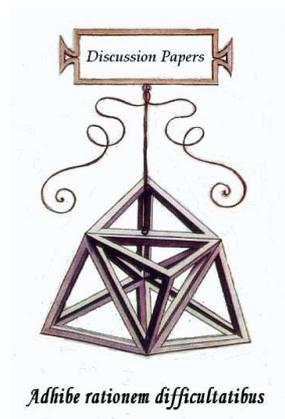




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**PAYG pensions and fertility drop: some
(pleasant) arithmetic**

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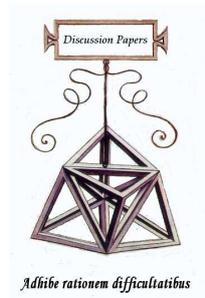
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Discussion Paper
n. 146



Luciano Fanti

PAYG pensions and fertility drop: some (pleasant) arithmetic

Abstract

This paper explores whether the common belief that the currently observed fertility drop is a threat (or, conversely, the invoked fertility recovery is beneficial) for PAYG pensions is really always validated by the basic accounting of the PAYG pension budget. It is shown, through a simple arithmetic, that, rather surprisingly, in the long run a fertility drop may be beneficial, while, conversely, a fertility recovery may be harmful for pensions, under rather realistic conditions as regards both fertility changes and time costs of childrearing. Furthermore, this result also holds a fortiori in the short run.

Keywords PAYG pension; OLG model

JEL Classification J26; O41

1. Introduction

Pay-as-you-go (PAYG) social security systems are prevalent in OECD countries, where in the recent decades even largely below-replacement fertility rates emerged. The attention of both economists and policy-makers towards pension systems, which has been always generally high, has even increased recently under the pressure of the aging process.

Both policymakers and economists (among many others, Sinn and Uebelmesser, 2002; Sinn, 2007; Bovenberg, 2007; Cigno, 2007; Cigno and Werding, 2007) are in accord between them in believing that the dramatic fertility drop will damage the sustainability of social security systems (through the consequent increasing ratio of those who are retired to those of working age). In particular they argue that, in order to keep balanced future PAYG pension budgets, either a reduction in the benefit entitled to old age pensioners or an increase in the payroll tax rate paid by young-aged people, or both is strongly necessary. Moreover it seems that such invoked pension reforms have low popularity because people, different from policymakers, do not understand the perils caused by demographic changes on future pensions.¹ However some recent papers has shown that, by also taking account for the general equilibrium effects both of demographic changes and payroll tax rates, the results may be different from those emerging by the simple accounting rules of the PAYG pension budget.²

In this paper we explore the relationship between fertility changes and sustainability of a PAYG pension system, investigating whether and how varying fertility rates affect the replacement ratio (i.e. a pension benefit - wage ratio) both in the short and in the long run. To do so, we analyse a PAYG pension system with a fixed replacement ratio and exogenous fertility. Therefore the question to be addressed in this paper is simple: even limiting us to only consider the basic accounting of the PAYG pension budget, is it really warranted the common belief that the currently observed fertility drop is a threat for pensions (or, conversely, the invoked fertility recovery is beneficial for pensions)?

It is shown, through a simple arithmetic, that, rather surprisingly, in the long run a fertility drop may be beneficial, while, conversely, a fertility recovery may be harmful for pensions, under rather realistic conditions as regards both fertility changes and time costs of childrearing, and, furthermore, that this result is even magnified in the short run. Section 2 presents a standard pay-as-you-go pension budget and analyses the short and long run effects of fertility changes. Section 3 concludes.

2 Pay-as-you-go pension budget analysis

¹ Indeed, a recent literature has explored the popularity of such pension reforms, and investigated how to inform successfully citizens as regard the unavoidability of such pension reforms due to the perils for PAYG pension systems caused by the demographic change, in primis by fertility drop. For instance, Boeri et al. (2001, 2002), drawing on surveys of European citizens, and Blinder and Krueger (2004) studying opinion polls in the US, noted that more informed individuals are more likely to support pension reforms and then advise a more operative “advertising campaign”.

² Indeed, for example, Fanti and Gori (2008, 2010) have shown that, in a conventional OLG neoclassical growth model, an increasing longevity as well as raising contribution rates may be harmful for the sustainability of pay-as-you-go pension systems.

We assume, as usual in the modern family economics, that the cost of rearing children is given by the forgone wages: the time for rearing children is subtracted to the labour time and thus having offspring has the cost due to the wage loss for rearing children. Moreover we assume that the reduction of wages increase proportionally with the number of children.³

This assumption is usual in literature, and may be justified on empirical grounds as well on technical needs, as explained for instance by Fenge and Meier (2005), arguing that this specification of labour supply “reflects observable patterns of families up to three children. Calhoun and Espenshade (1988) and Calhoun (1994) find that forgone lifetime labour supply rises roughly proportionally in the number of children in the range up to three children.” (p.33). As regards the technical point of view “allowing for economies of scale in the upbringing of children....will generally lead to multiple solutions of the utility maximization problem. Such a situation would create serious problems for the comparative static analysis.” (p. 33). Moreover, as noted by Fenge and von Weiszacker (2009), “Angrist and Evans (1998) estimate that that the presence of a third child reduces the probability of work of married women by about 17 percentage points and family income by 13%”.⁴

The government taxes labour income during the first period at a rate τ , and, then, uses the resulting tax revenue to fund the PAYG pension system. Note that we assume that the pension scheme is given: this means that either τ or the replacement rate p/w is given. It is supposed that the government has no budget deficit, so that the government runs a pure PAYG balanced budget policy in every period according to the following constraint:

$$p_t = \tau w_t (1 - qn_t)n_{t-1}, \quad (1)$$

where the left-hand side represents the social security expenditure and the right-hand side the tax receipts, p_t is the benefit perceived by each pensioner at time t , $0 < \tau < 1$ is the (constant) contribution rate paid by the young-adult contributors, w is the wage rate and n is the rate of fertility.⁵ Note that this PAYG pension budget is general in the sense that it is independent of whether the pension scheme is of Beveridgean or Bismarckian or Fertility-related type.⁶ Moreover we assume that the pension scheme is such that the pension benefit/wage ratio is kept in-haltered, so that we may investigate the effects of fertility changes on the sustainability of PAYG pension budget simply observing whether and how such a ratio changes, *ceteris paribus* as regards the payroll tax rate.

2.1 Long run analysis

³ Note that the possible existence of economies of scale in the childrearing activity does not alter the qualitative conclusions of the paper.

⁴ Of course it should be noted that “the impact of children on (female) labour supply is less negative in countries with more generous provision of public childcare and in countries with a lower level of economic welfare - where the economic necessity to work is high (Uunk et al., 2005)”(Fenge and von Weiszacker, 2009).

⁵ Notice that n represents the number of children with $n - 1$ being the population growth rate, as usual in models with endogenous fertility.

⁶ For an investigation of the different pension schemes in various countries, see Condè-Ruiz and Profeta (2007). As regards Fertility-related pension schemes (i.e. pension benefit contingent on the total number of the pensioner’s own children) we note that, for instance, according to Sinn (2007, p.11) “child-based pension systems would be the solution” to the problems of sustainability of pension budgets caused by the fertility drop.

Therefore, in the long run, the PAYG pension budget may be written as:

$$\frac{P}{w} = \tau(1 - qn)n \quad (2)$$

A simple observation of the replacement ratio formula (Eq. 2) reveals that the final effect of an increase in the rate of fertility on the long-run pension/wage ratio depends on two counterbalancing forces: an increase in such a rate, on the one hand, 1) increases the p/w ratio since it raises the number of worker contributors, and, on the other hand, 2) reduces the p/w ratio, since it reduces the work-time due to the increased childrearing time and consequently reduces the amount of paid contributions.

Therefore, the derivative of Eq. (2) with respect to n gives

$$\frac{d(p/w)}{dn} = \tau(1 - 2nq) \quad (3)$$

By observing Eq. (3) it is easy to prove the following result.

Result 1: *when the fertility rate is sufficiently high, and, in particular, is higher than a critical value given by the half of the reciprocal of the per child rearing time (i.e. $n > 0.5/q$), then further fertility increases (fertility drops) are harmful (beneficial) for the benefit/wage ratio.* The proof straightforwardly derives from the

investigation of Eq. (3): $\frac{d(p/w)}{dn} > 0 \Leftrightarrow n < n^{cr} = \frac{1}{2q}$.

This means that, since the value of q is an empirical matter, then also the effect of fertility changes on PAYG pensions has always an ambiguous sign. Let us now consider a particular analytical example of our basic framework. Now, without embarking here in a survey of the empirical literature estimating the value of q (e.g. Deaton and Mullbauer, 1989; Bradbury, 1994; Apps and Rees, 2002, Bonke and Browning, 2011), we conduct a rather “natural” exercise. First, we recall that in our model there is a “one-individual” family and thus $n=1$ corresponds to two children for each couple of parents. Assume that $q=0.5$, which amounts to say that, only one parent participates to the labour market while the other parent is retired in order to rear two children, or, both parents participate to the labour market but one of them is employed part-time (half-time) in order to rear one-child. Simple arithmetic – which given the concerns raised by the fertility drop may seem rather pleasant - says that a fertility drop from 2.6 children for couple to 1.6 children (recalling that 2.1 children for each couple may be approximately considered the replacement fertility rate) implies an increase of the pension/wage ratio around 5.5 per cent, while, alternatively, a fertility recovery from a below-replacement value of 1.6 children to 2.6 children for each couple implies a reduction of the pension/wage ratio around 5.2 per cent. This example shows that for this rather realistic case the currently observed fertility drop (the currently invoked fertility recovery) may be an opportunity (a menace) rather than a menace (an opportunity) for the sustainability of a PAYG pension systems in the long run. So far the analysis focused on the long run. In the next section we investigate how a current fertility change affects the replacement ratio both of the current pensioners and current young workers.

2.2 Short-run analysis

Result 2: Any increase of the current fertility rate is always harmful for the p/w ratio of the current pensioners.

The proof straightforwardly derives from the derivative of Eq. (1) with respect to the current fertility rate: $\frac{d(p/w)_t}{dn_t} = -\tau q n_{t-1} < 0$.

In addition to this analytical result it is easy to show, through a simple example, that also both the current and the subsequent generation of young workers may experience a reduction of their replacement ratio as a consequence of a gradual increase (through two periods) of the current fertility rate.

Assume that the fertility recovery from a below-replacement value of 1.6 children to 2.6 children for each couple (as in the previous sub-section) occurs gradually through two generations: e.g. the pre-existing fertility rate (i.e. that of the generation $t-1$) is 1.6 children, the fertility rate of generation t raises to 2 children, and finally the fertility rate of the generation $t+1$ becomes 2.6 children for each couple. Therefore, it derives from simple arithmetic that the current pensioners at the time t observe a reduction of their pension/wage ratio of -16.75 per cent, while the current young workers will observe when pensioners at the time $t+1$ a reduction of -27.1 per cent of their pension/wage ratio with respect to that existing before the fertility increase and even a reduction of -12.4 per cent with respect to that of their already penalized parents.

The above example based on a gradual (through two generations) increase of the fertility rate from 1.6 children to 2.6 children for each couple leads to the following remark.

Remark: An increase of fertility rates once for all at the current time (splitted between the current and the next period) may imply not only that in steady state all future generations may have a pension/wage ratio lower than that evaluated at the pre-existing very low fertility rate, but also that the current pensioners and even (in a magnified size) their children (i.e. the current young workers), may have a pension/wage ratio even lower than that of all future generations in the long-run.

3 Conclusions

In conclusion, let us turn back to the question raised in the introductory section of this paper: the common belief that the currently observed fertility drop is a threat (or, conversely, the invoked fertility recovery is beneficial) for PAYG pensions is really always validated by the basic accounting of the PAYG pension budget?

To answer that question, we firstly set up a standard PAYG pension scheme and develop some analytical results as well as, to study more concretely, a numerical example.

We find that the answer to the question raised in this paper depends only on the relative levels of the pre-existing fertility rate as well as the time cost of childrearing. Given rather plausible values of these levels, the main conclusions – even based on simple arithmetic – of this paper might be: *i*) on the one hand that the currently observed fertility drop may favour in such cases the sustainability of a PAYG pension systems both in the short and in the long run, and *ii*) on the other hand a policy warning with respect to the effects of the currently invoked fertility recovery.

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