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Ageing and the Cost of Health Services

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ABSTRACT

There have been a number of estimates of the impact of ageing upon the cost of health services in Australia. The broad methodology adopted has been similar in each of these and similar to the methods used in other countries. Current or projected expenditures for each age sex cohort are multiplied by the projected population in each cohort at future points in time and summed to obtain total expenditure. Two of these studies have recently made allowance for the 'Fuch's effect', viz, the hypothesis that illness and expenditure should be estimated, not from the age of a cohort, but from the number of years to expected death.

The chief theme in the present paper is that this methodology, is unreliable and misleading. The argument is supported by the analysis of three sets of data, viz, historical population and expenditure data, Australian cross sectional population and GP utilisation data for 1996 and expenditure and population data for 21 OECD countries for 1975, 1985 and 1995. In each case the relationship between age sex predicted and actual expenditure is examined. The conclusion is that expenditures are not driven mechanistically by demographic factors. This, in turn, implies that future health care costs will be determined by other factors. Some will be responsive to policy but not others. In the latter category is the impact of new technology. The former include incentive structure of the health sector and the supply of physical and human resources.

TABLE OF CONTENTS

List of Tables

List of Figures

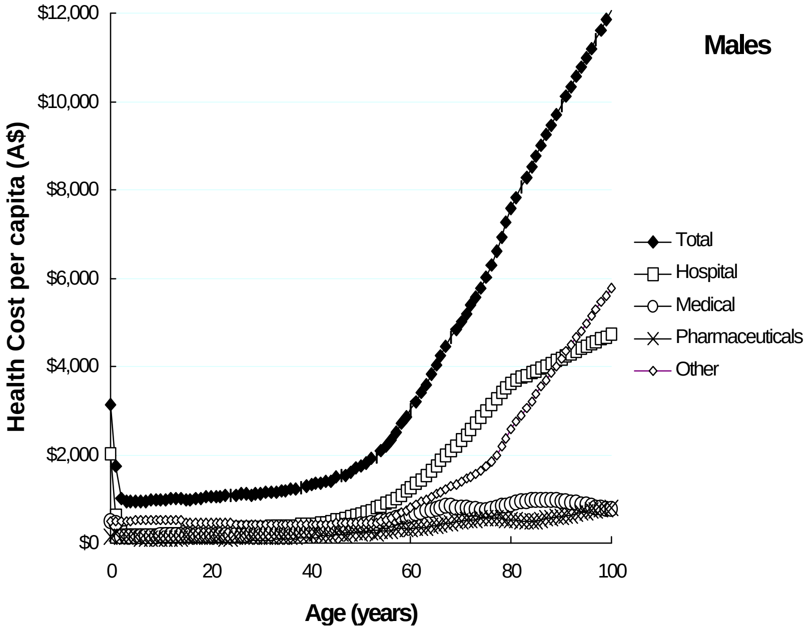
Ageing and the Cost of Health Services

1 Introduction

The issue to be discussed in this paper is whether or not the ageing of Australia's population is likely to increase the cost of health services to the point where it represents a problem for the economy or for public policy. The answer to this question depends, in part, upon social and political factors: whether the Australian public, collectively, wishes to use its resources on health services and whether or not it wishes to finance these through the public or private sectors. In part the answer depends upon a technical issue, namely, the cost of future health services and it is commonly assumed that these will be driven relentlessly upwards by the increasing demands of the ageing population and that the resulting cost burden will be exacerbated by the decreasing proportion of the population that is economically active and capable of supporting the needs of the elderly.

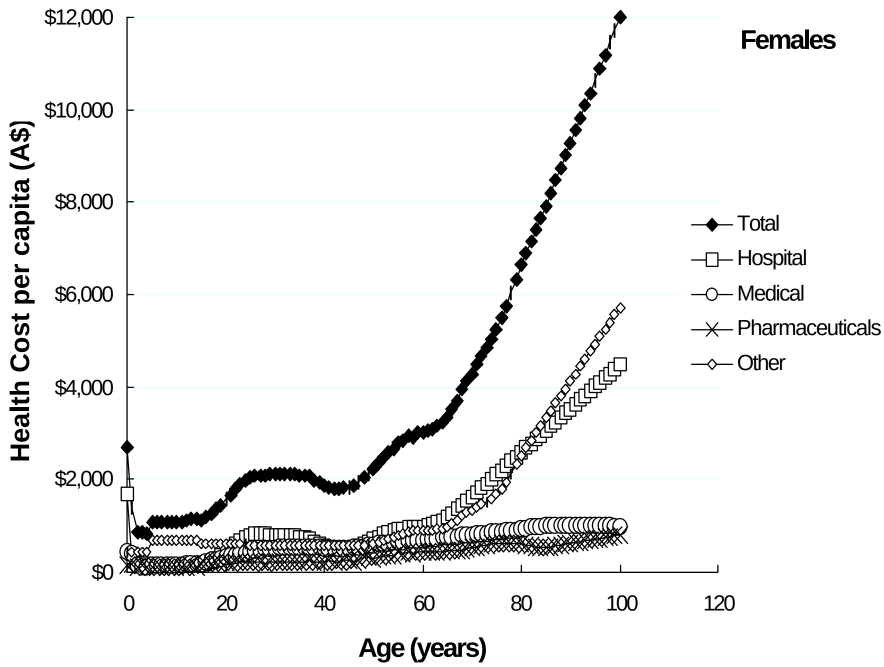
Figures 1 and 2 represent the basis for these concerns. The elderly consume significantly more resources than the young and this is particularly true for those above the age of 65 (Figures 1a, 1b). From this, it appears reasonable to infer that the demand for health services will rise steadily in the next half century as the proportion of the population above 65 rises. The second consequence of this ageing will be a reduction in the proportion of the population that is between the ages of 18 and 64 and, consequently, the proportion that is likely to be economically active (Figure 2).

Figure 1a: Best-Estimate Simulated Healthcare Cost Per Capita by Age and Type of Expenditures, 1994/95



Source: Based on data from Australian Institute of Health & Welfare, reported by Dr J Badham (See Appendix 1)

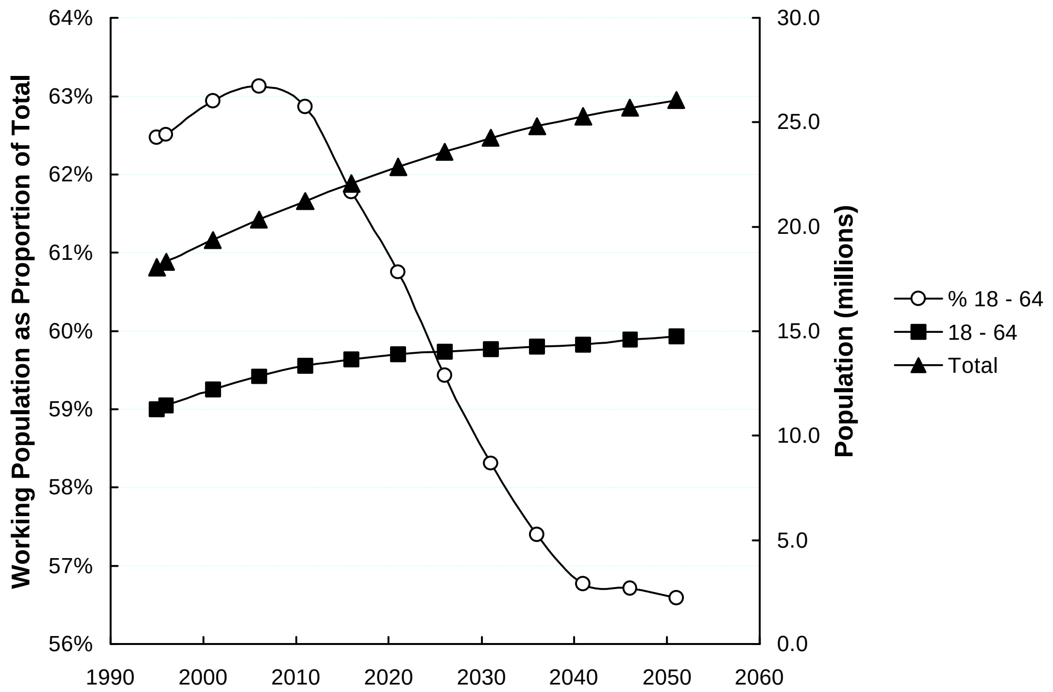
Figure 1b: Estimated Healthcare Cost per Capita by Age and Type of Expenditures, 1994/95



Source: Based on data from Australian Institute of Health & Welfare, reported by Dr J Badham (See Appendix 1)

Despite this evidence it is not necessarily true that future costs will be dominated by ageing and it is possible—as a matter of logic—that ageing per sé may have no effect. The existence of a cross sectional distribution of health costs as shown in Figures 1a and 1b does not imply that over time aggregate health costs will be determined by the age composition of the population and the costs per age cohort shown in these figures. The belief that there is a fixed medical need for each cohort of the population and that there is a well defined set of services required to meet these needs has been labeled by Evans (1984) as the 'naive medical model'. The deterministic view that health expenditures are defined fairly precisely by technical factors is simply wrong. (The issue is discussed further below.) In principle, the cost profiles displayed in Figures 1a and 1b are compatible with an historical pattern of aggregate costs which rises or falls independently of the demographic composition of the population. For example, a change in the age structure that would, *ceteris paribus,* increase aggregate costs by 10 percent could be accompanied by a downward shift in the cost profiles of 10 percent. More generally it is possible that aggregate costs may be determined by factors that are independent of the demographic profile and that the age profile simply determines the distribution of the predetermined expenditures. It is for this reason that an analysis of the impact of the ageing population must consider, not simply the effects that would occur if health costs per age cohort followed a given cross sectional pattern; it is important to consider the likelihood of this occurring, that is, the likelihood that ageing will indeed drive health costs.

Figure 2: Projected Persons Aged 18-64 as a Percent of Total Population, 1990-2060



Source: Australian Bureau of Statistics

For this latter reason the present paper considers five questions. These are:

1 How much will expenditures increase if they are driven only by ageing?

2 How much will health costs increase if they are driven by ageing and by other factors which follow their historical trend?

3 What evidence is there that ageing drives health expenditures and will continue to do so?

4 Is it desirable that age should drive health expenditures and that we should create capacity to accommodate the demands of the ageing population?

5 What other factors will determine future health care costs and what is the relative importance of ageing per sé relative to these other factors?

2 Projecting Health Care Costs

The implication of present spending patterns for future health care costs has been analysed in a number of studies (EPAC, 1988; Goss 1994, 1998; National Commission of Audit, 1996; Badham, 1998). A common methodology has now been employed with variants. In this, spending for each age/sex cohort in the future is assumed to be determined by the pattern of spending in a base year and future expenditures are estimated by summing the expenditures of the future cohorts. As the proportion of the population in the elderly cohorts rises this implies increased health expenditures. Fuchs (1984) has noted a likely error with this methodology, viz, that expenditures are more likely to be related to the number of years to death than to the number of years since birth. Consequently, with an increasing life expectancy the expenditures of a given age cohort are likely to decrease. Both Goss (1994) and Badham (1998) have explicitly adjusted their estimates to take this factor into account. Another significant adjustment is to assume that the expenditures of each cohort will continue to rise as they have done in the past. (This process is described by Badham (1998) and documented in the APHA model available on the web site.)

The most influential of these studies by the National Commission of Audit (1996) concluded that health expenditures are likely to rise to 17 percent of the GDP by 2040. Consistent with this Badham's study implied an expenditure of 12.9 percent of the GDP by 2021. Goss (1998) and Howe (1997) are both skeptical of these conclusions and argue that, because of the influence of other factors, these results are unreliable.

The results presented in this section were derived using the model described by Badham (1998) and made available at the APHA website. In summary the following assumptions and procedures were employed:

1 The pattern and level of expenditure per age/sex cohort in 1994 was used as the basis for future projections as this is the only year for which comprehensive data are available, and all Australian expenditures and costs throughout the paper are adjusted to 1994 prices;

2 Population projections to the year 2051 were obtained from the ABS;

3 All of these results were subjected to the 'Fuch's adjustment' as used by Badham;

4 Based upon the five year forward projection of Access Economics (1998) a GDP growth rate of 3.1 percent per annum was initially assumed and then adjusted for the declining participation rate which was assumed to follow the age structure shown in Figure 2. The initial GDP growth rate was varied upwards by 0.5 and downwards by 0.5 and 1.0 percent per annum. Relevant data for the time periods under consideration are summarised in Table 1.

Five sets of projections were carried out: (i) 1994 cohort expenditures were applied to hypothetical scenarios in which the total population and GDP were unchanged but the **proportion** of the fixed population in each cohort was equal to the proportion in future age sex cohorts in the ABS population projections (the 'ageing only' scenario); (ii) these ‘projections’ were repeated but with the total population increasing as forecast by the ABS and with GDP rising as described above; (iii) cohort expenditures (which are held constant in the first two sets of calculations above) were assumed to rise at a rate equal to the average of the historical ‘excess’ rate of inflation in the health sector[1] and the assumed rate of GDP growth per capita[2].

5 Badham’s default option for cohort projection was adopted, viz, the apparent age/sex component of growth in health expenditures for the period 1982-1984 was subtracted from total growth to obtain the average historical growth in expenditures within each age cohort. This average growth rate was then assumed to continue until the year 2051;

6 The default option described above was replaced by the assumption that expenditures for those aged above 65 grew at twice the rate of expenditures for those below the age of 65.

The five sets of results from the scenarios described above are reported in Table 2. First, when the only source of expenditure growth is ageing (Ageing Only and there is neither population nor GDP growth), health expenditures rise from $37.53 billion in 1995 to $52.6 billion in 2051 with most of this increase occurring in the decade to 2006. By this year health expenditures would have risen to 10.35 percent of the unchanging GDP. In the following 45 years to 2051 AD this would incrementally increase to 11.78 percent.

When both population and GDP growth are added to the model (results B) health expenditures as a percentage of GDP decline with each of the four rates of economic growth that have been employed. This indicates a GDP growth in this scenario significantly exceeds the effect of population and ageing upon health expenditures.

It is likely that per capita health expenditures within each cohort will rise because of the ‘excess inflation’ in the health sector if wages rise more rapidly than productivity. Between 1975 and 1996 the excess inflation was 0.1 percent per annum (AIHW 1998). If this rate is assumed to continue then by 2051 AD health expenditures would be only 5.76 percent greater than the rates shown in Table 2, Block B (that is, expenditure would have risen from $75.96 billion to $80.34 billion and, with a GDP growth of 2.1 percent per annum health expenditures as a percent of GDP would rise from 5.31 percent to 5.62 percent. That is, the impact would be negligible.

It is, of course, possible that a rate of excess inflation as low as 0.1 percent could not be sustained and that the historical rate was depressed by the unsustainable increases in hospital productivity that have accompanied the application of global budget caps. In Table 2 results in Block C increase the rate of excess inflation as described above so that the rate is an average of the historical trend and the assumed growth of GDP per capita. With this assumption health expenditures as percent of the GDP still decline except in the scenario with the lowest rate of GDP growth. When the expenditure in each age cohort is assumed to continue to expand along its 1982-94 growth path (Block D), expenditures by 2051 are about 260 percent greater than in

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1 The excess inflation is the increase in the cost of a unit of health output after adjusting for the general rate of inflation as measured by the GDP deflator (AIHW Health Expenditure Bulletins).

2 This is the rate shown in the table less the population growth rate.

the first scenario in which cohort expenditures were fixed (Block B). When the assumption of constant growth across cohorts is replaced by the assumption of a growth rate which is twice as great for those above 65 as for those below, then expenditures rise by another 80 percent.

These results illustrate several important conclusions. First, and most importantly, the pure 'age effect' is comparatively unimportant. If ageing were the only source of expenditure growth the relative size of the health sector would significantly decline as GDP would be expected to rise more rapidly than health expenditures. Second, the chief determinant of the size of the future health sector will be within cohort growth. Third, the size of the health sector is sensitive to the relative growth rates of different cohorts. If, as is likely, new technologies permit the more rapid growth of expenditures on the elderly then the health sector could expand more rapidly than with the same average growth of cohort expenditures. Fourth, the economic burden of the health sector will very largely depend upon the rate of growth of the economy. This is the conclusion also reached by Howe (1997). Part of the explanation for the relatively modest effect of ageing on health expenditure is that expenditure in the elderly, even though high on a per capita basis, forms a relatively small proportion of total health expenditure. Table 3 shows that a 73% increase in the percentage of total expenditure devoted to those over 75 will produce a 12% increase in the percentage of expenditure on all age groups, assuming that growth in cohort expenditure continues at the present rate.

Table 1 Percentage of Health Expenditure Generated by Each Group, 1995-2051: Assuming Growth in Costs of Expenditure Sectors Continues at Current Level

	0-4	5-19	20-44	45-64	65-74	75-84	85+
1995	5.0	11.0	29.4	23.0	15.1	11.9	4.5
2006	4.4	10.5	26.9	27.1	13.0	12.4	5.6
2021	3.7	9.2	23.1	27.0	17.6	12.8	6.6
2036	3.4	8.5	21.5	24.0	17.1	16.2	9.4
2051	3.2	8.2	20.8	23.6	15.8	16.4	11.9

Figure 3 represent the disaggregation of future expenditures with the baseline scenario in which all cohort expenditures rise at their trend rate but are adjusted to allow for the 'Fuch's effect'.

Table 1a: Growth in Population Health Expenditure and GDP in Australia 1981 to 1994.

	1982	1985	1988	1991	1994	Average Growth Rate 1981 - 1994
Population (M)	15.2	15.8	16.5	17.3	17.8	1.35%
% (15-64)	60.5	60.8	61.8	62.4	62.4	0.28%
GDP ($ 1994)	318.2	366.3	403.2	423.3	473.7	3.37%
Real Total Health Expenditure ($b 1994)	23.6	27.3	31.5	34.6	38.9	4.24%
Health expenditure as % GDP	7.4%	7.5%	7.8%	8.2%	8.2%	0.84%
Annual Growth Rates	1982	1985	1988	1991	1994	
Population Growth Rate (%)	1.8%	1.3%	1.7%	1.2%	1.0%	
GDP	-2.2%	4.4%	2.7%	1.8%	3.5%	
Real Total Health Expenditure	1.9%	5.7%	5.2%	3.8%	5.3%	

Table 1b: Projected Growth in Population, Health Expenditure and GDP in Australia, 1995 to 2051.

	1995	2006	2021	2036	2051	Average annual growth rate 1995 - 2051
Population	18.1	20.3	22.9	24.8	26.1	0.66%
% Population 18-65	62.5 %	63.1%	60.8%	57.4%	56.6%	
GDP (A$ billions)	488.4	676.3	1110.7	1858.5	2980.0	

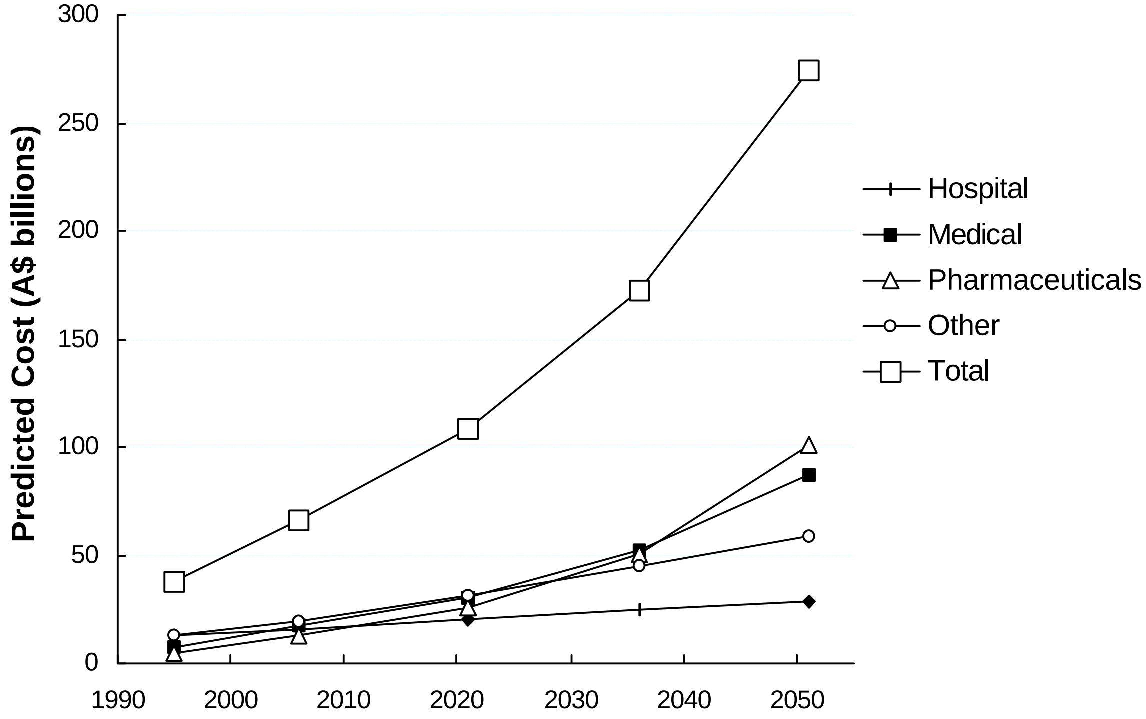
Table 2: Predicted Future Health Expenditures Calculated from Population Size, Ageing and Historical Trends ($1994, Billions)

		1995	2006	2021	2036	2051
A. Ageing Only	Health Cost (A$ billions)	37.53	46.27	49.36	51.67	52.60
	Health % GDP	8.40	10.35	11.05	11.56	11.78
B. Ageing plus Population Growth	Health Cost (A$ billions)	37.53	52.14	62.51	71.03	75.96
GDP Growth 2.1% p.a	Health % GDP	8.40%	9.28%	8.15%	6.78%	5.31%
GDP Growth 2.6% p.a	Health % GDP	8.40%	8.75%	7.14%	5.52%	4.02%
GDP Growth 3.1% p.a	Health % GDP	8.40%	8.26%	6.26%	4.50%	3.04%
GDP Growth 3.6% p.a	Health % GDP	8.40%	7.79%	5.49%	3.67%	2.31%
C. Ageing + Population Growth + excess inflation	Health Cost (A$ billions)	37.53	52.14	62.51	71.03	75.96
GDP Growth 2.1% p.a	Health % GDP	8.40%	9.92%	9.71%	9.15%	8.24%
GDP Growth 2.6% p.a	Health % GDP	8.40%	9.59%	9.05%	8.22%	7.14%
GDP Growth 3.1% p.a	Health % GDP	8.40%	9.28%	8.44%	7.40%	6.20%
GDP Growth 3.6% p.a	Health % GDP	8.40%	8.99%	7.89%	6.67%	5.39%
D. Ageing + Population Growth + uniform cohort trend	Health Cost (A$ billions)	37.53	65.66	107.86	172.82	274.63
GDP Growth 2.1 % p.a	Health % GDP	8.40%	11.69%	14.06%	16.49%	19.19%
GDP Growth 2.6% p.a	Health % GDP	8.40%	11.02%	12.32%	13.43%	14.52%
GDP Growth 3.1% p.a	Health % GDP	8.40%	10.40%	10.80%	10.95%	11.01%
GDP Growth 3.6% p.a	Health % GDP	8.40%	9.81%	9.48%	8.94%	8.36%
E. Ageing Population Growth + differential cohort trend	Health Cost (A$ billions)	37.53	69.07	124.94	238.38	494.35
Growth >65 = 2*growth <65						
GDP Growth 2.1% p.a	Health % GDP	8.40%	12.29%	16.28%	22.75%	34.54%
GDP Growth 2.6% p.a	Health % GDP	8.40%	11.59%	14.27%	18.53%	26.14%
GDP Growth 3.1% p.a	Health % GDP	8.40%	10.94%	12.52%	15.11%	19.82%
GDP Growth 3.6% p.a	Health % GDP	8.40%	10.32%	10.98%	12.33%	15.04%

Notes: GDP growth is assessed to commence at the rate shown in each row and then is reduced as the participation rate n the workforce declines.

Predicted Costs (C) = Costs based on 1995 costs for each population cohort which increases each year by ½(0.1 + % growth of GDP/capita)

Figure 3: Predicted Growth in Total Health Expenditure Disaggregated by Sector in Australia, 1995 to 2051



Notes: Figure 3 represents the 'base case' of GDP growth of 3.1 percent and uniform cohort growth equal to averaged cohort expenditure growth, 1981 to 1994.

3 Does Ageing Drive Health Expenditures?

The inevitability and importance of an ageing effect may be tested with four sets of readily available data. These relate to (i) time series Australian expenditures; (ii) cross sectional Australian expenditures; (iii) cross sectional international data; and (iv) time series cross national expenditures.

3.1 The Historical Experience

The methods that have been employed to forward project health expenditures were applied to historical data to determine the accuracy of the resulting projection. Results are shown in Table 3 and Figure 4 are based upon the assumption of fixed per capita expenditures within cohorts, actual rates of population growth and ageing and actual GDP growth. In view of the previous conclusions the results are unsurprising. If ageing had been the only drive factor in the health sector then health expenditures would be now a significantly lower percentage of the GDP. Of the $15.7 billion increase in expenditures (in 1994 constant dollars) only $6.2 billion or 40 percent of the increase, could be attributed to ageing. A minimum of 60 percent of the increase must be attributed to other factors and even this may be a significant overstatement of the importance of ageing if, as discussed below, ageing did not drive expenditures but occurred coincidentally at the same time as expenditures were independently driven by other features.

Figure 4: Validation of the 'Needs Methodology': Predicted vs Actual Growth, 1981 to 1994

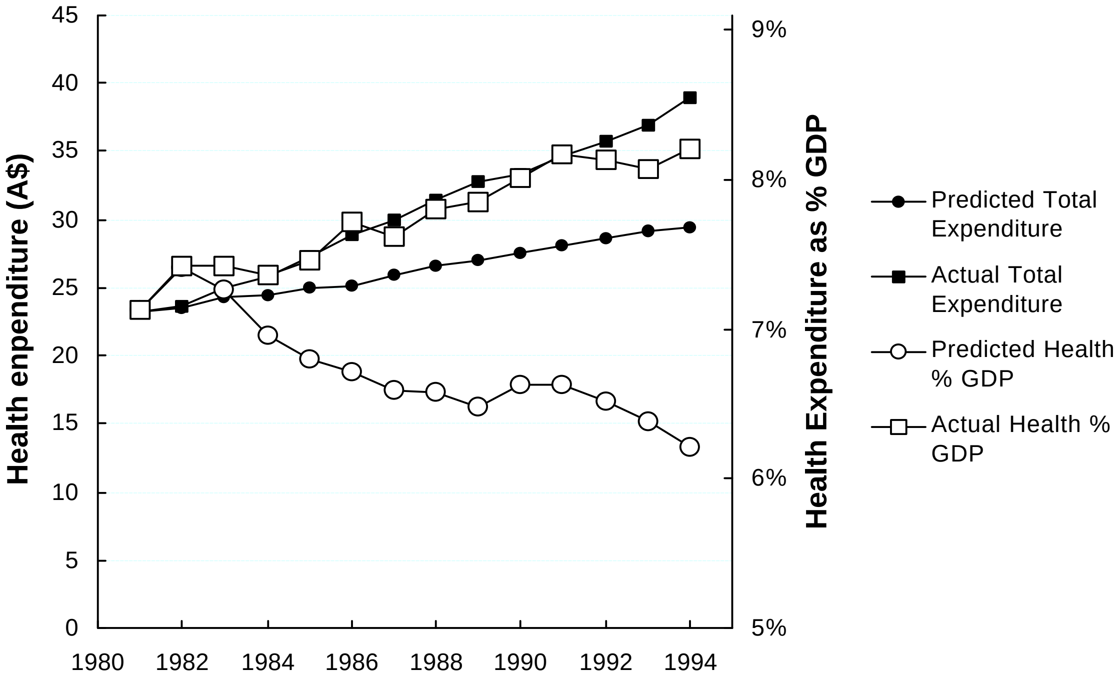


Table 3: Predicting Historical Expenditure from Population Size and Ageing

	1981	1985	1990	1994
Total Expenditure on Health (A$ billions)				
Predicted	23.20	24.93	27.55	29.43
Actual	23.20	27.33	33.32	38.90
Health Expenditure as % of GDP				
Predicted	7.13%	6.80%	6.63%	6.21%
Actual	7.13%	7.46%	8.02%	8.21%

3.2 Australian Cross Section Data

It is possible to argue that the previous results are an unreliable test of the importance of ageing. Expenditures over time may be dominated by the introduction of new technologies which, once they exist, will be used by all age cohorts and that, consequently, the effect of ageing cannot be considered independently of the introduction of new technologies. If this argument were correct it would be expected that cross sectional expenditures would be closely related to the demographic profile of regions and especially so after standardising for other sources of demand for health care.

This possibility was tested by comparing the use of GP services per capita with the predicted use based upon the age/sex composition of the 186 Australian statistical sub-divisions (SSD). Per capita use of GP services in each SSD were obtained for 1996 from the Commonwealth Department of Health and combined with other socio economic and demographic data (see Richardson, 1998). This permitted the comparisons reported below in Figures 5a, 5b and Table 4.

The first of these plots actual against expected use of GP services. The resulting correlation coefficient of 0.138 indicates that only 2 percent of the variance in the use of GP services could be attributed to age and sex. This rises to 12 percent after taking the logarithm of both variables.

The regressions in Table 4 report the importance of age/sex predicted use of GP services, $\overline{Q}(\text{GP})$, after standardising for other relevant variables that were found to be significantly related to the use of GP services[3]. The best fitting models included aboriginality as an index of socio economic status; urban versus rural location; the existence of a public hospital (and consequently an Out Patient Department providing primary care) and the out of pocket net fee paid by the patient. After standardising for these variables in a double log model the age/sex predicted use of services was statistically significant. Its coefficient implies that a 10 percent increase in predicted use of services is associated with an 11.1 percent increase in actual use. The hypothesis could not be rejected that a 10 percent increase in predicted would lead to a 10 percent increase in actual use.

[3] Other notable variables which were not significant included income per capita and the percentage of services that were bulk billed.

As it is possible that the significance of $\overline{Q}(\text{GP})$ is attributable to correlation with other variables (multi colinearity) a second test was conducted in which $\overline{Q}(\text{GP})$ was omitted from equation 1 and the resulting residuals were regressed against $\overline{Q}(\text{GP})$. The results, shown in Figure 5b, is that 12 percent of the variance of the residual is explained. As the residual represents only 28 percent of overall variance this indicates that the age/sex variable explains approximately 3 percent of total variance.

Two caveats to this result are of importance. First, the inclusion of the variable in equation 1 only increased the explanation of observed variance by 3.4 percent. Second, equation 1 is misspecified as its residual closely correlates with the supply of GPs. When this variable is included (equation 2) the age/sex predicted use of services ceases to be of importance. This result is repeated when the GP supply and net fees are endogenised in a two stage procedure (Richardson 1998).

In sum, the Australian cross sectional data suggest that, in the case of GP services age and sex may help to explain service use. However, its explanatory power is small and the data, as analysed in equation 2, are consistent with the hypothesis that they have no explanatory power. The simple correlation shown in Figure 5a may be attributable to a tendency for general practitioners to locate their practice in areas with a more elderly demographic profile and for the service use to be the direct outcome of this decision rather than the demographic characteristics per sé.

Table 4: Regression of GP Use/1,000 on Age Sex Predicted GP Use/1,000 Population

Dependent : Ln Q (GP)

Variable	(1)		(2)	
	B	P	B	P
% Abo	-2.10	(.00)	-1.51	(.00)
URBAN	0.08	(.00)	ns	
Ln (HOSP)	-0.02		-0.01	(.09)
Ln (Net.fee)	-0.16	(.00)	-0.14	(00)
Ln (GP)			0.41	(00)
Ln $\overline{Q}$ (GP)	1.11	(.00)	ns	
Constant	-0.187		1.25	
R^2 (adj)	0.78		0.89	

Key:
- % Abo = Aboriginals as a percent of the population
- URBAN = SSD in an urban location
- HOSP = Public hospitals in the SSD
- Net.fee = GP fee less rebate
- GP = GP/1,000 population
- $\overline{Q}$ (GP) = Age sex predicted use of GP services

Figure 5a: Actual vs Age Sex Predicted Use of GP Services by SSD Across Australia, 1996

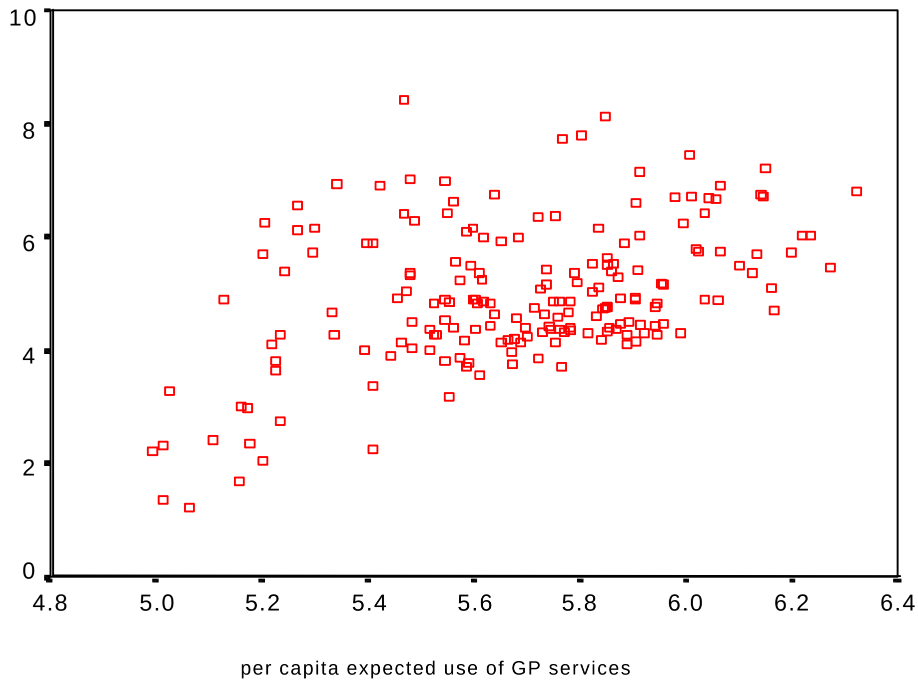
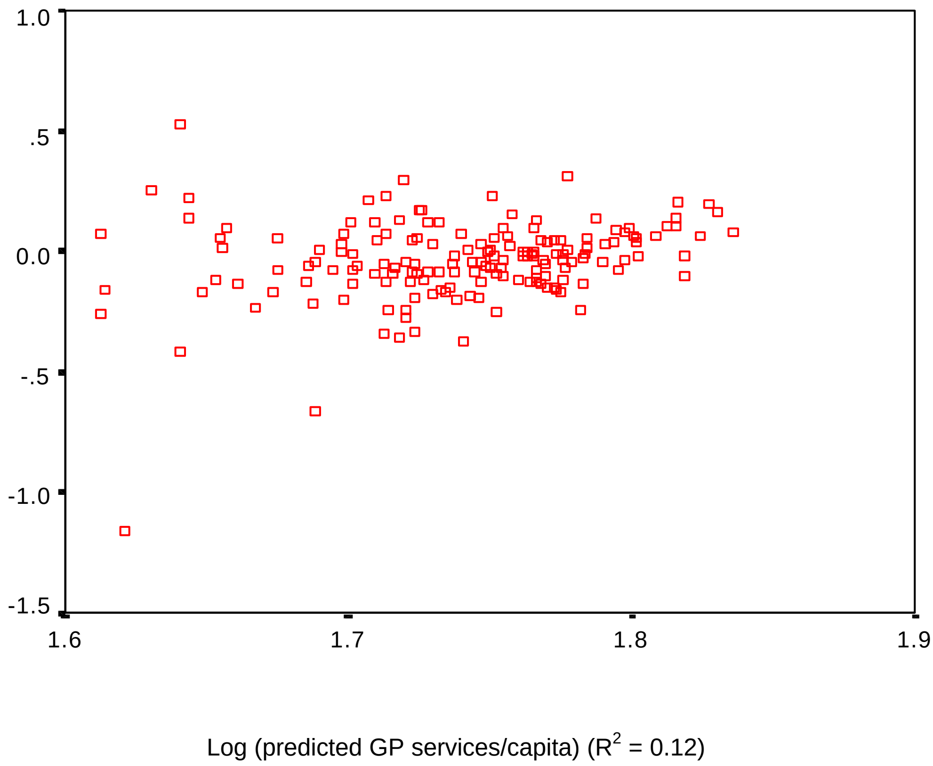


Figure 5b: Residual from Double Log Regression Omitting $\bar{Q}$ (GP)



3.3 Cross Sectional Cross National Data

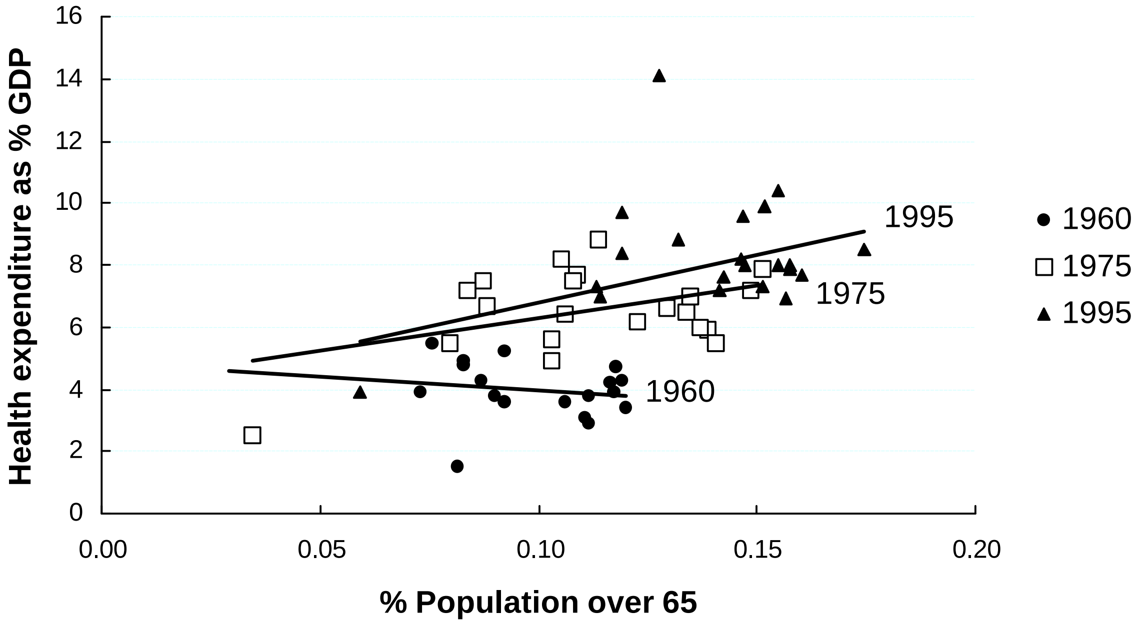
In the introduction it was noted that the existence of a cross sectional relationship between age/sex and health expenditures within a country need not imply that there is a relationship between national expenditures over time. For the same reason, the within-country relationship need not imply a cross national correlation between nations. That is, if age and sex do not drive expenditures then no relationship would be expected between national expenditures per capita and the demographic composition of countries.a

This hypothesis can be tested using publicly available OECD data on health expenditures in member countries. These were used in combination with three measures of the demographic composition of the population, viz, the percent of the population over the ages of 65 and 80 and an index of expected relative expenditures per capita, HP, which was obtained by weighting the proportion of each countries' population in each age/sex cohort by Australian expenditures in these cohorts in 1994-95.

Figure 6 presents a simple comparison of health expenditures as a percent of GDP against the first of the age variables, viz, the proportion of the population over age 65. This reveals no correlation in 1960, a weak and statistically insignificant correlation in 1975 and a weak and statistically significant relationship in 1995. The comparison is confounded by the dominating influence of GDP per capita on health expenditures. Simple regression of these variables results in the relationships shown in Figure 7. For all three years GDP per capita is a statistically significant determinant of health expenditures as a percent of GDP. The analysis indicates a structural shift in the relationship between 1960 and 1975 but no further change between 1975 and 1995. Results of the inclusion of both GDP and the age variables in the regression are shown in Table 5. The significant conclusion to be drawn from this table is that none of the demographic variables helps to explain the variation between national health expenditures as a percentage of GDP. As with the previous analysis, regressions were estimated with the demographic variables omitted and residuals were compared with the age variables. Results were uniformly insignificant.

The conclusion to be drawn from these cross sectional comparisons is that age cannot be regarded as a significant determinant of national health expenditures. Large differences in demographic structure are consistent with little or no difference in health expenditures per capita. This conclusion was also reached by Gerdtham et al (1994) in their analysis for the OECD.

Figure 6: Population Over 65 and Health Expenditure as a Percentage of GDP



Source: OECD Health Data 1998

Table 5: Regression Results: Health Expenditure as a Percent of GDP and Various Independent Variables from the Three Years (1960, 1975 and 1995) in 21 OECD Countries

Regression	1		2		3	
H % GDP	Coeff (b)	*p* =	Coeff (b)	*p* =	Coeff (b)	*p* =
Independent variable						
% over 80 1960	-32.0	0.64				
% over 80 1975	48.9	0.40				
% over 80 1995	33.4	0.49				
% over 65 1960			-11.09	0.41		
% over 65 1975			9.92	0.33		
% over 65 1995			8.07	0.56		
H.P. 1960					-2.229	0.21
H.P. 1975					1.127	0.49
H.P. 1995					1.386	0.58
GDP p.c.1960	0.176	0.102	0.179	0.084	0.184	0.069
GDP p.c.1975	0.213	0.055	0.213	0.023	0.231	0.012
GDP p.c.1995	0.397	0.003	0.406	0.001	0.422	0.001
constant 1960	3.15	0.026	3.72	0.022	6.99	0.055
constant 1975	3.18	0.01	3.01	0.015	1.48	0.65
constant 1995	0.54	0.78	0.28	0.89	-2.00	0.72
R-squared	0.767		0.773		0.774	
Het. Test p =	1.000		1.000		0.594	
O.V. Test p =	0.166		0.131		0.154	

Source: OECD Health Data 1998

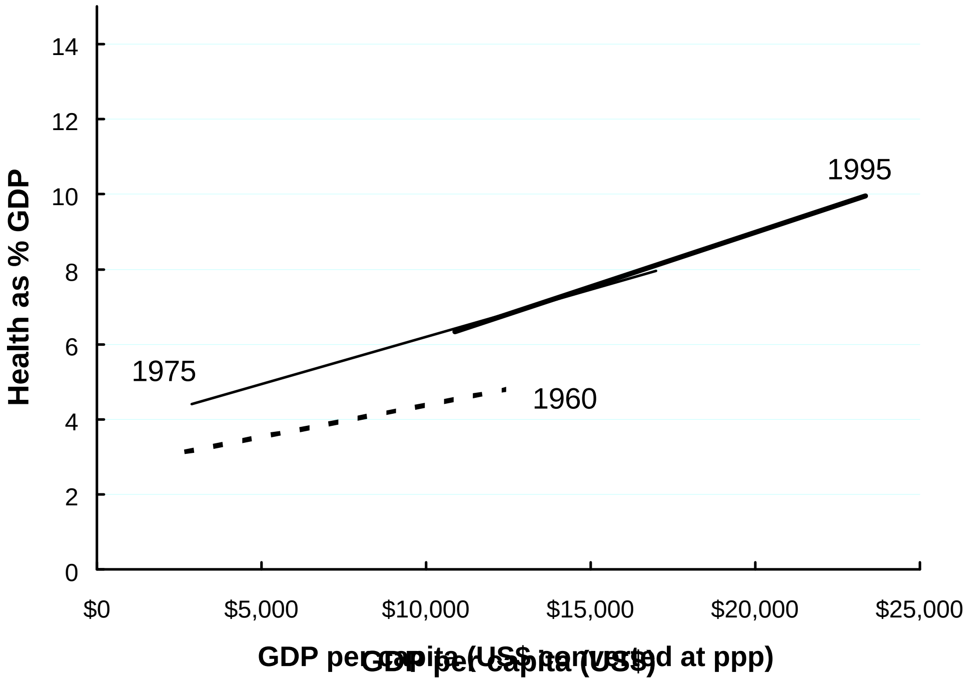
Regression 1: H % GDP = b . % over 80 1960 + b_1 . % over 80 1975 + b_2 . % over 80 1995 + b_3.GDP p.c. 1960 + b_4.GDP p.c. 1975 + b_5.GDP p.c. 1995 +constant 1960 + constant 1975 + constant 1995

Regression 2: H % GDP = b . % over 65 1960 + b_1 . % over 65 1975 + b_2 . % over 65 1995 + b_3.GDP p.c. 1960 + b_4.GDP p.c. 1975 + b_5.GDP p.c. 1995 + constant 1960 + constant 1975 + constant 1995

Regression 3: H % GDP = b . H.P 1960 + b_1 . H.P 1975 + b_2 . H.P. 1995 + b_3.GDP p.c. 1960 +b_4.GDP p.c. 1975 + b_5.GDP p.c. 1995 + constant 1960 + constant 1975 + constant 1995

- H % GDP: Health expenditure as a % of GDP.
- % over 80 and % over 65: The % of the population aged over 80 and 65
- H.P.: Health expenditure in 1960, 1975 and 1995 predicted from the populations of the 21 OECD countries in those years multiplied by the age and sex cohort costs for Australia in 1995.
- GDP p.c.1960: GDP per capita in 1960.
- Het. Test: Cook-Weisberg test for heteroscedasticity, Ho: Constant variance.
- O.V. Test: Ramsey RESET test using powers of the fitted values, Ho: model has no omitted variables.

Figure 7: GDP Per Capita And Health Expenditure as a Percentage of GDP



Source: OECD Health Data 1998

3.4 Cross National Time Series Data

The previous conclusion is consistent with the possibility that idiosyncratic historical factors dominate the cross sectional relationship between nations but that over time demographic changes determine the relative growth of health expenditures in different countries. This was tested using the third and most comprehensive of the demographic variables namely the health expenditures predicted from each country's demographic structure and from 1994/95 Australian expenditures in each cohort. The percentage increase in actual expenditures between 1960 and 1995 was compared with the percentage increase predicted from this third demographic variable before and after standardisation for the percentage increase in the GDP and the increase in population. One of the resulting comparisons is shown in Figure 8 and the regression results in Table 6. None of these comparisons found any relationship between the change in the demographic variable and the increase in health expenditures. The result again suggests that demographic variables are either of minor or no importance in explaining the relative growth of health systems.

Table 6: Regression Coefficients for the Regression Between the % Change in Health Expenditure Per Capita and the % Change in Values of Various Independent Variables Between 1960 and 1995 in 21 OECD Countries

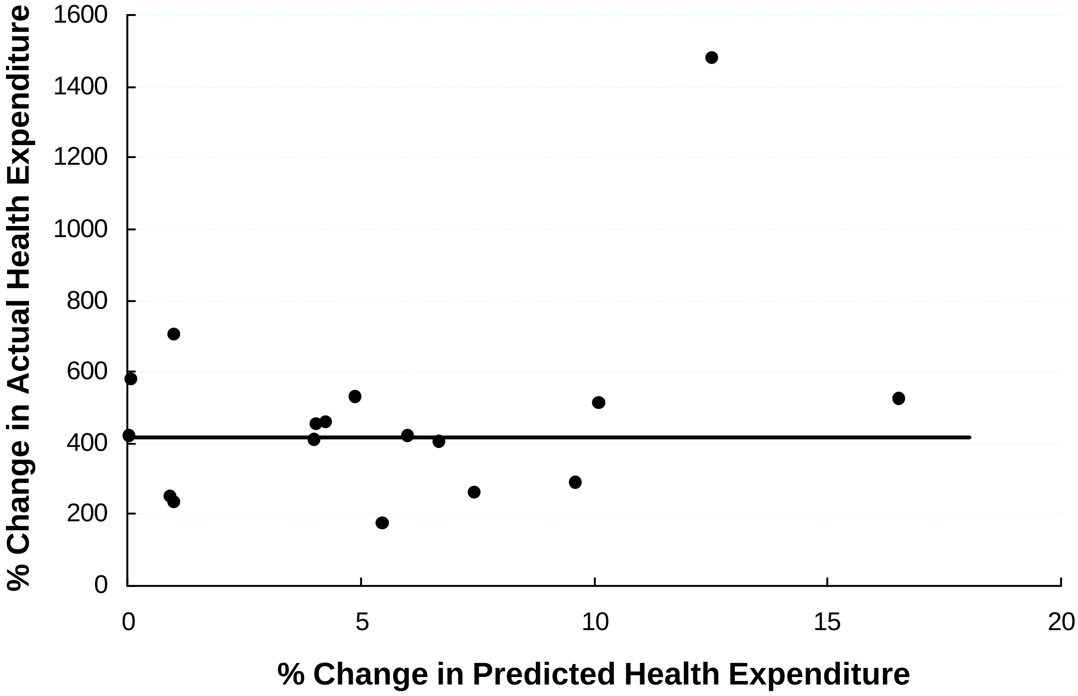
Regression % Change in Health Expenditure US$	**4** Coeff (b)	*p =*	**5** Coeff (b)	*p =*	**6** Coeff (b)	*p =*
Independent variable % Change over 80 1960 - 1995	0.900	*0.37*				
% Change over 65 1960 - 1995			-0.06	*0.95*		
% Change in H.P 1960 - 1995					-0.505	*0.93*
% Change GDP 1960 - 1995	3.28	*0.006*	1.96	*0.001*	1.96	*0.001*
constant	-119.5	*0.40*	142.4	*0.12*	140.2	*0.09*
R-squared Het. Test p = O.V. Test p =	0.454 1.000 0.138		0.578 0.646 0.291		0.576 1.000 0.277	

Source: OECD Health Data 1998

Regression 4: Residual $_{-GDP}$ = b . % Change over 80 1960 – 1995 + constant
Regression 5: Residual $_{-GDP}$ = b . % Change over 65 1960 – 1995 + constant
Regression 6: Residual $_{-GDP}$ = b . % Change in H.P 1960 – 1995 + constant

- % Change in Health Expenditure US$: The % change between 1960 and 1995 in the health expenditure per capita in constant US$.
- % change over 80 1960 – 1995 and % over 65 1960 – 1995: The % change between 1960 and 1995 in the % of the population aged over 80 and 65
- H.P.: Health expenditure predicted from the populations of the 21 OECD countries in those years multiplied by the age and sex cohort costs for Australia in 1995.
- Het. Test: Cook-Weisberg test for heteroscedasticity, Ho: Constant variance.
- O.V. Test**:** Ramsey RESET test using powers of the fitted values, Ho: model has no omitted variables.

Figure 8: **Change In Health Expenditures Compared with the Change in Age Sex Predicted Expenditures 1960 to 1995 in 21 OECD Countries**



Source: OECD Health Data 1998

4 Should Health Sector Capacity Anticipate Demographic Changes?

Evidence presented in the last section must lead to the conclusion that the simple needs model based upon demographically based need and need based expenditures cannot explain the relative per capita costs of different nations or the relative change in their costs over time. Nevertheless, it is possible to argue that despite the vagaries of history and despite the idiosyncratic factors driving different national health schemes, expenditures are or should be subject to a ratchet effect. Once a pattern of resource use has been established it will be difficult and undesirable to alter that pattern, at least in the short run. That is, as the population ages we should not spend less per age cohort and, consequently, we should minimally increase capacity to facilitate the continuation of existing medical practices.

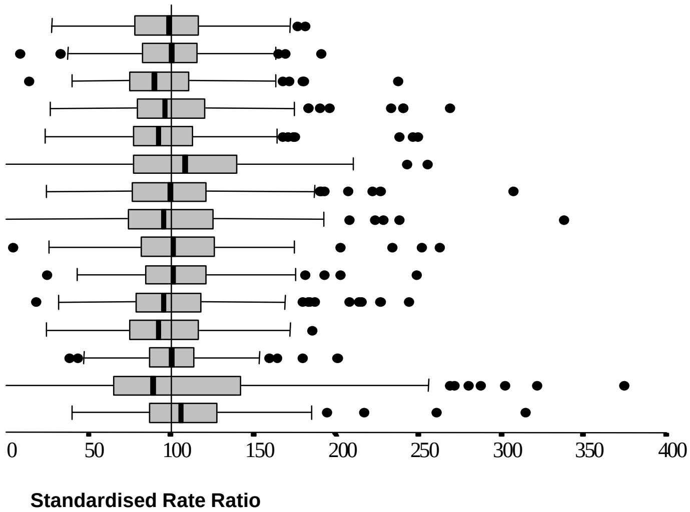
This argument is an unconvincing basis for a significant shift in policy for three reasons. First, and as described in Section 2, ageing per sé in the absence of other drive variables could be accommodated with modest expenditure growth and a declining share of the GDP spent on health services. Secondly, while there is, by construction, an 'average practice', there is little evidence that there is any particular pattern of treatment that could be described as 'normal' or 'accepted' which might, therefore, be used as the basis for expanding capacity. Results of recent analysis of small area variation in rates of service use are reproduced in Figure 9. In this, the age/sex predicted use of various services in each Victorian statistical local area (SLA) a set equal to 100 and the actual rates for the state SLAs are plotted for a number of well defined hospital services. Results indicate highly erratic practice patterns with variation between SLAs of 400-600 percent being the norm. Part of this erratic behaviour could, in principle, be attributed to random variation: the low probability of an individual needing these services and the comparatively small population in each SLA. Using State average use of each service and the assumption of a poisson distribution it is possible to predict the expected variance that would arise from age/sex and population only. In the second column in Figure 9 the observed variance between SLAs is divided by this expected variance. If variation was entirely explained by age/sex and random chance then this ratio would be one. The smallest ratio reported indicates a variance 70 percent greater than expected and, in the case of colonoscopy a variance which is 4,530 percent of expectation. This does not indicate an established pattern of service use which could be the basis for the expansion of medical capacity.

Similar variation in service use has been observed between OECD nations (MacPherson, 1990) and is not, apparently, associated with corresponding differences in health outcomes.

Thirdly, and especially in view of the previous result, medical services should only be expanded if there is good evidence that additional services and their associated costs will be matched by additional benefits. While there are, of course, numerous examples of individual services whose expansion would be of unquestioned benefit it has been difficult to demonstrate a relationship between increasing global costs and population health (Taylor and Salkeld, 1996). As the majority of health services that are provided have not been subject to systematic evaluation this disappointing result is not, perhaps, surprising. This conclusion, suggests that further expansion or even the maintenance of present expenditures should be dependent upon the outcome of reasonable evaluation or, minimally, critical review.

Figure 9: Standardised Rate Ratios for Various Operations in the Statistical Local Areas in Victoria, Compared to the Rate Ratios for all Victoria

Procedure	Variance / Ex(Variance)
Coronary Angiography	13.4
Cor Revasc Procedure	5.4
Cataract Extraction	15.4
Tonsils & Adenoids	7.5
Myringotomy	11.7
Carpal Tunnel Release	8.4
Vertabral discetomy	2.1
Decomp laminectomy	1.9
Total Hip Replacement	3.8
Hysterectomy	6.4
Prostatectomy	3.9
Colonoscopy	45.3
Cholecystectomy	5.3
Explorat Laparotomy	1.7
Appendectomy	5.9



Median, range, 25th & 75th centiles for Statistical Local Areas, standardised to Victorian State Ratio = 100. Extreme values greater than 3 times 50th-75th and 25th-50th centile intervals are recorded as separate points.

Source: Richardson, J 1998, 'The health care financing debate' in *Economics and Australian Health Policy*, eds G Mooney & RB Scotton.

5 Summary and Discussion

The purpose of this paper was to determine the likely impact of ageing upon future health expenditures. The chief analytical concern has been to determine whether or not increases in expenditures predicted from the simple aged based needs model are likely to translate into an effective demand for health services. As part of the analysis of this broader question the following conclusions have been drawn:

1. Application of the simple needs model suggests that the impact of future ageing on the need for medical services will be so small that, in the absence of other factors, the size of the health sector would diminish in relation to the GDP.

2. Scenarios exist in which the size of the health sector would significantly expand and represent a greater burden to the economy. The magnitude of the predicted burden is sensitive to the assumptions made about GDP growth, the average growth of cohort expenditures and the relative growth of different cohort expenditures. These important variables cannot be predicted from future demographic changes and it must therefore be concluded that any future problems arising from health sector expenditure will be primarily due to non-demographic factors.

3. Determining future cohort expenditure growth is problematical. There are no compelling reasons for believing that they will follow an historical trend as the historical trend has been determined by (poorly analysed) idiosyncratic decisions of the past.

4. Application of the population needs model to historical data indicates that it would have had very limited explanatory power with respect to the growth of past expenditures. Further, it is possible that apparent need grew coincidentally with expenditures and was not a causal factor. That is, the attempt to validate the methodology through historical analysis failed.

5. Australian cross sectional data suggest that the use of GP services is only very loosely associated with the local demographic profile. Regression results are consistent with the conclusion that a 10% increase in age/sex determined need is associated with a 10% increase in the use of GP services. It is also consistent with the view that the causal mechanism is from ageing to the supply of doctors to the generation of demand. That is, need may only determine the distribution of doctors while aggregate medical costs are determined by the doctor supply.

6. Cross sectional analysis of cross-national data indicates a limited simple association between the age of a population and its health expenditures but this association is only significant for one of the three time periods for which cross sectional data were analysed. After standardising for GDP, this association disappears. This suggests that the simple correlation was the result of a coincidence of wealthy and older countries in this time period.

7 Analysis of cross-national time series data lead to the rejection of the hypothesis that growth in demographically determined need has driven the growth of expenditures.

These results cast very significant doubt upon the belief that age/sex based need has been or will be a significant determinant of the demand for health services. While it is still possible to argue that, as a normative proposition, the country should create capacity to accommodate future age/sex determined needs, the enormous variation observed in practice patterns across the country (and between countries) suggest that there is no established practice pattern which could be sensibly employed for such an analysis.

The results also imply that the assertion that, because of ageing, future health care expenditures will be beyond the capacity of the government budget is unambiguously false unless the budget is downsized to the point where this problem is self fulfilling.

These conclusions raise the question of what has driven expenditures, if age and sex have been of limited or no importance. While detailed analysis has not been conducted in Australia, and is beyond the scope of this paper, the broad answer to the question is fairly clear. The usual variables focussed upon by many economists – price and personal income – are incapable of explaining a significant part of health sector growth. Price elasticities are too low and prices have changed too little (Richardson 1991). Personal income elasticities are similarly low and, in Australia, may be zero.

By elimination of other factors, the variables that have been significant on the supply side have been increased unit costs driven by the increase in provider incomes; the increased capacity to deliver services which have been determined by a diverse range of uncoordinated health and educational authorities and new technologies including the more intensive use of traditional therapies. This latter factor is probably the most important 'autonomous' variable in the equation and the most difficult for a small country to control. It should not, however, be assumed that the inflationary pressures from technologies of the past will continue. Technology in the USA is an endogenous variable and the US market has been undergoing a significant shift from one which rewards cost creation to one which rewards cost cutting.

On the demand side the two significant factors have been the growth in national income and supplier induced demand. The former factor is distinct from the conventional 'income effect' of economic theory. As noted above, personal income elasticities are very low. More significantly, it has been government authorities that have been responsible for the major expenditures. While poorly articulated in the literature there is clearly an 'institutional income effect' which operates through the growth of budgetary allocations to health authorities that are roughly improportional to income growth and adjusted up or downwards by either a 'betterment' or by an 'efficiency' factor.

The analysis reported in the paper reinforces the dictum that prediction is hazardous and especially when it is about the future. Despite this, there is a serious possibility of health authorities adopting the results of the simple needs approach on the grounds that 'any numbers are better than no numbers'. In the present case this is not necessarily true. There is compelling evidence that the creation of capacity in the health sector will be self justifying (Richardson 1998) and there is little evidence that the aggregate expansion of capacity creates benefits that warrant the costs (Taylor & Salkeld 1996).

In the absence of reliable needs based projections, policy guidelines with respect to the growth of the health sector must be general and qualitative. In principle, it would be desirable to have a needs based model which could project future requirements. From the evidence of small area variation within Australia and variation in procedure use between countries, it is clear that we do not have the basic parameters of such a model and that different medical practitioners are adopting radically different practices. The concomitant of this conclusion is that the theory and practice of 'best practice guidelines' and 'evidence-based medicine' must be developed as a high priority and then incentives created for their implementation. As provider incomes are determined by the chosen practice pattern this may prove the to be the more challenging political issue. Once achieved, it will be possible to use (in principle) simple needs based models to recommend changes in treatment capacity. In the short-run there appears to be little alternative to a continuation of the ad hoc approach to new technologies and to the changes in health sector capacities implied by these. Even this task is currently hindered by the lack of both epidemiological and economic evaluation which is a prerequisite to sensible decision making in the health sector.

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APPENDIX 1

Methods, Variables and Data

Projection Models

Data sources are listed in Table A1. They include the Australian Bureau of Statistics (ABS) actual and projected estimates of annual Australian population by sex and year of age, the ABS estimates of life expectancy for 1981 to 1994, the Australian Institute of Health and Welfare (AIHW) estimates of total and sectoral (hospital, medical, pharmaceutical and other) health expenditure for 1981 to 1994, the AIHW estimates of total and sectoral health expenditure per capita for the different age and sex cohorts for 1994 as reported by Dr Jenny Badham of the Australian Private Hospitals Association, and the ABS estimates of Australian expenditure GDP for 1981 to 1994. The population estimates are mid-year values, whilst the expenditure and GDP estimates are those for the July-to-June financial year (1981 = July 1981 to June 1982). Where sectoral expenditures per capita were reported for a range of years, a best-estimate of expenditure for individual years of age was made (see Figures 1a & 1b). The life expectancy difference from the base year of 1994 for each year of age in each projection year was determined by extrapolation, assuming no discontinuities across the age range. For each projection year between 1981 and 2051, the sectoral health expenditure per capita was adjusted to that of the year plus life expectancy difference above (for the earlier years) or below (for the later years) the corresponding value for 1994.

Retrospective Projection Model 1981 – 1994: For each year, the model calculated an estimate (in 1994/5 constant Australian dollars) of the total and sectoral health expenditure for year of age and sex cohorts, adjusted for the annual change in life expectancy. A growth factor was included in the calculation for each of the health expenditure sectors, and this factor was adjusted such that the model estimates of the total health expenditure most closely approximated to actual total health expenditure. The sectoral health expenditure per capita was then multiplied by the population of each age sex cohort, and a total estimate of the annual and sectoral health expenditure obtained by summation.

Prospective Projection Model 1995 – 2051: In the forward projection model, the same calculations were performed using the 1994/5 age cohort estimates of sectoral health expenditure and the ABS middle-case projections of the Australian population growth.

OECD Regression Analysis

Data was obtained from the CD of OECD Health Data 98. The figures for 1960, 1975 and 1995 were used. All financial numbers GDP were converted to constant 1995 US dollars, except for predicted health expenditure. Predicted health expenditure was calculated from the total age and sex cohort health expenditures in Australia in 1994/5 reported by Dr Jenny Badham multiplied by the age and sex population numbers of 21 of the OECD countries. The percentage change between 1960 and 1995 was calculated in: 1) predicted health expenditure; 2) actual health expenditure as a % of GDP; 3) GDP; and 4) proportion of the population over 65 and over 80.

Statistical analyses were performed using Stata version 5.0 Statistics/Data Analysis. Regression coefficients were calculated, with the validity of the linear regression assumptions being tested using the Cook-Weisberg test for heteroscedasticity and the Ramsey Reset test for omitted values.

TableA1: Data Sources

Data Source	Data description
Australian Bureau of Statistics (ABS)	Estimated Resident Population by Sex/Age: ABS Cat.3201.0 Deaths: Expectation of Life and Life Table Death rates, Australia: Year Book Australia ABS 1992 p.9 and 1995 p.15. GDP estimates: in Year Book Australia 1998 p.712.
Australian Institute of Health and Welfare	AIHW, Australian Health Expenditure 1970-91 to 1984-85 (1988), Health Expenditure Bulletin Number 11 (1995), Health Expenditure Bulletin Number 13 (1997)
Dr Jenny Badham, Australian Private Hospitals Association	Estimate Age/Sex Semental Health Expenditure: APHA Health Financing Model V2.0 (1998).
Organisation for Economic Co-operation and Development	OECD Health Data 1998