Modelling the Effect of Population Ageing on Government Social Expenditures

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Abstract

This paper reviews and extends a new framework, developed by Razin, Sadka, and Swagel, for capturing the effect of population ageing on public support for government social expenditures. Razin *et al* construct up an overlapping generations, median voter model, and investigate the empirical applicability of the model using panel data from 13 OECD countries. Their results suggest that population ageing will put downward pressure on per capita expenditures. These results rest, however, on an assumption that there is only one dependant age group: the old. This paper investigates the consequences of allowing for two such age groups: the young and the old. A replication of Razin *et al*'s empirical analysis, using two dependent age groups rather than one, suggests that population ageing will instead put upward pressure on per capita expenditures. Although these results are tentative, they illustrate the usefulness of including both youth dependency and old-age dependency in Razin *et al*'s framework.

JEL CLASSIFICATION

D72 - Economic Models of Political Processes

E62 - Fiscal Policy; Public Expenditures, Investment, and Finance; Taxation

J11 - Demographic Trends and Forecasts

KEYWORDS

Social expenditures; Median voter models; Population Ageing

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1 Introduction

Designing prudent fiscal policy that treats successive generations equitably requires estimates of how population ageing will affect government social expenditures. One way to derive estimates is to start with age-specific expenditure levels and calculate how overall expenditure levels vary in response to changing age structures. Substantial progress has been made in this area (Creedy 2002, Dang, Antolin and Oxley 2001, Foote and Spoor 2001, Woods 2000). A complementary approach is to examine the effect on the policy process of increases in the population share of older people. The conventional view is that an increase in the number of older voters will create strong pressures for increased social spending.

Razin, Sakda, and Swagel (2002) cast doubt on this view. Razin *et al* present a model of how changes in dependency rates affect social expenditures via their effect on the interests of the median voter. They show that, under some parameter settings, an increase in dependency rates can lead to a decline in per capita social expenditures. They also present results from a regression analysis, based on panel data for the United States and 12 European countries, suggesting that per capita social expenditures are indeed negatively correlated with dependency levels.

This paper argues, however, that Razin *et al*'s approach needs to be extended to allow slightly more demographic detail. Neither Razin *et al*'s model nor their empirics distinguish between old-age dependency and youth dependency. As with many overlapping generations models, the model contains only two age groups: young workers and old dependants. Razin *et al*'s empirical analysis carries over the use of one working and one dependent group, with the dependent group including both young and old.

Using data supplied by Razin *et al*, I have repeated their empirical analysis, but with dependency disaggregated into youth and old-age components. The revised analysis suggests that taxes and transfers are negatively correlated with youth dependency but positively correlated with old-age dependency. This finding can be reconciled with an extended version of Razin *et al*'s theoretical model.

The first two sections of this paper describe Razin et al's theoretical model and empirical results. The third section describes a new analysis. The final section discusses the implications.

2 Razin *et al*'s theoretical model

Razin *et al* construct a median voter model with overlapping generations. This section sketches out features of the model that are relevant to the extension and reanalysis described below. There are two generations: young workers and old dependants. The young are assumed to outnumber the old. The only tax is a labour tax, which is proportional to labour income.[1] The budget is balanced in every period, and the entire tax revenue is spent on benefit payments. Everyone, young or old, receives the same payment. People care only about their own income.

Young people face the decision of whether or not to acquire an education. Workers with an education have higher productivity and earn a higher wage than workers without an education. However, acquiring an education takes time, and has an opportunity cost in forgone wages. Young workers vary in their innate ability. The greater a person's innate ability, the more quickly the person can complete an education, and the lower the education's opportunity cost. All those whose ability is greater than a certain level acquire an education, while none of those whose ability is lower than this level acquire an education. The location of the cut-off point depends on taxes, wages, the pecuniary cost of education, and the extent to which education improves productivity. The lifetime incomes of the educated vary, depending on their innate ability and hence the time spent in the workforce. The lifetime incomes of the uneducated are identical.

As with standard median voter models, taxes and benefits are at their equilibrium level when the income that the median voter would gain through an increase in benefits exactly equals the income that he or she would lose through the corresponding increases in taxes. No other combination of taxes and benefits is politically sustainable. Suppose, for instance, that the median voter would gain more from a small increase in benefits than he or she would loose through the corresponding increase in taxes. The median voter would join a pro-benefits coalition, which would then have a majority, and the new regime of benefits and taxes could be voted in.

Old people pay no taxes, and are therefore always in favour of raising taxes and benefits. Young people are divided into pro-benefit and anti-benefit groups. Young people who do not acquire an education are either all pro-benefit or all anti-benefit, since they all receive the same income. Young people who do acquire an education are, in general, divided into pro-benefit and anti-benefit groups. The greater the educated young person's ability, and hence the higher their income, the more anti-benefit they are. The fact that young people can be ranked from most anti-benefit to most pro-benefit according to their innate ability keeps the analysis of coalition formation relatively simple. The identity of the median voter, and hence the equilibrium level of taxes and benefits, depends ultimately on the ratio of old to young, and on the distribution of innate ability among the young.

An increase in the ratio of old to young has opposing effects on the level of taxes and benefits. All the extra old people favour increasing tax and benefit levels. The rise in the number of dependants per taxpayer means, however, that a smaller proportion of any taxes paid are returned to taxpayers in the form of benefits; Razin *et al* describe this as an increase in 'fiscal leakage'. Increased taxes also lower pre-tax incomes by discouraging some young people from undertaking productivity-enhancing education. The first effect makes it more likely that the median voter will favour higher taxes and benefits, while the

[1] Razin, Sadka, and Swagel (2001b) use a different model with a tax on capital.

second and third effects makes it less likely. The balance between these effects, and hence the new level of taxes and benefits, depends on the ratio of old to young, and on the distribution of innate ability among the young.

3 Razin *et al*'s empirical results

Razin *et al*'s empirical analysis is designed to test which effects dominate in practice. The data come from 12 European countries[2] and the United States, over the period 1965-1992. They carry out an Ordinary Least Squares regression, with country-specific fixed effects. Because data are not available for all countries in all years, the panel is unbalanced. Two different dependent variable are used. The first is the 'labour tax rate', which uses 'revenue statistics to calculate an average tax rate on labor income' (Razin *et al* 2002: 912), and was assembled by Razin *et al* based on a method set out in Mendoza, Razin, and Tesar (1994). The second dependent variable is (the log of) benefits per capita. These are also calculated by Razin *et al* from OECD data, and include unemployment and disability benefits, though they are dominated by payments to the aged. The independent variable of interest is the 'dependency ratio', which Razin *et al* define as one minus the proportion of the population in the labour force.[3]

Razin *et al* include a number of control variables, based on previous studies of the size of the welfare state. These variables are shown in Table 1. Trade openness is measured by imports and exports as a percentage of GDP. Income inequality is measured by the share of total income received by the top quintile divided by the share received by the middle quintile. The other variables are self-explanatory. All data come from the OECD analytical database, apart from the data on income shares, which come from the World Bank's inequality database. Summary statistics for the variables are presented in Razin, Sadka and Swagel (2001a: Table 1).

As can be seen from the estimated coefficients on the dependency ratio in Table 1, Razin *et al* find that increased dependency rates are associated with reduced taxation and benefits. Within the framework of their model, this suggests that the fiscal leakage and education-reducing effects have outweighed the voting power effect.

[2] The 12 countries are Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, the United Kingdom.

[3] Razin *et al*'s definition is somewhat different from the usual definition in the literature on population ageing, though perhaps more economically meaningful. The usual definition is the number of people outside the working ages divided by the number in the working ages.

Table 1 - Determinants of labour tax rate and benefits per capita in Razin et al's original specification

	Labour tax rate		(Log of) benefits per capita	
	(1)	(2)	(3)	(4)
Dependency rate	-0.382 (-4.02)	-0.383 (-4.40)	-7.493 (-8.81)	-7.492 (-8.80)
Government jobs / employment	0.915 (12.17)	0.729 (10.01)	4.467 (6.64)	4.611 (6.47)
Trade openness	0.198 (8.09)	0.131 (5.45)	0.740 (3.73)	0.792 (3.37)
Per capita GDP growth	-0.187 (-2.83)	-0.127 (-2.09)	-2.716 (-4.59)	-2.762 (-4.63)
Rich / middle income share	-0.055 (-2.77)	-0.049 (-2.66)	0.276 (1.55)	0.271 (1.52)
Unemployment rate		0.480 (7.82)		-0.370 (-0.62)
Period*	1965-1992	1965-1992	1965-1992	1965-1992
N	330	330	330	330
R^2	0.753	0.793	0.617	0.618

Note – All specifications include fixed effects (coefficients not shown.) The value for R^2 does not include the contribution of the fixed effects. The numbers in brackets are *t*-statistics.

Source – Razin *et al* (2002: Table 1)

4 A reanalysis

Razin *et al*'s model makes some obviously unrealistic assumptions, such as the assumption that benefit payments are the same for everyone. Razin *et al* (p911) also caution that their empirical results should be seen merely as 'suggestive' and 'broadly consistent with the main implications of the theory'. They note (p915) that further statistical analysis is needed, such as the use of instrumental variables to deal with the possibility of reverse causation.

Both the unrealistic assumptions and the limited statistical testing are readily defensible. Razin *et al*'s work is an early exploration of a difficult topic. Moreover, much of the heuristic value of Razin *et al*'s model is due to its simplicity, which inevitably requires the sacrifice of some realism. Little is therefore gained from merely pointing out counter-examples to the assumptions or potential limitations in the statistical analysis. What is useful, however, is the identification of areas where substantively important extensions can be added to model without unduly complicating it. That is the aim of this section.

Razin *et al*'s theoretical model and statistical analysis both recognize only one sort of dependant. A straightforward extension of Razin *et al*'s framework suggests, however, that the effect on equilibrium taxes and benefits of increasing the number of young dependants may well be different from the effect of increasing the number of old dependants. The exact effects depend on whether benefit payments to children are treated as if they were payments to the children's parents.

The analysis is simpler when benefit payments are treated as if they were *not* payments to the parents. In this case, a rise in the number of young dependants parallels a rise in the number of old dependants, in that it unambiguously increases the extent of the 'fiscal leakage' and discouragement of education. However, because young people, unlike old people, cannot vote, a rise in their number adds no one to the pro-tax coalition. In sum, a rise in youth dependency, unlike a rise in old age dependency, does not have a voting power effect to offset the fiscal leakage and education effects. Youth dependency, unlike old age dependency, is unambiguously predicted to be negatively correlated with benefit levels.

The analysis is different, however, if some or all of the benefits paid to children are treated as if they were paid to the children's parents. In this case, working age parents see the tax and transfer system as having less fiscal leakage than do working age non-parents. A rise in the number of young dependants may add to or subtract from the pro-tax coalition, depending on how childbearing and innate ability are distributed among the working age population. Without knowledge of these distributions, the framework cannot be used to make unconditional predictions about whether youth dependency will be negatively or positively correlated with benefits levels.

The remainder of this section examines the empirical evidence. The first step is to disaggregate Razin *et al*'s original dependency ratio (defined as one minus the labour force participation rate). Equation 1 shows one way of doing so. This decomposition ignores labour force participation by people aged 65 and over; the rationale for doing so is that participation rates at these ages are typically under 10%, and treating them as zero simplifies the analysis to follow. To maintain comparability with Razin *et al*'s original analysis, the decomposition includes working age people not in the labour force, though the main focus is on old and young dependants. The numbers in brackets underneath Equation 1 are the means during the period 1965-1992 across the 13 countries included in Razin *et al*'s original regression. As is apparent, the third term on the right, representing old-age dependency, makes up less than one quarter of the combined dependency ratio.

Dependency ratio	=	Proportion of total population aged 0-14	+	Proportion of total population aged 15-64 and not in the labour force	+	Proportion of total population aged 65+	(1)
(0.56)		(0.22)		(0.21)		(0.13)	

As Table 2 shows, the old-age dependency ratio is negatively correlated with the combined ratio over the period 1965-1992. The combined dependency ratio did, as Razin *et al* point out, fall between 1965 and 1992. The old-age dependency ratio, however, rose.

Table 3 shows the results of repeating Razin *et al*'s (2002: Table 1) original fixed effects panel regression, replacing the combined dependency ratio with three separate dependency measures. For Specifications (3) and (6), which required more observations for growth in GDP per capita than were available in Razin *et al*'s dataset, growth rates were calculated from the Laspeyres Index GDP per capita series in the Penn World Tables (Heston, Summers and Aten 2002). Specifications (1), (2), (4), and (5) cover 1965-1992, the same period as used by Razin *et al.* Specification (3) covers the period

1965-1996, and Specification (6), 1960-1996. For all periods, some countries have missing observation, so the panel is unbalanced.

Table 2 - Correlation matrix for the components of the dependency ratio, for the 13 country sample, 1965-1992

	Aged 0-14	Aged 15-64, not in labour force	Aged 65+	Combined ratio
Aged 0-14	1.00	0.14	-0.75	0.49
Aged 15-64, not in labour force	0.14	1.00	-0.46	0.91
Aged 65+	-0.75	-0.46	1.00	-0.53
Combined ratio	0.49	0.91	-0.53	1.00

Source - Calculated from data supplied by Razin *et al* and data from the OECD labour statistics online database.

At first sight, an attractive way of disaggregating the combined dependency ratio is to use the three age-specific measures set out in Equation 1. This is what Specifications (1) and (4) in Table 3 do. Interpretation of Specifications (1) and (4) is, however, made difficult by the presence of the term for working-age dependency. This term is the product of two different things: the proportion of the 15-64 age group not in the labour force, and the proportion of the total population in the 15-64 age group. Moreover, the proportion in the 15-64 age group is perfectly (negatively) correlated with sum of the youth and old-age dependency ratios.

Specifications (2) and (5) replace the working-age dependency term with the labour force participation rate. The terms capturing dependency now all have clear interpretations. The term for the proportion of the population aged 0-14 shows the effect of holding both labour force participation and the proportion aged 65 and over constant, and increasing the proportion of the population aged 0-14 at the expense of the proportion aged 15-64. The term for the proportion aged 65 and over has an analogous interpretation. The term for labour force participation shows the effect of increasing participation while holding age structure constant. Specifications (3) and (6) are identical to Specifications (2) and (5), except that longer time periods have been used.

Table 3 - Determinants of labour tax rate and benefits per capita

	Labour tax rate			(Log of) benefits per capita		
	(1)	(2)	(3)	(4)	(5)	(6)
Proportion of population aged 0-14	-0.306 (-2.54)	-0.410 (-3.53)	-0.399 (-3.50)	-9.730 (-8.57)	-9.834 (-8.98)	-8.045 (-8.56)
Proportion of population aged 15-64 and not in the labour force	0.318 (2.37)			0.278 (0.22)		
Labour force participation rate, ages 15-64		-0.194 (-2.19)	-0.311 (-3.83)		-0.279 (-0.33)	0.457 (0.86)
Proportion of population aged 65+	1.179 (3.72)	1.056 (3.56)	1.439 (5.69)	1.959 (0.65)	2.012 (0.72)	5.122 (2.47)
Government jobs / employment	0.544 (5.94)	0.542 (5.92)	0.542 (7.20)	4.167 (4.82)	4.176 (4.83)	4.852 (8.01)
Trade openness	0.139 (5.88)	0.140 (5.89)	0.133 (5.83)	0.634 (2.83)	0.634 (2.83)	1.246 (6.60)
Per capita GDP growth	-0.125 (-2.19)	-0.123 (-2.16)	-0.143 (-2.38)	-2.775 (-5.15)	-2.775 (-5.15)	-2.473 (-4.56)
Rich / middle income share	-0.009 (-0.50)	-0.010 (-0.57)	0.011 (0.79)	0.611 (3.55)	0.616 (3.59)	0.574 (4.94)
Unemployment rate	0.215 (2.76)	0.222 (2.85)	0.200 (2.60)	-4.038 (-5.48)	-4.078 (-5.54)	-3.999 (-6.93)
Period*	1965-92	1965-92	1965-96	1965-92	1965-92	1960-96
N	330	330	349	330	330	441
R^2	0.815	0.815	0.827	0.681	0.681	0.774

*Shorter periods are used for countries with missing data.

Notes – All specifications include fixed effects (coefficients not shown). Values for R^2 do not include the contribution of the fixed effects (these values were calculated by subtracting country-specific means from all dependent and independent variables before conducting the analysis). The numbers in brackets are *t*-statistics.

The results for Specifications (2) and (3) show that, all else equal, higher population shares for ages 0-14 at the expense of ages 15-64 are associated with lower levels of taxes on labour income. Conversely, higher population shares for ages 65 and over are associated with higher taxes. Neither of these results is sensitive to the choice of period. The results for Specifications (5) and (6) show that higher population shares for ages 0-14 are associated with reductions in benefits per capita. The relationship between old-age dependency and benefits per capita is unclear. If the period 1965-1992 is used, the relationship is positive but not statistically significant at the 5% level; if the period 1960-1996 is used, the relationship is positive and statistically significant. The overall finding is that more young people implies lower taxes and lower benefits, while more old people implies higher taxes and, possibly, higher benefits.

Specifications (2) and (3) show that, holding age structure constant, higher labour force participation is associated with lower taxes. This result should be treated with caution, however, as there is likely to be reverse causality from taxes to participation. No clear relationship between benefit levels and labour force participation is apparent from Specifications (5) and (6).

5 Conclusion

Forecasting future trends in government social expenditures requires a model of how expenditure trends emerge from the policy process. Razin *et al* (2002) have recently made significant progress towards this objective. Their work is notable partly for its theoretical innovations and partly because the conclusions are contrary to the conventional wisdom. Whereas many commentators assume that rises in the number of older voters must put upward pressure on expenditures per capita, Razin *et al* draw attention to the offsetting effect of increased fiscal leakage and distortion of investment decisions. Their statistical analysis, which they warn is only preliminary, suggests that the fiscal leakage and distortion effects have been outweighing the voting power effect in their panel of 13 OECD countries, so that population ageing has been creating downward pressures on per capita expenditures.

This paper has argued, however, that the balance between the pro-benefit and anti-benefit effects is likely to be different for young dependants than for old dependants. This suggests that extending Razin *et al*'s framework to include young dependants as well as old ones would be productive. Repeating Razin *et al*'s statistical with a disaggregated dependency ratio indicates that changes in old-age dependency and youth dependency do indeed have different effects on taxes and benefits. Youth dependency seems to be negatively correlated with tax and benefit levels, while old-age dependency seems to be positively correlated with taxes and (possibly) benefits.

All the same caveats that Razin *et al* apply to their statistical analysis also apply to the analysis presented here. However, the results presented here demonstrate the value of distinguishing between broad age groups when modelling the effects of population ageing on the policy process. The results also imply an opposite prediction about the future size of the welfare state to the one made by Razin *et al* (2002: 917). Based on the finding that taxes and benefits are negatively correlated with the combined dependency ratio, Razin *et al* suggest that the rising dependency ratio associated with population aging may exert downward pressure on taxes and benefits. The analysis presented here suggests that falling youth dependency and rising old-age dependency both put upward pressure on taxes and benefits. Falling youth dependency and rising old-age dependency are exactly what current population projections envisage for coming decades.

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