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Population ageing and the size of the welfare state: Is there a puzzle to explain?

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Abstract

The view that demographic ageing will lead to a growing welfare state has recently been questioned by Razin, Sadka and Swagel (2001). Their empirical analysis suggests that growing dependency is associated with a *smaller* welfare state. They construct a model of welfare provision with heterogeneous workers consistent with this 'puzzle'. I show here that their empirical 'puzzle' simply does not exist – both cross-tabulations and econometrics show that demographic ageing is associated with a larger welfare state. Moreover, worker heterogeneity does not affect the welfare state in the suggested manner. There is evidence that social security design matters when considering the effect of old age dependency on the size of the welfare state.

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1. Dependency and the welfare state

In the competitive world of academic scientific publishing, it is attractive to find puzzling facts or events, and to construct theoretical models that are consistent with these apparent puzzles. It is, for example, well-established and indeed self-evident from the simple mathematics of pay-as-you-go (PAYG) social security programmes that a growing dependency ratio of elderly people to workers will, *ceteris paribus*, increase the tax rate required to finance social security benefits and thereby increase the size of the welfare state.

Razin, Sadka and Swagel (2001) (hereafter RSS) can therefore claim to have discovered a genuine puzzle, if they are factually correct:

> "Data for the United States and 12 western European countries for 1955-92 show a *negative* correlation between the dependency ratio and two measures of the size of the welfare state, namely the tax rate on labour income and the generosity of social transfers. This is the case after other factors that would be expected to influence the size of the welfare state are controlled for. This is a puzzle since it might have been expected that countries with larger shares of dependent populations would have higher taxes and more generous social transfers reflecting the increased political power of the retired population". (*ibid*, p.901) [*my italics*]

Note that this 'puzzle' persists, as implied by RSS, even if we relax the *ceteris paribus* assumption implicit in the standard accounting framework of PAYG programmes. A stylised median voter theorem of the determination of social security benefits should also generate a positive correlation between dependency and tax-financed social security, since an ageing population will increase 'grey power' and thereby the pressure for higher tax rates to finance more generous pensions (see Galasso and Profeta, 2002). RSS construct a theoretical model to explain this potential puzzle and test it on cross-country panel data. Their results appear to confirm the negative relationship between the dependency ratio and both the tax rate on labour and the level of social security transfers, so confirming the 'puzzle'.

But is there in fact a negative correlation between a measure of the dependency ratio that reflects the growing retired population and the size of the welfare state? There are two ratios that characterise the ageing of the population. The first, the *old-age dependency ratio*, describes the number of people over a certain age (typically 60 or 65)

relative to the number of working age (typically below that age and above age 15 or 16). This ratio is the appropriate one in considering simple political economy models of the relative political strength of different generations. The second ratio, the reciprocal of the *support ratio*, describes the number of pensioners to workers. Not only do not all people of working age work, but some older people may not be eligible for a pension and/or may still be working. This ratio is the appropriate measure when we consider the systemic finance of a PAYG programme.

Using data from 21 OECD countries over three recent decades (the data are described more fully in the Appendix), we can examine the 'puzzle' suggested by RSS: a negative correlation between dependency and the size of the welfare state. Note that the two measures of dependency – the one based on head count (the old age dependency ratio) and that based on economic activity (the reciprocal of the support ratio) – are positively correlated but not identical for obvious reasons. In fact for these countries and for each of the decades, the correlation averages between 0.8 and 0.9, and the correlation between differences from country means over the three decades (to control for 'country effects') is 0.7576.

Table 1 provides correlation coefficients between these two measures of the ratio of old to young people/workers and three measures of the size and generosity of the welfare state: the average direct tax burden as a % of GDP, the average social security contribution rate, and the average replacement rate from the social security programme. Under the standard hypothesis, these correlations should be positive, whereas if the 'puzzle' exists, they will be negative.

Table 1
Correlation coefficients of measure of aged dependency and the size of the welfare state

	Tax burden as % of GDP	Contribution rate (%)	Replacement rate (%)
Old-age dependency ratio	0.5391 (0.0000)	0.4252 (0.0005)	0.6016 (0.0000)
(reciprocal of) Support ratio	0.3201 (0.0105)	0.6440 (0.0000)	0.3932 (0.0014)

Note: Partial correlation coefficients, significance levels in brackets are of test that each coefficient differs from zero.

It will be easily apparent from Table 1 that the 'puzzle' is rejected for these data for a variety of measures. It is of course possible that a multivariate framework, control for country and time effects, and other adjustments might depart from this conclusion but it seem robust enough at first sight to reject RSS's contention. Why then do RSS

obtain the result described in the earlier quote? The answer is straightforward: the dependency ratio used to underpin the correlations and econometrics in RSS "…is defined as usual as one minus the labour force as a share of the population" (*ibid*, p.912). The variable therefore includes all inactive people, whether below working age, of working age or retired. It does not, as such, capture population ageing.

Bryant (2003), using the RSS data set, separates dependency into those below working age, those who are inactive of working age, and the elderly. He finds that the labour tax rate is negatively associated with the proportion of children, but (as here, but on RSS data) *positively* associated with the proportion of elderly people and the proportion of inactive people of working age, exactly as the 'traditional' hypothesis would suggest. He confirms that there is no empirical puzzle, although it should be noted that RSS can take refuge in the finding that there is no significant effect of the share of the old or the inactive on a measure of the generosity of the social welfare programme (*ibid,* Table 3).

What therefore if there is no puzzling 'fact' to explain? Is the theoretical model provided by RSS still useful? The RSS model is a standard 2-period OLG framework in which in the first period everyone works and in the second period everyone is retired. There are no children, no inactive people in the first period and no elderly workers in the second – this is why the dependency ratio in the model cannot support the alternative definitions proposed here and the empirical disaggregations implemented by Bryant. Even if the empirical 'puzzle' no longer exists, however, the theoretical model proposed by RSS has some interest in itself and can be evaluated in its own right (see Simonovits, *this issue*). Both that model, and the alternative suggested by Simonovits, can then be subject to further empirical examination. Accordingly, this paper proceeds as follows: a brief discussion of the RRS model and a retest of it on alternative data (Section 2) and an examination of a suggested modification of the model by Simonovits (Section 3).

2. Interpretation and a Test of the Razin-Sadka-Swagel (RSS) model

2.1. *The RSS model – a brief summary*

The bare bones of the RSS model are as follows (interested readers can read their paper or the companion paper here by Simonovits). As mentioned in the previous section, the model has a 2-period OLG set-up where workers in period 1 become pensioners in period 2. There is a PAYG public pension programme in which a flat (earnings-related) tax pays for lump sum benefits. The programme is not therefore

'actuarial' in the sense that individual benefits are linked to contributions. This is a crucial point in the set-up of the model.

There are skilled and unskilled workers. Skill is acquired by engaging in education or training at the start of the first period. Workers have a latent distribution of abilities, so the proportion of the workforce that acquires skills depends on this distribution and on the incentive to acquire skills. This incentive is governed by the post-tax wage differential (the wage differential is exogenous – presumably implicitly determined competitively). A key point is that the post-tax wage depends on the generosity of the PAYG public pension programme. Since the programme is intragenerationally redistributive given the lump sum benefits, a high tax rate will tend to discourage workers on the latent ability margin from acquiring skills; moreover skilled workers in general would tend to prefer a less generous programme for the same reason.

The political economy of the set-up is as follows. The generosity of the PAYG programme is voted on *within period* – in other words, workers take no account of their future lump sum benefits from the programme. Since population growth is positive, there would be no pension programme (as workers outnumber pensioners) without the additional assumption by RSS of *side-payments* from taxes raised by the programme. These payments might take the form of in-work (or out-of-work) benefits; again however these are lump sum benefits and of greater value to unskilled workers. Consequently a PAYG programme could exist through a coalition of pensioners and low wage workers who stand to benefit from the redistributive structure of the tax-and-transfer programme (I explore similar models of public pension programmes arising from coalitions and side-payments in Disney, 1996).

What therefore happens as the rate of growth of the population changes? Following RSS (p.909) consider the case where the growth rate rises. There are now two competing effects. First, the higher wage bill means that the marginal tax rate required to finance a given tax-and-transfer programme falls – this tends to increase the generosity of provision to pensioners because the marginal cost of generosity falls. On the other hand, the lower marginal tax rate induces an increase in the proportion of skilled workers, since the cost of acquiring skill has fallen. But skilled workers tend to prefer a smaller welfare state given its redistributive structure. Thus there are two, competing, factors at work. Consequently a change in the rate of population growth can either increase or reduce the generosity of the PAYG pension programme in contrast to the

'standard' model where faster/slower population growth might be expected to reduce/increase the burden of the welfare state. Clearly the magnitude and direction of the effect on the size of the welfare state will depend on the identity of the median voter (whether skilled or unskilled) and could also depend on other 'exogenous' events such as skill-biased technical progress.

Note therefore that the RSS model is perfectly consistent with the 'normal' hypothesis that growing aged dependency raises the burden of the welfare state, for certain parameter values. But, arguably, it then competes with other political economy models, and indeed the simple arithmetic of PAYG programmes, which give the same result. The model is more *picquant* if the empirical 'puzzle' concerning dependency and the welfare state exists. But, as I have shown, the puzzle does not exist. But this does not of itself invalidate the model.

2.2. *Testing the RSS model*

RSS test their model on data for 13 OECD countries on annual observations from 1965-92. Their discussion of the econometrics is somewhat cursory, but involves regressing measures of the generosity of the welfare state (value of labour taxes/social transfers as a % of GDP) on the dependency ratio (as described above), on some control variables and on a variable described as "the ratio of the income share of the top quintile [*sic*] to the combined share of the middle three quartiles ("rich" v. "middle")… This measure of income inequality is used in empirical tests of the standard theory because the proportionate share of income accruing to the upper quartile of the income distribution ensures that the mean income is determined in large part by the income of those at the top and thus exceeds the median income…" (*ibid*, p.912). The model is completed by country-specific effects, so that parameter estimates are identified off within-country variation.

The econometric results show a negative and significant effect of 'the' dependency ratio on the labour tax rate and the measure of social security benefits *per capita,* confirming the 'puzzle'. The results on the proxy variable capturing the ratio of the mean to median income are not very robust and hard to interpret (at least, the discussion in RSS is not very illuminating). As mentioned earlier, Bryant (2003) utilises the RSS data set and re-estimates the model separating the dependency ratio into its various components (young, old and inactive) and shows that the 'puzzle' disappears when the old age dependency ratio is included separately – its relation to measures of

welfare state generosity is always positive and mostly significant. The lack of robustness of the coefficient on income inequality is also confirmed.

Can we do better? Using the data for 21 countries and 3 sub-periods described in the Appendix, I re-estimate the RSS model on a different data set. I examine the impact of demographics, proxies for the skill structure of the workforce, macroeconomic variables and institutional structure on two measures of the size of the welfare state: the share of labour taxes in GDP and the equilibrium PAYG contribution rate to the social security programme. The latter is wholly determined by the support ratio and the average generosity of the programme.

Variables are defined in greater detail in the Appendix but can be summarised here. *Dependency ratio* is the *old age* dependency ratio (as described previously). *1/Support Ratio* is the reciprocal of the support ratio, to ensure sign comparability in the regressions. *Growth of* GDP (%)*, Unemployment rate (%)* and *Union density* (%) are self-evident variables: note that we estimate on mid-decade averages of these variables where available, or the nearest-to-mid point observation where annual series are not available. The *Strength of Labour Protection index* is a time-varying index constructed by Blanchard and Wolfers (2000) of the strength of employment protection legislation in each of the OECD countries in the sample. Time dummies for each decade are self-evident, and the regressions contain country effects in some specifications, as described shortly.

Table 2 contains pooled, weighted least squares regressions, where there are no country effects. This is because the regressions contain an additional regressor: *% unskilled in workforce,* which is only available from Labour Force Survey data in the 1990s. So there is only cross-country variation in the variable and additional country dummies cannot be included. There is wide variation in the proportion of unskilled in the workforce across countries – from rates upwards of 35% of the workforce in some countries (Portugal, Greece, Italy and Australia) through to figures as low as 10%-15% in some countries (such as Germany and the United States). 'Unskilled' is defined here as having no more than 'Level 2' education by the standard classification implemented by the International Labour Organization. The reason for introducing this variable is that it seems the most direct test of the RSS proposition that a less skilled workforce will tend to vote for a higher tax rate, *ceteris paribus*, which underpins RSS's model.

Table 2
Dependency, Tax Rates and Workforce Skill Content:
Weighted Least Squares Estimates

Dependent variable:	*Labour taxes as % of GDP*		*PAYG* contribution rate*	
	(1)	(2)	(3)	(4)
Dependency ratio	0.274**	-	0.679***	-
	(0.127)		(0.123)	
1/Support Ratio	-	0.138	-	0.544***
		(0.113)		(0.121)
% unskilled in workforce	–0.128***	–0.150***	0.162**	0.075
	(0.042)	(0.049)	(0.064)	(0.059)
Growth of GDP (%)	–1.889***	–2.142***	0.151	–0.159
	(0.594)	(0.566)	(0.688)	(0.689)
Unemployment rate (%)	0.347*	0.414**	0.309	0.424**
	(0.180)	(0.182)	(0.224)	(0.208)
Union density (%)	0.086***	0.110***	–0.105**	–0.062
	(0.032)	(0.033)	(0.042)	(0.045)
Strength of labour protection (index)	0.924*	1.143**	1.058*	1.740***
	(0.477)	(0.480)	(0.595)	(0.578)
1980s	0.006	0.009	–0.001	0.044
	(0.010)	(0.011)	(0.011)	(0.010)
1990s	–0.011	–0.006	0.005	0.016
	(0.015)	(0.016)	(0.017)	(0.020)
Country dummies	No	No	No	No
R^2	0.6333	0.5059	0.6654	0.6727
F(8,54)	12.90	11.19	15.63	15.19
Prob > F	0.0000	0.0000	0.0000	0.0000

Notes: *** 1% ** 5% *10% levels of significance. Weights are country levels of employment. N = 21 countries × 3 time periods = 63. Standard errors are Huber-White robust estimates. Constant included among regressors.

In each table, there are four specifications, with two measures of the size of the tax burden (welfare state) and two measures of aged dependency – one demographic, one economic. In all the columns of Table 2, it is clear that the measures of aged dependency are positively associated with tax rates, in clear distinction to RSS's findings and in support of the estimates based on greater disaggregation of their demographic measures by Bryant (2003). The positive coefficients are strongly significant when the measure of the welfare state focuses explicitly on the financing of the social security programme (contribution rate) but somewhat weaker when the measure is the overall tax burden. This is exactly as one might expect.

Turning to the impact of the unskilled variable, which the RSS model would predict to have a positive effect on the tax rate, we find exactly the reverse result for the overall labour tax burden and positive (and in one case significant) results for social security contributions. There is no strong support for the RSS theory in this overall result on the skill variable.

Other coefficients are very much as might be expected. Higher GDP growth reduces the overall labour tax burden whereas a higher unemployment rate raises it. Results are much less clear for the social security contribution rate. Higher union density and stronger employment protection tend to push up labour tax rates (consistent with a more neo-corporatist or social welfare economic environment) whereas again the results for the more specific social security tax rate are much less robust. There is some evidence of higher tax rates in the 1980s and 1990s. Note that all the coefficients conflate country-specific factors with time-variation in these variables – these results are driven by a combination of differences between countries and the changing economic and institutional environment over time. However the value of these simple pooled WLS results is that they allow us to test (and reject) the proposition that the skill structure of the workforce is a significant determinant of labour tax rates.

Table 3 moves to a specification much closer to that of RSS, using generalised least squares estimates with controls for country-specific differences included. Given the lack of a time-varying measure of skill structure (all other variables in the regression are time-varying), we replace this variable with the one utilised by RSS: the income share of the top quintile relative to the share of quintiles 2 to 5, denoted as *Income share top 20%/share 20-79%*. This variable, as with RSS, is derived from the updated online World Bank database provided by Deininger and Squire (1996). The inference to be drawn from the sign of the coefficient on this variable for RSS's theory is not entirely clear: if it is an alternative proxy for skill structure (from the proposition that a greater skilled proportion in the workforce increases inequality), then these quintile ratios are not necessarily the appropriate measure. RSS instead hint that their result (a negative coefficient, albeit not very robustly determined) is a rejection of the 'standard theory that inequality leads to pressure for redistribution' (*ibid*, p.914). Either way, by incorporating the variable, we can check the robustness of the RSS result.

Table 3
Dependency, Tax Rates and Income Inequality:
Generalised Least Squares Estimates

Dependent variable:	*Labour taxes as % of GDP*		*PAYG* contribution rate*	
	(1)	(2)	(3)	(4)
Dependency ratio	0.176***	-	0.567***	-
	(0.052)		(0.118)	
1/Support Ratio	-	0.144***	-	0.338***
		(0.038)		(0.094)
Income share top 20%/ share 20-79%	–0.069**	–0.063*	–0.056	–0.103
	(0.034)	(0.034)	(0.077)	(0.082)
Growth of GDP (%)	–0.824***	–0.791***	0.340	0.372
	(0.175)	(0.172)	(0.395)	(0.422)
Unemployment rate (%)	0.198***	0.186***	0.518***	0.480***
	(0.062)	(0.061)	(0.140)	(0.149)
Union density (%)	0.127***	0.134***	–0.100	–0.124
	(0.040)	(0.039)	(0.090)	(0.096)
Strength of labour protection (index)	1.743**	1.647**	–0.159	–0.585
	(0.678)	(0.664)	(1.532)	(1.624)
1980s	0.010***	0.012***	–0.007	0.002
	(0.003)	(0.003)	(0.007)	(0.007)
1990s	0.013***	0.019***	0.007	0.023**
	(0.004)	(0.004)	(0.011)	(0.011)
Country dummies	Yes	Yes	Yes	Yes
Log L	219.30	220.40	167.93	163.97
Wald $\chi^2(28)$	2418.5	2506.3	907.52	792.78
Prob > χ^2	0.0000	0.0000	0.0000	0.0000

Notes: *** 1% ** 5% *10% levels of significance. Weights are country levels of employment. N = 21 countries × 3 time periods = 63. Constant included among regressors.

The results in Table 3 suggest that, in a model with country dummies, the positive association between the dependency ratio or 1/support ratio and the measures to the welfare state burden is strengthened. The positive coefficients in all four columns are strongly significant (1% level). Again, the 'puzzle' is rejected.

The income distribution measure does have the same sign as in RSS, albeit it is only significant in columns (1) and (2). The result implies that greater inequality (implicitly, a high ratio of the mean to the median given the skewness of the income distribution) is associated with lower tax rates. A more simple explanation than a

'political economy of redistribution' model is that greater inequality is likely to be associated with falling union density and perhaps lower labour protection – both variables are in general positively associated with tax burden. Indeed a simple correlation of the inequality measure with union density is −0.3992, although of course the estimates here are calculated on differences from country means.

The results also suggest a strong negative relationship between GDP growth and labour tax rates and some evidence of labour tax rates growing over time. However neither result is confirmed in columns (3) and (4) in explaining social security contribution rates – here the 'story' simply seems to be that the contribution rates are driven by demographics (in the 'standard' fashion) and by the unemployment rate, which both reduces the tax base and possibly increases claims on the social security budget. There is of course also a strong relationship between contribution rates and the time-varying generosity of the social security programme (for evidence, see Disney, 2004). This generosity may be determined by a political economy model, but the model does not override the normal effect of growing aged dependency on contribution rates and nor does any model described here adequately characterise the process of changing generosity of the social security programme.

3. The design of the social security programme and the determination of tax rates

One of the features of the RSS model that most attracts the vehemence of Simonovits (this issue) is the implicit assumption that "…the average worker does not see any link between his present tax (or the present old age pension) and his future benefit". This is reflected in RSS's model insofar as the voting equilibrium is static (for example, suggesting that, without side payments, the voted social security programme would provide no benefits and levy no taxes). Now while it is true that survey evidence suggests that current workers expect to get *something* in the future for their social security contributions (see Dominitz, Manski and Heinz, 2003), they are rarely clear as to exactly how much. Moreover, RSS's set-up explicitly assume *no* link between current tax payment and future entitlements given the way that they have modelled the social security programme.

In reality, social security programmes differ widely in how closely they link an individual's social security benefits to his or her contributions. At one extreme, in so-called 'notional account' programmes such as Sweden, or points-based systems such as

France and Germany, the link is rather close. In other programmes, such as the income-tested programme of Australia (and, increasingly, the United Kingdom) and flat benefit ('Beveridge') programmes such as Ireland and New Zealand, there is very little link at all. Other countries lie in a spectrum between these extremes.

This might lead us to argue that, the closer the programme to an 'actuarial' programme in the sense of linking contributions to pensions, the less pertinent is the RSS model. In contrast, in programmes where there is little or no link, the more pertinent the model becomes. To illustrate the point: suppose we have a stylised programme in which an individual's benefits are exactly linked to his or her contributions. Then the RSS voting model and its implications are surely irrelevant – a skilled worker would not necessarily vote against a more generous welfare programme if he or she stands to benefit proportionately from the programme. Not will this affect the incentive to acquire skills, if the worker incorporates the prospective pension into the calculation of the 'return' to skill (leaving aside issues concerning uncertainty, time preference etc.). Conversely, in a pure tax-and-transfer programme as implicitly suggested by RSS, the future generosity of the programme will be determined by future workers. Current contributions, and preferences, are irrelevant.

We can try to capture this by introducing proxy variables into the analysis that capture the design of the social security programme (of course, this too may be a decision variable: see Galasso and Profeta (2004) and Conde-Ruiz and Profeta (2005) but I ignore this issue here) – in particular the strength of the link between current contributions and future benefits. Following the analysis of Disney (2004), I suggest two proxy variables that may capture this link. The first, *CofV of RRs*, utilises data in Blöndal and Scarpetta (1998) on the heterogeneity of expected replacement rates for different household types in a country at a given point in time to calculate a coefficient of variation of replacement rates. If the coefficient is very low, the link between benefits and contributions (at least in an *intra*generational sense) is very strong; if it is high, we are closer in spirit to the RSS model. The second variable, *IRR at age 65*, measures the internal rate of return on contributions to a representative individual aged 55 in each decade who retires at age 65. The higher this calculated internal rate of return, the less likely it is that the programme is levying an *implicit tax* (in the sense of Lindbeck and Persson, 2003) on the individual's contributions relative to a funded programme. This proxy therefore reflects *inter*generational differences in the cost of contributions to the public pension programme relative to an outside alternative.

In interpreting the empirical results, the prediction is that the 'standard' link between dependency (and perhaps inequality) and the tax burden of the welfare state should be strengthened the stronger the link between contributions and benefits. Conversely, we are more likely to get a RSS-type 'puzzle', especially on the coefficients on dependency rates, the weaker the link. If we interact the two measures of system design (*CofV of RRs*, *IRR at age 65*) with the dependency rates and inequality measures, we would expect a greater *CofV* to *reduce* the dependency effect (and possibly change the inequality effect, depending on how we interpret the political economy model) with a lower *IRR at age 65* having the same effect. Of course, with small sample size and the interaction of two proxy variables, these predictions may prove to be unrealised.

This experiment is implemented in Table 4, which augments the specifications in Table 3 with these additional interactions based on measures of programme design. The results can be briefly summarised. Columns (1) and (2), which utilise the overall labour tax burden as the dependent variable, suggest that inclusion of the interactions simply renders most of the coefficients insignificant. Columns (3) and (4) may be more pertinent, since they focus more narrowly on the impact of social security programme design on social security contribution rates. Here the coefficient of variation, the intragenerational measure, seems to have some effect (the IRR, the intergenerational measure, has no discernible effect). The underlying positive link between dependency and the size of the welfare state is strengthened, as in the 'standard' model, in the 'default' (where the coefficient of variation approaches zero i.e. where the link between contributions and benefits is very strong). It weakens as the variation of replacement rates, proxying a weakening of the link, is increased. The same pattern is observed for the inequality measure – a strong *negative* link between inequality and average tax rates, which is weakened where the link between contributions and benefits weakens.

These results are indirectly consistent with the set-up of the RSS model, in the sense that the 'standard' positive relationship between dependency and the size of the welfare programme is strongest in a programme where benefits are closely linked to contributions and diminishes as the programme approaches the RSS set-up where there is no link between the two. The negative sign on the inequality measure is difficult to interpret, as suggested in my earlier discussion of RSS, p.914. The positive sign on the interaction with *CofVofRRs* is more plausible as it suggests that there is stronger pressure (presumably from the less skilled) for a more generous programme when the programme is more redistributive but, as also suggested previously, a fuller model might want

simultaneously to determine the average cost of the programme and the degree of redistribution within it. But it should be emphasised that inclusion of all these system design features are not sufficient to eliminate the average positive coefficients on dependency ratios in the earlier results in Tables 2 and 3. So this augmented statistical model, whilst offering some tentative support for one facet of the RSS model, does not really override the more general reservations to their empirical approach.

Table 4
Dependency, Tax Rates and Social Security Design:
Generalised Least Squares Estimates

Dependent variable:	*Labour taxes as % of GDP*		*PAYG* contribution rate*	
	(1)	(2)	(3)	(4)
Dependency ratio	0.173	-	1.244***	-
	(0.114)		(0.185)	
1/Support Ratio	-	0.146	-	0.910***
		(0.097)		(0.183)
Ratio*CofV of RRs	–0.446	–0.193	–3.951***	–3.188***
	(0.442)	(0.319)	(0.654)	(0.604)
Ratio*IRR at age 65	0.011	0.005	0.028	0.008
	(0.011)	(0.010)	(0.018)	(0.018)
Income share top 20%/ share 20-79%	–0.075	–0.070*	–0.452***	–0.467***
	(0.052)	(0.048)	(0.085)	(0.092)
Share ratio*CofV of RRs	0.166	0.090	1.701***	1.785***
	(0.175)	(0.167)	(0.285)	(0.315)
Share ratio*IRR at age 65	–0.005	–0.003	0.005	0.006
	(0.004)	(0.006)	(0.008)	(0.011)
Growth of GDP (%)	–0.854***	–0.825***	0.202	0.031
	(0.174)	(0.176)	(0.283)	(0.332)
Unemployment rate (%)	0.172**	0.183**	0.384***	0.488***
	(0.082)	(0.080)	(0.134)	(0.152)
Union density (%)	0.154***	0.150***	0.026	0.057
	(0.042)	(0.044)	(0.069)	(0.084)
Strength of labour protection (index)	1.656*	1.605*	–0.212	0.615
	(0.859)	(0.831)	(1.395)	(1.571)
1980s	0.008	0.011*	0.004	–0.0001
	(0.005)	(0.006)	(0.008)	(0.011)
1990s	0.013***	0.017***	0.008	0.015
	(0.005)	(0.005)	(0.008)	(0.010)
Country dummies	Yes	Yes	Yes	Yes
Log L	220.83	220.79	190.26	180.66
Wald $\chi^2(28)$	2541.9	2538.1	1909.3	1391.98
Prob > χ^2	0.0000	0.0000	0.0000	0.0000

Notes: *** 1% ** 5% *10% levels of significance. Weights are country levels of employment. N = 21 countries × 3 time periods = 63. Constant included among regressors.

4. Conclusion

Razin, Sadka and Swagel (2002) is an original and provocative contribution to the literature on the size of the welfare state, population ageing and voting behaviour. However, the motivation of that paper, of resolving an empirical 'puzzle' in the data, is invalid. As shown by Bryant (2003) using those authors' data, and in this paper, which uses a considerably larger number of countries, the empirical puzzle simply does not exist: growing aged dependency leads to a larger welfare state. Since the authors' model does not necessarily imply that there is an empirical puzzle (although they use the illusory existence of a puzzle to motivate the model), this of itself may not invalidate their model. However, as I demonstrate here, it is hard also to find any cross-country evidence that backs up key predictions of the model (notably that a more skilled workforce will vote for a smaller social security programme), nor is it easy to interpret the authors' findings on the role of inequality (which *are* partially replicated here).

Simonovits (this issue) makes the point that the voting model chosen by RSS is a limiting case. It is, however, in my view broadly justified by the social security set-up envisaged by RSS in which there is no link between current contributions and future benefits. *That* set-up is the limiting case. In the last section, therefore, I explored specific predictions that might arise as we moved from programmes with, empirically, very little link between contributions and benefits, across the spectrum to programmes where the link is very strong. There is some tentative evidence from the econometrics that the 'traditional' result is strengthened as we move across the spectrum of social security programmes in this manner. This provides some very tenuous evidence for one proposition implicit in the RSS model: that were the programme organised in the way that they envisaged in their model, the standard positive link between dependency and tax rates would be much weaker. Beyond this tentative finding, which requires more detailed analysis, the traditional model of demographic ageing leading to a growing welfare state remains unscathed.

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Data Appendix

Countries used in the analysis

The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the UK and the US. The values of variables for each countries are calculated as averages of the 1970s, 1980s and 1990s, denoted '1975', '1985' and '1995'. Some of the calculations of the design of the social security programme described below are not calculated for each year and averaged but only calculated for the average economic data for each period.

Demographic variables, as well as institutions, tend to be low volatility variables – that is change occurs gradually over several years. Year-on-year observations are not typically *iid* and standard OLS procedures are inappropriate unless averaging procedures are utilised. RSS who appear to use OLS on a sample of 13 countries over 28 periods, reporting 330 observations.

The *old age dependency ratio* is derived from the online data set LABORSTA provided by the ILO Bureau of Statistics.

The support ratio
The calculation of support ratios of workers to pensioners is described more fully in Disney (2004). In summary, I estimate the number of workers by applying economic activity rates from ILO data to all workers up to age 75 and calculate the number of pensioners by assuming that all men are eligible above age 65 and that women's eligibility is determined by the highest economic activity rate observed among women of working age in the ILO data. Rules governing pensions of women with no contributions of their own are derived from the US Social Security Administration's *Social Security Programs around the World*, several recent issues.

The social security replacement rate (and CofV RR) is derived from Blöndal and Scarpetta (1998), with interpolation where necessary.

The contribution rate (for social security)
Is not the 'contribution rate' provided from administrative data which have little economic meaning. Instead it is derived from the requirement of PAYG finance, that the equilibrium contribution is equal to the average social security replacement rate divided by the support ratio. These last two variables are derived as defined above. See Disney (2004) for details, and for illustration of the magnitudes of this derived variable.

Labour taxes as a % of GDP is the burden of direct taxes as a share of GDP, obtained from OECD online data. *The unemployment rate* and *GDP growth rate* are derived from the same data set.

IRR at age 65 is the average rate of return to social security contributions for an individual at age 55 at t. The calculations are described in detail in Disney (2004), pp.306-309.

Income ratio: *Income share top 20%/ share 20-79%* is derived from Deininger and Squire (1996). Their updated online data set is at: http:/www.worldbank.org /research/growth/dddeisqu.htm

Union density. The core data are from Nickell (1997) and are also provided in Blanchard and Wolfers (2000) online data set http://econ-wp.mit.edu/RePEc/2000/blanchar/harry_data. The data, which are not time varying there, have been updated using information of changes in union membership over time from:
http://www.ilr.cornell.edu/library/downloads/FAQ/UNIONSTATS2002.pdf.

Strength of labour protection index is the time-varying index also available at
http://econ-wp.mit.edu/RePEc/2000/blanchar/harry_data.