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Investing for the old age: pensions, children and savings

Vincenzo Galasso · Roberta Gatti · Paola Profeta

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Abstract In the last century, most countries have experienced both an increase in pension spending and a decline in fertility. We argue that the interplay of pension generosity and development of capital markets is crucial to understand fertility decisions. Since children have traditionally represented for parents a form of retirement saving, particularly in economies with limited or nonexistent capital markets, an exogenous increase of pension spending provides a saving technology alternative to children, thus relaxing financial (saving) constraints and reducing fertility. We build a simple two-period OLG model to show that an increase in pensions is associated with a larger decrease in fertility in countries in which individuals have less access to financial markets. Cross-country regression analysis supports our result: an interaction between various measures of pension generosity and a proxy for the development of financial markets consistently enters the regressions positively and significantly, suggesting that in economies with limited financial markets, children represent a (if not the only) way for parents to save for old age, and that increases in pensions amount effectively to relaxing these constraints.

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V. Galasso
Università Bocconi, IGIER, CEPR and Dondena Research Center, Via Rontgen 1, 20136 Milan, Italy
e-mail: vincenzo.galasso@unibocconi.it

R. Gatti
Development Research Group, The World Bank and CEPR, MC3-353, 1818 H.St.N.W., Washington 20433, USA
e-mail: rgatti@worldbank.org

P. Profeta (✉)
Università Bocconi, Econpubblica and Dondena Research Center, Via Rontgen 1, Room 3B103, 20136 Milan, Italy
e-mail: paola.profeta@unibocconi.it

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1 Introduction

One of the most important economic changes of the last century is the decline of fertility. Although the magnitude of this effect varies across countries, the decline of fertility is a general trend, at least in developed countries. Boldrin et al. (2005) report that in 1920 the total fertility rate (the number of children expected to be born per woman) was 3.2 in the US and very similar in Europe, while in 2000 it dropped to 2.1 in the US and even more in Europe (1.8 in France, 1.3 in Germany, and 1.2 in Italy). At the same time, these countries have experienced a growing increase of government expenditures, in particular in PAYG pensions.

The interplay between the progressive extension of social security and the decline in fertility around the world has a natural explanation, if one believes that children are "investment goods." In traditional societies, old age support was guaranteed by intergenerational transfers within the family from the young to the old. The progressive weakening of family ties in modern societies has justified the introduction of social security systems. Yet, the presence of social security enabled families to substitute public for private transfers as a support for old age, and thus provided incentives to have fewer children.

This paper investigates a different angle in this interplay between social security and fertility. We argue that the role of children as a form of retirement saving for their parents is particularly strong in economies with limited or non-existent capital markets. Here, individuals can almost exclusively invest in children, i.e., they become parents under the expectation that children will transfer resources back to their parents when these reach the old age. In this context, an exogenous increase in pension spending provides a saving technology alternative to children and amounts to relaxing financial (saving) constraints of the current generation. Because of this, we would expect pension spending to have a differential impact on fertility according to the degree of development of capital markets.

We model this reasoning in a simple two-period overlapping generation model, in which the young work, provide a transfer to their parents, and take fertility and savings decisions. Raising kids is costly. But the reward of this fertility decision comes in old age, when the offsprings provide resources to their parents. Individuals may also save on the financial market by purchasing claims to capital. We consider different level of access to financial markets, which we model as a deadweight cost on the return factor. In this context, we show that for internal solutions with respect to fertility, an increase in pensions is associated with a larger decrease in fertility in countries where individuals have less access to financial markets.

This setup generates a testable empirical prediction. In particular, in a regression of fertility on pensions spending, a proxy for the development of financial markets, and other controls we would expect a negative sign on pensions and on the degree of

development in the financial market and a positive sign on a pensions-financial markets interaction term. We use cross-country data to investigate whether the model's prediction is consistent with the evidence. We regress average fertility on various proxies of pensions spending (see detailed description further) and a set of basic controls, including (log) of GDP per capita, the share of rural population, the share of elderly population, and legal origin dummies to rule the most likely sources of spurious cross-sectional correlation. We find that an interaction between pensions and a proxy for the development of financial markets consistently enters the regressions positively and significantly, lending support to the view that in economies with limited financial markets, children represent one way (if not the only one) for parents to save for old age. Increases in pensions amount effectively to a relaxation of these constraints.

Several previous studies have addressed the (negative) relation between pension spending and fertility, both at the theoretical and at the empirical level (see Cigno and Werding 2007). Many contributions have used the so-called "old-age security" motivation of fertility, according to which children are an investment for their parents because they will support them with transfers during their old age. This approach has been developed by a large literature (see Cigno 1995; Wigger 1999; and Rosati 1996) and this idea is also empirically promising (see Ehrlich and Lui 1991 and 1998, and Ehlrich and Kim 2007). The paper that is closer to ours is Boldrin et al. (2005). In a calibrated general equilibrium model, they calculate that about 50% of the fall in fertility over time can be explained by the growth of the pension system and about 60% of the difference between US and Europe is determined by the different growth in their pension systems. They also argue that in societies with a more difficult access to financial instruments to save for retirement or where the returns on capital are very low, improvements in capital market efficiency or returns may significantly contribute to decrease fertility.

Our paper contributes to this literature in two directions. First, we present a tractable theoretical model which highlights the interactions among these three saving devices: financial markets, social security, and children. Our simple theoretical environment yields an equilibrium closed form solution which provides a testable implication. Second, we address the impact that the interaction between pensions and capital market development may have on fertility in a comprehensive empirical analysis in which the role of capital markets is specifically taken into account.

Other empirical investigations of the relationship between pensions and fertility are Hohm (1975), Swidler (1983) for the US, Cigno and Rosati (1996) for Germany, Italy, the UK and the US; and Cigno et al. (2003) for Germany. Cigno and Rosati (1992) quantify the negative impact on fertility of both pensions and the development of financial instruments for the Italian case. The interrelation between pensions and the development of credit markets in affecting fertility is, however, left unexplored.

Other theoretical contributions have developed the idea that PAYG pension system and fertility may represent alternative saving instruments. In Sinn (2004), PAYG pension systems represent an insurance against the risk of not having children. If every household were able to have children, and had full control over fertility, they could receive their pensions from their own children. But when this is not the case, a PAYG scheme may insure against the risk of being infertile or not finding an appropriate partner, by pooling individuals, who may thus also receive pension from other

people's children. Clearly, this argument is particularly relevant when capital markets are not efficient and children represent the only means of transferring resources intertemporally. By pooling resources from the young generation and redistributing them to the old, PAYG systems may alleviate the problem of having ungrateful children (Sinn 2004), a relevant problem in modern societies, where family ties are weak. If pensions and fertility are alternative saving instruments, an "externality" problem may also arise: in presence of a PAYG system individuals may be induced to reduce their number of children and "free ride" in the pooling system, if pension claims depend on the average fertility in the economy rather than on the individual's number of children. As a consequence, fertility falls. Many contributions have analyzed policies, such as family allowances or fertility-related pensions, which could solve this free riding problem (van Groezen et al. 2003; Fenge and Meier, 2005, 2009; Fenge and von Weizsaecker 2006). See also Abio et al. (2004), Cremer et al. (2006, 2008), Kolmar (1997), Meier and Wrede (2008).

The paper is organized as follows. Section 2 presents the model. Section 3 discusses the empirical methodology and the estimation results and Sect. 4 concludes.

2 The model

2.1 The setting

We consider a simple two-period overlapping generations economy. Individuals value their current and future consumption. Young work and provide a private transfer to their parent. Moreover, every young pays a proportional tax on her labor income, which is used to finance a Pay-As-You-Go (PAYG) pension system. Young individuals take also fertility and savings decisions. Fertility is costly in terms of forgone labor income, since it takes time to raise kids. However, when they become old, parents receive a monetary transfer from their kids, who hence represent an "investment good." Individuals save on the financial market by purchasing claims to physical capital, which provide an interest rate which will be determined in equilibrium. To capture the efficiency of the financial markets, we assume that there may be a deadweight cost, ε, which reduces the return on the financial assets. In countries with a higher ε, that is, with a less developed financial market, savings provide a lower return and are thus less convenient.

Each young individual takes her fertility and saving decision in order to maximize the following utility function:

$$U\left(C_t^t\right) + \beta U\left(C_{t+1}^t\right), \tag{1}$$

where C_t^t and C_{t+1}^t represent respectively the consumption in youth and in old age for an individual born at time t and β is the standard discount factor. This maximization problem is subject to the following budget constraints:

$$w_t\left[1 - \tau_t - d - \phi_t(f_t)\right] = C_t^t + S_t$$
$$C_{t+1}^t = S_t R_{t+1}(1-\varepsilon) + w_{t+1} f_t d + P_{t+1}$$

where $\phi_t(f_t)$ represents the fertility cost, that is, the cost of raising children, which is a function of the number of children f_t, d is the gift to the parents, which is assumed to be proportional to the wage,[1] τ_t is the pension contribution rate paid by all young individuals, and S_t are the saving, that is, the purchase of the private claim on the stock of capital. In their second period of her life, at time $t+1$, an individual receives a gross interest factor R_{t+1} on her financial assets, S_t, which has to be reduced by a cost ε, measuring the financial efficiency of the credit market. Every individual receives also a gift from each of her child $w_{t+1} f_t d$, and a pension P_{t+1}.

The PAYG social security budget constraint is

$$P_{t+1} = \tau_{t+1} w_{t+1} \overline{f_t}$$

where $\overline{f_t}$ is the average fertility rate in the population.

2.2 The optimization problem

Each young individual takes decision over savings and fertility level. The corresponding first order conditions for savings and fertility are respectively:

$$U'\left(C_t^t\right) = \beta R_{t+1}(1-\varepsilon) U'\left(C_{t+1}^t\right) \tag{2}$$

and

$$w_t \phi_t'(f_t) U'\left(C_t^t\right) = \beta w_{t+1} d U'\left(C_{t+1}^t\right). \tag{3}$$

The saving decision is standard. The fertility decision at (3) resembles a saving decision. Individuals trade off the lower utility from the reduction in youth consumption, since a part of the resource (namely, the endowment of time) is used to raising kids, with the higher utility in old age, since they expect their offsprings to provide them with some resources as they become old.

The two first order conditions can be rewritten to obtain the following equation that characterizes the relation between the fertility and the saving decisions:

$$\phi_t'(f_t) = \frac{d}{w_t} \frac{w_{t+1}}{R_{t+1}(1-\varepsilon)}. \tag{4}$$

Fertility depends positively on the return from investing in kids, and thus on the gift d, and on the ratio between the future and the current wage, but negatively on the return from the alternative saving mechanism, and thus on $R_{t+1}(1-\varepsilon)$.

To simplify the analysis, we consider a logarithmic utility function, $U(C) = \ln(C)$ and we assume a convex cost of fertility:[2] $\phi_t(f_t) = \mu f_t^{\gamma}$ with $\gamma > 1$. We also consider a Cobb–Douglas production function

$$Y_t = g(K_t) = K_t^{\alpha}$$

[1] In Sect. 2.5, we will discuss the results with different specifications of the gift d.

[2] This convex cost function implies an increasing cost of having kids. Coupled with a constant gift, the assumption guarantees an interior solution for the fertility choice. An alternative specification that may allow for analytically tractable interior solutions features a linear cost of raising kids and a gift function that is concave in the number of kids.

where K_t is per capita capital.

Profit maximization delivers the equilibrium levels of wage and interest rates

$$R_{t+1} = \alpha K_{t+1}^{\alpha-1}$$
$$w_{t+1} = (1-\alpha) K_{t+1}^{\alpha}.$$

Using these functional forms, the condition at (4) can be written as

$$f_t = \left[\frac{dK_{t+1}}{\gamma \alpha \mu (1-\varepsilon) K_t^{\alpha}} \right]^{\frac{1}{\gamma-1}}. \tag{5}$$

Due to the logarithmic utility function, we can obtain a simple expression for the optimal level of savings. The FOC with respect to S_t can be rewritten as

$$C_{t+1}^t = \beta R_{t+1} (1-\varepsilon) C_t^t.$$

Substituting the expressions for C_{t+1}^t and C_t^t from the budget constraints and using the PAYG social security budget constraint, we obtain the level of savings:

$$S_t = \frac{\beta}{1+\beta} w_t \left[1 - \tau_t - d - \phi_t(f_t) \right] - \frac{w_{t+1}}{R_{t+1}} \frac{f_t d + \tau_{t+1} \overline{f_t}}{(1-\varepsilon)(1+\beta)}. \tag{6}$$

2.3 The equilibrium

Since individuals are homogenous, we concentrate on symmetric equilibria. In equilibrium, the stock of capital at time $t+1$ depends on the average savings in the economy, and thus also on the average fertility rate at time t:

$$\overline{S_t} = K_{t+1} \overline{f_t} \tag{7}$$

where $\overline{S_t} = S_t$, as defined at (6) and $\overline{f_t} = f_t$, as defined at (5). Combining these expressions and the equilibrium condition at (7), we can easily obtain the equilibrium level of capital at time $t+1$:

$$K_{t+1} = \alpha \gamma (1-\varepsilon) \Lambda^{\frac{\gamma-1}{\gamma}} \left(\frac{\mu}{d} \right)^{\frac{1}{\gamma}} K_t^{\alpha}, \tag{8}$$

where

$$\Lambda = \frac{\beta(1-\alpha)(1-\tau_t-d)}{(1-\alpha)d(\beta+\gamma) + \gamma(1-\alpha)\tau_{t+1} + \alpha\gamma(1-\varepsilon)(1+\beta)}. \tag{9}$$

Despite the endogenous fertility choice—the evolution of stock of physical capital is standard of an exogenous growth model. Moreover, combining (8) and (5), we can now obtain an expression for the fertility rate:

$$f_t = \left(\frac{d\Lambda}{\mu} \right)^{\frac{1}{\gamma}}. \tag{10}$$

2.4 Pensions and alternative savings

We are now able to identify the impact of a change in the pension system on the alternative form of savings available to the individuals: fertility and financial assets.

First, notice that from (8) an increase in the pension contribution rate at time t or at time $t+1$ decreases the level of capital at time $t+1$:

$$\frac{\partial K_{t+1}}{\partial \tau_t} < 0, \qquad \frac{\partial K_{t+1}}{\partial \tau_{t+1}} < 0.$$

Analogously, an increase in the pension contribution rate at time t or at time $t+1$ reduces the accumulation obtained through the alternative saving instrument, and hence the fertility rate. Since kids are an "investment good," more resources in the second period of life, for instance, because of more generous pension transfers, reduces the need to having kids.

$$\frac{\partial f_t}{\partial \tau_t} < 0, \qquad \frac{\partial f_t}{\partial \tau_{t+1}} < 0.$$

Moreover, it is easy to see that the (negative) effect of the pension contribution rate on fertility rate is larger the smaller is the efficiency of the credit market, i.e., the larger is ε. In other words, pension spending reduces the fertility rate more in those countries in which individuals save less, since they face a higher deadweight cost stemming from the financial market. The intuition of this results is straightforward. Savings and fertility represent alternative mechanisms to transfer resources into the second period of life. When the saving instrument is more costly, individuals rely more heavily on the fertility choice to ensure an adequate level of resources for their second period of life. Higher contributions in youth and a more generous pension transfer in old age reduces the need of saving. In financially developed countries, individuals will reduce both the financial savings and their fertility, whereas in financially illiterate countries, individuals will have to adjust their fertility more intensively, since they rely more on this channel of saving.

Yet, having kids may not always be a deterministic decision. In some cases, for instance, individuals are unable to have kids. If a large share of individuals in the population has no kids—either because they are unable to or because their cost of raising kids is too high—the overall effect of an increase in pension spending on fertility will be limited to the actual parents. In a developing society, in which capital markets are imperfect, higher pension benefits will still reduce fertility for the potential parents, while leaving the childless individuals unaffected. In a more developed economy, instead, both individuals will reduce savings, but potential parents will also adjust their fertility rate. If one believes that childless individuals are more common in developed societies—perhaps due to the recent tendency to have kids in older age—this additional element should magnify the effect described above: higher pension benefits should reduce fertility more in less developed economies.

2.5 Extensions

In the simple model introduced above, individuals are assumed to transfer a proportion of their labor income to their parents. But why should they? The existence and

the size of this intergenerational transfer is exogenous in our model. Yet, the literature has provided different motivations. Kids may choose to take care of their parents due to altruism. In other words, they may simply enjoy transferring money to or, alternatively, spending time with or providing care to their parents; or they may obtain utility from their parents consumptions (for instance, see Boldrin and Jones 2002). An active strand of literature (see Cigno 1993) has instead argued that kids may provide transfer to their parents also out of self interest. Individuals may choose to transfer resources to their parents, only because they expect that this behavior will in turn induce their kids to transfer resources to them in their old age. These intergenerational transfers may thus represent a (subgame perfect) equilibrium outcome of an intertemporal game of kids-to-parents gifts played by successive generations of parents and kids.

Our simple theoretical setting may easily be modified to accommodate the latter motivation for having a transfer from kids to parents. Assume that d can only take two values: $d = \{0, \overline{d} > 0\}$. That is, young either make a positive transfer to their parents, $\overline{d} > 0$, or none. For a constant sequence of proportional transfer $\overline{d} > 0$ to be a subgame perfect equilibrium of a repeated game among successive generations of players, it will have to be the case that young individuals are better off making the transfer to their parents than defaulting on this family system. If they make the transfer, they expect their own kids to transfer them an equal share d of their labor income. It is straightforward to derive the lifetime utility from complying with this family deal for a young individual at time t:

$$V\left(\overline{d}, \overline{d}\right) = \ln\left(\frac{\beta^{\beta}}{1+\beta^{1+\beta}}\right) + \beta \ln\left((1-\varepsilon)R_{t+1}\right) + (1+\beta)\ln(\Delta_t)$$

where Δ_t is the discounted lifetime income:

$$\Delta_t = w_t\left[1 - \tau_t - d - \mu(f_t)^{\gamma}\right] + \frac{w_{t+1}}{R_{t+1}}\frac{f_t d + \tau_{t+1}\overline{f_t}}{1-\varepsilon}.$$

If a young individual decides instead not to provide any transfer to her parents, she will also obtain no transfer in old age from her kids. In this case, she will prefer not to have kids, since they would represent—in this environment—a current cost with no future benefit. The lifetime utility from this deviation from the previous family plan for a young individual at time t is thus:

$$V(0,0) = \ln\left(\frac{\beta^{\beta}}{1+\beta^{1+\beta}}\right) + \beta \ln\left((1-\varepsilon)R_{t+1}\right) + (1+\beta)\ln(\Theta_t)$$

where Θ_t is the associated discounted lifetime income:

$$\Theta_t = w_t[1-\tau_t] + \frac{w_{t+1}}{R_{t+1}}\frac{\tau_{t+1}\overline{f_t}}{1-\varepsilon}.$$

Hence, young individuals will be better off to provide a monetary transfer if $\Delta_t > \Theta_t$, $\forall t$. Simple algebra shows that this condition is satisfied for $\alpha < \widetilde{\alpha}$, $\gamma > \widetilde{\gamma}$ and

$\overline{d} < \widetilde{d}$, where

$$\widetilde{\alpha} = \frac{(1-\tau_t)\beta - \tau_{t+1}}{(1-\tau_t)\beta - \tau_{t+1} + (1-\varepsilon)(1+\beta)},$$

$$\widetilde{\gamma} = \frac{(1-\tau_t)\beta(1-\alpha)}{(1-\alpha)[(1-\tau_t)\beta - \tau_{t+1}] - \alpha(1-\varepsilon)(1+\beta)},$$

$$\widetilde{d} = \frac{(1-\tau_t)\beta(1-\alpha)(\gamma-1) - \gamma(1-\alpha)\tau_{t+1} - \gamma\alpha(1-\varepsilon)(1+\beta)}{(1-\alpha)\gamma(1+\beta)}.$$

Providing transfer to the parents will lead to a reward in the future, which corresponds to a similar transfer from ones own kids. But it is costly. Moreover, besides transferring resources to their parents, individuals have to raise kids, if they want to have back some resources in the future. Is it convenient to use this complicated family saving scheme, when there exist alternative savings instruments, such as the financial assets? The above conditions suggest that family transfers are made and kids are raised when the share of the production that remunerates the capital (and thus the assets), α, is not too high, when the technology for raising kids is highly convex, so that the initial kids to be raised are relatively cheap, and finally when the transfer is not too large. Under these conditions, an endogenous level of family transfer, $\overline{d}$, arises as an equilibrium outcome of a family game. To fix ideas, consider the following case: a subjective discount factor, β, equal to one, a capital share of income, $\alpha = 0.25$, inefficient financial market with $\varepsilon = 0.2$, a constant contribution rate, $\tau_t = \tau_{t+1} = 0.2$, and a highly convex cost function with $\gamma = 30$. In this scenario, the young individuals would be willing to transfer to their parents up to 2% of their labor income. Moreover, if the cost function of raising kids is further characterized by $\mu = 0.00005$, the resulting fertility rate would be $f = 1.1$. which corresponds to an annual population growth rate of 1%.

3 Empirical methodology and results

The underlying intuition in this work is that in economies where financial markets are underdeveloped, children are a (relatively more) important source of old-age income for parents. By providing a technology for savings, pensions relax this constraint. As a result, we expect fertility to drop. In a cross-country setting, this would amount to finding evidence of a negative relationship between fertility and pensions, but a positive interaction between pensions and a measure of development of financial markets.

To investigate whether our argument is supported by the evidence, we augment a basic parsimonious specification of determinants of fertility with a measure of generosity of pension spending, a measure of the degree of development of financial markets, and the interaction between the two. This last variable allows us to capture the differential impact of increases of pensions generosity in countries with more or less functional capital markets. Our basic specification includes (log) GDP (to control for the established relationship between income and number of children), percent of rural population (to control for the fact that, in economies where agriculture is

more prominent, children are a relatively more important source of labor), legal origin dummies (to account for basic institutional cross-country differences), and the share of the population above 65 (to rule out that an association between fertility and pension would be a mechanical reflection of countries' demographic structure).

Data on pensions are sparse. The most detailed cross-country information on pension generosity is provided by the World Bank, which has undertaken an ongoing effort to update and expand the data reported in World Bank (1994). In particular, we are able to use two complementary measures: pension coverage, which captures active pension members as a share of the 15–64 years old population, and pension spending as percentage of GDP. Although documentation indicates accurate data collection, and possibly because of this, data on pension coverage and pension spending are available only as a cross section. Because issues of robustness and spurious correlation are of concern in cross-sectional, cross country settings, we also present estimations with alternative measures. These are drawn from ILO and IMF's Government Financial Statistics (GFS). These alternative measures capture the generosity of pension systems with less precision. However, they have an appreciable time series component, which can help attenuate concerns of cross-section spurious correlation.

To capture the level of development of financial markets, we use the ratio of private credit issued by deposit-money banks to GDP (CREDIT). This variable isolates credit issued to the private sector (as opposed to credit issued to governments and public enterprises; see Beck et al. 1999 for a detailed description). Indirect evidence suggests that financial development might be a good proxy for the extent of credit constraints faced by households in an economy. For example, using data on nearly 3,000 small and medium firms and 48 countries from the World Business Environment Survey dataset, Beck et al. (2008) show that financial development is negatively and significantly correlated with the degree of firms financing constraints (a correlation of -0.20, significant at 1%). As it is likely that small and medium enterprises face financing problems similar to those of households, this evidence lends support to our use of this proxy. Not surprisingly, financial development is also negatively correlated with the spread between lending and deposit rates, which is often interpreted as a measure of the cost of intermediation to households and firms (in our sample, the correlation is 0.24, significant at 5%). Table 1 reports descriptive statistics and the Appendix describes the variables and their sources.

Table 2 reports results from OLS estimation in a cross section of about 100 countries using the percentage of pension spending over GDP (PENGDP) as a proxy for pension generosity. A univariate regression returns the expected negative correlation between fertility and pension coverage (column 1). Similarly, we run a univariate regression of fertility and development of financial markets, with the expected negative correlation between the two (column 2). These negative correlations remain significant when fertility is regressed on both pension coverage and development of financial markets (column 3). These regressions are ran for 1995, year around which most of the reported data cluster. Of course, the negative pairwise relationship between these variables can result from many concurring factors, most of which are correlated with the development of both fertility and pensions. These include differences in income levels, institutional development, urban expansion, and the existing size of the

Table 1 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
FERTILITY	1553	4.13	1.96	0.95	8.50
COVERAGE	102	34.98	25.35	1.2	95.5
PENGDP	118	4.913	4.49	0	15.4
PENGDP _ILO	139	4.27	3.52	0	14.99
SSREV_GFS	677	10.55	12.52	0	82.34
CREDIT	1423	46.83	36.05	0.002	185.41
LRGDPPC	812	7.73	1.03	5.4	10.58
RIGIDITY EMPLOYMENT	174	38.28	18.28	0	77.5
CHRISTIAN	584	62.41	39.45	0	99.8
MUSLIMS	584	17.67	32.13	0	99.7
POP65	668	7.1	4.57	1.19	18.24
RURAL	677	46.18	24.32	0	96.8

older population. To control for these factor uniformly across the many estimations, we use the basic specification discussed above.

We find that fertility is significantly lower in richer, more urbanized countries, and in countries with a lower share of 65+ people. Surprisingly, in the augmented basic specification pension spending does not enter directly as a significant determinant of fertility (column 4). When included in the regression, the variable is not significantly different from zero, indicating that once all the other additional controls are included, the variation in pension generosity is not sufficient to identify significant changes in fertility. The same occurs when we include our measure of the development of financial markets (column 5). However, when interacted with credit development (column 6), the sign of the interaction is positive and consistent with our hypothesis—higher spending is associated with a more limited decrease in fertility in countries with more developed financial markets. The magnitude of the point estimate indicates that a one-standard increase in pension spending would be associated with a decrease in fertility of around 10% of a standard deviation in fertility when the share of credit is in the bottom quartile of the distribution. Instead, a similar increase in pension spending in a country at the median level of financial market development would be associated with a negligible decrease in fertility (about 1% of a standard deviation in fertility). Note that by controlling for (log) GDP and percent of rural population, we rule out first order concerns that the coefficient on the interaction simply identifies a correlation between pensions on fertility in low income countries, which have both higher fertility and less developed financial markets. Also, pension spending turns again significant, suggesting that the inclusion of the interaction introduces the needed differentiation across the spectrum of low-high development of credit markets.

We subject this result to a number of robustness checks, for instance by verifying that the estimation is not driven by outliers.

We also add to this basic specification other potentially relevant controls. For example, religious affiliation could be an important determinant of fertility behavior

Table 2 Fertility, pension spending, and credit.
Dependent variable: Fertility Rate, total (births per woman). Pension measure: pension spending as a % a GDP. Source: Averting the Old Age Crisis (cross section for 1991)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PENGDP	−30.12		−27.3	0.002	0.001	−0.071	−0.134	−0.067	−0.055	−0.026	−0.036
	(11.42)***		(9.51)***	(0.08)	(0.03)	(1.82)*	(3.24)***	(1.69)*	(1.32)	(0.78)	(0.98)
CREDIT		−2.1	−0.55		0.070	−0.993	−1.627	−0.895	−0.681	−0.607	−0.702
		(6.96)***	(2.07)**		(0.25)	(2.49)**	(3.64)***	(2.03)**	(1.64)	(1.30)	(1.69)*
PENGDP*CREDIT						0.166	0.229	0.155	0.130	0.117	0.108
						(3.75)***	(4.27)***	(3.29)***	(2.98)***	(2.54)**	(2.48)**
LRGDPPC				−1.333	−1.346	−1.254	−1.352	−1.276	−1.116	−0.911	−0.873
				(9.89)***	(8.94)***	(9.32)***	(9.47)***	(9.48)***	(7.98)***	(7.15)***	(3.98)***
RURAL				−0.003	−0.003	−0.007	−0.015	−0.007	−0.006	−0.013	−0.007
				(0.57)	(0.58)	(1.22)	(2.81)***	(1.31)	(1.14)	(2.96)***	(1.21)
POP65				−0.051	−0.051	−0.101	−0.065	−0.100	−0.122	−0.083	−0.139
				(1.53)	(1.54)	(2.80)***	(1.63)	(2.63)**	(3.18)***	(2.62)**	(4.27)***
CHRISTIAN							−0.003				
							(0.76)				
MUSLIMS							0.003				
							(0.76)				
RIGIDITY EMPLOYMENT								0.002			
								(0.30)			
LABOR FORCE FEMALE									0.016		
									(2.41)**		
SEC. EDU. FEMALE										−0.020	
										(4.08)***	
Constant	3.6	4.59	4.88	15.455	15.550	15.689	17.133	15.803	13.431	14.697	9.883
	(16.42)***	(20.54)***	(20.15)***	(12.26)***	(11.34)***	(12.29)***	(13.58)***	(12.33)***	(9.01)***	(15.14)***	(5.03)***
Obs	167	166	111	99	99	99	83	97	99	88	99
Legal origin dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Continent dummies	No	No	No	No	No	No	No	No	No	No	Yes
R-squared	0.52	0.22	0.52	0.87	0.87	0.88	0.90	0.88	0.89	0.91	0.89

Robust *t* statistics in parentheses
*Significant at 10%; **significant at 5%; ***significant at 1%

which is potentially correlated with income, pension generosity, and development of financial markets. However, inclusion of the percentage of the population of Christian and Muslim faith does not change significance and magnitude of the coefficient of interest (column 7). We then include in the regression a proxy for the extent to which labor market are rigid (column 8). This feature of countries' regulations is a potential source of spurious correlation because in countries with a more rigid labor legislation, entry into labor markets could be delayed, and thus result in lower fertility. This argument is often quoted to explain low fertility in a number of European countries, including Italy. At the same time, labor market rigidity could reflect polities' preferences for a larger social protection sector, and thus more pension spending or coverage. When we control for rigidity of labor markets, results are unchanged. Everything else equal, female labor participation (column 9) and female education (column 10) are also important determinants of fertility behavior. However, when either of these variable are included in the regression, results are unchanged. Finally, to provide an additional control for cross sectional institutional differences, we also include continent dummies (column 11). Although the magnitude of the coefficient of interest is slightly reduced, its significance is unchanged.[3]

We then present results from using pension coverage (COVERAGE) as a proxy for pension system generosity. Here as well, due to limited data availability, regressions are performed as a single cross section for 1995. Table 3 follows a structure similar to Table 2. We first present a univariate regression between fertility and pension coverage (column 1) and then estimation results from the augmented basic specification with pension coverage (column 2) and with pension coverage and financial markets development (column 3). Column 4 reports our main regression—where we find again that the pension/credit interaction has a positive and significant sign. As with pension spending, the estimation is robust to the inclusion of a large number of additional correlates (columns 5 to 9).

3.1 Robustness checks

Although we control for a number of potential sources of omitted variables bias, OLS estimates should not in principle be interpreted causally in a cross sectional setup. However, we should note that our main inference relates to the interaction between pension generosity (however measured) and development of financial markets, rather than the direct effects on fertility of the two. In this context, for example, the reverse causality concern would refer to possible feedback effects of fertility on the interaction between pensions and development of financial markets, probably a less compelling case than if we were interested in direct effects. A similar argument would run for issues of omitted variable bias.

[3] A potential drawback of cross country analysis is that the list of variables included as controls may not be exhaustive. Notice however that in our case, to be a relevant control a variable should be related with fertility, pension and with the interaction between these two. This last correlation in particular is not easy to arise. In addition to the ones explained above, another variable which may be potentially relevant is life expectancy. We have explored this possibility, by adding life expectancy (World Bank data) among the controls. As expected, life expectancy is negatively related with fertility. However, all our results are robust to the inclusion of this variable.

Table 3 Fertility, coverage, and credit.
Dependent variable: Fertility Rate, total (births per woman). Pension measure: Coverage. Source: World Bank (2007)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
COVERAGE	−4.9	0.007	0.007	−0.012	−0.016	−0.011	−0.012	−0.010	−0.011
	(10.61)***	(0.73)	(0.74)	(1.19)	(1.58)	(0.98)	(1.19)	(1.11)	(1.25)
CREDIT			0.001	−0.012	−0.015	−0.010	−0.012	−0.011	−0.074
			(0.45)	(2.43)**	(2.89)***	(2.15)**	(2.61)**	(1.86)*	(1.59)
COVERAGE*CREDIT				3.309	3.827	3.242	3.375	2.972	1.899
				(3.66)***	(3.84)***	(3.52)***	(3.86)***	(3.08)***	(2.40)**
LRGDPPC		−1.463	−1.484	−1.394	−1.543	−1.360	−1.404	−1.039	−0.967
		(6.34)***	(6.41)***	(6.61)***	(5.42)***	(6.59)***	(6.82)***	(4.71)***	(3.27)***
RURAL		−0.008	−0.008	−0.010	−0.014	−0.010	−0.010	−0.010	−0.010
		(1.44)	(1.44)	(1.98)*	(2.06)**	(1.76)*	(1.98)*	(2.00)*	(1.62)
POP65		−0.063	−0.066	−0.105	−0.068	−0.114	−0.104	−0.097	−0.124
		(1.74)*	(1.79)*	(3.02)***	(2.16)**	(2.81)***	(2.95)***	(2.79)***	(4.08)***
CHRISTIAN					0.001				
					(0.20)				
MUSLIM					0.005				
					(1.28)				
RIGIDITY EMPLOYMENT						0.008			
						(1.10)			
LABOR FORCE FEMALE							−0.001		
							(0.20)		
SEC. EDU. FEMALE								−0.012	
								(2.77)***	
Constant	4.67	16.444	16.606	16.942	18.071	16.329	17.130	14.956	11.612
	(19.96)***	(9.17)***	(9.20)***	(9.82)***	(7.25)***	(9.97)***	(9.77)***	(8.51)***	(4.69)***
Obs	98	80	80	80	68	77	80	71	80
Legal origin dummies	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Continent dummies	No	No	No	No	No	No	No	No	Yes
R-squared	0.59	0.82	0.82	0.85	0.88	0.85	0.85	0.86	0.85

Robust *t*-statistics in parentheses
*Significant at 10%; **significant at 5%; ***significant at 1%

Nonetheless, since our estimates are obtained on a fairly small sample, it is useful to subject them to further robustness checks. Moreover, the magnitude of the estimated effects is small, which could indicate the presence of serious attenuation bias due to measurement error. Lacking credible instrumental variable strategy for this set up, we use measures of pension spending from alternative sources to verify if our result is robust. In particular, we use data on pension spending as a percentage of GDP drawn from ILO (PENGDP_ILO) and on social security contributions as a percentage of revenues from Government Financial Statistics (SSREV_GFS). Pairwise correlations between these variables are high.

The sample of countries covered by PENGDP_ILO is smaller than the one covered by PENGDP. However, PENGDP_ILO has a small longitudinal component. Taking into account the availability of other correlations, this amounts to be able to estimate our basic specification for about 70 countries and a total of 145 observations. Estimated coefficients are robust to the use of this alternative measure of pension spending and are in the order of magnitude of those in the specification with PENGDP. Table 4 reports estimates.

Fixed effect estimation is a particularly useful robustness check in this context. Although they do not address directly the issue of causality, they tackle the main concern in the interpretation of cross sectional cross country estimates, i.e., that unobservable country effects might drive the estimated correlations.

Data from government financial statistics (GFS) cover a larger set of countries and measure the share of social security contributions over government revenues (including both provincial and central government level). Although the correlation between SSREV_GFS and PENGDP is high (0.73), SSREV_GFS is likely to include contributions to forms of social security other than pensions. However, as this measure is available for a large set of countries and for over 4 periods per country, it allows estimation with fixed effects.

We first estimate with OLS the same set of basic regressions using SSREV_GFS as dependent variable. The data are organized in 4 5-year periods per country, starting 1970. The interaction variable is consistently significant across different controls as well as in FE, although in this case coefficients are smaller in magnitude. Table 5 reports estimates.

4 Conclusions

Pensions, children and financial assets are different instruments to insure income during old age. We build a simple OLG model that predicts that more generous pensions reduce the need to having kids as "investment good," thus reducing fertility. This effect is larger in countries with less developed capital markets, because, when the saving instrument is more costly, individuals rely more heavily on the fertility choice to ensure an adequate level of resources for their second period of life. These effects are tested and quantified in a cross-country regression analysis.

Our study may provide a useful framework to address policy analysis. First, it may provide important policy implications for those developing countries that are currently dealing with defining their modern social security systems as well as for

Table 4 Fertility, pension spending, and credit.
Dependent variable: Fertility Rate, total (births per woman). Pension spending as a % a GDP from ILO

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PENGDP_ILO	0.030	0.040	−0.189	−0.168	−0.207	−0.185	−0.137	−0.106	−0.103
	(0.81)	(1.02)	(2.74)***	(2.34)**	(4.07)***	(3.08)***	(2.62)**	(1.73)*	(2.30)**
CREDIT		−0.268	−1.428	−1.226	−1.365	−1.375	−1.310	−0.897	−0.680
		(1.09)	(4.05)***	(3.08)***	(6.36)***	(6.00)***	(5.61)***	(4.15)***	(2.92)***
PENGDP_ILO*CREDIT			0.281	0.252	0.277	0.285	0.264	0.191	0.136
			(4.17)***	(3.48)***	(5.85)***	(5.08)***	(4.75)***	(4.12)***	(3.33)***
LRGDPPC	−1.413	−1.365	−1.158	−1.206	−1.209	−1.092	−1.112	−0.801	−0.562
	(9.42)***	(8.43)***	(6.98)***	(7.06)***	(7.11)***	(6.58)***	(7.52)***	(4.72)***	(2.66)***
RURAL	−0.011	−0.010	−0.012	−0.012	−0.012	−0.012	−0.013	−0.014	−0.010
	(1.89)*	(1.79)*	(2.04)**	(2.01)**	(2.09)**	(1.98)*	(2.37)**	(2.45)**	(2.30)**
POP65	−0.092	−0.092	−0.113	−0.109	−0.091	−0.130	−0.134	−0.067	−0.183
	(2.51)**	(2.46)**	(3.19)***	(3.08)***	(2.57)**	(3.11)***	(3.79)***	(2.25)**	(5.99)***
YEAR = 1995	−0.215	−0.227	−0.222	−0.206	−0.192	−0.215	−0.240	0.039	−0.221
	(1.29)	(1.34)	(1.43)	(1.31)	(1.25)	(1.30)	(1.55)	(0.25)	(1.65)
CHRISTIANS					0.006				
					(1.43)				

Table 4 (*Continued*)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MUSLIMS					0.009				
					(1.89)*				
RIGIDITY EMPLOYMENT						0.008			
						(1.12)			
LABOR FORCE FEMALE							0.009		
							(1.39)		
SEC. EDU. FEMALE								−0.023	
								(4.59)***	
Constant	16.901	16.556	15.756	16.028	15.483	15.004	14.893	13.961	10.392
	(13.58)***	(12.76)***	(11.83)***	(11.98)***	(10.13)***	(10.51)***	(11.11)***	(11.03)***	(5.45)***
Obs	117	117	117	116	110	113	118	104	121
Legal origin dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Continental dummies	No	No	No	No	No	No	No	No	Yes
R-squared	0.82	0.82	0.85	0.85	0.86	0.85	0.85	0.89	0.88

Robust *t* statistics in parentheses

*Significant at 10%; **significant at 5%; ***significant at 1%

Omitted category is year = 1990 Column (4): Guyana is not included in the sample

Table 5 Fertility, Social security contributions, and credit.
Dependent variable: Fertility Rate, total (births per woman). Social security contributions as % of Revenue from GFS, IMF

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS	(10) FE
SSREV_GFS	0.133	0.150	−2.793	−3.133	−2.293	−3.291	−2.325	−0.357	−2.290	−1.720
	(0.16)	(0.18)	(2.18)**	(2.38)**	(1.58)	(2.54)**	(1.75)*	(0.28)	(2.10)**	(1.32)
CREDIT		−0.073	−0.423	−0.535	−0.251	−0.355	−0.320	−0.128	−0.250	−0.176
		(0.40)	(1.88)*	(2.10)**	(0.96)	(1.62)	(1.35)	(0.64)	(1.23)	(0.93)
SSREV_GFS*CREDIT			3.076	4.070	2.118	3.065	2.717	1.263	2.292	1.771
			(3.43)***	(3.44)***	(2.21)**	(3.69)***	(2.80)***	(1.43)	(3.14)***	(2.21)**
YEAR = 1970	0.627	0.672	0.704	0.697	0.000	0.721	0.000	0.000	0.845	1.253
	(3.18)***	(3.28)***	(3.49)***	(3.37)***	(.)	(3.59)***	(.)	(.)	(4.06)***	(6.84)***
YEAR = 1980	0.468	0.489	0.516	0.505	0.000	0.543	0.568	0.000	0.504	0.524
	(5.20)***	(5.23)***	(5.56)***	(5.46)***	(.)	(5.62)***	(5.74)***	(.)	(6.10)***	(6.00)***
YEAR = 1995	−0.236	−0.221	−0.224	−0.240	−0.205	−0.257	−0.227	0.036	−0.217	−0.336
	(4.01)***	(3.66)***	(3.66)***	(3.93)***	(3.04)***	(4.11)***	(3.74)***	(0.38)	(3.74)***	(4.54)***
LRGDPPC	−0.937	−0.975	−0.958	−0.953	−1.375	−0.963	−0.967	−0.931	−0.684	0.037
	(5.37)***	(5.36)***	(5.36)***	(5.33)***	(9.65)***	(5.36)***	(5.06)***	(5.56)***	(2.86)***	(0.21)
RURAL	0.006	0.006	0.005	0.004	−0.007	0.004	0.001	−0.004	0.006	0.038
	(0.98)	(0.92)	(0.68)	(0.63)	(1.30)	(0.64)	(0.19)	(0.73)	(0.95)	(3.71)***
POP65	−0.131	−0.120	−0.112	−0.122	−0.034	−0.094	−0.128	−0.052	−0.144	0.140
	(4.37)***	(3.97)***	(3.91)***	(4.11)***	(1.22)	(3.08)***	(4.09)***	(2.07)**	(4.48)***	(2.76)***

Table 5 (*Continued*)

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS	(10) FE
CHRISTIANS					0.004					
					(1.17)					
MUSLIMS					0.007					
					(1.72)*					
RIGIDITY EMPLOYMENT						0.006				
						(1.21)				
LABOR FORCE FEMALE							0.009			
							(1.36)			
SEC. EDU. FEMALE								−0.016		
								(3.38)***		
Constant	12.320	12.557	12.587	12.693	15.703	12.185	12.308	13.493	9.849	0.664
	(7.67)***	(7.66)***	(7.72)***	(7.73)***	(11.99)***	(7.45)***	(6.61)***	(9.94)***	(5.46)***	(0.47)
Obs	303	291	291	287	161	272	268	155	291	294
Legal origin dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Continental dummies	No	No	No	No	No	No	No	No	Yes	No
R-squared	0.81	0.81	0.81	0.81	0.85	0.82	0.82	0.86	0.85	0.67
Number of group (wbcode)	116	115	115	114	90	107	115	98	115	118

Robust *t* statistics in parentheses

*Significant at 10%; **significant at 5%; ***significant at 1%

Omitted category is year = 1990. Column (4): Switzerland is not included in the sample

middle and high-income countries that are tackling issues of pension system sustainability. It may be useful to provide insights on the effects of the extension of social security coverage on fertility, which are particularly relevant for some countries, such as China, where currently high saving rates coexist with a (mandatory) low fertility and a small public pension system covering less than 10% of the population. In these contexts, in fact, the link between the social security system and fertility may be one of the most important policy levers to realign fertility incentives. For example, given the low level of fertility in China, the adjustment following an extension of pension coverage would most likely be reflected in changes in savings. As many see in China's high savings rate, an important engine of the country's stellar growth, the issue of how an extension of pension coverage will affect savings is critical.

Moreover, our study provides new insights to understand long-term demographic dynamics both in developed and in developing countries. In developed countries with a high pension expenditure, longevity increases might trigger reforms that reduce benefits and per-capita pension wealth. This in turn may induce an increase of fertility motivated by the need of increased support to the old (see also Billari and Galasso 2008). In developing countries instead, an increase of longevity will create pressure to increase pension coverage, and thus pension expenditure and would lead to a decrease in fertility.

More generally, the degree of development of the financial markets, and the availability of instruments to ensure against longevity, health, and long term care risks, as well as the design of the social security systems and availability of public programs of old age care are bound to have a large impact on the individual fertility decisions. The study of family policies in conjunction with the design of pension schemes and other welfare state programs is a prominent research area.

Appendix: Variable description

FERTILITY: Fertility rate, total (births per woman). Source: World Bank, World Development Indicators (WDI).

PENGDP: Old age pension spending over GDP, various years. Source: World Bank (2007).

PENGDP _ILO: Pension spending over GDP, various years. Source: ILO.

SSREV_GFS: Social security contributions as a share of government revenues, various years. Source: Government Financial Statistics, IMF.

CREDIT: Domestic credit provided by banking sector (% of GDP). Source: WDI.

RIGIDITY OF EMPLOYMENT: Rigidity of employment index. It measures the flexibility of labor regulations as an average of difficulty of hiring a new worker (Difficulty of Hiring Index); restrictions on expanding or contracting the number of working hours (Rigidity of Hours Index); and difficulty and expense of dismissing a redundant worker (Difficulty of Firing). Range: 0 (completely flexible)–100 (completely inflexible). Source: World Bank, Doing Business, http://www.doingbusiness.org/.

LRGDPPC: (log) Real GDP per capita in 1985 US $, various years. Source: World Bank, World Development Indicators (WDI).

CHRISTIAN: Percent Christians, various years. Source: CIA factbook.
MUSLIM: Percent Muslims, various years. Source: CIA factbook.
POP65: Percent of the population above 65 years of age, various years.
RURAL: Percent of rural population, various years. Source: WDI.
COVERAGE: Active Members (% pop. 15–64) of mandatory pension systems. Source: World Bank (2007).
LEGAL ORIGIN: Dummy variables for the origin of the legal system, classifying a country's legal system into Anglo-Saxon Common Law (UK), French Civil Law (FR),German Civil Law (GE), Socialist Law (SO), or Scandinavian Law (SC). Source: La Porta et al. (1998).
FEMALE LABOR FORCE: Labor force participation rate, female (% of female population ages 15–64). Source: WDI.
FEMALE SECONDARY EDUCATION: School enrollment, secondary, female (% gross). Source: WDI.

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