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A Positive Theory of Social Security

XAVIER X. SALA-I-MARTIN

Department of Economics, Yale University, New Haven, CT 06520 and Universitat Pompeu Fabra, Barcelona

In this paper I make two points. First, I argue that social security programs around the world link public pensions to retirement: people do not lose their pensions if they make a million dollars a year in the stock market, but they do confront marginal tax rates of up to 100 percent if they choose to work. Second, after arguing that most existing theories cannot explain this fact, I construct a positive theory that is consistent with it. The main idea is that pensions are a means to induce retirement—that is, to buy the elderly out of the labor force because aggregate output is higher if the elderly do not work. This is modeled through *positive* externalities in the *average* stock of human capital: because skills depreciate with age, the elderly have lower-than-average skill and, as a result, have a negative effect on the productivity of the young. When the difference between the skill level of the young and that of the old is large enough, aggregate output in an economy where the elderly do not work is higher. Retirement is desirable in this case, and social security transfers are the means by which such retirement is induced. The theory developed in this paper is also shown to be consistent with a number of other regularities documented in Section 1.

Keywords: social security, pensions, human capital, growth, transfers

JEL classification: H53, H55, I38, O4

> *My . . . fixed idea is the uselessness of men above sixty years of age, and the incalculable benefit it would be in commercial, political and in professional life, if, as a matter of course, men stopped work at this age. . . . That incalculable benefits might follow such a scheme is apparent to any one who, like myself, is nearing that limit, and who has made a careful study of the calamities which may befall men during the seventh and eighth decades. Still more when he contemplates the many evils which they perpetuate unconsciously, and with impunity.*

These words are taken from Dr. William Osler's controversial valedictory address at Johns Hopkins University on February 22, 1905 (see Osler, 1910; Graebner, 1980). After sixteen years in Baltimore as physician-in-chief of the University Hospital, Osler was about to leave for Great Britain as Regius Professor of Medicine at Oxford. This address was to be one of his main contributions to American society, as it became the starting point of the first American debate over mandatory retirement.

Attracted by the doctor's reputation as one of the top American physicians, the press correctly perceived that the public would be interested in his original yet scandalous vision of aging. His remarks about the "uselessness of men above sixty years of age" made headlines all around the country. The *Washington Times* wrote: "Dr. Osler declares that men are old at 40 and worthless at 60. There must be an age at which a man is an ass. What is the doctor's age anyhow?" The newspapers characterized the doctor's views as "insensitive," "too rationally and too aggressively in search of efficiency and productivity," and "cold-blooded" (White, 1937). Some newspapers even reported that Osler's lecture was a call for euthanasia at the age of sixty. Senators quickly highlighted the great historical

contributions of political figures over sixty. Professors, businessmen, and professionals were outraged and felt threatened by the physician's views. James Angell, president of the University of Michigan, reiterated that men above sixty were not useless: "I would like to extend the time of a man's life instead of shortening it. The experiment of killing off old men has been tried in Africa for centruies, and I would suggest to the distinguished physician that civilization has not advanced very rapidly there" (White, 1937). For the first time in United States history, people debated whether free individuals should be forced to retire for age reasons. The debate ended in 1935 when the enactment of the Social Security Act and the creation of what was to become one of the largest public budgets in the world.

In the United States today, transfers represent about 12.7 percent of GDP (up from 5 percent in 1940) and account for 46 percent of total government spending. As a comparison, public investment represents about 4 percent of GDP—only one-third of that is non-defense investment—and account for 13 percent of federal spending, while defense purchases account for 21 percent of public spending and represent 5.6 percent of GNP. The largest and fastest-growing component of transfer payments is the benefits paid through social security. For example, the expenditures for old-age survivors' and disability insurance increased from .3 percent in 1950 to 5.6 percent in 1991. Most of the other components of government spending have remained more or less constant (or sharply decreased in the case of defense purchases) throughout the same period (see the 1994 Economic Report of the President).

Despite the large and growing importance of transfers, most of the researchers studying the determinants of long-run economic growth have ignored the existence of transfers.[1] Following Barro (1990), a substantial fraction of the literature has concentrated on the positive effects of public investment and the negative effects of public consumption and distortionary taxes. Transfers have been modeled as something that provides social utility (maybe because underlying them there is some kind of socially desirable redistribution aspect) and need to be financed with distortionary taxes (see, for instance, Persson and Tabellini, 1991; Alesina and Rodrik, 1994). From a growth perspective, therefore, transfers are a bad thing to have. Yet if one includes transfers in a cross-country regression of the type used by Barro (1991), one is surprised by the fact that among three components of public spending—public investment (GI), public consumption (GC), and public transfers (SS)—the only one that seems to be positively related to growth is the transfer variable. Public consumption spending is negatively related to growth and public investment is insignificant. An example of such regressions is the following:

$$Gr7085 = \underset{}{-0.000} \underset{(0.004)}{-0.015}\ Ln(GDP70) \underset{(0.047)}{-0.129}\ GC \underset{(0.155)}{-0.228}\ GI \underset{(0.054)}{+0.111}\ SS \underset{(0.041)}{+0.217}\ I$$

$$R^2 = .39, s.e. = .0182, obs. = 74,$$

where the log of initial per capita GDP (ln(GDP70)) and the investment share (I) have also been included (the dependent variable is the annual average growth rate of per capita GDP taken from Summers and Heston). Cashin (1993) gets even stronger results using panel data for twenty OECD countries: transfers seem to be the only component of public spending that is positively correlated with the growth rate (holding constant the initial level of income).

The goal of this paper is to present a positive theory of social security. The main idea is that social security programs and intergenerational transfers are a way to buy the elderly out

of the labor force. Societies may want to do such a thing because output per capita is higher if the elderly do not work, even though the private marginal product of an old worker (and therefore his spot market wage rate) may be positive. In other words, transfers are a way to achieve higher economic efficiency, a way to achieve Osler's controversial objective.

I model this idea through *positive* externalities in the *average* stock of human capital. Like Lucas (1988, 1990), I use a production function where people's productivities depend not only on their own ability but also on the ability of the people surrounding them. Because the externality is on the *average* level human capital, a worker with lower-than-average skill lowers the average skill in his environment and has a negative effect on the rest of the workers.

And the rest of the story is simple: it is an unfortunate yet hardly disputable fact that human skills (both physical and mental) depreciate with the passage of time. Kotlikoff and Gokhale (1992) find that both male and female productivity reaches a peak at around age forty-five and declines afterwards. Productivity at age sixty-five is less than one-third of the peak.[2] Hence, old workers have lower-than-average skill and, consequently, exert a negative effect on the rest of the labor force. If the externality is important enough, aggregate output will be larger if the elderly do not work. Social security transfers in this context are just the payments received by the elderly in exchange for their jobs.

The idea of social security providing economic efficiency is not new. In fact, the very people who debated over the desirability of introducing social security in the United States during the 1920s and 1930s did not have only redistribution in mind: they were also thinking about efficiency.[3]

The word *efficiency*, however, does not appear in the final text of the Act. On reason for that omission is that in 1934 the Supreme Court ruled that forcing people to retire for age reasons in order to achieve economic efficiency represented age discrimination and was therefore unconstitutional. Of course, saying things like[4] "We should get rid of workers above age sixty-five because they interfere with the normal functioning of the economic system" is not politically attractive, as Dr. Osler found out after his 1905 valedictory address. Even though the result was the same, the political packaging of the Act as "a reward for a life-long job well done" was more appealing: altruism and redistribution seem to sell politically a lot better than efficiency. Of course, it is much easier to be "altruistic" toward strangers when you can do it for free ... or for a profit.

Because the text of the Social Security Act calls for the federal government being at last charged with the obligation to provide its citizens with a measure of protection from the hazards of life, and because Roosevelt and the other politicians behind it have been seen as such great humanitarians, the real motivation behind social security is never questioned. We are so used to the institution of retirement, so attached to the written spirit of the Social Security Act, that we have taken it as an act of faith that its stated purpose is its real purpose. And with this assumption, economic researchers have asked whether the form of financing increases or decreases savings, how social security programs affect labor market incentives, what will happen when the elderly outnumber the young, or whether it should be fully funded or pay-as-you-go (PAYG) (see, for instance, the collections of papers in Boskin, 1978a, 1978b; and Campbell, 1977, and 1979) (see also Barro, 1978; Feldstein, 1978; Pechman, Aaron, and Taussig, 1968; and Diamond, 1977). When asking

about the reasons behind the existence of public transfers, people talk about imperfect financial markets (such as inability to diversify risk, incomplete insurance markets, and adverse selection problems) and/or individual irrationality together with a paternalistic government to ensure that individuals have enough income when they retire (see Diamond, 1977; Feldstein, 1977a, 1978b; Merton, 1983). Browning (1979) and Vergara (1990) provide a public-choice approach where people know that the government will take care of them when they end up being poor so they choose not to save when young. Kotlikoff (1987) shows that social security arises as people who care for each other try to free ride on each other's utility—that is, if I know that you will take care of me if I am poor, I will not save when young. Finally, political scientists argue that social security systems arise as the elderly achieve a majority and vote themselves a big transfer (see Tabellini, 1992).

All these theories completely assume that the elderly retire, and by doing so, they don't analyze what I believe is the key point: old-age pensions could be *designed* to buy the elderly out of their jobs. If this was the case, transfers and retirement would be two faces of the same coin.[5]

The rest of the paper is organized as follows. In Section 1 some facts about social security progams around the world are presented. In Section 2 the model is introduced, and some empirical evidence in support of human capital externalities (a key aspect of the model) is cited. Section 3 studies the steady-state behavior of the economy and analyzes the conditions under which economies will choose to introduce a social security system. The next section deals with the transition and explains why economies might introduce social security only as they reach a certain level of income. Section 5 allows for changes in the population structure and shows that when life expectancy increases, the desirability of social security increases and that when the dependency ratio increases, the desirability of a social security system is reduced. The final section concludes and suggests some extensions.

1. Social Security Systems Around the World: Some Facts

1.1. Social Security is Like a Luxury Good

The first modern country to introduce the kind of welfare programs to which we have been accustomed was the German Empire under the leadership of the "iron chancellor" Otto von Bismarck. Welfare programs and old-age pensions were created in 1881 and 1889, respectively. Since then, social security programs have mushroomed all over the globe. Great Britain's Old Age Pensions Act was enacted in 1908, and the National Insurance Act in 1911 (Hemming and Kay, 1982). Sweden enacted compulsory old-age pensions in 1915 (Stahl, 1982) and Switzerland did so in 1925 (Janssen and Muller, 1982). In the United States, the Social Security Act was enacted in 1935. By 1940, thirty-three countries had some kind of old-age social security program. By 1958 the number of countries was eighty, and by 1979, it was 123. The number in 1989 was 130 (see Table 1, columns A and B, for information on the year when the first old-age social security legislation was enacted and the latest piece of relevant legislation in each country).

The short history of social security systems suggests that these programs are introduced only after a certain level of development (or income) has been reached. This is certainly

Table 1. Social Security Programs Throughout the World

Country	Law First	Law Current	Coverage	D	E	F	G	H	I
1. Afganistan			P						
2. Algeria	49	83	E, S	Y		60	Y	C	Y
3. Antigua	72	72	E			60	Y	C	Y
4. Argentina	44	67	E, S	N	Y	60(M)	Y	3	Y
	46					55(F)			
5. Australia	08	47	Residents of	N	Y	65(M)	Y	N	N
			limited income			60(F)			
6. Austria	06	55	E(>min.w), S	N	Y	65(M)	Y	C	Y
	38	57				60(F)			
7. Bahamas	56	84	E, S	Y	Y	65	Y	C	Y
8. Bahrain	76	76	E (firm size>=10), S	Y	Y	60(M)	Y	1	Y
			(excl.) agr., temp.			55(F)		1	
9. Barbados	37	66	E, S			65	Y	C	Y
10. Belgium	24	69	E, apprentices	Y	Y	65(M)	Y	Y	Y
			(sp.) P			60(F)			
11. Belize	79	79	E, S	Y		60	Y	C	Y
12. Benin	70	70	E	Y	Y	55	Y	I	Y
13. Bermuda	67	70	E, S	N		65	N	C	Y
14. Bolivia	49	56	E: industry,			55(M)	Y	C	Y
		77	Commerce, mining, government			50(F)			
15. Botswana			P						
16. Brazil	23	60	E: Industry and commerce			65(M)	Y	C	Y
	34	88	S, (sp.) P			60(F)			
17. Bulgaria	24	57	E, S, collective		D	60(M)	Y	2	N
			farmers, handicraft			55(F)		2	
18. Burk. Faso	60	72	E. (exc.) temp, (sp.) P	Y		55	Y	I	Y
19. Burma			P						
20. Burundi	56	81	E. (sp.) P	N		55	Y	I	Y
21. Cameroon	69	84	E, (sp.) P	Y		60		C	Y
22. Canada	27	65	(1) all	N	Y	65	Y	Y	N
	37	66	(2) E, S	Y	Y	65	Y	Y	Y
23. Cape Verde	57	83	E, (sp.) P			65	Y	1	Y
24. C. Africa	63	81	E	Y	Y	55	Y	C	Y
25. Chad	77	77	E	Y	Y	55	Y	Y	
26. Chile	24	52	E. (vol.) S	Y		65(M)	C	C,	Y
						60(F)			
27. China, P.R.	51	86	E	Y	Y	60(M)	Y	2	N
						55(F)		1	
28. Columbia	46	46	E: industry and commerce	N	Y	60(M)	Y	C	Y
			S, (sp.) P, (excl.) agriculture			55(F)			
29. Congo	62	71	E, (sp.) P	Y		55	Y	I	Y
30. Costa Rica	41	71	E, (vol.) S	Y	D	57–65	Y	C	Y
31. Cuba	21-56	79	E, S, members of some producers' cooperatives	Y	Y	60(M) 55(F)	Y	2	N

D. Is retirement necessary?
E. Are there economic incentives for retirement?
F. What is the retirement age?
G. Are pensions related to past earnings?
H. Are pensions related to previous work? How many years?
I. Is it wage financed?

Table 1. (continued)

Country	Law First	Law Current	Coverage	D	E	F	G	H	I
32. Cyprus	56	80	E, S	N	N	65	Y	C	Y
33. Czhecho-	06	75	E	Y	Y	60(M)	Y	2	N
Slovakia	24		(sp.) farmers			55(F)			
34. Denmark	91*	64	(1) all	N	N		N	N	
	21	86	(2) E, apprentices,	N	Y	67	D	C	Y
35. Dominica	70	75	E, apprentices			60	Y	C	
36. Dominican	47	48	E, P, etc.	Y	Y	60	Y	C	Y
Republic			(exc.) S, white Collar						
37 Ecuador	35	88	E: ind, comm, and agriculture	Y	Y	55	Y	C	Y
38. Egypt	50	84	E, (sp.) S, etc.	Y	Y	60	Y	C	Y
39. El	53	53	E: industry and commerce	Y	Y	60(M)	Y	C	Y
Salvador			S			55(F)			
40. Ethiopia			P						
41. Fiji	66	74	E, (excl.) P	Y	Y	55	C	C	Y
42. Finland	37	56	(1) all	N	N	65	N	C	Y
		86	(2) E	Y	Y	65	Y	C	N
43. France	42	80	E, (sp.) agriculture, miners, railroads, P.	N		60	Y		Y
44. Gabon	63	75	E, (sp.) P	Y	Y	55	Y	C,	
45. Gambia	81	81	E, (sp.) P			55	C		
46. E. Germany	89*	79	E, (sp.) S, miners	N		65(M)	Y	I	Y
		84	Railroad, cooperatives			60(F)			
47. W. Germany	89*	11	E (> min w., > min.	Y	D	63	Y	I	Y
		57	Hours), (sp.) S, P,						
		73	Farmers, miners						
48. Ghana,	65	72	E (firm size >= 5)	N		55(M)	C		Y
			(vol.) small firms and S			50(F)			
49. Greece	34	51	E: industry and commerce	Y	Y	65(M)	Y	C	
		81	(sp.) P and agriculture			60(F)			
50. Grenada	69	83	E			60	Y	C	Y
51. Guatemala	69	69	E. large firms (Sp) P	Y		60	Y	C	Y
52. Guinea	58	85	E	Y	D	55	Y	C	N
53. Guyana	44	81	E, S (> min. w)	N		60	Y	C	Y
54. Haiti	65	67	E: (sp.) P			55	Y	C	Y
55. Honduras	59	59	E, S, (sp.) P	Y		65(M)	Y	C	Y
			(excl.) casual workers			60(F)			
56. Hong Kong	71	80	residents			65–70	N		N
57. Hungary	28	75	E. cooperatives	Y	D	60	Y	1	Y
58. Iceland	09	71	(1) all	N	D	67	N	N	N
			(2) E	N	Y	67	Y	Y	N
59./ India	52	52	E of firms established	Y		55	N	N	Y
	71	71	At least 3 years						
	72	72	(sp.) P, miners, railroads						
60./ Indonesia	51	77	E of large firms			55	C		N

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Country	Law First	Law Current	Coverage	D	E	F	G	H	I
61. Iran	53	75	E in specific occupations and geographical areas, (sp.) P	Y		60(M) 55(F)	Y	Y C	Y
62. Iraq	56	71	E (firm size >= 5) (exc.) agr. (Sp.) P	Y		60(M) 55(F)	Y	C	Y
63. Ireland	08	81	E	*		66	N	C	Y
64. Israel	53	82	all, (Sp.) P		Y	65(M) 60(F)	N	I	Y
65 Italy	19	52-84	E, (sp.) P, S, farmers, railroad, merchants	*		60(M) 55(F)	Y	C	Y
66. Ivory Coast	60	68 88	E, (sp.) P (excl.) S	Y		55	Y	1 C	Y
67. Jamaica	58	65	E, S	Y		65(M) 60(F)	Y	C	Y
68. Japan	41	85	(1) E: industry and commerce (firm size >= 5)	N	Y	60(M) 56(F)	Y	co	Y
			(2) others	N	Y	65	N	C	Y
69. Jordan	78	78	E, (excl.) S, agriculture			60	Y	C	Y
70. Kenya	65	65	E (sp.) P (exc) casual	Y		55	C		Y
71. Kiribati	76	76	E		Y	50	C		Y
72. S. Korea	73	86	resident (firm size >= 10)			60	Y	I	Y
73. Kuwait	76	76	E	Y		50	Y	C	Y
74. Lebanon	63	63	E: industry, commerce and agriculture, (sp.) P,	Y		60(M) 55(F)	Y	2 et	N
75. Liberia	72	80	E (firm size >= 25) (excl.) casual workers	Y		60	Y	C	Y
76. Libya	57	80	E	Y		65	Y	C	Y
77. Luxembourg	11	25	E, (SP.) P, railroads	Y		65(M)	Y	C	
	31	64	(vol.) S Ind. and Trade			60(F)			
78. Madagascar	69	69	E, (excl.) temporary and casual workers, (sp.) P	Y		60(M) 55(F)	Y	C,	Y
79. Malawi			(sp.) P						
80. Malaysia	51	51	E (< max. w),	Y		55	C		Y
	69	69	(exc.) agriculture and casual						
81. Mali	61	66	E, (sp.) P, (vol.) S	Y		55	Y	3	Y
82. Malta	56	56	Residents (excl.) nonemployed married women		Y	61(M) 60(F)	C	C,	Y
83. Marshalli	67	83	E			60	Y	co	Y
84. Mauritania	65	67	E, (sp.) P	Y		60	Y	C,	
85. Mauritus	51	76	(1) all residents			60	N		N
			(2) E, (vol.) S			60	Y		Y
86. Mexico	43	73	E, cooperatives	*		65	Y	C	Y
87. Micronesia	67	83	E			60	Y	co	Y
88. Morocco	59	81	E: industry, commerce, agriculture	Y		60	Y	I	Y
89. Nepal	62	62	Government, corporate	Y			C		Y

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Country	Law First	Law Current	Coverage	D	E	F	G	H	I
90. Nether-Lands	13	75	All residents	N		65	N	C	Y
91. New Zealand	98*	76	All residents (sp.) P	N	Y	60	N	N	N
92. Nicaragua	55	82	E, (excl.) temporary; etc	Y		60	C	Y	Y
93. Niger	67	67	E, (sp.) P	Y		60	Y	C,	Y
94. Nigeria	61	61	E (firm >= 10), (sp) P (excl.) S, Casual	Y		55	C		Y
95. Norway	36	66	(1) all residents			67	N	co	Y
			(2) E & S (> min. w)			67	Y		Y
96. Pakistan	72	76	E large firms (sp.) P, railroads	Y		60(M) 55(F)		C	N
97. Palau	67	87	E			60	Y	co	Y
98. Panama	41	54	E, etc. (sp.) P (excl.) agr., casual		Y	60(M) 55(F)	Y	C	Y
99. Papua NG	80	80	E (firm size >= 25)	Y			C		Y
100. Paraguay	43	73	E, (sp.) P, railroads	N	Y	60	Y	C	Y
101. Peru	36	73	E, (vol.) S	Y		60(M) 55(F)	Y	co	Y
102. Philippine	54	54	E, (sp.) government (Exc.) S	Y		60	Y	C	Y
103. Poland	27	82	E, farmers, coopertives	Y		65(M)	Y	2	N
	33		(sp.) miners, railroads			60(F)		1	
104. Portugal	35	77	E, (sp.) S in industry	Y		65(M)	Y	C,	Y
		88	, gov., etc.			62(F)			
105. Romania	12	77	E, (sp.) agriculture cooperative			60(M)	Y	3	Y
						55(F)		2	
106. Rwanda	56	74	E	Y		55	Y	C,	Y
107. Saint Christopher and Nevis	70	77	E, (vol.) others			62	Y	C	Y
108. Saint Lucia	70	78	E, apprentices	Y		60	Y		Y
109. Saint Vincent	70	86	E			60	Y	C	Y
110. Sao Tome and Principe	79	79	E, (sp.) S	N		65(M) 60(F)	Y	C	Y
111. Saudi Arabia	62	69	E, large firms, (Sp) P. (exc.) Agriculture, casual workers	Y		60	Y	C	Y
112. Senegal	75	75	E, (sp.) P	Y		55	Y		Y
113. Seychelles	71	79	E		Y	65	N		Y
114. Sierra L.			(sp.) P						
115. Singapore	53	85	E (>min. w)			55	C		
116. Solomon I	73	73	E (>min. w)	Y*			C		
117. Somalia			(sp.) P						
118. South Africa	28	67	Residents of limited			65(M)	N		N
		68	Means, (sp.) P			60(F)			
119. Spain	19	74	E: industry and services	Y		65	Y	C	Y

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Country	Law First	Law Current	Coverage	D	E	F	G	H	I
			(sp.) S, P, agriculture						
120. Sri Lanka	58	58	E, (sp.) P	Y		55(M) 50(F)	C	N	Y
121. Sudan	74	74	E (firm size >= 30) (sp.) P, (excl.) S, etc.	N		60(M) 55(F)	Y	C	Y
122. Swaziland	74	74	E, (sp.) P, (excl.) casual		Y	50	C		Y
123. Sweden	13	76	(1) all residents	N	D			N	N
			(2) E, S (>min. w)	N	Y	65		Y	Y
124. Switzer-land	46	46	All residents	N		65(M) 62(F)	Y		Y
125. Syria	59	59	E: ind, commerce and agriculture (sp.) P, (exc.) casual		Y	60	Y	C	Y
126. Taiwan	50	68	E: Large Ind., Mining, P. (vol.) small firms	Y	D	60(M) 55(F)	Y	co	Y
127. Tanzania	64	64	E (firm size > 4), (sp.) P	Y		55	C		Y
128. Thailand			(sp.) P						
129. Togo	68	73	E, cooperatives (sp.) P	Y	Y	55	Y	C,	Y
130. Trinidad &	39	39	E	Y	Y	60		C	Y
Tobago	71	71	Poor residents	Y	Y	60		C	Y
131. Tunisia	60	74	E	Y		60	Y	C	Y
132. Turkey	49	64	E: industry and commerce			55	Y	C,	Y
133. Uganda	67	72	E (firm size >= 5) (sp.) P, (excl.) temporary		Y	55	C		Y
134. Soviet Union	22	56	E, state farmworkers collective farms		Y	60(M) 55(F)	Y	2 2	N
135. U.K.	08 25	86	All residents, coverage optional for E with < min. w.	N	Y	65(M) 60(F)	Y	Y C	Y
136. U.S.A.	35	35	E. (exc.) casual, agriculture limited S, etc.	N	Y		Y	co	Y
137. Uruguay	28	87	E, S	Y		60(M) 55(F)	Y	3 co	Y
138. Vanuatu	70	86	E			60	Y	C	Y
139. Venezuela	66	66	E, (excl.) S, temporary casual workers	N	D	60(M) 55(F)	Y	C	Y
140. W. Samoa	72	72	E	Y		55	C		Y
141. Yemen	87	87	E, (excl.) agriculture, casual workers			60(M) 55(F)		I	Y
142. Yugoslavia	22	72	E: industry, commerce and agriculture, P, handicraft	Y		60(M) 55(F)	Y	I	Y
143. Zaire	56	61	E, (sp.) P	Y		58	Y	I	Y
144. Zambia	65	73	E, (sp.) P. (Exc.) S, casual, cooperatives	Y		50	C		Y

D. Is retirement necessary?
E. Are there economic incentives for retirement?
F. What is the retirement age?
G. Are pensions related to past earnings?
H. Are pensions related to previous work? How many years?
I. Is it wage financed?

Table 1. (continued)

(1) Abbreviations

- For coverage column:

  E-employees or employed persons, S-self-employed persons

  P-public, (sp.)-special systems, (excl.)-exclusion, (vol.)-voluntary
- For Column E:

  D-incentive for deferral of retirement or pension
- For Column H:

  C-related to years of contribution, I-related to years of insurance

  cov.-related to years of coverage
- For Column F:

  M-men, F-women (same for H)
- For column H:

  c-equal to the total amount of contribution

(2) Other notes ('*' in Table 1)

- To Column A:

  34: 1891, 46: 1889, 47: 1889, 91: 1898
- To Column D:

  63: necessary if pension is drawn at age 65

  65: may work until 65 if less than 40 years of contribution necessary for length of service pension

  86: not required if you work for a new employer and after 6 months of waiting

  116: you get pensions form age 40 if retired otherwise from 50
- To Column G:

  64: related to national average wage

not true for other components of government spending such as defense, police protection, or imperial palaces.

One way to assess the relation between social security and the level of development is to look at the correlation between income per capita and the size of social security transfers as a share of GDP for a cross-section of countries. The correlation coefficient is .7.[6] The regression coefficient is 1.08 (s.e. = .14), which implies that a 1 percent increase in income per capita increases social security transfers by about 2.08 percent.

This positive association is still true after the fraction of old people in the total population is held constant (the coefficient on initial income is .406, s.e. = .202, which suggests that a 1 percent increase in income per capita increases transfers by 1.406 percent).[7]

1.2. Transfers Are Linked to Retirement

In order to collect old-age pensions in most countries, the elderly must show that they do not get labor income from any other source. In other words, they must effectively retire (column

D in Table 1 shows that this is true for 70 out of 108 countries where this information is available). For most other countries the social security program provides strong economic incentive to retire (Australia, Canada, Japan, New Zealand, the United Kingdom, and the United States are examples of this; see column E in Table 1). In the United States, for example, retirement is not mandatory, but marginal tax rates on labor income over $7,440 for retirees under age sixty-five is 50 percent (these are 1992 figures). The marginal tax rate between age sixty-five and seventy is 30 percent. Note that I said *labor* income: a person can be earning a million dollars a year in dividend income and receive a full retirement pension, but if he receives more than $7,440 a year in labor income, he will be taxed one dollar for every two dollars earned. This, of course, introduces a distortion that reduces a person's willingness to work after a certain age. There is substantial amount of evidence showing that this is, in fact, the outcome of the social security program (Pechman, Aaron, and Taussig, 1968, ch. 6; Boskin, 1986; Boskin and Shoven, 1987; Kotlikoff and Wise, 1987; see also the extensive survey of empirical results in Atkinson, 1987).

Social security programs do not seem to want to take care of the elderly as long as they have no income but, rather, as long as they don't work.

1.3. Pensions Are Linked to Previous Wages

In most social security programs, a worker's earnings determine, in full or in part, his benefits. For 130 out of 139 countries where information is available, the pension a person receives is linked to his previous wage history (see column F in Table 1). In some countries the benefits are simply proportional to the contributions. In other countries the relation is not as clear. Some of them (Canada, Denmark, Finland, Iceland, Japan, New Zealand, Norway, and Sweden are examples of this) have two or even several tiers: a basic pension scheme, usually unrelated to previous contributions, provides a minimum amount of income for all the elderly. This basic tier acts as a welfare program much in the same way that British poor laws provided poor people with a minimum subsistence level of income. A second tier relates the pension benefits to the history of previous wage earnings.

1.4. Pensions Are Linked to Work History

Before being able to collect pensions, people have to have worked (and contributed to the system) for a while. For virtually all countries, the pension received is related to the number of years of contribution (Table 1, column H). The exact requirement to collect full pensions varies from country to country: it ranges from three years in Norway, Sweden, and the United Kingdom to forty years in Belgium.

1.5. Social Security Programs Enjoy a Great Deal of Political Support

A Gallup poll taken in December 1935 found that 89 percent of the population supported the Mandatory Old Age Pension System introduced just a few months earlier. The support

increased to 93 percent by July 1941 and 96 percent by August 1944. Among the people who did not support the program in 1935, 24 percent did not do it because "congress will spend the money on something else before the people get any benefit." The Social Security Program, therefore, has enjoyed widespread support since its very inception.

Of course, the popularity of the system can be inferred from the absence of alert politicians making "the destruction of the pension system" an issue in an electoral campaign. It has been argued that one of the reasons Barry Goldwater lost the 1964 election to Lyndon Johnson was his reform proposal of the social security program.

1.6. Social Security Programs Tend to Be Financed with Wage Taxes

Column 1 in Table 1 shows that, in almost all countries in the world, the Social Security Program if financed with wage taxes. The worker generally pays a fraction, and the firm pays the rest (although in some countries the government pays a final fraction).

1.7. The Creation of the Social Security Program Is Not Related to a Political System

Pension programs seem to appear in democratic countries as much as they do in nondemocratic ones. The very first program was created in Emperor William's autocratic German state in the 1880s. Other examples of nondemocratic countries that created such programs are Lenin's USSR in 1922, King Alfonso XIII's Spain in 1919, Emperor Ito's Japan in 1941, or Kuwait in 1976. Populist governments include Argentina under General Peron in 1946 and Mexico under General Avila-Camacho in 1943. Democratic examples are the United Kingdom in 1908, Sweden in 1913, or the United States in 1935.

1.8. How Do Existing Theories Explain These Facts?

Existing theories of public social security can explain some, but not most, of these facts. For instance, the political economy story argues that at some point in time the elderly achieve some kind of majority and vote themselves a big transfer. This can certainly explain why transfers appear only after a certain level of development has been reached (it is true that the fraction of the population above age sixty-five increases with the level of development of a country). The main problem for the political economy theory is that it cannot readily explain why the elderly would vote themselves a big transfer and then force themselves to retire in order to collect it. It would make much more sense for the elderly to give themselves a choice as to whether to retire or not.[8]

Theories of paternalistic governments run into similar kinds of problems. They cannot explain why the (paternalistic) government forces old people to retire in order to collect the benefits, instead of leaving them the choice as to when to terminate their working lives. Furthermore, it needs to explain why, all of a sudden, the government became paternalistic at the end of the nineteenth century or why governments in rich countries are more paternalistic than governments in poor countries.

Theories that rely on capital market imperfections cannot explain why rich countries have larger social security programs and, at the same time, less imperfect capital markets. Similarly, since capital markets have been imperfect for a long time, why didn't social security programs exist until the last decade of the nineteenth century? Finally, it is not at all clear why imperfect capital markets should lead to the introduction of public pensions conditional on retirement. The same criticisms also apply to the theory of people free-riding on each other's utility.

2. The Model

In this section I present a model that is consistent with most of these facts.

2.1. Production Functions and Human Capital Externalities

Firm j employs N_t^j workers during period t. Each worker has a different level of skill or human capital. A worker of skill h^{ij} is assumed to be h^{ij} times more productive than a worker of skill 1. There are n_t^{ij} people with a level of skill h_t^{ij}. The effective amount of labor in firm j is therefore $H_t^j = \sum n_t^{ij} h_t^{ij}$. The production possibilities of a firm at time t can be described by a neoclassical production function extended by two human capital externality factors:

$$Y_t^j = A K_t^{j^\alpha} H_t^{j^{1-\alpha}} \left(\frac{H_t^j}{N_t^j}\right)^{\epsilon_j} \left(\frac{H_t}{N_t}\right)^{\epsilon}, \tag{1}$$

where Y_t^j is output, K_t^j is the stock of physical capital, A is a parameter that reflects the level of technology, H_t is the aggregate level of human capital or skill-weighted labor, and N_t is the aggregate level of employment (where $N_t^j = \sum_i n_t^{ij}$). The term $\left(H_t^j/N_t^j\right)^{\epsilon_j}$ is an *intrafirm externality*[9] from the *average* human capital of the firm's workers on its own workers. In other words, the marginal contribution of a worker of quality h^{ij} to the output if firm j is the sum of his "private" productivity plus his contribution to the average level of human capital, which in turn, affects everybody else's productivity. Note that the production function (1) is homogeneous of degree 1 in workers and physical capital (holding constant aggregate variables). The term $(H_t/N_t)^{\epsilon}$ reflects a similar externality from the average level of human capital of the economy. This will be called *interfirm externality.*

These externalities capture the type of social interactions among workers within as well as across firms, which has been emphasized by Lucas (1988, 1990). Social interaction is an important part of everyday work: coworkers exchange ideas and learn from each other. People meet in seminars, conventions, and national meetings and also exchange ideas and learn from each other. Japanese workers spend some time after work drinking with their colleagues and with workers of other firms. They claim that this enables them to develop informational networks that make them more productive at work.

If workers are in contact with high-performing people, their own productivity is greater. The productivity of a worker depends on the quality or human capital of the average person

he happens to encounter in his work environment (which includes people working in other firms). The productivity of a particular engineer or economics professor would improve if, during the next twenty years, the best students in the best colleges decided to become engineers or economics professors rather than lawyers. Of course, the people who would benefit most from these superstars would be their coworkers, but professors at other universities would also benefit from having the smartest people as part of their profession.

Jacobs (1969) provides a number of examples highlighting the importance of these social interactions in academics, the arts as well as many other occupations. As Lucas puts it, "Much of economic life is 'creative' much in the same way as 'art' and 'science.' New York City's garment district, financial district, diamond district, advertising district and many more are as much intellectual centers as Columbia or New York University. The specific ideas being exchanged in these centers differ, of course, from those exchanged in academic circles, but the process is much the same. To an outsider, it even looks the same: A collection of people doing pretty much the same thing, each emphasizing his own originality and uniqueness."

Lucas (1988) claims that these externalities are the force pulling cities together: "why can people be paying Manhattan or downtown Chicago rents for, if not for being near people?" Furthermore, they are the reason that rich countries have higher wages for every level of human capital, which explains why there is a tendency for people to migrate from poor to rich countries. Using macroeconomic data, Lucas (1988, 1990) estimate ϵ to be about .36. Using a large cross-section of countries, Chua (1993) quantifies the human capital externality to be somewhere between .06 and .15.

Caballero and Lyons (1990) and Bartelsman, Caballero, and Lyons (1991) provide microeconomic evidence on the importance of these externalities in the manufacturing sector of the United States and Europe. Their estimate of the size of the inter-firm externality (which corresponds to ϵ in equation (1)) is about 5 percent.

2.2. *A Two-Generation Economy*

I assume that there are only two types of people in this economy: young and old. At time t, there are n_t^y young people with a skill level h_t^y and n_t^o old with a skill level h_t^o. If all firms are identical, the production function in (1) can be written as

$$Y_t^{all} = AK_t^{\alpha}\left(n_t^y h_t^y + n_t^o h_t^o\right)^{1-\alpha}\left[\frac{(n_t^y h_t^y + n_t^o h_t^o)}{N_t}\right]^{\epsilon_j}\left[\frac{(n_t^y h_t^y + n_t^o h_t^o)}{N_t}\right]^{\epsilon}, \tag{2}$$

where, again, I assume that all young and old people work (the superscript j has been omitted from (2)) Y^{all} stands for output produced when *all* workers are employed (as opposed to output produced when only the young workers are employed, as it will be the case when I discuss economies with social security later on). Competitive firms choose the amount of workers of each type and the amount of investment in physical capital so as to maximize profits taking the last term (interfirm externality) and input rental prices as given. The first-order conditions entail the equalization of input rental prices to private marginal

products:

$$w^{o,all} = \frac{\partial y^{all}}{\partial n^o} = (1-\alpha)\frac{h^o y^{all}}{n^o h^o + n^y h^y} + \epsilon_j y^{all}\frac{n^y[h^o - h^y]}{(n^o + n^y)(n^o h^o + n^y h^y)}, \tag{3a}$$

$$w^{y,all} = \frac{\partial y^{all}}{\partial n^y} = (1-\alpha)\frac{h^y y^{all}}{n^o h^o + n^y h^y} + \epsilon_j y^{all}\frac{n^o[h^y - h^o]}{(n^o + n^y)(n^o h^o + n^y h^y)}, \tag{3b}$$

$$r^{all} = \frac{\partial Y}{\partial K} = \alpha\frac{Y^{all}}{K}, \tag{3c}$$

where I omitted time subscripts to simplify notation. The firm internalizes the intrafirm externality in that wages reflect not only the direct contribution of a worker to the firm's output (this is the firm term in (3a) and (3b)) but also his effect on the productivity of the other workers of his firm through his contribution to the average human capital (second term in (3a) and (3b)).

An important point is that if human capital of the old person is lower than that of a young, then the wage rate of the old will be lower in the presence of intrafirm externalities (note that the second term in (3a) involves ϵ_j multiplying $[h^o - h^y]$; this term is negative if $\epsilon_j > 0$ and $h^o - h^y < 0$.) The opposite is true for young workers, whose skill is above average. The intuition is that when a firm hires a person with lower than average skill, there is a reduction in that firm's average skill and consequent reduction in everybody's productivity. Firms internalize this effect by lowering that person's wage rate. Note that if the difference between h^y and h^o is large enough and the externality is large enough, it is conceivable that an old person's overall productivity be zero or even negative. A profit-maximizing firm would not like to hire that person at any positive wage rate.

Firms, on the other hand, do not internalize the interfirm externality represented by $\epsilon > 0$: the effect of a person working for firm j on the workers of all other firms is *not* reflected on his wage. The social marginal products of old and young workers are

$$\frac{\partial y^{all}}{\partial n^o_{social}} = (1-\alpha)\frac{h^o y^{all}}{n^o h^o + n^y h^y} + (\epsilon_j + \epsilon)y^{all}\frac{n^y[h^o - h^y]}{(n^o + n^y)(n^o h^o + n^y h^y)},$$

$$\frac{\partial y^{all}}{\partial n^y_{social}} = (1-\alpha)\frac{h^y y^{all}}{n^o h^o + n^y h^y} + (\epsilon_j + \epsilon)y^{all}\frac{n^o[h^y - h^o]}{(n^o + n^y)(n^o h^o + n^y h^y)}.$$

The difference between the *social* and the *private* marginal products is that the second term in the social involves $\epsilon_j + \epsilon$ rather than ϵ_j. If the elderly have lower human capital than the young, their social marginal product will be lower than their private product if the interfirm externality is positive ($\epsilon > 0$). Furthermore, if the interfirm externality is large enough and the difference between young and old ($h^y - h^o$) is large enough, the social marginal product of labor of an old worker may be negative, even though his private marginal product is positive. In other words, some societies may not want the elderly to work, despite the fact that profit-maximizing firms are willing to pay positive wage rates for their services.

2.3. *An Economy with Social Security*

Consider an alternative economy where the young people work and the elderly retire. The production function (2) can be rewritten as

$$Y_t^{SS} = AK_t^{\alpha}\left(n_t^y h_t^y\right)^{1-\alpha}\left[\frac{n_t^y h_t^y}{N_t^y}\right]^{\epsilon_j}\left[\frac{n_t^y h_t^y}{n_t^y}\right]^{\epsilon}, \tag{2'}$$

where Y^{SS} stands for output under social security. The only difference between (2) and (2') is that n^o has been set to zero in (2'). The wage rate for the young in the social security economy is given by

$$w_t^{y,SS} = \frac{\partial Y_t^{SS}}{\partial n_t^y} = (1-\alpha)\frac{Y^{SS}h^y}{n^y}. \tag{3'}$$

The key point here is that the externality parameters disappear from the wage rate. The reason is that when only the young people work, all employed have the average level of skill, and therefore nobody affects the rest of the workers in a negative (or positive) way. The externality is relevant only if there are workers with different levels of skill.

2.4. *Human Capital over the Life Cycle*

Most of the human capital literature studies how individuals allocate their time over various activites so as to increase their skills or human capital in the manner that maximizes their lifetime utility (Becker, 1964; Rosen, 1976). Some authors study how the incentives to accumulate skills affect aggregate economic growth (Lucas, 1988). As noted earlier, Kotlikoff and Gokhale (1992) show that the skill-age profile for the typical worker is an inverse-u shape with a maximum at approximately forty-five years of age. This paper is most interested on the effects of the inevitable decline in human capital that accompanies the passage of time—that is, the downward-sloping section of the skill-age profile. Therefore, and in order to keep the model as simple as possible, the early stages of life when individuals accumulate skills will be neglected. I will simply assume that a young person born at $t+1$ inherits the human capital that his parents had when they were young, augmented by some growth factor γ[10]:

$$h_{t+1}^y = (1+\gamma)h_t^y. \tag{4}$$

The growth factor is similar to the one postulated in the old neoclassical literature. It reflects the improvement in training methods as well as technological progress. Implicitly, I am assuming that these technological improvements more than offset the human capital depreciation that occurs due to the imperfect transmission of skills from parents to children. Following Romer (1990) and Grossman and Helpman (1991), the rate of technological innovation could be assumed to be an increasing function of the level of human capital ($\gamma(h^y)$ with $\gamma'(h^y)$.) This result reflects the fact that technological innovations are made by researchers whose quality is reflected in h^y.

The growth rate could also reflect the effects of investment in education while young. For the sake of simplicity, I prefer to take γ as given and use a two-generation overlapping-generations model than to use a three-generation model where babies chose the level of investment in education during the initial period of life. As will be apparent later on, the main lessons from this paper do not depend on whether growth is exogenous or endogenous.

The abstraction from the "learning age" implies that a young person in this model represents an adult worker at the peak of his career. In order to reflect the loss of human capital due to the passage of time, it is assumed that if an agent's skill level is h_t^y when young, his skill when old will be

$$h_{t+1}^o = \left(1 - \delta(h_t^y)\right)\ h_t^y, \tag{5}$$

where $\delta(h_t^y)$ is the rate of human capital depreciation with $\delta'() > 0$ and $\lim_{h^y \to \infty} = \bar{\delta} \leq 1$. The assumption of increasing depreciation rates is based on two arguments. First, I want to capture the idea that technology in rich economies changes rapidly, and, as a result, a person's skills become obsolete relatively quickly. In other words, in the real world most people's skills are linked to the technology available at the time when they are learnt (like physical capital, human capital is vintage- or technology-specific). Moreover, it is hard for old people to learn new technologies: old secretaries find it difficult to learn modern computer programs, old professors have a hard time learning new theories and tools, old salespeople cannot cope with new sales methods.[11] When technological progress occurs, the skill embodied in existing workers suffers economic depreciation (because their skills are linked to the previous technological environment, technological progress renders them obsolete). It follows that the larger the rate of technological progress, the larger the rate of technological depreciation (so $\delta = \delta(\gamma)$ with $\delta'() \geq 0$). If, as in Romer (1990) and Grossman and Helpman (1991), technological progress is positively related to the stock of human capital ($\gamma = \gamma(h^y)$ with $\gamma' \geq 0$), the effective depreciation rate of human capital is a function of the level of human capital. In other words, rich economies are rapidly changing economies where the skills of a person suffer quick economic obsolescence.

Second, empirically, the variance of skills across people at the peak of their careers is proportionally larger than that at much older ages. Mincer (1974) regresses wages on some explanatory variables (excluding ability) and finds that the variance of the residuals (which he interprets as the variance of ability) is positively related to experience for the first twenty-five years and negatively afterwards. Glaeser (1992, fig. 2) provides similar evidence (and an alternative interpretation) using more recent data. Thus, people who had larger skill at age forty-five had lost proportionally more of their skills by age sixty-five.[12] It follows that the depreciation rate is an increasing function of the level of skill.

Since we are consideringly only two generations, we should think of $\delta()$ as the depreciation rate over a period of approximately twenty-five years. Kotlikoff and Gokhale (1992) document that human capital increases with age over the first forty-five years of life and declines to about a third of that by age sixty-five.They find this to be true for males and females, for office workers, sales workers, and managers alike. Hence, depreciation rates of two-thirds over a period of twenty-five years do not seem unreasonable.

2.5. *Consumers*

Following Barro (1974), it will be assumed that individual agents care about their own lifetime utility and about that of their children.[13] Hence, the utility function of a person born at t is

$$V_t = u(c_t^y) + \frac{1}{1+\rho}u(c_t^o) + \frac{1}{1+\Psi}V_{t+1}, \tag{6}$$

where ρ and Ψ are the rates at which an individual agent discounts his own future utility that of his children respectively. An agent born in period t receives a positive bequest b_t from his parents. While young, he works at a wage rate w_t^y. If society chooses to introduce a social security system, then the young worker will be taxed a fraction τ of his wage.[14] He allocates his resources between consumption c_t^y and assets s_{t+1}^y. At the end of youth (or the beginning of old age) he has n children, each of whom he endows with a bequest b_{t+1}. He receives interest on the assets he saved when young $s_{t+1}^y(1+r_{t+1})$ as well as a wage w_{t+1}^o for his work while old. If a social security system has been introduced, he may not work when old, and he may receive a pension T_{t+1} instead. He consumes c_{t+1}^o. His budget constraints are therefore

$$\begin{aligned} c_t^y + s_{t+1}^y &= w_t^y(1-\tau) + b_t \\ c_{t+1}^o + (1+n)b_{t+1} &= w_{t+1}^o + T_{t+1} + s_{t+1}^y(1+r_{t+1}). \end{aligned} \tag{7}$$

The government budget constraint depends on whether the social security system is pay as you go (PAYG) or fully funded. If it is PAYG, then at time t the government just collects taxes from the young ($\tau > 0$) and gives them to the old: $\tau \cdot w_t^y \cdot (1+n) = T_t$.[15] If we add up the constraint for all the people alive at time t, we get

$$C_t + S_{t+1} - S_t = W_t^y + W_t^o + r_t S_t, \tag{8}$$

where C_t is total consumption, S_t is the total amount of financial assets in period t, and W_t^y and W_t^o are the total wage bills for young and old respectively (W_t^o will be zero if the elderly retire). The economy is closed to foreign financial and goods markets so aggregate savings equal aggregate investment. The only asset in this economy is physical capital, so $S_t = K_t$ for all t. Using the first-order conditions for the firm (equations (3)), the right hand of (8) is total output. Equation (8) says therefore that consumption plus investment equals total GDP. The first-order conditions are

$$\begin{aligned} u'(c_{t+1}^y) &= u'(c_{t+1}^o)(1+\Psi)/(1+\rho), \\ u'(c_t^y) &= u'(c_{t+1}^o)(1+r_t)/(1+\rho), \end{aligned} \tag{9}$$

where I assume that $b_t > 0$ for all t. Again, this assumption is made so as to get the Ricardian equivalence result. For simpliciy, I have assumed zero population growth, $n = 0$ (in Section 5 I analyze changes in the population structure).

2.6. *Equilibrium*

In order to get closed-form policy functions I consider the case of logarithmic utility and full depreciation of physical capital. Furthermore I assume that $\rho = \Psi$—that is, the rate at which we discount our children is the same as the rate at which we discount our own future.[16] The resulting policy function for investment is

$$K_{t+1} = \alpha \frac{Y_t}{1+\rho}, \tag{10}$$

where the first-order conditions for firms have been used.[17] This policy function says that savings (and investment) are a constant fraction of total GDP. Using (10), the output path for an economy where all people work is described by the following difference equation

$$\begin{aligned} \ln Y_{t+1}^{all} &= \eta + \alpha ln Y_t^{all} + (1 - \alpha + \epsilon_j + \epsilon) ln(n_{t+1}^y h_{t+1}^y + n_{t+1}^o h_{t+1}^o) \\ &\quad - (\epsilon_j + \epsilon) ln(n_{t+1}^y + n_{t+1}^o), \end{aligned} \tag{11}$$

where $\eta = \alpha ln(\alpha/(1+\rho))$ is an unessential constant. The initial condition needed to solve this difference equation is the initial capital stock, K_0. Using the policy function (10), the path of aggregate output is described by the difference equation

$$ln Y_{t+1}^{SS} = \eta + \alpha ln Y_t^{SS} + (1 - \alpha + \epsilon_j + \epsilon) ln(n_{t+1}^y h_{t+1}^y) - (\epsilon_j + \epsilon) \ln(n_{t+1}^y), \tag{12}$$

where η is the same unessential constant as in (11) and the initial condition is given by K_0.

3. Desirability of Social Security in the Steady State

Define the steady state as the state where all variables grow at a constant rate. The policy function (10) says that in the steady state, physical capital and output grow at the same rate. The level of human capital for all workers grows at rate γ and its depreciation rate is at its maximum possible value, $\bar{\delta}$. Using (11) and the behavioral equations for human capital (4) and (5), the steady-state growth rate of the economy where all people work is

$$(\gamma_y^{all})^* = \frac{1 - \alpha + \epsilon_j + \epsilon}{1 - \alpha} \gamma. \tag{14}$$

If there were no externalities ($\epsilon_j = \epsilon = 0$), the growth rate of output would be equal to the (exogeneous) growth rate of human capital, γ. The steady-state growth rate of output of the economy with social security is

$$(\gamma_y^{SS})^* = \frac{1 - \alpha + \epsilon_j + \epsilon}{1 - \alpha} \gamma. \tag{15}$$

Note that $(\gamma_Y^{all})^* = (\gamma_Y^{SS})^*$, so whether the elderly work or not does not affect the steady-state growth rate of output. The reason is that, in steady state, the relevant depreciation rate is constant, and therefore the stock of human capital of the young and the old grow at the

same rate. It follow that the effective labor and the marginal product of physical capital also grow at the same rate in both economies, so final output must also grow at the same rate.

Consider two economies in the steady state. Imagine that, at time t, they have the same amount of inputs. The difference is that in one economy everybody works. In the other, the elderly retire. We just showed that the two growth rates are the same so the steady-state difference in the log of output is constant. This difference is given by

$$[\ln(y_t^{all}) - \ln(y_t^{SS})]^* = \frac{1-\alpha+\epsilon_j+\epsilon}{1-\alpha}\ln\left(\frac{n^o}{n^y}\frac{1-\bar{\delta}}{1+\gamma}+1\right) - \frac{\epsilon_j+\epsilon}{1-\alpha}\ln\left(1+\frac{n^o}{n^y}\right). \tag{16}$$

Equation (16) suggests that if there are no externalities ($\epsilon_j = \epsilon = 0$), the level of output is always larger in the economy where all work. It also says that if the externalities ($\epsilon_j > 0$ and/or $\epsilon > 0$) and the limiting depreciation rate, $\bar{\delta}$ (which determines the gap between h^y and h^o) are large enough, then total output in the economy where all work is lower than the total output produced when the elderly retire. In other words, output can be increased if the elderly retire.

3.1. *Private or Public Retirement Schemes?*

An important question is whether retirement schemes should be introduced by the government or by the market. The answer according to the model depends on what type of externality is important. If retirement is desirable because $\epsilon_j > 0$ (intrafirm externality), the private marginal product of the elderly is negative so no firm has an incentive to hire them at positive wage rates. As people reach a certain age when their positive contribution to the firm's output no longer offsets the negative effect on their colleagues, firms will offer the elderly a negative wage rate (they have to pay a fee for working). Unless they really enjoy their jobs, the elderly will optimally choose to abandon them. The market therefore will do the job without the need for government intervention.

If the interfirm externality is important, however, retirement would yield higher aggregate, but individual firms would be willing to pay positive wages for the elderly's services (their overall private marginal product is positive). Because their social contribution is negative, however, government intervention is necessary to introduce the social security system.[18]

Obviously in the real world there could be both intrafirm and interfirm externalities. As a result, we should observe both privately induced as well as publicly induced retirement schemes. The important point, however, is that as long as the interfirm externalities are large enough, government intervention will be necessary.

3.2. *Transfers Versus Taxes as a Means to Induce Retirement*

This paper provides an explanation as to why it may be desirable for the government to induce the retirement of old workers. The question is whether this goal can be best achieved

by taxing the old or by the transfer system introduced by the social security program. In the working version of this paper (Sala-i-Martin, 1995) I argue that the transfer system is optimal under some circumstances. For example, if there are distortions, the second-best solution would make the rationing-subsidy (transfer) scheme better than the market-tax scheme as suggested by Guesnerie and Roberts (1984).

3.3. *Retirement or Relocation?*

I have been assuming that output was a good measure of social welfare and that the elderly could not form a firm or division where they could work without impairing the ability of the young. If this was a feasible alternative, the economy as a whole could produce more output by confining the aged to these isolated jobs than with the social security program: when all workers are old, there are no negative externalities, since everybody has the average human capital.

But even if was possible to increase aggregate output by confining the elderly to some new job, it is not clear that social welfare would also be higher. This would be particularly true if (1) the elderly valued leisure, (2) they were not very good at performing these new jobs (for which they have not been trained), or (3) it were costly to adjust from their previous jobs. In other words, we should consider that a person may not like to start flipping burgers at McDonald's after being the president of an international corporation or a professor of economics at Yale. He will probably prefer to enjoy leisure instead. Hence, even though aggregate output would be higher if he worked at McDonald's, to the extent that society values his utility, it will be better to retire him rather than to relocate him.

4. The Transition: Endogenous Creation of Social Security

Up to now I have showed that if the externality parameters and the human capital depreciation rates are large enough, the steady-state level of income will be larger in the economy with social security. But *in the real world we observe economies going from a system with no pensions to a system with pensions as they develop.* In other words, if social security is so good, why didn't societies create it back the middle ages?[19] Why are social security systems created only after a certain level of development has been reached?

To answer these questions consider two economies that, at time zero, have the same level of physical capital, human capital, and number of people of both generations. In one economy everybody works and in the other, only the young work. The difference in (log) output between these two economies is given by

$$\ln(y_0^{all}) - \ln(y_0^{SS}) = \frac{1-\alpha+\epsilon_j+\epsilon}{1-\alpha}\ln\left(\frac{n^o}{n^y}\frac{1-\delta(h^y)}{1+\gamma}+1\right) - \frac{\epsilon_j+\epsilon}{1-\alpha}\ln\left(1+\frac{n^o}{n^y}\right). \tag{17}$$

All the terms in equation (17) are equal to equation (16) with the exception of the depreciation rate inside the first log. In the steady state (equation 16) the relevant rate is $\bar{\delta}$. Out of the

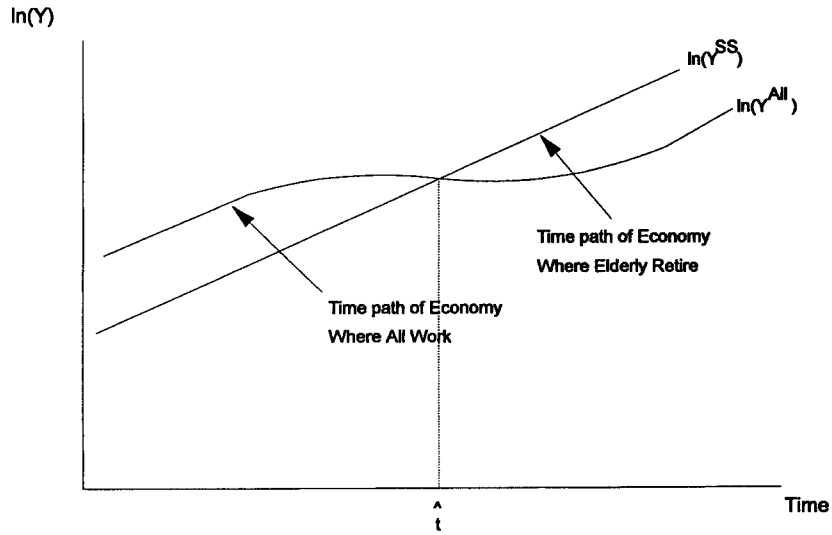

Figure 1. Time paths

steady state (equation 19), the relevant rate is $\delta(h^y)$, where h^y is the level of human capital corresponding to the previous period. Since $\delta'() > 0$, it is possible to find sets of parameters for which $\ln(Y_0^{all}) > \ln(Y_0^{SS})$ but $\ln(Y^{all})^* < \ln(Y^{SS})^*$.

The transitional paths of aggregate output for the two economies are described by equations (11) and (12). We can solve for the time paths numerically. Figure 1 reports an example of such time paths. The path labeled $\ln(Y^{all})$ refers to the economy where all work and the one labeled $\ln(Y^{SS})$ corresponds to the economy with social security. The corresponding underlying parameters are the same, the only difference between these two economies is, therefore, that in Y^{SS} the elderly do not work. There is a point in time $\hat{t}$ at which the two time paths cross. At this point, aggregate output with and without social security coincides. For $t < \hat{t}$, the economy without social security produces more output. Hence, we should not expect to observe a social security system before $\hat{t}$. For $t > \hat{t}$, aggregate output is higher when the elderly do not work, so we should expect a social security scheme to be created around $\hat{t}$.

The economic intuition behind this result is the following: at low levels of development, technologies do not change very rapidly, and therefore the skills of the elderly are very similar to those of the young. As we argued above, when the skills of all workers are similar, no worker exerts negative effects on the rest of the workers, so output is higher when all work. As human capital accumulates and technologies change more and more rapidly, the economic depreciation rate starts to increase, thereby introducing an increasing gap between the human capital of the old and the young. The elderly start to be a burden on the young. There is a point in time $\hat{t}$, where the social product of the elderly becomes negative as the negative effect of the externality outweighs their positive private marginal

product. After this point, the economy with social security will produce more output: the introduction of legislation to buy the elderly out of their jobs will look desirable.[20]

One prediction of the model is that, around the time when social security is introduced (that is, around $\hat{t}$), the economy with social security grows faster.[21] We can see in Figure 1 that at around the time when Y^{SS} is close to Y^{all}, the line $\ln Y^{SS}$ is steeper than $\ln Y^{all}$ (since the units are logs, the slopes are the growth rates of output). Hence, if the economies in the data are within a reasonable range of $\hat{t}$, then the model predicts a positive relation between social security transfers and growth, so it will appear as if transfers were productive. And in a way they are because "buying the elderly out of their jobs" could be thought of as an input of production that increases aggregate output.

5. Changes in Population Structure

The model has assumed a constant population structure. Most analyses in the literature link the introduction and the desirability of a potential elimination of social security systems to changes in life expectancy and dependency ratios (the ratio of the number of old to young people.) It can be shown (see Sala-i-Martin, 1995, for details) that an increase in life expectancy increases the incentives to introduce a social security program and that, once the social security has been created, a sufficient increase in the dependency ratio reduces its desirability.

6. Conclusions and Extensions

In this paper I made two simple points. First, I argued that in most countries, social security benefits can be collected only after the person retires (or in some countries, like the United States, there are severe penalties for earning labor income, although not other types of income). This suggests that the social security system puts great emphasis on retirement and that social security theories should explain why the government seems so interested in retiring the elderly. Second, I provided a theory that is consistent with this regularity. The main idea is that social security is just a way to buy the elderly out of their jobs, that is a way to induce retirement. The reason that societies choose to do such a thing as that aggregate output is higher if the elderly do not work. This idea was modeled through *positive* externalities in the *average* stock of human capital. Since human capital depreciates with age, old workers have lower-than-average human capital, and, as a result, they exert a negative effect on the productivity of the young. When the difference between the skill level of the young and that of the old is large enough, aggregate output in an economy where the elderly do not work is higher. Social security systems arise as a means to achieve this end. This explains why, in most countries, the elderly can collect their pensions only after they retire.

I also argued that, unlike other branches or government (like defense), social security programs were not introduced until a certain level of development had been reached. That is, social security appears to be a luxury good. In Section 4 I show how a social security system is created endogenously as the economy reaches a certain level of income. The

economic intuition behind this result is that at lower levels of development the rate of technological innovation is low and, therefore, the rate at which human capital depreciates is low. The difference between the skill level of the young and that of the old is not large enough to warrant the introduction of retirement schemes. As the economy develops, the rate at which new technologies are introduced increases, and, as a consequence, so does the rate of human capital depreciation. Accordingly, the gap between the skill level of the young and the old increases. There is a point at which this gap is large enough so that it pays a society to introduce a social security system.

The model is also consistent with a number of other empirical regularities (also documented in Section 1): people have to work for a number of years prior to being able to collect pensions (the reason is that people who do not have jobs do not have to be bought out of the labor force); pensions are linked to previous wages (the higher a person's previous wage is, the higher the payment required to induce him to abandon his job); social security programs enjoy widespread support (because income is higher for all agents in the economy); and social security programs are created irrespective of the political system (as long as political leaders or other voters favor higher levels of aggregate income, buying the elderly out of their jobs will be desirable).

Throughout the paper a number of shortcomings and interesting extensions to the analysis were highlighted. The model was fairly aggregative in that had only one sector. In the real world, jobs in different sectors require different skill levels, and the rates at which these skills depreciate over time are also likely to differ across sectors. Likewise, human capital externalities are probably more important in some sectors than in others. One could extend the model to embrace a multisectoral world along these lines. The main conclusions, however, would not change: retirement in a particular sector would depend on how fast the skill level depreciates with age and on how important the externality is in that particular sector. It is interesting to not that one of the first firms to introduce retirement-inducing pensions in the United States was the explosives division of the Dupont Corporation in Wilmington, Delaware. Railroads, on the other hand, were the first sector to introduce similar schemes (Graebner, 1980). These are two examples of industries where externalities (intrafirm or interfirm) seem important and where, due to the continuous tension and stress at work, skill depreciation is probably high. Another example of a profession where externalities and depreciation rates are large is that of the commercial air pilot. As expected, air pilots are forced to retire at a fairly young age (and they are forced by government regulation).

The final point is that the model presented in this paper relies on the assumption of human capital externalities in production. Some readers may not like this assumption, and one must confess there is limited evidence on the existence of such externalities (despite their widespread use in the modern theories of endogenous growth). Following Friedman's methodology of positive economics, we should not care about the assumptions made but, rather, about whether the model can explain the existing evidence. And in this regard, one should view this paper as presenting a puzzle to the existing theories of social security: *why is it that most social security systems around the world so heavily link pensions to retirement*? The message is that researchers should focus more on the theoretical relation between pension and mandatory retirement.

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Notes

1. One of the initial motivations of this paper was my dissatisfaction with such treatments. I wanted to provide a framework to think about transfers and study their effects on long-run growth.
2. The productivity of people above age sixty-five is probably lower. Since most of them do not work, we do not have real data on this.
3. See, for instance, Barbara Armstrong's Memoirs, Columbia University (Armstrong was a Berkeley law professor and a member of the committee on social security appointed by the president in 1934 to draft the Social Security Act).
4. *Railroad Retirement Board v. Alton Railroad.* The dispute was over the 1934 Railroad Retirement Act introduced by Senator Robert F. Wagner of New York. The 1935 Social Security Act was also challenged on the same grounds. In 1937 the Supreme Court found it to be constitutional.
5. Acknowledging that pensions reduce the work incentives of the elderly, some researchers call this an "unintended and damaging effect of social security." Pechman, Aaron, and Taussig (1968) write: "Payment of early retirement benefits has proved *unsatisfactory* for two reasons: first, it causes low benefits to be paid to very needy aged persons; *second, it is still another aspect of the social security system that reduces the work incentives of the aged*" (p. 148). They go on to describe policies to get rid of this undesirable feature of the system.
6. The income data come from Summers and Heston (1988). The transfer data are taken from Government Financial Statistics (various issues) and are the average of social security transfers as a fraction of GDP over the period 1970 through 1985. This is the variable SOCSEC in the Barro (1991) dataset.
7. Measurement error in the population ratio could explain why the income-level variable is significant. By the same token, however, measurement error in the income variable would tend to give "too much" importance to the population ratio. It could be persuasively argued that it is easier to count people than to count units of GDP, so I would guess that these coefficients tend to underestimate the true partial correlation between transfers and the level of income. The reason that the fraction of old people is not enough to account for the positive relation between income and transfers is that in most industrial nations, the system is universal in that all employed persons are covered by the social security program (agricultural workers and self-employed seem to be an exception in a lot of countries). In developing countries, on the other hand, social security programs are often token programs where only a minority of workers employed in a few selected sectors or regions are covered. Table 1, column C, reports on the sectors that were covered in each country in 1989. See also Burgess and Stern (1989), Mesa-Lago (1978), Ahmad (1991), Mackenzie (1991), and the papers in Ahmad et al. (1989) for evidence on this point.
8. Furthermore, the political story cannot explain why social security schemes are introduced in nondemocratic countries.
9. I call this an externality because it represents an effect from one worker's productivity on other worker's productivity. Hence, it is an effect external to the worker, even though it is not external to the firm. It is part of the marginal product of human capital, and it is not an externality in the widely accepted sense of the word. This intrafirm externality is not really central to the paper, but it will be useful to distinguish the necessity of a publicly provided social security program from a private retirement or pension scheme.

10. A small amendment along the lines proposed by Lucas (1988) could embody this analysis into a model of endogenous growth. The endogenous growth of human capital would depend on the "learning technology" available to educate people, on the willingness to substitute over time, on the rate of temporal impatience, and on human capital depreciation rates. See Mulligan and Sala-I-Martin (1993) for a detailed analysis of such models. The main lessons from the present paper, however, do not depend on whether growth is exogenous or endogenous.
11. In talking about the problems of the American University, Osler thought that the problem with old professors was not their loss of judgement or memory. He argued that "the change is seen in a weakened receptivity and in an inability to adapt oneself to an altered intellectual environment. It is this loss of mental elasticity which makes them so slow to receive new truths" (Osler, 1910). The inflexibility of some departments of economics which are dominated by old professors is an extraordinary example of this effect.
12. This is true of the residuals represent the log of ability. It is hard to see, however, what function of ability these residuals really are.
13. As pointed out by Barro, this intergenerational altruism generates debt neutrality. The main lessons of the paper in no way depend on whether Ricardian equivalence holds or not. In fact, this Ricardian world is the most hostile environment to explain the existence of social security, so if we can explain it in this environment, it would be even easier to do it in a simple OLG model where people are linked only at conception.
14. Almost all existing social security systems get their resources through wage taxes. See column 1 in Table 1.
15. A fully funded social security system would require agents to buy τw_t^y units of asset A_{t+1} when young and would refund $\tau w_t^y (1 + r_{t+1})$ when old.
16. This later assumption is not necessary and it does not introduce too much additional complication. The main implication is that $c_t^y = c_t^o$.
17. Note that this investment policy function is independent of the social security tax rate. The reason is that is a tax on wages. Since interest income is not taxed, the social security tax does not distort intertemporal investment decisions. Since most social security programs around the world are financed with wage taxes (see fact 1f in Section 1), this assumption is not too unrealistic.
18. In a set of clever and original papers, Lazear (1979, 1983) outlined reasons that mandatory retirement was beneficial: an increasing wage-age profile is an efficient way for firms to solve agency problems with the workers. But if the wage-age profile is increasing, the marginal product of labor for people of age sixty-five is lower than the wage rate, and at this "high" wage rate, the elderly will chose to keep working but the firm will like separation. Knowing this in advance, the firm will hire people with the understanding that the job will be terminated at age sixty-five. Mandatory retirement is, therefore, desirable. Lazear's story explains why private firms would like the elderly to retire. It does not explain, however, why in most countries, it is the government that organizes large-scale social security programs that provide the incentives for retirement.
19. Social insurance programs throughout history have usually been left to other institutions such as churches, families, or villages. Government-sponsored social security schemes are fairly recent innovations (see discussion in Section 1).
20. Another plausible story that would explain the creation of social security in the nineteenth century and not earlier is that the externality was not important before the industrial revolution: the type of intellectual interaction that generates the human capital externalities described in this paper would probably not apply to agricultural economies. In terms of the model, it is possible that the parameters ϵ and ϵ_j increase with the level of development—that is, $\epsilon(h)$, $\epsilon_j(h)$ with $\epsilon' > 0$ and $\epsilon_j' > 0$.
21. Asymptotically, however, the growth rate of the economy with social security economy will be the same as the economy without.

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