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ScienceDirect
European Journal of Political Economy 23 (2007) 917–931
European Journal of POLITICAL ECONOMY
www.elsevier.com/locate/ejpe

The role of ageing in the growth of government and social welfare spending in the OECD

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Received 4 February 2004; received in revised form 10 March 2006; accepted 15 January 2007
Available online 21 March 2007

Abstract

Government expenditure as a share of GDP in the OECD rose at an annual growth rate of 1.02% in the period between 1970 and 1997. Government spending has increased most on functions particularly demanded by elderly population: social welfare, health and defence. Ageing is the main driving force of the growth of government spending, followed by relative prices and population. However, we also find that the other age groups react to ageing, thereby preventing increases in benefits per retired persons and that institutional reforms have been successful at reducing the impact of ageing on pensions in recent years.

JEL classification: H11; H50; D72; J11
Keywords: Public sector size; Composition of government expenditure; Ageing

1. Introduction

In the period 1970–1997, government expenditure as a share of GDP in the OECD countries increased from 30.5% in 1970 to 43.3% in 1997. Social welfare and health, the most age-related expenditures, account for more than 85% of this growth of government expenditure. However, previous evidence is not conclusive with regard the role of the aged population in the growth of the welfare state and government spending. Razin et al. (2002) find that the dependency ratio has a negative effect on per capita social transfers. Bryant (2003) and Disney (2007) show that this negative relationship is reversed when the dependency ratio is appropriately measured. These studies use static fixed effects panel data and focus on total government spending and social

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doi:10.1016/j.ejpoleco.2007.01.003

welfare spending. In this article, we examine whether the ageing process is the main factor behind the growth of government expenditure in the OECD countries during the period 1970–1997. For this purpose, we firstly use the error correction model (ECM) suggested by Beck and Katz (1996). This dynamic panel data econometric method is more appropriate than static panel data because it reflects that adapting to changes in the demand for government expenditure is a process requiring slow adjustment and allows us to separate long-term permanent effects from short-term transitory effects. Secondly, we analyse the role of ageing not only on total public spending and social welfare, but also on all the other categories of government expenditure. The use of the full functional composition of government expenditure for many OECD countries over a long period allows us to examine whether, even when ageing increases social welfare and health spending, the elderly offset this rise by reducing other components of government spending. Thus, we also benefit from exploiting the efficiency gains of seemingly unrelated regressions. Moreover, we take into account other factors affecting government spending such as per capita income, relative prices and two other demographic aspects: total population and population density. In this way, we analyse whether factors other than ageing are more important in pushing up the demand for government spending. Thirdly, we use the Craig and Inman (1986) voter group model which is more useful in analysing the effects of ageing on social welfare than the median voter model previously used in literature, because such effects do not depend on a single voter any more, but rather on the weight of each of the age groups in total population (the elderly, the middle-aged and the young population). Thus, Section 2 presents the theoretical framework. Section 3 estimates a dynamic panel data model of the demand for the functional components of government expenditure in the OECD in the period 1970–1997. Section 4 checks the robustness of the results and Section 5 assesses the contribution of each factor to the growth of government spending in the OECD. In Section 6 we draw the most significant conclusions.

2. Theoretical model

The effect of ageing on social welfare is ambiguous. Razin et al. (2002) and Galasso and Profeta (2004) claim that ageing has two opposite effects on the size of social welfare. On the one hand, ageing has a political effect because the median voter becomes older, hence increasing his demand for social welfare spending. On the other hand, ageing has an economic effect based on the fact that a higher dependency ratio puts a higher tax burden on the people around the median voter to satisfy the increased proportion of pensioners. Razin et al. (2002) find that the net effect of the dependency ratio on per capita social transfers is negative. In contrast, Bryant (2003) argues that when the dependency ratio is appropriately measured (excluding the population below the working age and the inactive working-age population) there is a net positive association between the old age dependency ratio and the size of the welfare state. Furthermore, Simonovits (2007) argues that the assumption of absence of any link between individual contributions and pension benefits is critical for the theoretical predictions of Razin et al. (2002). Thus, Galasso and Profeta (2007) argue that the relative strength of the positive political effect and the negative economic effect of ageing on social welfare spending depend on the strength of the link between current contributions and future pension benefits. The negative economic effect of ageing becomes stronger as the pension benefits link to individual contributions weakens. Disney (2007) finds empirical support for the prediction offered by the Galasso and Profeta model, though this author claims that the net effect of ageing on pension is always positive even in the extreme case where the link between contributions and benefits is absent. Even if the elderly increase social welfare spending, they could offset this rise by reducing other expenditure functions from which they do

not benefit much, particularly public education spending. However, ageing also has two opposite effects on this type of spending. On the one hand, the political effect reflected from the fact that ageing increases the influence of the elderly who do not demand public education spending because they do not benefit from it. In this way, Harris et al. (2001) find that the elderly share in the population has a negative effect on education spending per pupil. On the other hand, ageing brings about an economic effect on public education spending. Gradstein and Kaganovich (2004) argue that the young and working-age population support public education because it increases productivity and promotes growth, assuring higher returns on their savings when they retire. Ageing raises longevity and the prospect of longer retirement, hence increasing the demand for education of the young and the working-age population. Furthermore, Levy (2005) contends that when the young are a minority in the population then it is also the case that public education is relatively cheap. Thus, the rich, who demand low taxes and the young segment of the poor can form a winning coalition which reduces the tax burden but shifts resources to public education.

We depart from theoretical models based on the median voter theorem because in these models the effect of ageing on social welfare spending critically depends on how ageing affects the way the median voter benefits from this program or on whether it changes the identity of the median voter. Furthermore, these theoretical models do not lead to a stable majority rule equilibrium allocation when issues are multidimensional, such as the composition of government spending. Instead, we follow the Craig and Inman (1986) voter group decision model, in which the composition of government expenditure in equilibrium is a weighted average of each group's preferred allocation:

$$G_f^* = \sum_{h=1}^{H} \omega^h f^h(Y^h, P_1, \ldots, P_f, N, Z);\ f = 1, \ldots, F.;\ h = 1, \ldots, H.;\ \sum_{h=1}^{H} \omega^h = 1.;\ P_f = C_f N^{(\eta_{f-1})} \quad (1)$$

Where, G_1,G_2,...,G_f is per capita consumption of component f of government expenditure, ω^h is the political strength of group h and f^h is the demand function for group h. This demand function f^h depends on per capita income of group $h(Y^h)$, prices for each component of government expenditure (P_f), population (N) and structural characteristics (Z). Prices for each component of government expenditure are a function of the cost of a unit of component $f(C_f)$ and its degree of congestion (η_f). We assume that age is the characteristic distinguishing the demand of voter groups. Indeed, the largest functions of government expenditure—social welfare, education and health—are, in fact, mainly directed at particular age groups. We consider three voter groups: the young group, below 15 years ($h=1$), the working age group, between 15 and 64 ($h=2$) and the elderly, over 64 years ($h=3$). We assume that the political strength of a group is a function of each group's share in the population (see Galasso and Profeta, 2004). According to this voter group decision model, ageing has two opposite effects on government spending when increasing the elderly share (w^3). On the one hand, the elderly increase the weight of their demand in the new equilibrium. This political effect would be reflected in a positive association of the elderly population share with regard to the expenditures benefiting their group—social welfare and health—and negative with regard to education. On the other hand, the young and the working-age population attempt to avoid the cost of satisfying the demand of the increased proportions of the elderly by reducing their own demand for social welfare and health. These age groups may also increase their demand for public education spending to take advantage of the new prospect of a longer retirement. These economic effects will lead to a negative association between the elderly population share with regard to social welfare and health and a positive one with regard to

education. The relative size of the political and economic effects, reflected in the sign of the elderly share with respect to age-related spending, has to be empirically assessed.

3. Data and econometric analysis

The voter group model is estimated for the components of government expenditure according to the international standard classification, COFOG, which is independent of the organizational structure of governments. Data is built on various issues of National Accounts of OECD countries: Detailed Tables, Volume II. This source is based on accrual accounting and consolidated for general government, avoiding the distortion of comparing countries with different degrees of fiscal decentralization.[1] The model is estimated for a panel of 26 OECD countries in the period 1970–1997 (all the OECD Member States except Poland, the Czech Republic, Hungary and Slovakia). Due to a lack data we assume that unit costs across functions are equal ($C_f = C \forall f$) and that each age group has the same per capita income.[2] We include relative prices, measured as the ratio of the public sector deflator to the GDP deflator (see Gemmell et al., 1999). Peltzman (1980) argues that public consumption decisions are based on permanent rather than temporary income levels. Therefore we use permanent per capita income, measured as a three-year moving average. Among the structural characteristics, we introduce population density since public goods and services connote geographic proximity (see Mueller, 2003). Appendix A shows the descriptive statistics and sources of the variables used in the econometric analysis. Expenditures most related to the elderly population—social welfare and health—showed the highest annual growth rates, accounting for more than 85% of the growth of the public sector. Education expenditure grew annually at a rate of 1.07%, even though the share of the population below 15 significantly diminished in the OECD. We estimate the demand functions for aggregate government expenditure and all components except cultural affairs so as to avoid one equation being redundant. We proceed to estimate by the three-stage least squares (3SLS) estimator since contemporaneous error terms across components are correlated, and use the TSCS analogue of the error correction model (ECM) suggested by Beck and Katz (1996):[3]

$$\Delta \ln(G_{fit}) = \phi \ln(G_{fit-1}) + \sum_{k=1}^{6} \beta^k \ln(X^k_{it-1}) + \sum_{k=1}^{5} \beta^k_{\Delta} \Delta \ln(X^k_{it}) + \sum_{i=3}^{26} u_{fi} + \sum_{t=1974}^{1996} u_{ft} + \varepsilon_{fit};$$
$$f = 1, \ldots, 8. \quad t : 1973, \ldots, 1996; \quad i : 1, \ldots, 26. \tag{2}$$

Where G_{fit} is government expenditure on component f as a share of GDP, Δ is the first difference operator, X^k is the independent variable k (share of population over 64, share of

[1] We exclude interest payments from the analysis since this spending is exogenously determined. The IMF: Government Finance Statistics Yearbook is generally focused on central government and uses the cash criterion.

[2] It can be shown that if own price elasticities are close to one or if the ratio (C_f/C) were constant across time the assumption of the same unit prices across functions only biases country dummies. Similarly, the assumption that per capita income is the same across age groups only biases country dummies if the relative per capita income of each group were constant across time. Precisely, Förster and Mira d'Ercole (2005) show that changes in the OECD distribution of income by age have taken place only within the group between 18 and 65. Thus, relative per capita income in the age groups considered here has been remarkably stable.

[3] We instrument permanent per capita income and prices as these variables are mutually interdependent with the quantity of government expenditure. Wooldridge (2001) shows that the GMM estimator, though more efficient than the 3SLS in the presence of heteroscedasticity, have poor finite sample properties. Hence, we have used the 3SLS estimator, because it is, in any case, consistent.

population below 15, population, population density, per capita income and relative prices), i and t are country and year, respectively and ε is the disturbance term. We also introduce country (u_i) and time (u_t) dummies to capture institutional factors and time shocks.[4] The empirical analysis reviewed in Section 2 used static panel data. In contrast we take into account dynamics in the model, which reflects the fact that adapting to changes in the group's political strength or changes in the voter group's demand is a process requiring a slow adjustment. Moreover, the ECM separates long-term permanent effects from short-term transitory effects. Results in Table 1 show the increasing share of the elderly as a clear source behind the growth of government expenditure. This age group increases five functions in the long-term including the most important ones (social welfare, education, health, transport and communications and defence) and does not significantly reduce any of the other four components (public services, economic services, housing and cultural affairs). Among the five functions for which we find a positive effect of the elderly, the elasticity of social welfare expenditure is the highest. In the short-term, we also find a significant effect of the elderly on social welfare spending which is not different from the long-term elasticity. Increases in the elderly share lead to immediate rises in social welfare spending which become permanent in the long-term. The political effect of ageing dominates the economic effect. However, the permanent elasticity is not significantly different from one, i.e., we cannot reject the hypothesis that a rise in the share of the elderly leads to proportional increases in the share of social welfare in the GDP. The elderly are not able to take sufficient advantage of their greater political influence in order to increase benefit per retiree. There also seems to be an economic effect of ageing at work, thanks to which other age groups partially offset the political effect, which prevents increases in per capita social welfare expenditure. This is an interesting result, because it shows that social welfare increases as a result of ageing only because the number of pension recipients also rises.

Interestingly, we find that the elderly population share decreases education spending only in the short-term. The increased influence of the elderly leads to an immediate reduction of education spending but this political effect disappears in the long-term when the young and working-age population react to ageing by increasing their demand for education along the lines of the Gradstein and Kaganovich (2004) hypothesis. The elasticity of health with respect to the elderly is not significantly different from one, implying that we cannot reject the hypothesis of rises in the elderly share leading to proportional increases in health spending. In contrast to social welfare spending, the effect of the elderly on health is not immediate, as shown by the not significant short-term elasticity. Indeed, the speed of adjustment for health spending indicates that countries require around seven years to adapt to the new demand for health spending after an increase in the elderly share. The positive long-term elasticity of defence and the large short-term elasticity of public services (including public order and law) with regard to elderly indicates that this sector of the population also demand more security-related expenditure than the other age groups.

We find that the diminishing share of the young population generated by ageing does not reduce the need for public expenditure. The reduction of the share of the young population will, if anything, increase expenditures because of its negative association with transport and

[4] We leave out country dummies for Australia and Austria to avoid multicollinearity with the intercept, population and population density. Using country dummies induces a correlation between the lagged dependent variable and the error term. Nickell (1981) derived the asymptotic bias and showed that the bias decreases as the number of years available, T, increases. Indeed, the Monte Carlo analysis shows that, when T is twenty or more, using individual dummies with a lagged dependent variable performs better than other alternatives such as the Anderson–Hsiao estimator (see Beck and Katz, 2007).

communications and defence. The young share is not positively associated with education expenditure, which indicates that decreases in the young population lead to an increase in spending per head. Education spending is sticky downwards when the number of students is decreasing. The political effect of the reduced support for education is offset by the economic effect, which is consistent with the Levy (2005) hypothesis about the diminishing opposition to public education because this service becomes relatively cheaper. In sum, ageing increases government expenditures, because of the effects of the increased elderly population share, which are not offset by the reduced young population share. Still, other determinants might have also pushed up government expenditures. Population also raises aggregate government spending, confirming that increases in population decrease the tax price, offsetting the fact that the consumption of government services can be shared because government spending is a public good (see Borcherding et al., 2004). Population significantly increases merit goods such as education and housing. Surprisingly, defence also shows a positive association with population. This result supports Mueller and Murrell's (1986) hypothesis that population raises the demand for defence because country size increases the threat of aggression. We find positive elasticities of housing with respect to population and population density, suggesting that demographic pressure increases the need for the implementation of measures in the area of urban planning. Transport and communications, economic services, and cultural affairs have a negative association with density, given that they are a pure public good. In fact, Sturm (2001) contends that individuals living in low-density areas may need higher expenditures on transport and communications for a given level of infrastructure service. Per capita income has not been a source of growth of government spending as shown by the negative long-term elasticity. Government expenditure grows less than proportionally to GDP, rejecting Wagner's hypothesis. Per capita income reduces activities traditionally undertaken by governments, such as transport and communications and defence. Social welfare expenditure is not affected by per capita income in the long-term but, as expected, is countercyclical in the short-term. Relative prices have indeed been a factor pushing up government spending. Results reveal own-price inelasticity for most of the functions and aggregate government spending.[5] Finally, the speed of adjustment shows that certain functions of government are highly rigid: those functions for which compensation of generally permanent employees is an important proportion of expenditures (public services, education and health).

4. Robustness check

We shall now check the extent to which those other relevant variables highlighted in economic literature might interfere with the population ageing in the explanation of government expenditure. Rodrik (1998) suggests that international trade exposes economies to external shocks and, therefore, citizens require their governments to provide more social insurance to mitigate this external risk. Therefore, the growth of social welfare spending and total government spending in the OECD might be more related to the impact of the increasing openness than to the rise in the elderly population share. Public debt–GDP ratios also influence aggregate government expenditure, since high levels of public debt–GDP ratios push up government interest payments. Tanzi and Schuknecht (2000) claim that fiscal adjustments implemented by OECD countries in the 90's fall upon social welfare so as to protect productive government expenditure, whereas de Haan et al. (1996) contend that political reasons make it easier to diminish productive

[5] The own-price elasticity in the long-term is the coefficient associated with relative prices minus one because government expenditure as a share of GDP has been computed in nominal terms.

government expenditure. Hence, if the hypothesis of Tanzi and Schuknecht (2000) were true, the elderly would not have obtained more than proportional increases in social welfare spending because fiscal adjustments would have fallen upon this spending. Economic freedom also affects government expenditures. de Haan and Sturm (2000) find that greater economic freedom, measured by the Economic Freedom of the World index (EFW), fosters economic growth. Thus, governments promoting higher economic growth rates would not have been able to increase social welfare by as much as demanded by the increased proportion of the elderly in order to achieve greater economic freedom. In Table 2, we use the five cross-sections available to estimate by the three-stage least squares (3SLS) the determinants of the composition of government expenditure, including as well openness, government debt position and economic freedom.[6]

Evidence in Table 2 does not support the Rodrik (1998) hypothesis. Openness does not affect the size of the public sector, or social welfare spending. Reductions in public debt lead to decreases in aggregate government and the most important functions: social welfare, education and health. Consistent with Gwartney and Lawson (2004), we find that the protection of individuals (defence spending) and the provision of education do not restrict economic freedom. As for ageing variables, results show that the positive effect of the elderly on aggregate government expenditure, social welfare, health and defence is robust. The introduction of public debt and economic freedom removes the positive effect of the elderly on education spending, but still this effect is not significantly negative, which confirms the existence of a compensatory economic effect through the reaction of the young and working-age population groups. We also corroborate that the decreasing share of the young population will not reduce the need for government services.

5. Sources behind changes and country dispersion in government expenditure

Using the results of Table 1, we analyse the forces behind the growth of government spending, disaggregated by functions, in the OECD from 1970 to 1997.[7] Table 3 shows that the increasing elderly population explains most of the growth of government expenditure, accounting for 0.96% of the total 1.02% annual growth of the public sector size. The growth of the elderly population share has pushed up social welfare spending as a share of GDP by 1.17% annually, more than 50% of the total increase of this component. Relative prices and population have also contributed to the growth of government spending, but by far less than the elderly population share (0.50% and 0.34%, respectively). Population has increased government spending particularly because of its contribution to the growth of merit goods such as education and health along with social welfare. The decreasing young population share has not been an offsetting force on the growth of

[6] We instrument openness and the public debt position since these variables can also be affected by government spending. The EFW index is a summary index of the degree of economic freedom based: on size of governments; legal structure and protection of property rights; access to sound money; international exchange; and regulation, and is available for 1970, 1975, 1980, 1985, 1990 and 1995 (see Gwartney and Lawson, 2004). de Haan and Sturm (2000) contend that the population decides the size of government and that some core functions of government are consistent with economic freedom. Therefore, we have excluded the size of government from the EFW index. The small number of observations does not allow for the estimation of the determinants of government expenditure in a dynamic framework or for introducing country dummies. Results including openness, the government debt position and economic freedom at a time—in a dynamic context for openness and public debt—are remarkably similar to results presented in Table 1 (available upon request).

[7] We have computed the contribution of each variable k as $\beta^k \sum_{t=1970}^{1997} (1+\phi)^{1997-t} \Delta \ln(\bar{x}_t^k)$, where $\bar{x}_t^k$ is the OECD average of variable k in year t. We only consider the long-term contribution of a determinant to the change in the size and composition of government expenditure and if the coefficient is at least significant at a 10% level.

Table 1
Determinants of the composition of government expenditure [a]

	Public sector size	Social welfare	Education	Health	Public services	Economic services	Transport and communications	Defence	Housing	Cultural affairs
Long-run effects										
Elderly share	0.132 [b]	0.269 [c]	0.081 [d]	0.124 [c]	0.043	0.056	0.223 [c]	0.184 [b]	−0.472	−0.101
	(3.45)	(2.48)	(1.72)	(2.01)	(0.35)	(0.39)	(2.07)	(2.58)	(−1.19)	(−0.06)
Young share	−0.014	−0.131	−0.023	0.036	0.095	−0.044	−0.266 [c]	−0.137 [d]	−0.165	2.773
	(−0.31)	(−1.14)	(−0.39)	(0.51)	(0.62)	(−0.26)	(−2.06)	(−1.64)	(−0.35)	(1.50)
Total population	0.071 [d]	0.301 [b]	0.159 [b]	−0.002	0.225	−0.362 [c]	0.007	0.238 [b]	0.889 [d]	−4.167 [c]
	(1.68)	(2.75)	(2.98)	(−0.03)	(1.52)	(−2.01)	(0.05)	(2.97)	(1.90)	(−2.25)
Population density	0.013	0.081 [b]	0.020 [d]	−0.005	0.058 [c]	−0.067 [d]	−0.076 [b]	−0.021	0.185 [c]	−0.699 [d]
	(1.50)	(3.55)	(1.87)	(−0.39)	(1.98)	(−1.87)	(−2.95)	(−1.29)	(1.97)	(−1.82)
Per capita income	−0.052 [d]	−0.077	−0.008	−0.109 [c]	0.043	−0.007	−0.161 [c]	−0.247 [b]	0.159	0.359
	(−1.76)	(−1.07)	(−0.19)	(−2.04)	(0.46)	(−0.07)	(−2.04)	(−4.30)	(0.53)	(0.30)
Relative prices	0.234 [b]	0.697 [b]	0.208 [c]	−0.103	0.163	0.286	0.379 [c]	0.230 [c]	1.062 [d]	−6.584 [c]
	(3.99)	(3.75)	(2.57)	(−0.95)	(0.79)	(1.35)	(2.30)	(2.13)	(1.67)	(−2.22)
Adjustment parameter	−0.140 [b]	−0.230 [b]	−0.083 [b]	−0.156 [b]	−0.069 [d]	−0.116 [c]	−0.247 [b]	−0.216 [b]	−0.142 [b]	–
	(−8.04)	(−5.91)	(4.00)	(−5.82)	(−1.81)	(−1.96)	(−8.17)	(−7.16)	(−4.76)	
Short-run effects										
Elderly share	0.478 [c]	1.312 [c]	−0.480 [d]	0.452	1.276 [d]	0.659	−0.529	0.422	−2.635	−0.911
	(2.17)	(2.33)	(−1.72)	(1.30)	(1.71)	(0.77)	(−0.85)	(1.05)	(−1.13)	(−0.10)
Young share	0.315	0.662	0.058	0.186	0.008	−0.128	−0.225	0.089	−1.897	8.398
	(1.50)	(1.23)	(0.21)	(0.56)	(0.01)	(−0.16)	(−0.38)	(0.23)	(−0.85)	(0.96)
Total population	0.768	0.383	1.061	−0.327	3.377 [d]	0.725	−1.284	−1.547	5.301	4.953
	(1.46)	(0.29)	(1.54)	(−0.40)	(1.90)	(0.38)	(−0.86)	(−1.60)	(0.92)	(0.23)

Per capita income	−0.644 [d]	−2.369 [b]	−0.066	−1.851 [b]	1.668	−2.397 [d]	−3.236 [b]	−2.280 [b]	−0.311	40.374 [b]
	(−1.94)	(−2.84)	(−0.15)	(−3.61)	(1.53)	(−1.82)	(−3.49)	(−3.81)	(−0.07)	(2.68)
Relative prices	0.909 [b]	2.318 [b]	1.382 [b]	0.852 [b]	0.461	1.127 [d]	0.710	0.063	1.402	−19.551 [c]
	(5.04)	(4.97)	(6.08)	(2.83)	(0.73)	(1.69)	(1.39)	(0.19)	(0.69)	(−2.51)
Constant	−1.053 [d]	−5.080 [b]	−2.389 [b]	1.427 [d]	−3.855 [c]	2.390	0.669	−0.698	−13.585 [c]	68.397 [b]
	(−1.95)	(−3.36)	(−3.57)	(1.72)	(−2.17)	(1.11)	(0.44)	(−0.72)	(−2.44)	(2.68)
Significance of time dummies $\chi^2(23)$	48.89	25.40	77.40	33.22	43.04	23.59	34.36	48.23	24.69	124.07
	p-value 0.00	*p*-value 0.33	*p*-value 0.00	*p*-value 0.08	*p*-value 0.01	*p*-value 0.43	*p*-value 0.06	*p*-value 0.00	*p*-value 0.37	*p*-value 0.00
Significance of country dummies $\chi^2(24)$	78.42	46.90	74.84	61.07	19.09	14.88	73.73	73.33	22.03	81.39
	p-value 0.00	*p*-value 0.00	*p*-value 0.00	*p*-value 0.00	*p*-value 0.75	*p*-value 0.90	*p*-value 0.00	*p*-value 0.00	*p*-value 0.52	*p*-value 0.00
Hansen–Sargan test of overidentification $\chi^2(10)$	9.399	4.922	9.983	14.558	10.225	15.316	10.498	11.863	10.959	–
	p-value 0.49	*p*-value 0.90	*p*-value 0.44	*p*-value 0.15	*p*-value 0.42	*p*-value 0.12	*p*-value 0.40	*p*-value 0.29	*p*-value 0.36	
First-order serial correlation test $\chi^2(1)$	0.05	0.20	8.36	8.52	0.24	0.03	0.01	2.92	1.44	–
	p-value 0.83	*p*-value 0.65	*p*-value 0.00	*p*-value 0.00	*p*-value 0.63	*p*-value 0.87	*p*-value 0.92	*p*-value 009	*p*-value 0.23	
Observations	624	624	624	624	624	624	624	624	624	624

[a] In parentheses *t*-statistics.
[b] Significant at 1%.
[c] Significant at 5%.
[d] Significant at 10%.

Table 2
Determinants of the composition of government expenditure (Robustness check controlling for openness, public debt and economic freedom)[a]

	Public sector size	Social welfare	Education	Health	Public services	Economic services	Transport and communications	Defence	Housing	Cultural affairs
Elderly share	0.533[b]	1.530[b]	−0.155	1.722[b]	−0.115	0.679[b]	−0.735[b]	2.365[b]	0.558	−15.995[b]
	(5.51)	(5.29)	(−0.98)	(9.02)	(−0.53)	(2.63)	(−3.37)	(2.90)	(0.77)	(−3.62)
Young share	−0.216	0.030	−0.491[c]	0.974[b]	−0.822[d]	0.231	−1.431[b]	−1.612	−1.278	3.263
	(−1.22)	(0.06)	(−1.68)	(2.78)	(−2.07)	(0.49)	(−3.57)	(−1.08)	(−0.96)	(0.40)
Openness	0.019	−0.414	−0.269	0.011	0.764[c]	−0.741	0.001	1.599	0.126	2.767
	(0.11)	(−0.78)	(−0.92)	(0.03)	(1.96)	(−1.57)	(0.02)	(1.07)	(0.09)	(0.34)
Public debt	0.054[c]	0.215[d]	0.141[b]	0.154[b]	−0.073	0.158[d]	0.079	−0.633[b]	−0.006	−1.015
	(1.93)	(2.55)	(3.06)	(2.77)	(−1.16)	(2.11)	(1.24)	(−2.67)	(−0.03)	(−0.79)
Economic freedom	0.357	1.414[c]	1.027[d]	0.026	−0.865	−0.350	0.305	4.728[d]	−1.360	−23.962[c]
	(1.25)	(1.66)	(2.20)	(0.05)	(−1.36)	(0.46)	(0.48)	(1.97)	(−0.64)	(−1.84)
Significance of time dummies $\chi^2(4)$	11.12	6.56	15.63	7.53	2.35	5.05	38.87	4.76	2.59	9.45
	p-value 0.03	*p*-value 0.16	*p*-value 0.00	*p*-value 0.11	*p*-value 0.67	*p*-value 0.28	*p*-value 0.00	*p*-value 0.31	*p*-value 0.63	*p*-value 0.05
Hansen–Sargan test of overidentification $\chi^2(7)$	10.585	9.803	6.048	8.109	7.989	11.269	9.521	9.260	5.314	–
	p-value 0.16	*p*-value 0.20	*p*-value 0.53	*p*-value 0.23	*p*-value 0.33	*p*-value 0.13	*p*-value 0.22	*p*-value 0.23	*p*-value 0.62	
First-order serial correlation test $\chi^2(1)$	23.58	78.83	7.48	25.61	16.82	22.24	28.30	73.40	4.55	–
	p-value 0.00	*p*-value 0.00	*p*-value 0.01	*p*-value 0.00	*p*-value 0.00	*p*-value 0.00	*p*-value 0.00	*p*-value 0.00	*p*-value 0.03	
Observations	130	130	130	130	130	130	130	130	130	130

All variables in logs. Other regressors not shown in the table: total population, population density, constant, per capita income, relative prices and year dummies for 1980, 1985, 1990 and 1995.

[a] In parentheses *t*-statistics.
[b] Significant at 1%.
[c] Significant at 10%.
[d] Significant at 5%.

Table 3
Contribution to changes in the average size and composition of government expenditures in the OECD (1970–1997)

	Annual growth rate (%)	Contribution to changes in									
		Public size G/GDP	Social welfare	Education	Health	Public services	Economic services	Transport and communications	Defence	Housing	Cultural affairs
Elderly	1.05	0.96	1.17	0.92	0.81	0.00	0.00	0.90	0.86	0.00	0.00
Young	−1.23	0.00	0.00	0.00	0.00	0.00	0.00	0.86	1.52	0.00	0.00
Population	0.90	0.34	0.88	1.22	0.00	0.00	−2.09	0.00	0.74	4.24	−20.14
Density	0.90	0.00	0.24	0.15	0.00	0.51	−0.38	−0.21	0.00	0.88	−3.38
Per capita income	2.12	−0.64	0.00	0.00	−1.19	0.00	0.00	−1.61	−1.83	0.00	0.00
Relative prices	0.36	0.50	0.91	0.69	0.00	0.00	0.00	0.46	0.32	2.24	−14.04
Time shocks	–	−0.05	−1.33	−1.68	1.34	0.98	0.00	−3.03	−0.99	−0.81	38.18
The 70's		0.02	0.00	0.01	0.02	0.17	0.00	−0.00	0.00	0.00	0.79
The 80's		0.02	−0.02	−0.44	0.17	0.81	0.00	−0.23	0.00	0.10	5.57
The 90's		−0.09	−1.31	−1.25	1.15	0.00	0.00	−2.80	−0.99	−0.92	31.82
Sum of all contributions		1.11	1.87	1.30	0.96	1.49	−2.47	−2.03	−0.37	6.55	0.62
Actual change (%)		1.02	2.01	1.07	1.78	1.42	−0.75	−0.48	−1.21	0.80	1.85

government. It has, on the contrary, softened the decrease in transport and communications and defence spending. The only factor contributing to slowing down the growth of government has been per capita income. By leading to less than proportional increases in health, transport and communications and defence spending, per capita income has reduced the share of these expenditures and aggregate government spending in the GDP. Common time shocks across OECD countries have only slightly reduced the growth of the public sector size but they have had a significant role in the composition of government spending. Interestingly, these time shocks have reduced the annual growth of social welfare spending by 1.33%, compensating the positive effect of the elderly population. The year dummies of the 90's are responsible for such a negative effect on social welfare spending, reducing the growth of this spending by 1.31%. This result reflects the institutional reforms implemented during the 90's by OECD countries including, among other measures, shifts from the indexation of pensions on wages towards prices or the lengthening of the reference period for calculating pensions (Than Dang et al., 2001). In the context of our model, these institutional reforms might also reflect the reaction of the other age groups to increases in the share of elderly population in order to prevent further rises in the tax burden. In contrast, time shocks have contributed with a 1.34% to the total 1.78% annual increase of health spending. Technology increases health costs, even though some innovations in techniques, drugs and equipment in providing health are cost saving. The negative effect of time shocks on the evolution of defence spending might also reflect the "peace dividend" (see Davoodi et al., 2001). To sum up, our model explains an annual growth of the share of government expenditure in GDP of 1.11%, whereas the actual growth has been 1.02%, which indicates that the model explains reasonably well changes in the public sector size. Across functions, the model performs remarkably well for the core functions of governments, such as public services and education, along with social welfare.

6. Conclusions

In this paper, we have examined the role of ageing in the growth of government spending in the OECD countries in the period 1970–1997. We find that the increasing elderly share explains most of the growth of the public sector size, particularly because this age group increases functions of public expenditure mainly benefiting their group: social welfare and health. The elderly also demand other types of spending such as defence, revealing a preference for security-related public spending. Interestingly, we also find that an increase in the elderly share reduces education spending only in the short-term. This evidence suggests that other age groups react to ageing, with the subsequent prospect of a longer period of retirement, by increasing their demand for this type of spending, thereby offsetting the greater influence of the elderly population. Furthermore, the decreasing young population share has not reduced the need for government expenditures, but has increased spending on transport and communication and defence. Other factors have boosted the growth of government spending by far less than the elderly population share-relative prices and population—or not significantly affected it—density and common time shocks. The less than proportional impact of per capita income on the public sector size has only partially compensated for the impact of the elderly. Ageing is, hence, the main force driving of the growth of government spending because of its effect on social welfare and health, which is not offset by its impact on other functions, such as education. We could conclude that the prospect of an intensified ageing process in the OECD countries could undermine the sustainability of public finance and have important (negative) implications for economic growth. The size and composition of government expenditure are relevant factors determining long-run economic growth (see Kneller et al., 1999).

Ageing might prevent governments from choosing the growth-maximising size and composition of government spending. However, we also find some evidence of increasing counteracting forces at work. The elderly are not able to materialise their increased influence in rises on benefits per retiree, suggesting that the rest of the age groups react to ageing by reducing their demand for social welfare government expenditure to prevent further rises in the tax burden. Furthermore, we find that common time shocks across OECD countries during the 90's offset the contribution of elderly to the growth of social welfare spending. Recent institutional reforms implemented in OECD countries seem to have been successful at reducing the impact of ageing on pensions.

Acknowledgements

We are grateful to Norman Gemmell, Carmela Martin, Richard Kneller, John Ashworth and Bruno Heyndels for their helpful suggestions on this paper. We would also like to thank the anonymous referees for their useful comments. Part of this research was undertaken while the first author was a Visiting Research Fellow at the University of Nottingham and the University of California, Santa Barbara (UCSB). Financial support from the Ministry of Science and Technology of Spain (SEC2003-00516) and the Bank of Spain is gratefully acknowledged.

Appendix A. Variable definitions and descriptive statistics

Variable	Definition	Source	Mean (S.D.)	Growth rate (%)	Between S.D. Within S.D.[a]
Public sector size	Aggregate government spending excluding interests (% GDP).	OECD: National Accounts of OECD countries.	35.9 (11.0)	1.02	B 10.2 W 4.5
Social welfare	Public spending on social protection (% GDP).	OECD: National Accounts of OECD countries.	12.2 (6.9)	2.01	B 6.6 W 2.5
Education	Public spending on education (% GDP).	OECD: National Accounts of OECD countries.	5.0 (1.4)	1.07	B 1.3 W 0.8
Health	Public spending on health (% GDP).	OECD: National Accounts of OECD countries.	4.7 (2.0)	1.78	B 1.9 W 0.9
Public services	Public spending on public services and public order (% GDP).	OECD: National Accounts of OECD countries.	3.8 (1.4)	1.42	B 1.0 W 0.9
Economic services	Public spending on economic affairs (% GDP).	OECD: National Accounts of OECD countries.	3.2 (1.8)	−0.75	B 1.5 W 1.0
Transport and communications	Public spending on transport and communications (% GDP).	OECD: National Accounts of OECD countries.	2.6 (1.2)	−0.48	B 1.1 W 0.5
Defence	Public spending on defence (% GDP).	OECD: National Accounts of OECD countries.	2.3 (1.4)	−1.21	B 1.3 W 0.5
Housing	Public spending on housing (% GDP).	OECD: National Accounts of OECD countries.	1.3 (0.9)	0.80	B 0.8 W 0.5

(*continued on next page*)

Appendix A (*continued*)

Variable	Definition	Source	Mean (S.D.)	Growth rate (%)	Between S.D. Within S.D.[a]
Cultural affairs	Public spending on recreational, and cultural affairs (% GDP).	OECD: National Accounts of OECD countries.	0.8 (0.5)	1.85	B 0.5 W 0.2
Elderly population	Share of the population aged 65 and over.	OECD: Labour Force Statistics	11.8 (3.5)	1.05	B 3.3 W 1.2
Young population	Share of the population below 15 years.	OECD: Labour Force Statistics	23.6 (6.4)	−1.23	B 5.7 W 2.9
Population	Total population	OECD: Labour Force Statistics	35716 (50013)	0.90	B 50696 W 5162
Population density	Inhabitants per square kilometre	OECD: Labour Force Statistics	120.6 (117.7)	0.90	B 119.5 W 10.3
Per capita income	Three-year moving average of per capita income (PPPs, real terms).	OECD: National Accounts of OECD countries.	15880 (5525)	2.12	B 4930 W 2669
Relative prices	Ratio of the public sector deflator to the GDP deflator.	OECD: Economic Outlook	106.0 (8.1)	0.36	B 6.1 W 5.4
Openness	Exports and imports as a share of GDP.	OECD: National Accounts of OECD countries.	62.5 (38.5)	1.35	B 38.3 W 8.6
Government debt	Gross government debt as a share of GDP.	OECD: Economic Outlook	47.3 (27.9)	2.35	B 21.4 W 18.4
Economic freedom	Economic Freedom World Index	Gwartney and Lawson (2004)	6.9 (1.1)	0.55	B 0.9 W 0.7

[a] Between (B) and within (W) standard deviation.

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