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Abstract

A broad political economics literature explains the introduction and expansion of pension systems, but the effects caused by the endogenous reduction of fertility are typically disregarded, as the fertility choice is usually considered exogenous. This paper suggests a political model that takes into account these effects and analyzes the net effect of the reduction of fertility costs on the dimension of pension systems. Some stylized facts support an inverted-U development pattern: a continuous and progressive increase of the fertility cost, after inducing the introduction of pension systems, tends to reduce, *ceteris paribus*, their political support.

JEL classification: H55; D72; O15; J13; J14
Keywords: Family economics; Fertility; Political sustainability; Social security; Voting

1 Introduction

In the last century, in most developed countries, the transition from a state with low economic growth and a primarily rural economy to a state with fast growth and industrial economy had some strong effects on the domestic economy causing, on the one hand, a huge reduction of the fertility rate and, on the other hand, the introduction and subsequent development of pension spending.

Among the factors that led to the decline of the fertility rate one can list: the increase of the return on human capital, which induces the substitution of quantity with quality of children (see Becker and Lewis, 1973; Becker and Barro, 1988; Barro and Becker, 1989; Galor and Weil, 2000); the agricultural and medical development, which reduced the mortality rate and its volatility, hence reducing the need for a high number of children (see Kalemli-Ozcan, 2002); the change in family relations (weakening of the family ties, reduction of the

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socioeconomic differences between men and women), which induced a reversal in the direction of the net wealth flows reducing the economic attractiveness of fertility (see Caldwell, 1976, 1978; Boldrin and Jones, 2002); some social policies (pensions, compulsory education, child labour regulation), usually accompanying the economic development, which increased the fertility costs and decreased the fertility benefits (see Leibenstein, 1957; Caldwell, 1976, 1978; Cigno and Rosati, 1992).

As regards the introduction and development of unfunded pension systems, a broad literature has studied this phenomenon, developing models that explain why they exist and have been continuously expanding during the 20th century. The question that immediately arises is why these pension systems exist and why their growth is supported by the voters: it needs to be noticed, in fact, that the main purpose of pension systems is to transfer wealth from a majority of worker-voters to a minority of pensioner-voters. Since the Seventies, numerous papers have tried to answer this question, and some interesting reviews of the literature are offered by Breyer (1994), Galasso and Profeta (2002) and de Walque (2005). Focusing the attention only on the voting models, which is the approach taken by the present paper, Galasso and Profeta (2002) identify five motives for the introduction of pension system: dynamic inefficiency, limited time horizon, crowding-out of the investment, intragenerational redistribution and optimal social contract.

The first explanation for the political support to pension systems is given by their economic attractiveness in the special case of dynamic inefficiency: if the ratio between interest rate and growth rate, also called Aaron variable, is less than one then the present value of the wealth of future generations does not converge, therefore a pay-as-you-go pension system (and public debt) is Pareto-improving (see Samuelson, 1958; Diamond, 1965; Aaron, 1966).

Another explanation is given by the fact that the portion of pension contributions already payed are considered a sunk-cost by the voters, hence if for the median voter the present value of the benefits coming from the pension system is higher than the portion of contributions yet to be paid then a majority of voters will support the pension system; moreover the older is the median voter, the higher will be the size of the system (see Browning, 1975).

The third explanation relates to the crowding-out effect of pension systems (and public debt) on investment, which increases the return on capital hence motivating interest-earners to support it (see Cukierman and Meltzer, 1989; Cooley and Soares, 1999; Boldrin and Rustichini, 2000).

A typical characteristic of pension systems is that contributions are proportional to income, whereas benefits are partially independent of it, suggesting us another explanation for the political support for pension system: low-income voters are favourable toward the introduction and development of pension systems (see Tabellini, 1991, 2000; Casamatta et al., 2000).

The last explanation comes from the hypothesis of ascendant altruism: individuals tend to "undersave" during youth in order to obtain a transfer during old age from the young generation, therefore the introduction of social security would be Pareto-efficient and supported even under unanimity rule (see Hansson and Stuart, 1989; Veall, 1986, with funded pensions).

These motives, however, do not explain the timing of the introduction of social security. In other words, they do not explain why pension system have been implemented just at the same time as economic development. Several reasons have been proposed as possible answers to this question, summarized by Cutler and Johnson (2004) as follows: insurance against the risks of the capitalist system (e.g., Great Depression and the 1935 U.S. Social Security Act); political legitimacy of non-democratic governments (e.g., the German and Argentinean social security systems introduced by Bismarck and Perón); the Wagner's law, which assumes social insurance as luxury good (e.g., U.K. and Australia implemented social security when they were the richest countries in the world, and it was financed by general revenue); the demographic heterogeneity, which may induce the implementation of income redistribution policies; the Leviathan theory, which claims that the governments tend to expand their range of action; the demonstration effect, which induces countries to copy their neighbours'successful policies.

Caucutt et al. (2007) suggest the transition from a rural economy to an urban one as a possible explanation for the development of pension systems. They conclude that the urbanization is led by the faster technological progress of the city compared with that of the farm and the increase of the life expectancy, because of the larger productivity of the urban economy, and the need for a larger amount of savings. This transition caused the passage from a rural median voter, who grounds his old-age economic security on the land rent and is not interested in a pension system (even though it could be more profitable), to an urban median voter, who has a flat (or even hump-shaped) age-earning profile, therefore more favourable to the introduction of the pension system.

This last model draws a parallel with the Caldwell hypothesis about fertility: the economic transition from a rural-Malthusian to a urban-Solowian economic system affects the domestic economy; the individuals cannot ground their old-age economic security on children (Caldwell) and land factor (Caucutt et al.), hence, on the one hand, they choose to reduce their fertility, triggering the demographic transition and, on the other hand, support a system which is able to substitute the old familiar structure. Since the reduction of the overall fertility rate affects the attractiveness of a pay-as-you-go pension system, the economic transition has two opposite effects on it.

The purpose of the present paper is to study these two effects, in order to evaluate their empirical relevance on the development of pension system. It will be suggested a model which tries to evaluate the effects of the increase of fertility cost on the introduction of pension system, taking into account the effect of fertility reduction. The paper is organized as follows: section 2 presents the model, section 3 presents some stylized facts which support the theoretical model and section 4 concludes.

2 The basic model

2.1 The environment

In our economy agents live for two periods: middle-age and old age. Moreover the economy has two locations, the *farm* and the *city*: in the farm the fertility cost is lower than in the city. A proportion γ_t of the population lives in the city and the others live in the farm. Individuals differ in their first period income (w^i), which is distributed in the population with mean w and cumulative distribution function $F(\cdot)$. The objective function of a middle-aged agent born in t, living in the $k \in (C, F)$ location and having an income level w^i is:

$$u(c^{ik}_{1,t}, c^{ik}_{2,t+1}) \equiv \ln(c^{ik}_{1,t}) + \beta \ln(c^{ik}_{2,t+1}) \tag{1}$$

In the first period each agent i receives w^i units of good, upon which she has to transfer a fixed share of her income δ and pay a contribution to the pension system τ_t proportional to her income (if a pension system is established), with $0 \leq \tau_t \leq 1 - \delta$. Moreover, she chooses how many children to have: for each child she bears a cost of θ^k, which is lower for farmers. The income that is not invested in children should be consumed, otherwise it is wasted. Hence the budget constraint for the first period is:

$$c^{ik}_{1,t} + \theta^k N^{ik}_t \leq (1 - \delta - \tau_t) w^i \tag{2}$$

In the second period, agents receive an average transfer δw from the child they had in the first period. Moreover agents receive a transfer from the social security system, which is equal to the total amount of contributions collected by the system from workers of the following generation. Hence the budget constraint in the second period is:

$$c^{ik}_{2,t+1} \leq \delta w N^{ik}_t + \tau_{t+1} w N_t \tag{3}$$

where N_t is the total (or mean) fertility, hence it is given by:

$$N_t \equiv \gamma_t N^c + (1 - \gamma_t) N^f$$

where N^k stands for the mean fertility in location k.

It should be noticed that as savings are not allowed, the only way in which agents can voluntary transfer wealth from the first period to the second is by having children. In this economy, children are perceived as investment, and this investment is more profitable for farmers than for urban residents.

Similarly to Boldrin and Rustichini (2000), I assume that there exist a sequence $\{\gamma(j)\}_{j=0}^{\infty}$ such that:

$$\begin{aligned}
\gamma(j+1) &> \gamma(j) \quad \forall j \\
\lim_{j \to \infty} \gamma(j) &= 1 \\
Pr(\gamma_{t+1} = \gamma(j); \gamma_t = \gamma(j)) &= 1 - p \\
Pr(\gamma_{t+1} = \gamma(j+1); \gamma_t = \gamma(j)) &= p
\end{aligned}$$

The choice to establish a social security system is taken by vote. The "winner" policy τ_t is determined by majority vote. The vote will take place in t if $\gamma_t \neq \gamma_{t-1}$, otherwise $\tau_t = \tau_{t+1}$.

The social security system allows people to transfer wealth to their old-age, but the amount they can transfer is chosen collectively. Therefore there are agents who would prefer to transfer more than what is established, and they will have children, and other agents who would like to transfer a smaller amount, and they will not have children (actually they would like to have a "negative" amount of children, which is obviously not possible).

2.2 Voters' behaviour

Maximizing (1) subject to (2) and (3), with respect to the choice variables $\{c_{1,t}^{ik}, c_{2,t+1}^{ik}, N_t^{ik}\}$, we obtain the following conditions:

$$c_{1,t}^{ik} = \frac{w^i}{(1+r_k)(1+\beta)}\left[(1-\delta)(1+r_k) - \tau_t(1+r_k) + \tau_{t+1}\frac{N_t w}{w^i}\right] \quad (4)$$

$$c_{2,t+1}^{ik} = \frac{\beta w^i}{(1+\beta)}\left[(1-\delta)(1+r_k) - \tau_t(1+r_k) + \tau_{t+1}\frac{N_t w}{w^i}\right] \quad (5)$$

$$N_t^{ik} = \frac{\beta}{\theta^k(1+\beta)}\left[(1-\delta-\tau_t)w^i - \frac{\tau_{t+1} w N_t}{\beta(1+r_k)}\right] \quad (6)$$

where $(1+r_k) \equiv \frac{\delta w}{\theta^k}$ is the return on the familiar investment.

It should be noticed that for every pair $(\tau_t^\circ, \tau_{t+1}^\circ)$, there exists a threshold endowment $w^{\circ k}$, such that agents living in k with endowment lower than $w^{\circ k}$ will not have children:

$$w^{\circ k} = \frac{\tau_{t+1}^\circ w N_t}{\beta(1+r_k)(1-\delta-\tau_t^\circ)}$$

The effect on individual fertility of an increase in τ_t or in τ_{t+1} is unambiguously non-positive: as τ_t increases, the agents have a smaller available income to invest on children, and as τ_{t+1} increases they already have a larger amount of transfer from the pension system in the second period, then they need to shift a smaller amount of income to the old-age through children investment.

Moreover, from (6), we can easily see that urban residents have a lower fertility than farmers, then as γ_t increases the total fertility will decrease.

Assuming that w^i is uniformly distributed between 0 and 1, the total fertility in k is:

$$\begin{aligned} N_t^k &\equiv \int_{w^{\circ k}}^1 N_t^{ik} dw^i \\ &= \frac{\beta}{2(1+\beta)\theta^k}\left[1-\delta-\tau_t - \frac{\tau_{t+1}N_t}{\beta(1+r_k)}\left(1+\frac{3\tau_{t+1}N_t}{4\beta(1+r_k)(1-\delta-\tau_t)}\right)\right] \end{aligned} \quad (7)$$

2.3 Political equilibrium

Substituting (4) and (5) in the utility function (1), we get the following indirect utility function

$$\begin{aligned} V_t^{ik}(\tau_t, \tau_{t+1}) &= \beta \ln\left[\beta(1+r_k)\right] + (1+\beta)\ln\frac{w}{(1+r_k)(1+\beta)} + \\ &+ (1+\beta)\ln\left[(1-\delta-\tau_t)(1+r_k) + \frac{\tau_{t+1} w N_t(\tau_t, \tau_{t+1}; \gamma_t)}{w^i}\right] \end{aligned} \tag{8}$$

Let $\tilde{\tau}_j$ be the "winner" policy when $\gamma_t = \gamma(j)$. Taking into account the dynamic of γ_t and the voting mechanism, we know that $\tau_{t+1} = \tau_t = \tilde{\tau}_j$ with probability $(1-p)$ and $\tau_{t+1} = \tilde{\tau}_{j+1}$ with probability p. Now the voter's problem is to maximize V_t^{ik} with respect to $(\tilde{\tau}_j, \tilde{\tau}_{j+1})$.

It can be shown that $\frac{\partial V_t^{ik}}{\partial \tilde{\tau}_{j+1}} > 0$ for any $(\tilde{\tau}_j, \tilde{\tau}_{j+1})$: intuitively, this means that every voter born in t has an incentive to vote $\tau_{t+1} = 1$ if in $t+1$ voting will take place.

More interesting is the question about the preferred $\tilde{\tau}_j$. Differentiating (8) with respect to $\tilde{\tau}_j$, we get:

$$\frac{\partial V_t^{ik}}{\partial \tilde{\tau}_j} = \frac{1+\beta}{\varrho^{ik}}\left\{\frac{w}{w^i}\left[(1-p)N_t + \tau_{t+1}\left(\frac{\partial N_t}{\partial \tau_t} + (1-p)\frac{\partial N_t}{\partial \tau_{t+1}}\right)\right] - (1+r_k)\right\} \tag{9}$$

where $\varrho^{ik} \equiv (1-\delta-\tau_t)(1+r_k) + \frac{\tau_{t+1} w N_t}{w^i}$.

A marginal increase in the rate of contribution $\tilde{\tau}_j$ has three effects on the voters' indirect utility. First, an increase in the share of income compulsorily invested in the pension system: this effect depends on the return on pension system, which is higher for poorer voters. Second, a decrease in the return on pension system, keeping fixed the amount of income invested in it. Third, a decrease in the share of income invested in children: this effect depends on the return on children, which is higher in the farm than in the city.

The sign and the size of the overall effect is different between farmers and urban residents and between poor and rich voters: farmers have a larger negative effect, as they have to give up a larger return from children; rich voters have a smaller positive effect, as for them the return on pensions is smaller.

We can rewrite equation (9) as follows:

$$\frac{\partial V_t^{ik}}{\partial \tilde{\tau}_j} = \frac{1+\beta}{W^{ik}}\left\{\frac{w}{1+r_k}\left[(1-p)N_t + \tau_{t+1}\left(\frac{\partial N_t}{\partial \tau_t} + (1-p)\frac{\partial N_t}{\partial \tau_{t+1}}\right)\right] - w^i\right\} \tag{10}$$

where $W^{ik} \equiv (1-\delta-\tau_t)w^i + \frac{\tau_{t+1} w N_t}{1+r_k}$.

From this equation we can easily identify a pair of farmer and urban resident who have similar preference toward the policy rule. In fact we get:

$$w^{if} = \frac{1+r_c}{1+r_f} w^{ic} \tag{11}$$

For any urban resident with income w^{ic}, there is always a farmer, with income w^{if}, with the same preference toward the policy rule, and the farmer is always poorer than his urban correspondent. Since a farmer has a higher return from children investment, he must have a lower income (then a higher return from pension) in order to prefer the same level of pension as an urban resident.

Since preferences are monotonic in endowment, the single crossing condition is satisfied and a Condorcet winning tax rate does exist. To find the equilibrium policy, we need to know which is the pair of voters (a farmer and an urban resident) who play the median voter role. Let w^{*k} be the endowment of a voter resident in k and with preferred policy $\tilde{\tau}_j^*$; setting (10) equal to zero and solving for w^{*k}, we find that the relation between favourite policy and endowment is given by:

$$w^{*k} = \frac{w}{1+r_k}\left[(1-p)N_t + (p\tilde{\tau}_{j+1} + (1-p)\tilde{\tau}_j^*)\left(\frac{\partial N_t}{\partial \tau_t} + (1-p)\frac{\partial N_t}{\partial \tau_{t+1}}\right)\right] \quad (12)$$

Let $\tilde{\tau}_j^{*m}$ be the equilibrium policy at time t, when $\gamma_t = \gamma(j)$; in equilibrium, the number of voters who support $\tilde{\tau}_j > \tilde{\tau}_j^{*m}$ must be equal to the number of voters who support $\tilde{\tau}_j < \tilde{\tau}_j^{*m}$. In the first coalition there will be all the elderly and the poorer among the middle-aged voters (with a larger proportion among the urban residents, as they are more favourable to the pension system).

Hence, the political equilibrium is defined by the following equation:

$$\gamma(j)F[w^{*c}(\tilde{\tau}_j^{*m})] + (1-\gamma(j))F[w^{*f}(\tilde{\tau}_j^{*m})] + \frac{1}{N_{t-1}} = \frac{1}{2}\left(1 + \frac{1}{N_{t-1}}\right) \quad (13)$$

Using equations (11) and (12), and assuming that the income is uniformly distributed between 0 and 1, the equilibrium is implicitly defined by the following equation:

$$w\left[(1-p)N_t(\tilde{\tau}_j^{*m}) + (p\tilde{\tau}_{j+1} + (1-p)\tilde{\tau}_j^{*m})\left(\frac{\partial N_t}{\partial \tau_t} + (1-p)\frac{\partial N_t}{\partial \tau_{t+1}}\right)\right] \times$$
$$\times \left(\frac{\gamma(j)}{1+r_c} + \frac{1-\gamma(j)}{1+r_f}\right) = \frac{N_{t-1}-1}{2N_{t-1}} \quad (14)$$

A higher level of urbanization has two opposite effects: it increases the weight of urban voters, who are more willing to support the pension system, but it also decrease the fertility, making the pension system less attractive. It is important to stress that this second effect is not captured in a model with exogenous fertility; therefore in this model the positive effect of the urbanization on the probability of introduction of the pension system is dampened, and the relation pattern between pension expenditure and urbanization is ambiguous.

Using implicit differentiation on equation (14), we can find the derivative of the relation between the equilibrium contribution rate ($\tilde{\tau}_j^{*m}$) and the weight of urban population ($\gamma(j)$):

$$\frac{\partial \tilde{\tau}_j^{*m}}{\partial \gamma(j)} = -\frac{R_j\Lambda(\tilde{\tau}_j^{*m}, \gamma(j)) + \frac{\partial \Lambda(\tilde{\tau}_j^{*m}, \gamma(j))}{\partial \gamma(j)}}{\frac{\partial \Lambda(\tilde{\tau}_j^{*m}, \gamma(j))}{\partial \tilde{\tau}_j^{*m}}} \quad (15)$$

where

$$\Lambda(\tilde{\tau}_j^{*m}, \gamma(j)) \equiv \frac{\partial(\tilde{\tau}_j^{*m} N_t)}{\partial \tilde{\tau}_j^{*m}}$$
$$= (1-p)N_t + \tau_{t+1}\left(\frac{\partial N_t}{\partial \tau_t} + (1-p)\frac{\partial N_t}{\partial \tau_{t+1}}\right)$$

and

$$R_j \equiv \frac{r_f - r_c}{\gamma(j)(1+r_f) + (1-\gamma(j))(1+r_c)}$$

.

In equilibrium the function Λ is always positive, as long as the elderly are not the majority (see equation (12); moreover, if Λ was negative, a reduction of $\tilde{\tau}_j^{*m}$ would increase disposable income during middle and old-age); therefore, as R_j is positive as well, the first term in the numerator of (15) is positive. It can be shown that the numerator of (15) is equal to zero when $\gamma(j) = \frac{1}{2}$. Moreover it can be numerically shown that the denominator is negative. Hence, expression (15) is positive up to $\gamma(j) = \frac{1}{2}$, and negative afterward.

3 Stylized facts

The main conclusion of the model is that the weakening of family ties at first promotes the introduction of pension systems, due to the reduction of the economic support from the descendants and the need for substitution between a familiar system and a centralized one, and then causes a reduction of the political support, due to the reduction of total fertility and resulting reduction of the profitability of the centralized system.

This section will show the results of some estimation in order to find if a similar pattern may be supported by the data.

3.1 Methodology

The basic specification that will be used for the regression is the linear model:

$$\tau_i = \beta_0 + \beta_1\gamma_i + \beta_2\gamma_i^2 + \beta_3 w_i + \beta_4 N_{t,i} + \beta_5 N_{t-1,i}, +u_i \qquad (16)$$

The idea is to test the coefficients β_1 and β_2, in order to pick up the prevalent development pattern. On the strength of what has been said above, we expect β_2 to be negative, whereas the relation between β_1 and β_2 will allow us to pick up the pattern (since γ is measured in percentage, if $\beta_1 > -200\beta_2$ the relation is monotonically increasing, if $0 < \beta_1 < -200\beta_2$ the relation is an inverted-U, whereas if $\beta_1 < 0$ the relation is monotonically decreasing; see figure 1).

Initially, I use the OLS method and, after an endogeneity test, I eventually use the IV estimator. Moreover, at first cross-sectional results are shown, and then those obtained with panel-data.

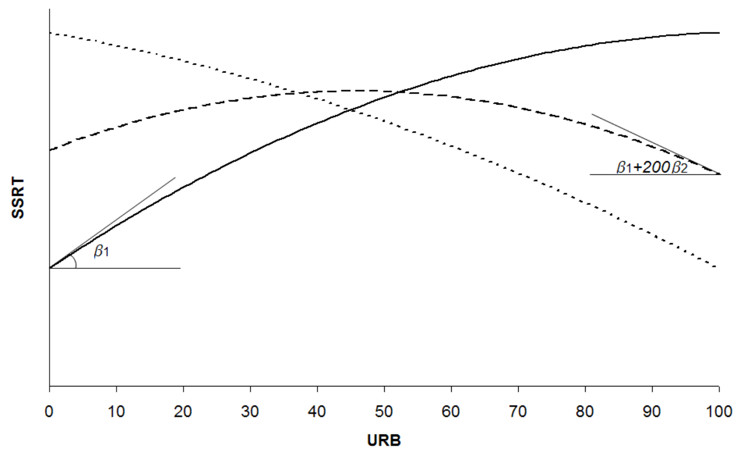

Figure 1: Possible development patterns of pension systems

Variable	**D**escription	**M**ean	**S**t. Dev.	**N**	**M**in	**M**ax
SSRT	Social contributions (% of GDP)	5.49	5.31	90	0	17.94
URB	Urban population (% of the total)	62.51	21.66	90	9.16	100
OPOP	Over-65 population (% of the total)	9.34	5.19	90	1.08	18.88
GDPPC	Per-capita GDP, PPP (thousands of 2005 international dollars)	14.03	13.02	90	0.34	65.81
TFR	Total fertility rate	2.37	1.3	90	0.84	6.8
CMR	Child mortality rate (under 5 per 1000 births)	37.14	46.38	89	3.22	186.1
SCFMRT	Ratio of female to male in the secondary school enrollment	99.58	12.68	87	42.6	121.3
GINI	Gini index	39.08	9.43	66	25	60.05
TAXAT	Tax revenue (% of GDP)	16.28	6.3	90	0.96	29.53

Table 1: Descriptive statistics (2002 cross-section)

3.2 The data set

Given the specification (16), the data set needs to include:

SSRT the dimension of pension system, measured by the ratio between contributions and GDP;

URB the urban rate, that is the ratio of urban to total population;

GDPPC the per-capita GDP based on PPP;

TFR the total fertility rate, that is the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with prevailing age-specific fertility rates;

OPOP the size of old-age population, measured by the ratio of over-65 to total population.

Moreover I will use some control variables, the Gini index (GINI), as a measure of income heterogeneity, and the fiscal incidence (TAXAT), measured by the ratio of fiscal contributions to GDP.

For the endogeneity test and the IV regressions other two variables will be used: the child (under the age of five) mortality rate (CMR) and the female education level, measured by the ratio of female to male secondary enrollment (SCFMRT). Thus, I consider such variables relevant in explaining the fertility rate (because of the "hoarding" effect and the Caldwell hypothesis about social policy and fertility cost), but exogenous with respect to the estimated model.

The data used are those provided by the World Bank[1]. Since we need a data set which include the largest possible number of countries, we can perform two type of analysis: either a cross-sectional one on 2002 data (the year with the highest number of observations) and, if not available, on the closest ones, or a panel one on five-year average data between 1990 and 2005, which will have a limited validity because of the smaller number of observations per country. Using the cross-sectional data we can analyze up to 90 countries (except when we will include the Gini index in the regression, reducing the number of observations to 66). The countries included in the study are listed in appendix A.

Figure 2 shows a scatter plot of the contribution rate versus urban population rate, which loosely support a hump shaped relation between family ties and size of pension system.

3.3 Estimates

Table 2 shows the results of the regression analysis. Model A is the basis one, represented by equation (16), whereas the others add more control variables. It is important to notice that B and D estimations include a smaller number of countries, because of the fewer observations of the Gini index, therefore the results are not perfectly comparable.

[1]World Bank, World Development Indicators April 2008, ESDS International, University of Manchester

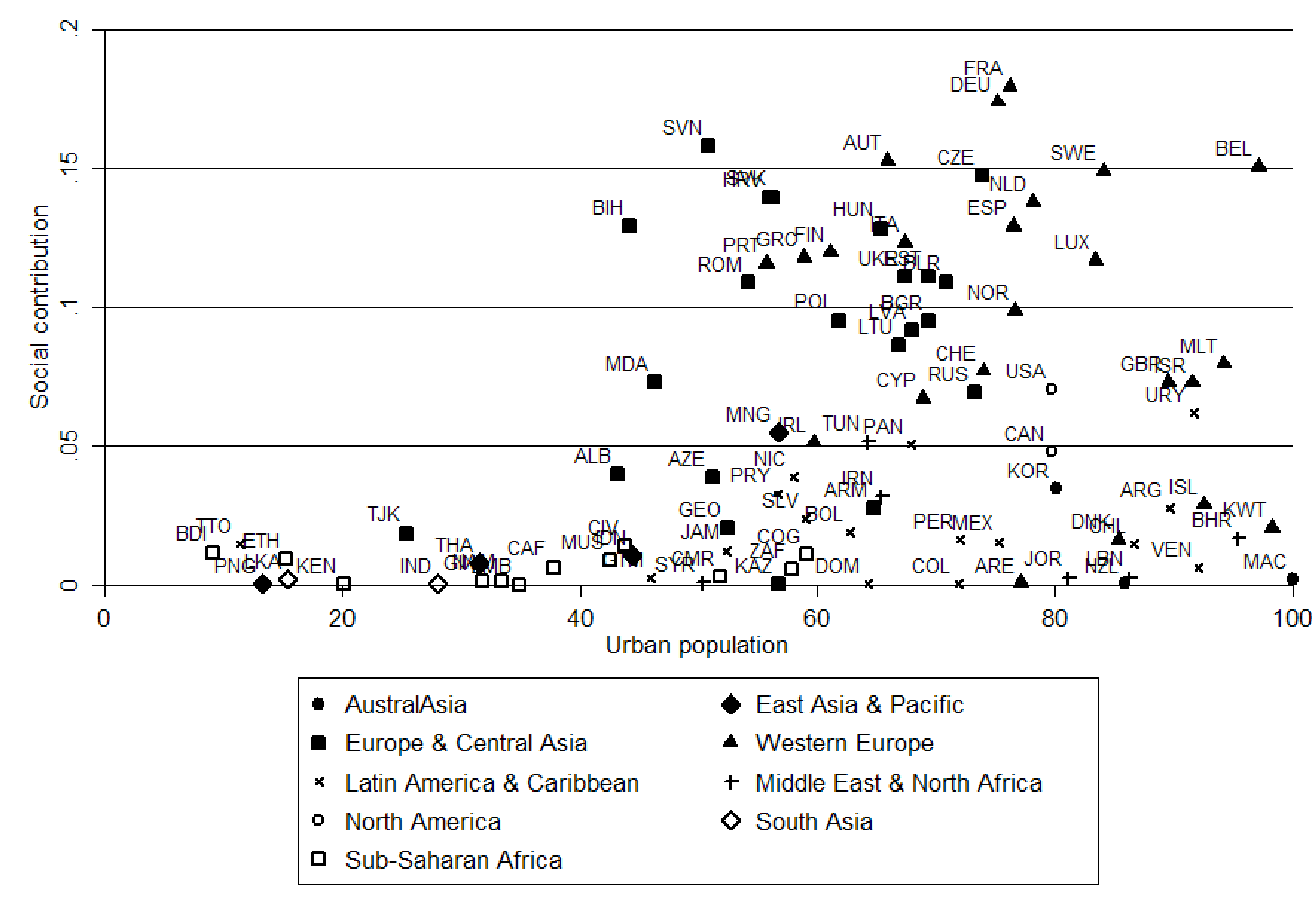

Figure 2: Scatter plot of social security contribution rate (SSRT) vs. urban population rate (URB)

Variable	A	B	C	D	B2	B2-IV
URB	0.1053**	0.1753***	0.0948**	0.1733***	0.1778***	0.1514**
	(2.385)	(2.867)	(2.103)	(2.881)	(2.935)	(2.499)
URBSQ	-0.0011**	-0.0014**	-0.0011**	-0.0014**	-0.0013**	-0.0011*
	(-2.583)	(-2.504)	(-2.444)	(-2.569)	(-2.49)	(-1.969)
OPOP	0.8485***	0.7632***	0.8837***	0.748***	0.7946***	0.6926***
	(9.577)	(6.685)	(9.725)	(6.658)	(7.592)	(6.144)
GDPPC	0.055*	0.0242	0.0598**	0.0126		
	(1.981)	(0.833)	(2.134)	(0.422)		
TFR	0.2674	0.5195*	0.2918	0.4834*	0.5807**	0.1054
	(0.97)	(1.966)	(1.068)	(1.85)	(2.149)	(0.331)
GINI		-0.1222***		-0.1181***	-0.13***	-0.1331***
		(-3.017)		(-2.909)	(-3.101)	(-3.192)
TAXAT			-0.0593	0.081		
			(-0.894)	(1.121)		
Constant	-5.4967***	-3.3746	-4.6515**	-4.3179*	-3.5276	-0.8212
	(-3.231)	(-1.475)	(-2.244)	(-1.941)	(-1.556)	(-0.322)
URB^{MAX}	46.707	63.902	45.004	63.200	66.749	70.513
	(5.455)	(7.914)	(6.853)	(7.601)	(8.817)	(12.065)
N	90	66	90	66	66	65
AIC	448.694	309.96	449.427	310.121	308.593	
BIC	463.693	325.288	466.925	327.639	321.731	
R^2	0.732	0.804	0.735	0.809	0.802	0.806

* 10% significant; ** 5% significant; *** 1% significant
Standard errors are Huber-White corrected
T-statistics in parentheses for the estimated coefficients
Standard errors in parentheses for the estimated URB^{MAX}

Table 2: Cross-section estimates

The first evident observation is the important role played by the share of elderly: this result is quite predictable, both from a political viewpoint (elderly get a stronger political power) and from an economic one (a higher number of elderly requires a bigger pension system). The estimated coefficients imply that a 1% increase in the old-age share of the population induces a 0.8% increase in the ratio between social contributions and GDP.

The URB and URBSQ estimated coefficients support the concavity of the relation, and in particular the inverted-U pattern: for low levels of the urbanization rate, as it increases the pension system expands, but for higher levels of urbanization the relation is inverted. URB^{MAX} is the estimated maximum of the relation. The considerable difference between the models including the Gini index or not may be ascribed to the reduction of the observed countries, hence to a different distribution of the URB variable.

The per-capita income level seems to have a small positive effect on the dimension of pension system, as claimed by the Wagner law. However, such effect is rather limited, and it is not significant when the Gini index is taken into account.

The Gini index is significant, but the sign of the estimated coefficient is negative, which seems to contradict the hypothesis that a higher income heterogeneity leads to bigger pension system, due to the demand of income redistribution policies. The negative relation, instead, seems to catch the effect of the welfare state level of development: in countries where higher is the development of welfare state, the Gini index is lower as outcome of the income redistribution policies. Moreover, when the Gini index enter the equation, it makes the per-capita income not significant, absorbing its role of measure of the socioeconomic development. The B2 model does not take into account the per-capita income variable, and the results are not significantly different from the B model.

The fiscal incidence is never significant in explaining the size of pension systems: this in part contradicts the Leviathan theory about the tendency of governments to expand as much as possible the scope of their authority.

For the B2 model, I performed an endogeneity Hausman test on fertility, using the child mortality rate and the ratio of female to male in the secondary school enrollment, and the null hypothesis of exogeneity was rejected. Then I estimated the B2 model, using the IV estimator, and the results are shown in the last column of table 2. In the first stage, the two instruments resulted highly significant and the F-statistic was equal to 64.82. The null hypotheses of the J-test and the Sargan test about the exogeneity of the instruments were not rejected (respectively with 0.513 and 0.582 p-value). The estimated coefficients results quite similar to those obtained with the OLS estimator, and URB^{MAX} becomes higher, but not significantly.

In conclusion, all the estimates support the inverted-U pattern of development. However the models provide noticeably different estimates of the maximum of such curve, in particular when the Gini index is taken into account (probably because of the smaller number of observations and the consequent different distribution of URB). The best estimates seem to be the A, because of the higher number of observations, and the B2-IV, because it takes into account

Variable	A	B	C	B2	A-IV	A2-IV
URB	0.1623***	0.1428***	0.1585***	0.1407***	0.1494**	0.1434**
	(3.423)	(3.036)	(3.397)	(2.933)	(2.316)	(2.247)
URBSQ	-0.0015***	-0.0011**	-0.0014***	-0.001**	-0.0013**	-0.0012**
	(-3.227)	(-2.396)	(-3.189)	(-2.139)	(-2.351)	(-2.316)
OPOP	0.4864***	0.431***	0.4796***	0.4995***	0.5768***	0.6046***
	(5.214)	(3.298)	(4.962)	(4.512)	(6.258)	(7.474)
GDPPC	0.0263	0.0566	0.0236		0.0244	
	(0.905)	(1.107)	(0.881)		(0.773)	
TFR	-0.2317*	-0.1158	-0.2435*	-0.0598	-0.0772	-0.1208
	(-1.797)	(-0.758)	(-1.89)	(-0.363)	(-0.205)	(-0.32)
GINI		-0.111***		-0.1184***		
		(-3.439)		(-3.292)		
TAXAT			0.038			
			(1.051)			
Constant	-2.4842**	1.8052	-2.9188**	1.7376	-3.6474	-3.4024
	(-2.124)	(0.936)	(-2.449)	(0.875)	(-1.299)	(-1.208)
URB^{MAX}	55.275	64.220	55.411	69.261	57.830	58.741
	(4.714)	(9.358)	(4.847)	(12.731)	(7.827)	(7.391)
N	226	130	226	131	182	186
N_g	99	75	99	76	95	98
g	2.283	1.733	2.283	1.724	1.916	1.898
R^2	0.706	0.707	0.7	0.701	0.723	0.72

* 10% significant; ** 5% significant; *** 1% significant
Standard errors are cluster corrected
T-statistics in parentheses for the estimated coefficients
Standard errors in parentheses for the estimated URB^{MAX}

Table 3: Panel estimates

also the Gini index and seems to be more precise. Both models suggest that over a certain level of urbanization, between 50 and 70%, the pension systems tend to become smaller.

Table 3 shows the results of the panel analysis: the specification are analogous to those of table 2, and are estimated with random effects.

The pattern supported by all the estimates is still the inverted-U one. The maximum of the relation, again, depends on whether the Gini index is included in the regression or not.

Both the per-capita income and the fiscal incidence are not significant, whereas the Gini index is highly significant and, again, seems to have a negative influence on the dimension of pension systems.

The fertility rate results significant only for the specifications which do not include the Gini index. In this case the Hausman test rejects the null hypothesis of exogeneity, hence I used IV, and the results are shown in last two columns. The main difference concerns the coefficient on old-age population, whereas the maximum of the relation between pension system and urban population holds essentially steady at 58%.

4 Conclusions

Part of the economic literature, and particularly the Caldwell hypothesis, explain the reduction of fertility with the evolution of the social structures and the transition from a rural economy, in which the children were a source of wealth, to a urban and westernized economy, in which children subtract resources from the domestic economy.

The smaller ascendant intergenerational transfer causes the need for a social policy able to maintain old-age consumption, stimulating the introduction of pension systems and their expansion.

The theoretical model presented in section 2 analyzes the net effect of the weakening of family ties on the dimension of pension system, taking into account the reduction of fertility and, therefore, the reduction of the rate of return of pay-as-you-go pension systems. The model concludes that the relation between the strength of family ties and the dimension of pension system should be hump shaped.

The empirical analysis, shown in section 3, supports this inverted-U development pattern: a continuous and progressive weakening of family ties, after inducing the introduction of pension systems, tends to reduce, *ceteris paribus*, their political support.

The reduction of political support toward social security systems, caused by the reduction of the fertility rate, is partially offset by the progressive ageing of the population which, on the one hand, reduces as well the profitability of pension system, but on the other hand increases the political weight of old-age voters: the overall effect of the ageing of the population is positive, as acknowledged by the previous literature in the field.

However, if fertility rates continue their rapid decline, as in the past years, pay-as-you-go pension systems may not be sufficiently profitable for them to be supported by the majority of the voters, hence being destined to disappear or replaced by the funded ones.

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A List of countries included in the study

Country	Code	Region	Country	Code	Region
Albania	ALB	ECA	Kenya	KEN	SSA
Argentina	ARG	LAC	Korea, Rep.	KOR	AAS
Armenia	ARM	ECA	Kuwait	KWT	EUR
Austria	AUT	EUR	Latvia	LVA	ECA
Azerbaijan	AZE	ECA	Lebanon	LBN	MNA
Bahrain	BHR	MNA	Lithuania	LTU	ECA
Belarus	BLR	ECA	Luxembourg	LUX	EUR
Belgium	BEL	EUR	Macao, China	MAC	AAS
Bolivia	BOL	LAC	Malta	MLT	EUR
Bosnia and Herzegovina	BIH	ECA	Mauritius	MUS	SSA
Bulgaria	BGR	ECA	Mexico	MEX	LAC
Burundi	BDI	SSA	Moldova	MDA	ECA
Cameroon	CMR	SSA	Mongolia	MNG	EAP
Canada	CAN	NAM	Namibia	NAM	SSA
Central African Republic	CAF	SSA	Netherlands	NLD	EUR
Chile	CHL	LAC	New Zealand	NZL	AAS
Colombia	COL	LAC	Nicaragua	NIC	LAC
Congo, Rep.	COG	SSA	Norway	NOR	EUR
Côte d'Ivoire	CIV	SSA	Panama	PAN	LAC
Croatia	HRV	ECA	Papua New Guinea	PNG	EAP
Cyprus	CYP	EUR	Paraguay	PRY	LAC
Czech Republic	CZE	ECA	Peru	PER	LAC
Denmark	DNK	EUR	Poland	POL	ECA
Dominican Republic	DOM	LAC	Portugal	PRT	EUR
El Salvador	SLV	LAC	Romania	ROM	ECA
Estonia	EST	ECA	Russian Federation	RUS	ECA
Ethiopia	ETH	SSA	Slovak Republic	SVK	ECA
Finland	FIN	EUR	Slovenia	SVN	ECA

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(continued)

Country	Code	Region	Country	Code	Region
France	FRA	EUR	South Africa	ZAF	SSA
Georgia	GEO	ECA	Spain	ESP	EUR
Germany	DEU	EUR	Sri Lanka	LKA	SAS
Greece	GRC	EUR	Sweden	SWE	EUR
Guatemala	GTM	LAC	Switzerland	CHE	EUR
Guinea	GIN	SSA	Syrian Arab Republic	SYR	MNA
Hungary	HUN	ECA	Tajikistan	TJK	ECA
Iceland	ISL	EUR	Thailand	THA	EAP
India	IND	SAS	Trinidad and Tobago	TTO	LAC
Indonesia	IDN	EAP	Tunisia	TUN	MNA
Iran, Islamic Rep.	IRN	MNA	Ukraine	UKR	ECA
Ireland	IRL	EUR	United Arab Emirates	ARE	EUR
Israel	ISR	EUR	United Kingdom	GBR	EUR
Italy	ITA	EUR	United States	USA	NAM
Jamaica	JAM	LAC	Uruguay	URY	LAC
Jordan	JOR	MNA	Venezuela, RB	VEN	LAC
Kazakhstan	KAZ	ECA	Zambia	ZMB	SSA

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