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Population Aging and the Growth of Health Expenditures

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To what extent can rising per capita health expenditures be attributed to the changing age composition of the population? While numerous projections have been made, all have been based on cross-sectional spending differences between individuals at a single point in time, rather than on national expenditures as the age structure of the population changes over time. Cross-sectional and time series analyses of 20 countries in the years 1960–1988 show population aging is associated with higher health expenditures if no other variables are allowed in the equation; this "effect," however, is due to the secondary association of aging with rising per capita income and other omitted trend variables. Once these factors are controlled for, there is no longer any discernible association between age structure and health care costs. Age affects the allocation of spending, but not the total amount of funds available. The increasing burden of health expenditures is largely a policy and cost management problem rather than a demographic one.

THE inexorable rise of per capita health care costs in the United States and other countries has been attributed to many factors, of which the aging of the population is among the most common and apparently well founded. In a recent book, Philip Longman asserts "the first and primary cause of the crisis is once again the aging of the population. Older people, on average, inevitably require much more health care than do the young. . . . And so, as the elderly's share of the population increases, so too will the demand for health care" (Longman, 1987, p. 88). Similar views have been expressed by a number of academic and popular commentators (Bös and von Wiezsäcker, 1989; Cohn, 1990; Freudenheim, 1990; Russel and Manning, 1989; Schneider and Guralnik, 1990; Schulz, 1980; Shanas and Maddox, 1985; Torrey, 1982). The attribution of aging as a primary cause rests upon two observations: (a) that older people consume more health care and (b) that the period of rapid population aging which commenced around 1960 coincides with the period of explosive growth in health care costs. While these associations are both well established, neither necessarily implies that population aging itself causes national health expenditures to rise. Indeed, in counterpoint to the popular chorus of commentators blaming higher health care costs on increases in the number and disability of older persons, there are several researchers who have suggested that aging plays only a minor role (Barer et al., 1989; Ermisch, 1983; Habib, 1985).

Extrapolation from higher health care costs per elderly person to higher national health care costs for a more elderly population suffers from a "fallacy of composition" by assuming that what is true for the individual must also be true for the whole. The association between rapid population aging 1960–1990 and rapid growth of health expenditures fails to control for other factors that were also increasing at the same time. As noted above, concerns about the simplistic equation of aging with higher health expenditures are not original. What is new is the availability of the empirical evidence needed for tests of causality, and the application of cross-sectional and time series analyses which are able to control for confounding factors. Through the coordinated efforts of many governments over 20 years, reliable and comparable international data on health spending, age structure, and numerous other variables of interest have recently been published (OECD, 1990). Analytical methods with both discriminant and predictive validity have been developed and tested on this data set (Getzen, 1990, in press[a]; in press[b]; Getzen and Poullier, 1991). These can provide robust and consistent estimates of the effects of population, as distinct from individual, aging.

Literature Review

While there have not been any previous empirical studies that directly assessed the effect of population aging on national health expenditures, the many related and relevant books and articles can be conveniently grouped into three categories: (a) differences in individual health expenditures by age, (b) general studies of the economic effects of population aging, and (c) general studies of the determinants of national health expenditure.

The relationships between age, health status, and utilization are well known. Difficulties in estimating expenditure differences by age category arise mainly from the fact that payment is divorced from the receipt of care. Care of elderly persons may be paid for by other family members, social welfare organizations, or government as well as the person who receives care. Counts of individual spending obtained through consumer surveys based on the age of the "head of household" are thus apt to be incomplete. An alternative is to use a top-down allocation of the total budgets of health systems (hospitals, physicians, nursing homes, etc.) based on the age of the users. However, counting "number of visits" or "patient days" will be inaccurate to the extent that the intensity of services provided to different age groups is different, and data on patient age are not always obtainable. In practice, a combination of individual surveys and institutional budget allocations is used to arrive at reasonable estimates, so that the measurement errors are not large. The reports by Boulet and Grenier (1978), Fisher (1980), Mizrahi and Mizrahi (1985), and Waldo et al. (1989) are representative examples. The ratio of health spending on elders to the average for all other ages ranges from 2:1 to 5:1 (OECD, 1988). Given the organizational, cultural, and historical differences between nations, it is not surprising that there is substantial variation across countries. Discrepancies in the old : other ages ratio are more affected by disagreement over exactly what services should be included as health care (nursing homes, board and care, lay home visitors, meals?) than in measuring expenditures per se.

The health care consumption of elderly persons has been rising faster than can be accounted for by demographic change alone across all countries. Barer et al. (1989) documented that use of physician services by persons over age 75 in the Canadian province of British Columbia grew twice as rapidly as for younger persons, and that this increased usage was concentrated in the more expensive specialist services. In the United States, the ratio of per capita expenditures by persons age 65 + :others increased from 3.0:1 in 1965 to 3.3:1 in 1970, 3.6:1 in 1977, and 4.2:1 in 1987 (Fisher, 1980; Waldo et al., 1989). These observations suggest that rising health expenditures for elderly persons may be more of a policy and cost management problem than a demographic one.

There have been a number of elaborate and sophisticated studies of population aging on the economy as a whole. However, they have either ignored the health care sector and its special features entirely (Lee, Arthur, and Rodgers, 1988; Parks and Barten, 1973), or have resorted to ad hoc assumptions and extrapolations to such an extent that Espenshade and Braun, in their comprehensive review of the literature, were forced to characterize all such work, including their own, as "based more on reasoned speculation than on empirical evidence" (Espenshade and Braun, 1983, p. 33). Instead of observing the actual correlation between health expenditures and population aging, these models use a method that can be termed "age group projection," which extrapolates from *current individual* differences in spending by age to hypothetical *future aggregate* differences in total expenditures. Per capita expenditures in each age group are multiplied by the weight (fraction of the total population in that age category) to obtain the average for all ages. Next, the weights are changed to reflect the fraction that is projected to be in each category in the future. The original per capita expenditures in each age group are then multiplied by these new weights to obtain the projected average for the future. The difference between the original and projected average is an estimate of age composition effects. For example, suppose 10 percent of the population is now age 65 + with per capita expenditures of $4,000 compared to the other 90 percent of the population with expenditures of $1,000, an aged : others ratio of 4:1. The average per capita expenditure for all ages is:

$$\text{original (10\% age 65+)} = .1 \times \$4{,}000 + .9 \times \$1{,}000 = \$1{,}300$$

The projected effect of a rise in the proportion of elderly persons to 12 percent is:

$$\text{projected (12\% age 65+)} = .12 \times \$4{,}000 + .88 \times \$1{,}000 = \$1{,}360$$

The change in age composition from 10 percent elderly persons to 12 percent elderly persons is projected to raise expenditures from $1,300 to $1,360, an increase of 2.3 percent in spending for each 1 percent rise in the proportion of persons who are elderly.

This method of direct age group projection is familiar to demographers. It is very useful for estimating future mortality because mortality is essentially an individual phenomenon without group interaction effects, that is, excess mortality among 15- to 20-year-olds does not lead to a decline in mortality among 20- to 25-year-olds, or vice versa, and because mortality rates are relatively stable and predictable over time. Spending, however, fluctuates with the level of GNP and is subject to an aggregate budgetary constraint. Excess spending on 15- to 20-year-olds must be offset by lower spending on other age groups or a rise in taxes (Davis, 1986; Ermisch, 1983). The estimated effect on total spending due to changes in age composition is misleadingly large unless some form of budget constraint is included in the model. This difficulty is mitigated to some extent by the fact that pure aging effects are usually small relative to other influences on the cost of health care (Habib, 1985; Schwartz, 1987). However, that relative smallness also means that such demographic models capture little of the variation in spending. Denton and Spencer (1975) use a direct age group projection method, including the caveat that all their health spending projections assume "constant quality" (p. 334), by which they mean constant real expenditures. Musgrove (1982), in making projections for the United States through the year 2025, modifies the direct projection methodology by tying the level of per capita spending to a function of GNP which increases at a decreasing rate over time. The OECD (1988) methodology developed by Maguire abstracts from income effects by assuming that per capita real benefits remain constant at 1980 levels. Other examples of age group projection methods are found in Ogawa (1982), Russel (1981), Schneider and Guralnik (1990), Schwartz (1987), and Torrey (1982). The studies that estimate demographic effects alone tend to characterize aging as having a major impact, whereas those that consider a wide range of factors usually consider GNP growth and financial organization to be more important, with pure age effects relatively small by comparison, accounting for only 0.3 percent per year (Schwartz, 1987), 0.4 percent a year in Canada (Barer et al., 1989), or 2–10 percent of total cost increases 1975–2025 (Musgrove, 1982).

All of these studies are "what if" projections of hypothetical demographic effects based solely on individual spending differentials by age group. They do not empirically evaluate the effect of *population* aging. Bös and von Wiezsäcker (1989) have argued that each individual's or group's behavior should be analyzed separately and then aggregated, yet the budget constraint is binding only for society as a whole, not the individual. A macroeconomic perspective, which acknowledges the nation as a social and political entity with established boundaries and budgets subject to revenue constraints, is necessary for analysis of the real world.

The accuracy of hypothetical projection methods can be checked by "backcasting," evaluating the explanatory power of the model when fit to historical data. The first empirical analysis of national health expenditures which explicitly addressed age effects was the study by Kleiman (1974) of 16 countries for the year 1969 (in some cases, 1967 or 1968). He found that the percentage of the population age 60+ was correlated with per capita health expenditures before controlling for income effects, but that once income effects were included, the correlation dropped to a negligible level. Leu (1986), in a study of 19 mostly different countries for the year 1974, found no significant effects for percentage of population over age 60 (or 65 or 75) with income included in the regressions. Maxwell (1981) performed a more intensive study of 10 countries, again finding no discernible effects of population age on total health spending per capita. A deficiency of all of these studies is that they are cross-sectional, looking across countries with different age structures at a single point in time. They do not provide direct evidence of the effects of population *aging* over time, which is the question of interest to policy makers. Furthermore, basing the estimates solely on international comparisons between countries confounds age effects with residual errors due to difficulties in correcting for exchange rates and inflation, varying definitions of the health sector, and differing systems of financial organization and reporting. In order to address these econometric problems, Getzen (1990; in press[a]; in press[b]) developed a dynamic model which is able to reconcile both cross-sectional and time series results. He showed that expenditures were a distributed lag function of both current and previous GNP growth. The results reported here are an extension of that analysis to include demographic effects.

Methods

Only data on national health expenditures can be used to directly and empirically examine the effect of population, as opposed to individual, aging. The OECD health data file includes health expenditures, age structure, and other variables for 24 countries for the years 1960–1988. As it has been extensively described elsewhere (OECD, 1985; 1990) and used in many international comparative studies, the exposition here may be brief. To obtain real per capita health expenditures, total national health expenditures in domestic currency are divided by population, then by the domestic GNP deflator and most recent purchasing power parity exchange rate, so that all figures are expressed in constant 1990 United States dollars (1990 $US). Age structure is measured by the percentage of the population age 65 or over. Tests were repeated for other definitions (age 70+, 75+), but the results were essentially unchanged and hence are not reported here. Although age structure is reported for every year, giving a possible total of 29 observations from 1960 to 1988, many of these are not independent measurements but extrapolations. Only the decennial and most current years (1960, 1970, 1980, 1988), four observations per country, are used in this analysis. Even if one could rely on the single year age measurements, there is so little variation in the rate of aging from year to year that there would be little gain in statistical power if 29 observations were used instead of four. Twenty countries are included in this analysis (Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom, and the United States). Four OECD countries were excluded due to incompleteness or other data problems (Ireland, Luxembourg, Portugal, and Turkey). In addition, the initial (1960) observations were excluded for Spain and Switzerland due to inconsistencies in reporting. Thus, the analysis is based on a total of 78 observations for 20 countries covering 29 years, 1960–1988. Per capita health expenditures and income are expressed in log values, so that the difference between years provides an approximation of the percentage rate of change.

Cross-sectional analyses of observations for the year 1960, and (separately) for the year 1988, are performed for comparison with the results reported in earlier studies. A pooled cross-section, which includes all countries in all years (1960, 1970, 1980, 1988), is used to discriminate between the effects of aging and other unspecified trend variables.

Time series analysis provides a better test of the longitudinal effects of aging. The rate of change in health spending for each decade is regressed on growth rates in GNP, and a pure trend variable (year of observation). Because it has been demonstrated that health is a distributed lag function of GNP, economic growth in the previous decade is also tested for inclusion. Previous analyses (Getzen, in press[b]; Maxwell, 1981) have shown that many other variables which might be included (percentage of public financing, hospital and physician supply, mortality and morbidity rates, centralization, system organization and insurance) do not significantly affect expenditure levels and can reasonably be omitted from the specification. More extensive discussion of model specification and testing is found in Getzen (1990; in press[a]; in press[b]).

If population aging does, in fact, increase health expenditures, then *after controlling for other factors* spending should be higher in those countries with older populations, and should have grown faster in those countries that have aged most rapidly during the last three decades. As can be seen from Figure 1, there are considerable differences between countries to be utilized in both cross-section and time-series. Sweden, with 17.7 percent of its population age 65 or above in 1988, has a far older population than did Japan in 1960 with only 5.7 percent. On the other hand, Japan's rate of increase in aged persons, to 11.4 percent in 1988, was much more rapid than occurred in France, which rose by less than half as much over the same period (from 11.6% to 13.8%).

How large would the aging effect be if spending at each specific age remained constant as assumed in the age group projection method? Consider a simplified equation with only two groups, over 65 and under 65. Denoting the ratio of older:other spending by "r" and the percentage of the population over 65 by "p," a 1 percent increase in "p" will result in approximately a $[(r-1) \div (100 + p[r-1])]$ increase in health expenditures. For the United States, with a ratio of

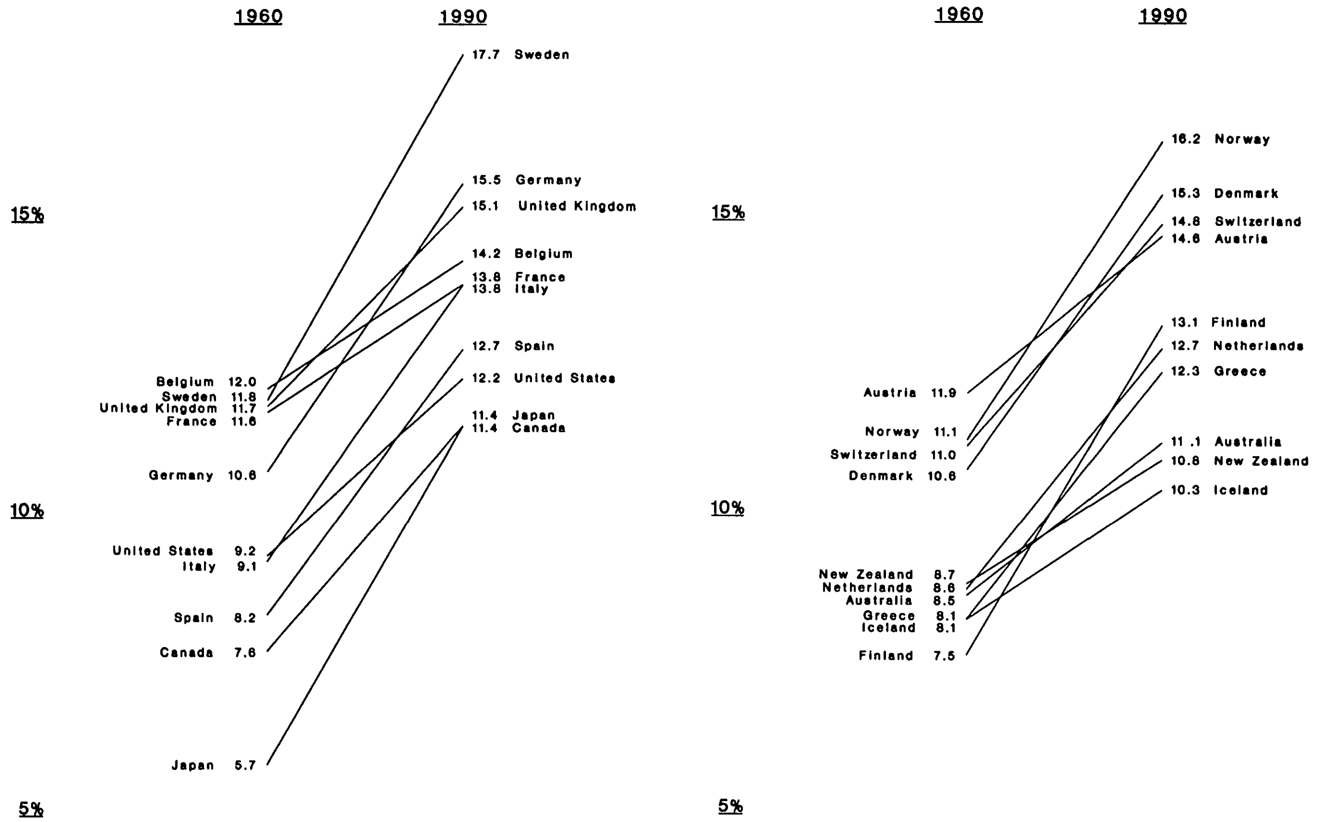


Figure 1. Percentage of population aged 65 + in 1960 and 1990 for 20 countries. Slope of the line joining the two years indicates the rate of growth in the percentage of population age 65 + . Sources: OECD (1990) and OECD Health Data Files.

4:1 (near the OECD average) and 10 percent of the population age 65 + , a 1 percent increase should result in a 3 ÷ 130 = 2.3 percent increase in per capita health expenditures. Projected growth in expenditures due to changing age composition from 1960 to 1988 ranges from 4.5 percent (Belgium, France) to 14 percent (Japan, Finland). The expected maximum cross-sectional difference in levels due to age composition in 1960 (Japan vs Belgium) is a bit larger, about 15 percent, with roughly the same span in 1988 (Australia vs Sweden).

Results

The cross-sectional association between age (percentage of population aged 65 +) and per capita health expenditures is large but not significant when it is the only variable in the regression. For 1960, the regression coefficient across 18 countries is 7.5 (t = 1.2, $p > .10$) (Equation 1, Table 1). Income is highly significant, and when it is included in the regression, the coefficient for age, −0.3, is negative and negligibly different from zero (Equation 2, Table 1). A similar pattern is observed for the 1988 cross-sectional analysis (Equations 3 and 4, Table 1). If observations for all four years are pooled, the age coefficient is large (13.9) and highly significant (t = 5.4) when entered alone, becomes smaller (1.5) and marginally significant when income is entered, and becomes smaller still (0.4) when both income and a trend variable (year of observation) are entered (Equations 5, 6, and 7, Table 1). This suggests that the remaining association between spending and aging over time, after controlling for income effects, is largely due to indirect association through omitted variables that are also trending upward during this period.

Regression analysis of rates of growth in health expenditures over the full span 1960–1988 yields a large age coefficient, 11.8, which is marginally significant ($p < .07$) when age is used as the sole explanatory variable. With income included, the equation has a much greater explanatory power, $\bar{R}^2$ = .875, and the age coefficient is negative (Equations 1 and 2, Table 2). Separating the series into decennial (e.g, 1960–70, 1970–80, 1980–88) observations indicates that there is a secular trend in addition to the current and lagged income effects, but no age effect (Equations 3, 4, and 5, Table 2). The age coefficient is −0.1, essentially zero. A time series analysis of annual data used to forecast individual country health spending (Getzen, in press [a]) reveals a complex distributed lag income effect that falls, rises, and then tapers off over time, but evidences the same lack of association between age composition and spending once income effects are controlled for in this more detailed specification. The findings are consistent with the hypothesis

Table 1. Cross-Section Analyses of National Health Expenditures

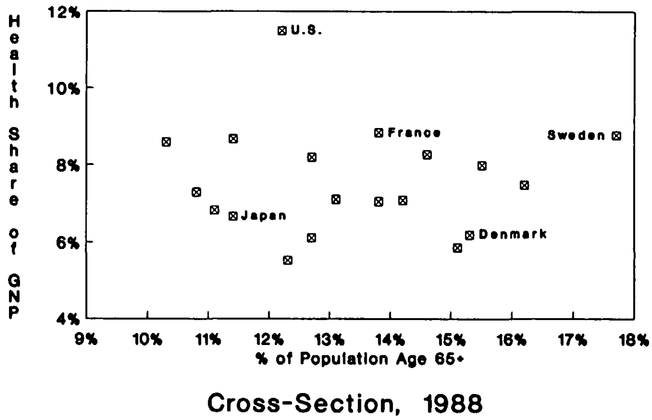
	% Age 65+	Income	Year	$\bar{R}^2$
	1960 Cross-Section (n = 18)			
Eq. 1:	7.5 (1.2)			.025
Eq. 2:	−.3 (0.1)	1.4 (13.5)		.921
	1988 Cross-Section (n = 20)			
Eq. 3:	1.6 (0.4)			.000
Eq. 4:	−.4 (0.2)	1.5 (11.3)		.870
	Pooled (1960,1970,1980,1988; n = 78)			
Eq. 5:	13.9 (5.4)			.265
Eq. 6:	1.5 (2.0)	1.6 (33.7)		.954
Eq. 7:	0.4 (0.5)	1.5 (25.2)	.009 (3.9)	.961

Note. Seven regressions on real per capita health expenditures in 1990 $US across 20 countries (18 for 1960). First, percent of population aged 65+ is used as the sole explanatory variable. The next equation in each set includes per capita GNP as well, with the final equation with the pooled data also including year of observation. (t-values) in parentheses. Source: *Health Care in Transition* (OECD, 1990).

Table 2. Rates of Change in National Health Expenditures

	Aging (%pop 65+)	Income (per cap GNP)	Lag Income (prior decade)	Year	$\bar{R}^2$
	Growth 1960–1988 (n = 20)				
Eq. 1:	11.8 (1.8)				.107
Eq. 2:	−1.1 (0.4)	1.3 (10.5)			.875
	Growth 1960–70, 1970–80, 1980–88 (n = 58)				
Eq. 3:	10.3 (2.8)				.111
Eq. 4:	1.4 (.6)	1.4 (11.0)			.717
Eq. 5:	−0.1 (.06)	.90 (6.6)	.30 (2.8)	−.013 (4.7)	.803

Note. Five regressions on the rate of growth in real per capita health expenditures. (t-values) in parentheses. Source: *Health Care in Transition* (OECD, 1990).



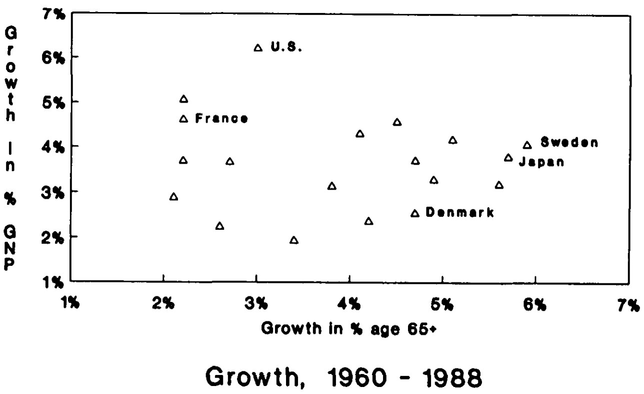


Figure 2. *(top panel)* Health expenditures as a share of GDP and percentage of population age 65+ for 19 OECD countries for the year 1988. *(bottom panel)* Increase in health expenditures as a share of GDP and increase in percentage of population age 65+ for 19 OECD countries over the years 1960 to 1988. Sources: OECD (1990) and OECD Health Data Files.

that need, as proxied by changing age, affects the allocation of expenditures, but does not substantially increase the total amount of funds available for health care.

The income elasticity of health expenditures is near unity (expenditures rising proportionately with incomes), and therefore income effects are to some extent controlled for if expenditures are measured by the share of GNP spent on health. Figure 2 graphically illustrates the lack of correlation between aging and health care costs. The top panel shows that countries with older populations in 1988 are neither more nor less likely to have higher expenditures. The bottom panel shows that in those countries where the fraction of the population over age 65 has grown most rapidly, spending has not increased any more rapidly than in countries where the elderly population has grown most slowly. Comparisons between countries reinforce this negative result. Denmark has a population that is already more elderly than the U.S. will be 25 years from now, in 2017. It has a broadly supportive care network, including many services for elders, yet spends half as much per capita as the U.S., and has actually reduced the health share of GNP over the last decade. The cost outlier in both graphs (11% of GNP, 6% growth) is the United States, yet, with only 12 percent of the population age 65+ and a rise of only 3 percent since 1960, it is below the OECD average in both level and rate of aging.

The decline in the age coefficient as the model becomes more fully specified demonstrates why any simple correlation between aging and health expenditures which does not control for income effects and trend must be discarded as evidence of a causal association. While no data can refute the hypothesis that a correlation does exist, the results do suggest some upper limits on the magnitude of any undetected population effects. The 3 percent increase in spending for each 1 percent increase in the fraction of the population aged 65+ implied by the age group projection method is ruled out. Simulations were run assigning one country's aging pattern to another country and simulating hypothetical age composition effects of varying magnitude. Old : other spending ratios of 2 : 1 or greater were readily apparent in the simulation coefficients, whereas anything below 1.5 : 1 tended to disappear into the residual noise in the data. Hence, it is possible that there is some modest effect, perhaps a .25–.50 percent increase in expenditures for each 1 percent increase in population over age 65. However, an effect of this size would not be discernible in this data set, or in any other data now available. In sum, while it is possible that population aging may increase total national health expenditures, no corroborating evidence for such an effect currently exists, and, if found in subsequent studies, its magnitude is apt to be significantly smaller than has customarily been assumed.

Discussion

The means by which aging will act to increase health expenditures seem so common and compelling that the lack of confirmation appears troubling at first. It is helpful to put the results in perspective. During the period 1960 to 1988, average per capita income among OECD countries increased by 230 percent, and health expenditures increased by 460 percent. Inflation and rising GNP far outweigh all other causes as explanations of rising health expenditure. Within this context of rapid economic growth, a 5–15 percent increase attributable to population aging is easily obscured. There has been an error in emphasis; the dominant macroeconomic effects have not been sufficiently analyzed, whereas the lesser effects of demographic change have been highlighted. Fixed demographic effects are implausible. If the population ages and there is no increase in GNP, governments cannot significantly raise health spending. Aging will increase the demand for health care, but adjustment to budgetary realities will limit that increase so the *structural*, or aggregate, effect of one person becoming older is not 200 percent or 500 percent of average per capita spending, as is assumed in age group projection models, but more on the order of 5–50 percent. Such an impact is too small to be reliably discerned with the available data.

Why this fixation on aging, which is not a major cause of higher expenditures, and is also not amenable to policy influence, when there are so many relevant dimensions to explore? Robert Evans (1985) suggests that it provides an "illusion of necessity." If rising health care costs are due to aging and other external forces, then they are not "my" responsibility, nor can they be blamed on doctors, hospitals, insurance companies, governments, or indeed any of the institutions which should, in fact, be held responsible. By making it seem as if cost increases are inevitable, attention is diverted from the real and difficult choices that must be made, and the institutions which make them. While a reluctance to face reality may be endemic, it also indirectly benefits some professional and political groups by supplying increasing amounts of money to certain types of care without adequate oversight, evaluation, or search for alternatives.

A clear and robust negative empirical result, that aging is *not* a significant cause of rising health care costs, may help to lessen the frequent and misleading blaming of elderly persons. It may also strengthen the recognition that spending is a result of political and professional choices, rather than the outcome of objective trends in demography, morbidity, technology, or other relentless forces beyond our control. In order to effectively restrain health care costs, we must first halt the search for someone else to blame—the poor, the old, the disabled, the drug abuser, the bureaucrat — and recognize that "the problem is us" and the system we have constructed.

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