,
why should we worry that fewer are born?[1]

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Abstract

The laissez-faire fertility rate is likely to be inefficiently high. Pensions reduce fertility, but it may not be desirable to use them as a tool to bring fertility to its efficient level. A second best can be implemented using a public pension system made up of two parallel schemes, one allowing individuals to qualify for a pension by working and paying contributions, the other allowing them to do so by having children, and investing in the children's human capital.

1. Introduction

The population of the world has increased nearly fourfold in the course of the last century. It is still increasing, but at a decreasing rate. The UN Population Fund (UNFPA, 2007) predicts that it will stabilize at around 10 billion by the middle of the present century as fertility decline catches up with mortality decline. In view of global warming, rising food and oil prices, and other signs of pressure on natural resources, this might be regarded as a homeostatic adjustment. Yet, governments fret about the financial strain population aging is putting on the welfare state in general, and the public pension system in particular. Where the latter is concerned, the strain arises from the fact that the policy adjustments required to maintain financial balance in the face of a changing age distribution is delayed by the organized opposition of the age groups with a vested interest in preserving the status quo. But the questions on which I want to focus here are of a different nature. Could it be that the demographic decline is at least in part a consequence of pension policy? If it is, is the policy efficient?

The answer to the first question is yes. There is substantial evidence that public pension provision discourages fertility. The earlier studies refer essentially to developing countries, and do not go much beyond establishing the sign of the correlation between fertility and some measure of pension coverage.[2] The more recent ones include developed countries,[3] and establish causality.[4] What transpires from these studies is that pension policy may respond to fertility in the short run, but the opposite is definitely true in the long run. This is consistent with the fact that the largest decline in the total fertility rate has occurred in the developed part of the world since the 1960s, when public pension systems reached their maximum expansion. It is consistent also with the fact that the contraceptive pill became widely available only in the late 1960s. By reducing the cost of birth control, this technical innovation made fertility more responsive to policy.[5] I shall argue that the answer to the second question is no, and that the way forward is an unconventional pension scheme which restores the incentive to have children, and invest in their human capital.

2. Laissez faire

Suppose that there is no public pension system, and that no other policy affecting the private marginal cost and benefit of having a child is in place. Suppose also that there are no population externalities. Assuming that parents derive direct utility not only from their own present and future consumption, but also from the number ("quantity") and well-being ("quality") of their children, Baland and Robinson (2002) demonstrate that, if parental decisions are effectively contrained by the legal principle that a person is not obliged to accept a negative transfer (e.g., an onerous bequest) from anyone including his or her own parents, the quality of the childen will be inefficiently low, and the quantity inefficiently high. In other words, parents will have too many children, and bring them up the wrong way.

The nonnegativity constraint on parental transfers will be less stringent if people can be expected to support their elderly parents for reasons other than contract law. Confucian ethics in the East, guilt feelings (craftly inculcated by parents when the children are at an impressionable age) in the West, are often invoked to justify this urge to support one's own parents. Be that as it may, we as economists know that people respond to incentives. In any given cultural environment, people are thus more likely to support their parents if it is in their own interest to do so. Cigno (2006) shows that an unwritten "family constitution" prescribing the minimum amount of money or personal services yielding the same utility that a working-age person must give each of her young

[2] See Hohm (1975), Nugent and Gillaspy (1983), Entwisle and Winegarden (1984).
[3] See Cigno and Rosati (1992, 1996, 1997), Ehrlich. and Zhong (1998), Gabos and Kezdi (2005), Zhang and Zhang (2004).
[4] See Cigno et al. (2003a).
[5] Evidence of that is reported in Cigno et al. (2003a).

children if she has any, and her retirement-age parents if they in turn obeyed the rules, may be self-enforcing both in the (Nash equilibrium) sense that it is not in any adult's interest to complied with the constitution, and in the (renegotiation-proofness) sense that it is not in any generation's interest to amend it.[6] I say may rather than will be self-enforcing because people have the alternative of disobeying the rules, and providing for their own old age by saving while still of working age. If the interest rate is sufficiently high, no set of family rules will be a Nash equilibrium. If it is sufficiently low, the Nash-equilibrium requirement will not constitute a binding constraint on the choice of rules, and the constitution will then induce the family members to behave efficiently. At any in-between level of the interest rate, there will be sets of rules which satisfy the Nash-equilibrium requirement, but these rules will induce parents to have more than the efficient number of children.

Therefore, the possible existence of self-enforcing family constitution reduces, but does not eliminate the excess fertility problem. As we shall see in a moment, however, it has implications for the design of an efficiency-inducing policy.

3. Why do pensions reduce fertility?

Now suppose that a public pension system is in place. Suppose that it is actuarially fair, so that there are no implicit pension taxes or subsidies.[7] What this means is that, at the date of retirement, the expected value of the stream of future pension benefits is equal to the capitalized value of the pension contributions made up to that date. If the expected benefits were larger than the contributions, the agent would be receiving an implicit subsidy. If it were smaller, she would be paying an implicit tax. In the absence of self-enforcing family constitutions, and assuming a perfect credit market, the only effect of introducing an actuarially fair pension system would be to reduce the household saving rate by the amount of the pension contribution rate. Fertility would remain inefficiently high. There would be a negative (positive) effect on fertility only if the benefit formula were less (more) than actuarially fair, and the agent were consequently paying an implicit pension tax (receiving an implicit pension subsidy).

In the presence of self-enforcing family constitutions, however, the policy would reduce fertility even if the benefit formula were actuarially fair. For the simple case in which people are completely selfish, and there is no uncertainty, this can be explained with the help of a diagram taken from Cigno and Werding (2007). Under these simplifying assumptions, the agent has children only if she complies with her family constitution.[8] In Figure 1, c_1 denotes the agent's present

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[6] Cigno et al. (2006) find evidence that a substantial fraction of the adult Italian population is bound by a family constitution.
[7] For a definition and method of calculation, see Sinn (1990).
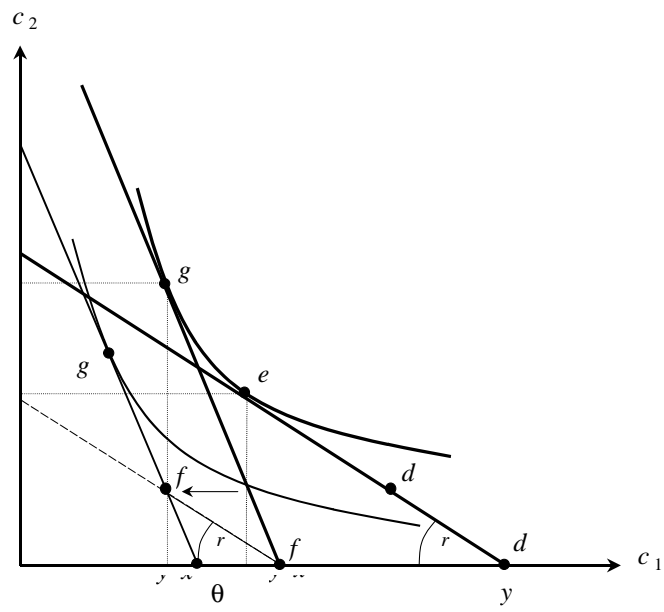[8] See Cigno (2006).

Figure 1: Effects of an actuarially fair pension scheme

(working-age) consumption, c_2 her future (retirement-age) consumption, y her present income, x the amount that she must pay to her retirement-age parent according to the family constitution, and r the market interest factor. The convex-to-the-origin curves are loci of intertemporal consumption plans giving the agent the same lifetime utility.

Suppose there is no pension system. If the agent did not comply with her family constitution, her intertemporal budget constraint would be represented by the straight line, with absolute slope equal to r, through the endowment point d. She would then have no children, and her lifetime utility would be maximized by the consumption plan represented by point e. By contrast, if the agent did comply with the constitution, her endowment point would be f, and the budget constraint would be represented by the line through points f and g. This line is steeper than the one through points d and e because the marginal return to money spent on children must be necessarily greater than the return to money invested in conventional assets, r, or there would be no way for the agent to recover the fixed cost of complying, x. It can be shown that the marginal return to money spent on children is equal to the number of children.[9] If the agent complies, she will have n children, and maximize her utility at point g. The diagram is constructed under the assumption that the agent is just better-off complying.

Let us now introduce an actuarially fair pension system. Let θ denote the pension contribution. In the absence of uncertainty, actuarially fairness simply means that the pension benefit is equal to θr. For an agent who does not comply with a family constitution, the budget constraint and the utility-maximizing consumption plan will then the same as if there were no pension system. All that will change is her endowment point, from d to d', and thus her voluntary saving, which will be reduced by the amount θ. Not so for an agent who complies with her family constitution. Her budget constraint will in fact shift inwards, because the policy obliges her to contribute to a scheme (the pension system) which yields a lower return than the family one. If she complied, her utility would be maximized at g'. As this point lies on a lower indifference curve than point e, however, she will not comply. Her fertility will then fall from n to zero.

Of course, different agents may have different family constitutions, and behave differently both with and without the policy. In particular, not all agents will necessarily switch from complying to not complying if an actuarially fair pension system is introduced. Furthermore, in the presence of altruism or uncertainty, an agent may well have children (for the pleasure of it, or as a form of insurance) even if she does not comply. But the aggregate fertility effect will still be negative.[10] There is evidence that this effect may be very large. Controlling for all other relevant factors (including the development of financial markets, and any implicit pension taxes or

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[9] See Cigno (2006).
[10] See again Cigno (2006).

subsidies), Cigno and Rosati (1992) estimate that as much as three-quarters of the reduction in the total fertility rate which occured in Italy between 1930 and 1984 can be ascribed to the expansion of the public pension system. Similar effects are estimated by the other econometric papers cited. Notice that, with implict taxes or subsidies controlled for, the effects estimated are those that the policy would have if the pension system were actuarially fair. As the theory predicts, implicit taxes are estimated to strengthen, and implicit subsidies to weaken, the fertility effect.[11]

Given that pensions discourage reproduction, pension policy could be used to reduce the fertility rate to its efficient level. But it is extremely unlikely that it actually is, because the existing pension systems were created at a time when their fertility implications were not yet understood, and in any case for purposes other than fertility control.[12] More fundamentally, as these systems are all underfunded, and thus essentially "pay-as-you-go", it may not be desirable to reduce the fertility rate. In such a system, the average rate of return to the contributions paid is in fact equal to the growth rate of total earnings, and thus increasing in both the fertility, and the productivity growth rate. Put another way, as individuals do not take account of the effect that their reproductive decisions will have on the profitability of the system,[13] the existence of a pay-as-you-go pension system gives rise to a positive population externality.

The reason why all existing public pension systems are underfunded is that they were either set up or greatly expanded between the end of the second world war and the mid-1960s, when the growth rate of total earnings was high. That changed in the 1970s, when population and, in some countries, productivity growth started to falter. This reduced the rate of return of underfunded systems relative not only to that offered by the market, but also to that enjoyed by earlier participants. In some cases, the organized opposition of the older part of the population succeeded in preventing the increase in the contribution rate, reduction in the benefit rate, or rise of the age of retirement, that would have kept the current account of the pension administration in balance. Irrespective of whether the ensuing deficit was paid for by raising taxes or issuing public debt, this pushed some of the burden of the adjustment on to future generations,[14] but could not change the fact that the sustainable rate of return of the pension system was now lower. Would it have been (and is still) advisable to switch from pay-as-you-go to full funding? The answer is no, because the

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[11] Remember that, in the absence of self-enforcing family constitutions, pension policy would reduce fertility only in presence of an implicit tax. Thefore, the finding of a negative fertility effect controlling for any implicit pension tax rejects the hypothesis that no such constitution exists.

[12] This is not the place to go in depth into the arguments for compulsory pension coverage. They are essentially time-inconsistency (the young do not see far enough to save at the efficient level), and redistribution in the face of moral hazard (in a compassionate society, the very poor have no incentive to save, because they expect to receive public charity when they get old).

[13] For Germany, Werding and Hofmann (2005) estimate the benefit of an extra birth to the pension system at about 139000 euros.

[14] There is no contradiction between this and the altruism assumption. Those clamouring for higher pensions from other people's children and grandchildren may be making presents to their own children and grandchildren.

cost of funding the pension benefits of the generation caught in the transition would never be recovered.[15]

This leaves us with two alternatives. One is to cut the pension system back drastically, or do away with it altogether. This would be justified if the objectives of pension policy could be pursued equally effectively by other means. The other is to restore the incentive to have children, and invest in their future earning capacity, sufficiently to equate the growth rate of aggregate earnings to the market rate of interest. Fertility can be encouraged using child benefits, but this will induce parents to substitute quantity for quality of children,[16] and is thus unlikely to be socially desirable.[17] Assuming that quality correlates with future earning capacity, it may be bad also for the financial viability of the pension scheme. Depending on the relative elasticities of quantity and quality of children, the policy may in fact reduce the aggregate earnings of the next generation. That may be countered by educational subsidies. But, if fertility and education subsidies are financed at least in part by an income tax, this will reduce the incentive to work. The net effect could then be a reduction rather than an increase in aggregate earnings.

4. Optimal pension policy

Cigno et al. (2003b) characterize first and second best pension policy under the assumption that a person's lifetime earning ability, and thus his or her capacity to pay conntributions, depends not only on early investment, but also on luck. The policy instruments are a contribution, payable by all working-age individuals, and a benefit, payable to all retirement-age ones. In first best, the policy maker observes not how many children a couple has, and how much time and money it invests in them. The benefit covers the cost for the couple of having the socially optimal number of children , and investing in them at the socially optimal level. The contribution covers the cost for the policy maker of paying these benefits.

In second best, the policy maker observes only how many children a couple has. Since parents have no reason to take into account the benefit that their investment will bring to the policy maker's budget, there is a moral hazard problem. The second-best pension benefit is a compromise between incentive and insurance considerations. On the one hand, it should be an increasing function of the children's earning capacity to provide the couple with the incentive to invest in them. On the other, it should be a decreasing function of the children's earning capacity to

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[15] See Breyer (1989), Fenge (1995) and Sinn (2000).
[16] This was pointed out for the first time in Cigno (1986).
[17] Like public pensions, child benefits were introduced, in many cases, for purposes other than encouraging fertility, and without a full understanding of their effects on parental behaviour (in particular, without undestanding that subsidizing parents is the same as subsidizing children).

compensate the couple if a child is unsuccesful. The tension between these opposite requirements may result in a U-shaped benefit schedule.

The second-best policy bears a superficial resemblance to, but is fundamentally different from, a pay-as-you-go pension system. In both, current benefits are in fact paid out of current contributions. In the latter, however, there is no link between the amount received by a pensioner and the amount paid by his own children, and there is thus no incentive to have children and invest in them. In the former, by contrast, the amount received by a pensioner increases with the amount paid by his own children, and there is thus an incentive to do both. If parents are credit rationed, part of the benefit should be paid in advance, while the child is still young. This part could then be interpreted as a conventional child benefit. As the children's earning ability will not be fully revealed until they are well into working age, however, the part left to be paid when the parents are of retiring age should be large enough to fulfill its incentive role.

If working-age individuals differ in their ability to raise children or make money, couples (and individuals within them) should specialize according to their comparative advantages. If these are known to the individuals concerned, but not to the policy maker, there is then an adverse selection problem. Allowing for that, Cigno et al. (2004) show that the second-best policy induces couples and individuals to reveal their true personal abilities, and thus to make the contributions, and receive the benefits, that were intended for them.

5. A proposal for pension reform

In the light of these theoretical results, Cigno and Werding (2007) propose a pension system composed of two parallel schemes. A contribution-related (Bismarckian) one allowing working-age individuals to qualify for a pension by working and paying contributions in the usual way, and a child-related one allowing them to qualify for a pension by raising children, and investing in their human capital. In the former, individual benefits are increasing in individual contributions. In the latter, they are increasing in the earning capacity of the pensioner's own children. This capacity is estimated according to a pre-defined formula on the basis of observable parameters such as education achievement, sector of activity, and age-profile of actual earnings at the date when the parents retire.[18] As the child is typically in middle age when that happens, the estimate is likely to be pretty accurate. In both schemes, the benefit formula should contain a redistributive or insurance element to compensate those who, for no fault of their own, meet with bad luck in the lbour market, or have unsuccesful children.

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[18] These are the variables typically used by labour econometricians to proxy earnings.

Individuals should be free to combine the two schemes, and switch in and out of them, any way they like. A woman might then study until the age of 18, work and pay contributions from the age of 19 to that of 25, withdraw from the labour market for three years to raise a child, and then work from the age of 29 to that of retirement, or until the next pregnancy. Another, by contrast, might choose to study until the age of 21, work full time from 22 to 30, and then withdraw from the labour market for three months to have a baby. For the following 33 months, she and her partner would work part-time, sharing the care of the child between them. In both cases, the couple would get its pension partly through the child-related scheme, and partly through the contributions-related one. Singles and couples without children would rely entirely on the latter.

A merit of the proposed reform is that it would encourage couples and individuals to specialize in child-raising or money-making activities according to their comparative advantages, best known to them.[19] Another is that it would minimize labour distortions. These could be reduced to zero by designing the Bismarckian part of the system to be actuarially fair. That, however, would do away with the fundamental functions of a public pension system, namely to provide insurance, and redistribute from rich to poor pensioners. It is thus unlikely that second-best policy will be actuarially fair. In any case, the aggregate labour effect of insurance and redistribution is likely to be small,[20] because the implicit taxes charged to high-wage earners would induce these workers to supply less labour, but the implicit subsidies paid to low-wage earners would induce these other workers to supply more. Besides, Cigno (2008) demonstrates that a Bismarckian scheme will always discourage labour less than a comparable Beveridgean one (where individual benefits are independent of individual contributions), and this is indeed the reason for proposing the former. In any case, any distortion caused by the contributions-related part of the pension system will apply only to that fraction of a person's time which is spent working, not to that which is spent looking after children. Yet another is that the transition from an existing pay-as-you-go pension system to the proposed new one does not have the same problem as the transition to a fully-funded one because the transition generation would not need to be funded. Only the benefit formula would change. Provided that the administrative cost is not excessive, the reform would thus be a Pareto improvement.

A small element of what is being proposed exists already in some pension systems. The *majoration de durée d'assurance pour enfants* of the French *Régime Général*, and the Swedish *extrapension för barn*, are examples of fertility-related pension benefits. In 1986, the German

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[19] Fenge and Meier (2005) derive the actual weights that should be given to children and pension contributions in the the calculation of pension benefits. But this is done under the assumptions that all individuals are the same, and thus that there are no comparative advantages.
[20] For evidence, see Disney (2004).

government similarly started to credit parents who withdrew from the labour market to look after a child with a notional pension contribution, *Kindererziehungszeiten*, originally set at 75 percent of average earnings, for up to one year. Later, the notional contribution was raised to 100 percent of average earnings, and extended to three years. As this reflected the opportunity-cost component of the cost of having a child, the policy went some way towards providing an incentive not just to have children, but to invest in them. It was, however, only a very rough measure of the opportunity-cost because it did not take account of wage dispersion, and did not capture the amount of time that the parent actually spent with the child. Since 1996, the condition that the parent should give up work in order to qualify for the benefit has been removed, and *Kindererziehungszeiten* has become a fertility-related pension benefit just like the French and Swedish ones.

Cigno and Werding (2007) simulate the effects of the proposed pension reform, and of more conventional policies, using the Cigno et al. (2003a) econometric model of West Germany. The latter was estimated using aggregate data relating to the 1960-95 period, the longest for which the relevant information is available, and allows for possible cross-links between saving and fertility. The results show that the fertility recovery induced by the proposed pension reform could otherwise be achieved only by an unrealistically drastic reduction in benefits or increase in contributions.

6. Conclusion

In conclusion, the laissez-faire fertility rate is likely to be inefficiently high. Pensions reduce fertility, but it may not be desirable to use them as a tool for bringing fertility down to its efficient level. Second-best pension policy is a compromise between incentive and insurance considerations, and induces couples and individuals to specialize according to their comparative advantages. A public pension system with these chracteristics consists of two parallel schemes, a conventional one which allows individuals to qualify for a pension by working and paying contributions, and an unconventional one which allows them to do so by raising children, and investing in their human capital. An individual should be free to combine the two schemes, and switch in and out of them, at will. Childless singles and couples would rely exclusively on the on the contributions-based scheme. Unlike a switch from an underfunded to a fully-funded pension system, the proposed reform could be a Pareto improvement.

REFERENCES

Breyer, F. (1989), "On the intergenerational Pareto efficiency of pay-as-you-go financed pension systems", *Journal of Institutional and and Theoretical Economics* 145, 643-658.

Cigno, A. (1986), "Fertility and the tax-benefit system: A reconsideration of the theory of family taxation", *Economic Journal* 96, 1035-1051.

------------ (2006), "A constitutional theory of the family", *Journal of Population Economics* 19, 259-283.

------------ (2008), "Is there a social security tax wedge?", *Labour Economics* 15, 68-77.

------------, L. Casolaro and F. C. Rosati (2003a), "The impact of social security on saving and fertility in Germany", *FinanzArchiv* 59, 189-211.

------------, G. C. Giannelli, F. C. Rosati and D. Vuri (2006), "Is there such a thing as a family constitution? A test based on credit rationing", *Review of Economics of the Household* 4, 183-204.

------------, A. Luporini and A. Pettini (2003b), "Transfers to families with children as a principal-agent problem", *Journal of Public Economics* 87, 1165-1172.

------------, A. Luporini and A. Pettini (2004), "Hidden information problems in the design of family allowances", *Journal of Population Economics* 17, 645-655.

------------ and F. C. Rosati (1992), "The effects of financial markets and social security on saving and fertility behaviour in Italy", *Journal of Population Economics* 5, 319-341.

------------ and F. C. Rosati (1996), "Jointly determined saving and fertility behaviour: Theory, and estimates from Germany, Italy, UK, and USA", *European Economic Review* 40, 1561-1589.

------------ and F. C. Rosati (1997), "Rise and fall of the Japanese saving rate: The role of social security and intra-family transfers", *Japan and the World Economy* 9, 81-92.

------------ and M. Werding (2007), *Children and Pensions*. Cambridge (Mass.): MIT Press.

Disney, R. (2004), Are contributions to public pension programmes a tax on employment?, *Economic Policy*, July 2004, 269-311.

Ehrlich, I. and J. G. Zhong (1998), "Social security and the real economy: An inquiry into some neglected issues", *American Economic Review* 88, 151-157.

Entwisle , B. and C. R. Winegarden (1984), "Fertility and pension programs in LDCs: A model of mutual reinforcement", *Economic Development and Cultural Change* 32, 331-354.

Fenge, R. (1995), "Pareto-efficiency of the pay-as-you-go pension system with intergenerational fairness", *Finanzarchiv* 52, 357-364.

---------- and V. Meier (2005), "Pensions and fertility incentives", *Canadian Journal of Economics* 38, 38-48.

Gabos, A., R. Gal and G. Kezdi (2005), Fertility effects of the pension System and other intergenerational transfers: A test on Hungarian data. PIE Discussion Paper.

Hohm, C. H. (1975), "Social security and fertility: An international perspective", *Demography* 12, 629-644.

Nugent, J. B. and R. T. Gillaspy (1983), "Old-age pensions and fertility in rural areas of less developed countries", *Economic Development and Cultural Change* 31, 809-829.

Sinn, H. W. (1990), "Korreferat zum Referat von K. Jaeger", in B. Gahlen, H. Hesse and H. J. Ramser (eds.), *Theorie und Politik der Sozialversicherung*. Tübingen: Mohr-Siebeck.

------------- (2000), "Why a funded pension system is useful and why it is not useful", *International Tax and Public Finance* 7, 389-410.

UNFPA (2007), *State of World Population*, New York: United Nations Population Fund.

Werding, M. and H. Hofmann (2005), "Die fiskalische Bilanz eines Kindes im deutschen Steuer- und Sozialsystem", *Ifo Forschungsbericht*, No. 27.

Zhang, J. and J. Zhang (2004), "How does social security affect economic growth? Evidence from cross-coutry data", *Journal of Population Economics* 17, 473-500.