Health Expenditures and the Elderly: A Survey of Issues in Forecasting, Methods Used, and Relevance for Developing Countries[1]

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Abstract

Over the course of the next fifty years, the share of the elderly (defined as those aged 65 years and above) is expected to climb from 6.9 percent in of the total population to 15.6 percent. The share of the elderly is expected to grow rapidly in the less developed countries of the world, rising from only about 5.1 percent of population in 2000 to 14.0 percent in 2050 as per projections of the United Nations. The rapidly increasing numbers of the elderly will have a number of significant economic consequences worldwide.

The purpose of this paper is to review the known links between ageing and health spending, and methods currently used to project the future health spending impacts of an ageing population. The existing literature, most of it relating to developed countries, suggests a relatively small effect of increases in the proportion of population that is elderly on health spending linked to acute care. Increasing life spans, while leading to ageing and increasing expenditures on the one hand, also lead to reductions in health spending on acute care account of reduced mortality at all ages, and may also be accompanied by declines in disability that also lead to lower acute health spending. However, factors that do appear to significantly impact on health spending are changes in the technology of care, incomes and the spread insurance. In the case of long-term care, the structure of the family, and changes in it over time, and public policy related to care also become relevant. The paper also reviewed approaches that use the linkages highlighted above to project health care spending. The methods range from the so-called "actuarial" methods and their more sophisticated variants, micro-simulation models, and econometric approaches to forecasting.

The survey yields four main conclusions that emerge for health expenditure forecasting for developing countries. First, existing methods call for a fairly large set of baseline information relating to population size and age-structure, health spending, disability and mortality patterns, and use patterns of care. Second, forecasting utilization patterns among the elderly will be a key in developing countries, given that many of the elderly, especially among the poor, will not be able to afford care outside the public sector and that social structures of support will rapidly change in the future. Third, the effects of HIV/AIDS on health spending of the elderly will have to be explicitly accounted for in forecasting exercises in the worst affected countries. Finally, technology change in developing countries would need to be carefully accounted for, given the potential rapid cross-border spread of information and potential of trade in health services and

I. Introduction

The world population is ageing. Over the course of the next fifty years, the share of the elderly (defined as those aged 65 years and above) is expected to climb from 6.9 percent in of the total population to 15.6 percent (United Nations (UN) 2001).[2] In countries that are considered "more developed" as per the UN definition, this share is expected to climb from 14.3 percent to 26.8 percent over the same period. The share of the elderly is expected to grow even more rapidly in the less developed countries of the world, rising from only about 5.1 percent of population in 2000 to 14.0 percent in 2050 as per projections of the United Nations.

The primary reason for the increase in the proportions of the elderly is the combination of ageing of the "baby-boom" generation that emerged from a demographic transition characterized by a decline in mortality rates (and subsequent declines in fertility rates) and increased survival rates at higher ages. Mortality rates have been continuously declining, so that life expectancy at birth in less developed countries increased from 41 years in the early 1950s to 62 years in the early 1990s. Even this is forecast to increase to 75 years by the year 2050 (United Nations 2001, p.10). One consequence of these trends is that we can expect a growing proportion of the "oldest-old" (85 years and above) in less developed country populations as well.[3]

The rapidly increasing numbers of the elderly will likely have a number of significant economic consequences worldwide. These include the possibility of overwhelming social security funds based on pay-as-you-go system, as is the case in many OECD countries and, in the case of developing countries, an expansion of the unmet financial needs of the elderly (Alam 1998; Antolin and Suyker 2001; Antolin, Oxley and Suyker 2001; Bloom, Nandakumar and Bhawalkar 2001; Lloyd-Sherlock 2000, Mason, Lee and Russo 2001 and references cited therein). The rising numbers of retirees and dependents

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[2]Medium variant projections made by the United Nations (UN 2001).
[3]Expected to increase from 0.10 percent of the total population in 2000 to 0.34 percent of the total population by the year 2050 (calculations based on medium-variant projections in United Nations 2001).

related to ageing could also result in a negative "demographic dividend" with adverse consequences for economic growth (Bloom and Williamson 1998).

There is also concern that an ageing population would have large effects on health expenditures, both public and private, with obvious consequences for public budgets and private expenditures, the subject of this paper (for example, Fuchs 1998a). While much work has been done on estimating and projecting ageing-related health expenditures and exploring their underlying factors in developed countries, little is known on this topic for developing countries. If we start with the reasonable premise that effective policymaking for the elderly requires that future implications of ageing for health systems be accurately assessed, the need for good information on the links between ageing and health expenditures as well as projection methods that can be used to highlight the future health spending impacts of an ageing population in developing countries, becomes obvious.

The purpose of this paper is to review what is known about the links between ageing and health spending, and methods to project the future health spending impacts of an ageing population. Most of the literature that we discuss in this paper relates to developed countries, particularly the United States, mainly because that is where the bulk of the existing literature focuses.[4] We believe, however, that an analysis of this literature can contribute effectively to the creation of policy-relevant information in developing countries in two important ways. First, by highlighting key factors in the growth of health spending related to the elderly, it would help, in the short-run, to better guide planners to relevant "knobs" of the health system that can influence such spending, even in the absence of fully accurate data. Second, it would contribute by identifying the data and methods that are needed for effective estimation of health expenditures linked to the elderly and for their reasonably accurate projection into the future.

The remainder of the paper is divided into three sections. Section II focuses on the links between health spending and ageing. Section III examines different projection methods that have been used to assess the future health expenditure implications of ageing in

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[4]We do examine information from developing countries, whenever available.

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different countries. Section IV discusses the implications of existing work for information collection and methods for estimating and forecasting health expenditures linked to a growing elderly population in developing countries.

II. Linking Health Spending to Ageing: What do we know?

Perhaps the simplest approach is to begin by positing the following identity:

$$(1) \qquad H(t) \qquad = \qquad \Sigma_a e_a(t) N_a(t)$$

Here $H(t)$ is total health spending in year 't', $e_a(t)$ is the average per-person health spending in age-group 'a' in year 't', and $N_a(t)$ is the total number of individuals in age-category 'a' in year 't'. In principle, $H(t)$ can refer to public spending, or private spending, or a total of both. $\Sigma_a N_a(t)$ ($\equiv N(t)$) refers to total population.

We can also write,

$$(1') \qquad H(t) \qquad = \qquad N(t) \Sigma_a e_a(t) n_a(t)$$

Where $n_a(t)$ is the share of age-group 'a' in the total population in year 't'.

From (1′), we have that age is linked to aggregate health spending in three ways at any given point in time, together with any interaction effects:

   a. Per-person health spending differences across age-groups;
   b. The proportion of each age-group in total population;
   c. A scaling factor equal to the total population.

Thus, an increase in the proportion of the elderly, everything else the same, will increase the total amount of health spending attributable to them. Whether the increased share of elderly in the population also increases aggregate per capita health spending, however,

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depends on whether per-person health care expenditures are higher among the elderly, than among the non-elderly. Finally, multiplying by the scaling variable N(t) provides an estimate of the total health spending attributable to a particular group in the population.

Over time, the share of aggregate health spending accounted for by the elderly can vary depending on their share of the population and whether health spending per person is changing differentially across various age groups. Thus, if per-person health expenses of the elderly rise faster than those of the non-elderly, the share of the elderly in total health spending will also increase.

A. Age-specific differences in health spending per capita

Several studies indicate that per person expenses are greater among the elderly than the non-elderly. This is certainly the case in the United States (for example, Waldo et. al. 1989; Cutler and Meara 1997; Fuchs 1998a). It is also true for seven other OECD countries for which data are available, and one study indicates that in the mid-1990s the ratio of per-capita spending in the population 65 aged years and above to per capita spending in population of less than 65 years, ranged from 2.7 to 4.8 in these countries (Anderson and Hussey 2000). A recent study in Sri Lanka also suggests that more is spent on the elderly on a per capita basis, with a ratio of 2.9 (Rannan-Eiya 1999). Similar findings for hospital care in Uruguay in the early 1990s are reported in Micklin *et al.* (1993) and for both inpatient and outpatient care in India during 1995-6 (Mahal et al. 2002).

A second set of findings has to do with differences in per person health expenditures by age group, among *subsets* of the elderly. Thus, Fuchs (1998b) estimated that per capita personal health expenditures among the oldest-old (85 years and above) were three times those of in the age-group 65-74 years, and twice those in the age-group 75-84 years in the United States (similar findings are reported by Cutler and Meara (1999)). Zweifel, Felder and Meiers (1999) indicate rising payouts in a sample of elderly members of a sick fund in Switzerland, with a 90-year old member costing twice as much to the sick fund as a

65-year old. In India, individuals aged 65 and years had per capita health expenditures that were nearly 1.5 times the per capita expenditures among groups aged between 60 and 64 years (Mahal et al. 2002).

There is also evidence that health care expenditure, per capita, for the elderly may be increasing at a rate faster than for the non-elderly. For instance, the ratio of the per capita expenditures of the elderly to the non-elderly in the United States was 3.0 in 1987 (Fuchs 1998a) climbing to 3.9 in the mid-1990s (Anderson and Hussey 2000). Cutler and Meara (1997) found that over the period 1953-87, annual growth of per-person spending on the elderly was about 8 percent, significantly higher than the estimated 4.7 percent annual rate of growth for those aged 1-64 years (see also Cutler and Meara (1999) for differential rates of growth of Medicare spending per person among the *old-old* and the *young* elderly).

In sum, available evidence from developed countries and a limited set of developing countries indicates not only that health expenditures per person are increasing in age, but also that the rates of increase in per capita health spending are greatest for the older groups.

B. Changes in Age Distribution and changes in Health Spending per capita

The number and proportion of elderly in a population have obvious implications for total amounts of health spending on the elderly, as well as their share in total health spending. The literature suggests, however, that increases in the proportion of the elderly, by themselves, have a relatively small role to play in influencing *changes* in health expenditures per capita.

Newhouse (1992) assessed the relative importance of ageing in the increase in health expenditures per capita during the period from 1940 to 1990 in the United States. He found that that ageing, in the sense of an increasing proportion of population in the 65-plus age group, holding constant age-specific health expenditures, explained only 2

percent of the increase in per capita health spending during this period, a result confirmed by Cutler (1995). Both Newhouse and Cutler used Paasche's index number calculations in their analyses, holding constant the final year weights (age-specific per person health expenditures) while varying the age-distribution of the population (for example, Newhouse 1992, p.6). Used similar methods, Fuchs (1998a) also found an extremely small age-distribution effect in increases in per-person health care spending by the elderly in the United States during the period from 1975 to 1995.[5]

These results have faced the objection that a changing age distribution in favor of the elderly arising from increased survival probabilities is likely to be accompanied by (or cause) changes in the per-person health spending among the elderly. This could occur if increased longevity makes possible the introduction of more aggressive (and expensive) medical procedures on the elderly (Fuchs 1990). On the other hand, it is entirely possible that lower mortality rates at each age that both define and accompany the process of ageing might reduce age-specific per-person spending (see below for additional details). Econometric analyses of health spending per capita and its determinants can be quite useful in assessing the importance of these links and other possible "indirect" influences of ageing, defined in the sense of a changing age-distribution, on health spending. One key source of information in this regard is the large number of panel data analyses linking aggregate health expenditures, per capita income, indicators of ageing, and other relevant variables available from the OECD (Organization for Economic Cooperation and Development) database. Most examine cross-country differences in the *level* of health spending per capita (Getzen 1992, O'Connell 1996, Roberts 1999). At least one study also examines cross-country differences in the *growth rates* in health spending per capita (Barros 1998).

The primary finding from the econometric literature cited above is that the proportion of people aged 65 years and above in total population, the main indicator of "ageing" used in these studies, does not have a statistically significant role in explaining either cross-

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[5]Micklin et al. (1993) also report a small "pure" ageing effect on the projected costs of hospital care in one Uruguay health care organization.

country differences in the level of per capita health spending, or on its rate of growth. The one exception to these findings is the econometric work of O'Connell (1996) who allowed for country-specific ageing effects and found ageing to have a statistically significant and positive effect on health expenditures per capita in several of the OECD countries – with the United States and Canada having the largest effects.

C. Per-person health spending, age and health status

How can one reconcile the idea that ageing as measured by the proportion of population aged 65 and above, has a "small" but *positive* effect on per-person health expenditures in the index-number type calculations of Newhouse and Cutler with the predominant finding of statistical insignificance of the coefficient on the "proportion of elderly" variable in econometric analyses? An obvious explanation is that although there are several influences of ageing on health expenditures per capita, these tend to cancel each other out. That is, if only the proportion of the elderly in the population increased, and nothing else, the outcome would be increased per capita health spending (albeit small), but if accompanied by other influences on health or medical practices that lowered spending, the net statistical effect would be zero. Another is a possible two-way relationship between health expenditures and ageing, so that econometric analyses that do not fully account for this possibility would yield inconsistent estimates tending towards zero.[6]

One way to think more carefully about these issues is to reformulate (1′) as (due to Cutler and Sheiner 1998)

$$(2) \qquad H(t) \qquad = \qquad N(t). \Sigma_a e^*_a(t) h_a(t) n_a(t)$$

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[6]Increased health spending may cause an improvement in health status, as also improved health status may reduce health spending.

Here $e^*_a(t)$ is the average per-person health spending in age-group 'a' in year 't' conditional on health status, and $n_a(t)$ is the proportion of total population in age-category 'a' in year 't' and $h_a(t)$ is the average health status of age group 'a' at time 't'.

Reductions in Mortality

It is worth taking a step back and noting that the changing age-distribution in favor of the elderly reflects two influences – increased life expectancy at older ages and an ageing of the baby-boom generation, itself the consequence of a bulge in the population resulting from declining infant mortality, followed by a trailing edge of declining fertility rates. It can be, and has been, argued that lowered age-specific mortality rates among the elderly associated with longer life spans could act to reduce age-specific per-person health spending due to the widespread finding, thus far in developed countries, that the bulk of the *acute* health care costs of the elderly are concentrated in the immediate years (and months) before death. In (2) this would suggest interpreting $h_a(t)$ as indicating "proximity to mortality," and $e_a(t)$ as age-specific per person expenditures that are increasing in proximity to mortality. Developed countries for which the finding of high expenditures in the period immediately prior to death has been reported include the United States, Canada, Sweden, the United Kingdom, Netherlands and Switzerland (Emanuel and Emanuel 1994; Fisher 1980; Garber, MaCurdy and McClellan 1997; Lubitz and Riley 1993; Meerding *et al.* 1998 and references cited therein; O'Neill *et al.* 2000; Scitovsky 1988, 1994 and references cited therein; Zweifel, Felder and Meiers 1999). Some of the studies that we cite focus narrowly on payments made by one type of payer (Medicare in the United States, or specific insurers in other countries), whereas others focus on *all* sources of payment for acute care – but the difference in emphasis does little to change the basic conclusion noted above. Data for India suggests similar findings among developing countries as well (Mahal et al. 2002). These studies also find that per-person expenditures on acute care, both inpatient and outpatient in the year before death, decline with age at death.[7] For both these reasons, and apart from the usual

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[7] One specific type of long-term care, in hospices, is likely to be particularly closely associated with proximity to death.

suspicion on "measurement errors" in econometric specifications, there are ageing related influences on average health, declining mortality in this case, that influence per-person acute care health expenses on the elderly in a *downward* direction.

Confounding the effects of the previous paragraph is the further observation that declines in mortality among the elderly achieved in recent decades in the United States are at least partially due to better treatment methods and medical advancements generally (see, for instance, Cutler and Meara 2001). Even if health expenditures that prolong life substantially are much cheaper, say in the form of primary and secondary prevention programs, than those incurred just prior to death, there is still the two-way relation between health expenditures and longevity to contend with. Thus, empirical analyses of the relationship between ageing and aggregate health expenditures would require taking into account the contribution of health expenditures to the process of ageing itself.[8] Most econometric analyses tend not do so (for an exception, see Cutler and Sheiner 1998).

Declines in Disability

Even with declining age-specific mortality among the elderly, and ignoring for the moment the effect of medical spending on mortality, the process of ageing could lead to increased health spending per person if survivors at each age are increasingly "unhealthy" or disabled, and need more health care and support services as a result. In fact, a major reason for greater health expenses on the elderly in the year prior to death appears to be the greater disability rates that they experience (Cutler and Sheiner 1998). There is a second important element of the cost of care associated with the elderly that is worth noting – long-term care expenditures associated with survivors. Such expenditures typically encompass amounts spent on care received at nursing homes, hospices, and any formal care at home, as also "private" expenses related to informal care received from family members and friends. Expenses on long-term care tend to increase sharply with age. For instance, Meerding *et al.* (1998) found that in Netherlands, per-person

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[8]The existence of a two-way relationship between ageing and health expenditures suggests the need for being careful in econometric analyses of the relationship between the two – in general, the direction of the bias is unclear.

expenditures on long-term care increased "exponentially" with age among the elderly. Scitovsky (1994) reports a similar finding, using data from the United States.

A key explanatory factor for differences in age-specific magnitudes of per-person long-term care expenditures, however, is disability. Disability has been used to refer to a range of conditions – inability to perform "major tasks", activities of daily living (ADL), instrumental activities of daily living (IADL), and mental ill-health.[9] As in the case of mortality rates, the proportion of people living with disability is increasing in age in a population at any given point in time. Cutler and Sheiner (1998) show this for United States for different age-groups in the population aged 65 years and above – whether measured in terms of average numbers of "restricted activity" days or the average number of days bed-ridden, or the proportion of the group reporting some activity limitation. Available empirical evidence also shows a strong association between disability and long-term health care expenditures, and ADL limitations are found to be a strong predictor of admissions to nursing homes and formal home care among elderly survivors (Cutler and Sheiner 1998; Wiener *et al.* 1990).

The effect of longevity on long-term care health expenditures is likely to be transmitted through two mechanisms -- additions to increases in the proportion of people who are more likely to be disabled (that is, the elderly); and any effects via morbidity "compression," or "expansion". The latter effect focuses on the issue of whether increases in number of years lived are *purchased* by increased years lived in disability. Certainly, there is some evidence that disability rates have been falling over time in the United States, Canada, France and Japan, and especially among men (Cutler and Sheiner 1998, Jacobzone *et al.* 1998, Jacobzone 2000, Manton, Corder and Stallard 1997, Suzman 2001). Other international evidence – in the United Kingdom and the Netherlands – is more mixed, suggesting slight declines, or even increases in disability rates among some of the elderly. In developing countries, the trend appears to be towards increasing disability rates, particularly among women (Bloom, Nandakumar and Bhawalkar 2000).

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[9]For definitions and comparability issues, see Gudex and Lafortune (2000).

The main argument linking declining disability with increased longevity is the source of longevity – prevention, primary or secondary, rather than better treatment – such as regular exercise and behavioral changes, as well as better post-operative care in the context of cardiovascular disease (Cutler and Sheiner 1998). If so, an indicator such as the proportion of the elderly in cross-country econometric specifications will capture two effects -- increases in expenditures due to an increased proportion of the group that is more likely to be disabled; as well as factors that ameliorate increases in health expenditures, because longevity and reduced disability rates may have a common determinant. As in the case of reduced mortality, the relationship would be further confounded if reductions in mortality and disability themselves stem from increased health expenditures.

The above relationship between health expenditures and its major determinants is likely to be affected, in addition, by a variety of factors that influence the type of care (both long-term and acute) consumed by the elderly, and consequently the amounts spent on their care. These factors that will be discussed further below, include the nature of living arrangements in societies, the economic conditions of the elderly, public policies relating to the care of the elderly, and technological change in medical care. Some, such as living arrangements and changes in public policy towards care for the aged, are likely to be strongly influenced by the general process of ageing. Others, such as technological change may be influenced by ageing as well, further emphasizing the complex link between ageing and health expenditures.

D. Social Arrangements and Long-Term Health Expenditures on the Elderly

Not surprisingly, expenses on care for the elderly (especially long-term care) are likely to depend on the type of care consumed – formal institution based long-term care at nursing homes and hospices, formal home-based care, or informal support from family members and friends. The latter two are often thought of as complementary, but some studies also seem to suggest an element of substitutability between formal home-based care and informal care from children, spouses or relatives (van Houtven and Norton 2001;

Lakdawalla and Philipson 1999 and references cited therein). In general, informal home-based care is the least costly in terms of expenditures incurred, with institution-based care being the most expensive. Informal home-based care turns out to be less expensive also because in some traditional societies the degree of care, whether acute or long-term, received depends directly on the economic contribution of the elderly, and that may be small. Kochar (1999) highlights this last point, using data from Pakistan. Again, in the case of acute care, hospital-based treatment is obviously more expensive than ambulatory care.

The literature analyzes a number of factors that can potentially influence the use of institution-based long-term care, instead of informal care. The first is obviously the degree of disability that a person experiences, as discussed in the previous section (Cutler and Sheiner 1998, Jacobzone *et al.* 1998, Lakdawalla and Philipson 1999). However, controlling for the severity of disability, other factors also matter. The use of formal institutional care may be delayed, or reduced, if there are adult children who live near their elderly parents or, are in co-residence with them (Cutler and Sheiner 1998; Lakdawalla and Philipson 1999; van Houtven and Norton 2001). Similarly, married elderly individuals are less likely to be found in institutional care settings than single elderly individuals (Cutler and Sheiner 1998). Understanding the factors that influence these variables is obviously important for assessing or predicting the use-pattern of long-term care services.

There is a vast literature that addresses the dynamics of family organization and its association with inter-generational living under a common roof, family support networks, the proportion of elderly likely to be living alone, cohabiting with a spouse, or living with children. One major finding of this literature is that the proportion of elderly living alone, or not cohabiting with children, has been rising over time, all over the world. Another is that the proportion of elderly not living with their children is significantly higher in Europe and the United States than in the developing countries of Asia and Africa (Mason *et al.* 2001 and references cited therein; Ogawa and Retherford 1997 and

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references cited therein; Oshomuvwe 1990; Vanlandingham et al. 2001 and references cited therein; da Vanzo and Chan 1994).

Several of the studies also analyze the reasons for the trends reported in the previous paragraph, many intricately linked to the processes of economic development, demographic transition and ageing. Thus, declines in adult mortality rates coupled with declines in fertility rates likely imply an increase in the elderly dependency ratio over time, so that the number of younger adults (siblings) potentially available to care for the elderly in informal settings potentially declines over time (Mason *et al.* 2001). This increases the cost to any one individual of caring for his/her elderly parents, so that separate living for the elderly is one outcome. The outcome might happen through declining levels of co-residence, as the number of children of the elderly declines (see Da Vanzo and Chan 1994 for evidence from Malaysia) and Mason *et al.* (1997) document a slow but steady decline in intergenerational co-residence in a number of Asian countries. On the other hand, increasing life expectancies can serve to enhance the proportion of the elderly who live together, rather than individually. For instance, it appears that in most of the developed countries, future gains in life expectancies are likely to disproportionately occur among males, who have typically had shorter life spans than females (Fuchs 1998a cites evidence from the United States; see also WHO 2001b). Thus the proportion of the elderly who are widowed is likely to go down and also reduce the demand for institutional long-term care if spouses take care of each other (Lakdawalla and Philipson 1999; WHO 2001b).

While spousal support may potentially reduce the demand for formal long-term care in institutions, the increased participation of females in the work force that is occurring worldwide is likely to negatively affect the magnitude of informal care provided to parents by children and their spouses (for example, Carey 1999; Mason et al. 2001; Ogawa and Retherford 1997). Increasing female labor force participation is itself the result of a number of factors, including scarcity of labor and potentially high returns to participation and the great strides made by women worldwide in terms of relative power

within households and societies and the like (Mason *et al.* 2001).[10] Thus informal care-giving responsibilities are likely to impose a cost on the family of the children of the elderly. There are opposite effects as well – working families may find it economically beneficial to have an elderly parent look after their children in urban areas – so the effect of the tendency to have less of co-residence, or reduced support from children, is somewhat mitigated (Ogawa and Retherford 1997; da Vanza and Chan 1994).

Economic growth is typically also accompanied by urbanization and the migration of young workers to urban areas. In Japan this has led to very sharp increases in proportions of the elderly in some rural areas (Ogawa and Retherford 1997). To the extent that some of the growth in real income per capita may itself be an outcome of the process of demographic transition, factors that influence growth are directly related to the proportion of elderly in a population, and so influence the organization of family relationships that, in turn, influence the nature of (and the demand for) long-term care provided. See Bloom and Williamson (1998) for an analysis of the links between economic growth and the process of demographic transition. Enhanced incomes of the elderly, possibly through expanded pension programs could also have dual effects – by enabling the elderly to maintain their privacy by living alone, but also at the same time serves to increase their attractiveness to informal caregivers who may view them as a provider of significant financial resources (for some suggestive evidence from Japan, see Ogawa and Retherford 1997).

In some developing countries, social reorganization has been influenced by the disproportionate impact of HIV/AIDS on the mortality of young adults. A direct consequence has been the increasing financial, physical and emotional burden on the elderly who often have to care for people living with AIDS and after their death, for their orphaned children. This has led some researchers to inquire about the health impact and financial position of the elderly resulting from the added physical and financial burden faced by them from caring for orphans and persons with HIV/AIDS (Ainsworth and

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[10]Increased scarcity of labor is also directly linked to the process of demographic transition, fertility declines, and the ageing of the baby-boom generations.

Dayton 2001; Barnett and Blaikie 1992; Vanlandingham *et al*. 2000, WHO (World Health Organization) 2001). In a study of Tanzania, Ainsworth and Dayton (2001) found a short-term impact on the physical health, but not a long-term effect, of the extra financial and physical burden on the health of the elderly. They attribute the lack of long-run effects to support from extended members of the family and community support. Preliminary results from another study in Zimbabwe suggest that older carers' health suffers substantially on account of taking care of HIV/AIDS patients and orphans in the household, although it is unclear whether the effect was short- or long-term (WHO 2001). Irrespective of the health outcomes for the elderly caregivers, it is apparent that at least in the short run, elderly dependency ratios will increase, while stabilizing over the longer run, as only the uninfected younger adults reach old age. Whether this will influence health expenditures for adults is however, less clear – on the one hand, there is less support from adult children, but on the other there is community support. There are no obvious implications for the chance of having a surviving spouse, since it is increasingly apparent that HIV prevalence among women is catching up rapidly with that among men. Moreover, many of the countries where the AIDS epidemic is occurring are desperately poor, so it is also not clear whether the expansion of expensive long-term institutional care is a likely outcome; more likely, total expenditures might decline if individuals find themselves to be financially badly off.

E. Per person spending, ageing and public policy

Governments, too, can influence the relationship between ageing and health expenditures. They can do so by introducing generous pension and insurance schemes thereby enhancing the incomes of the elderly and influencing the social arrangements in which they live; by expanding public insurance coverage of specific services and influencing health care utilization patterns, given a specific health status; and the rate of change of medical technology used in the health sector. In addition, governments can regulate – in the case of institution-based long-term care there may be limitations as to the number of beds in the form of certificate of need (CON) laws – so that, alternative (and presumably cheaper) means of care emerge.

There is some evidence from Japan that a 1986 law that greatly reduced the benefits from pension schemes was partially responsible for changing attitudes among adult children against co-residence, because their economic burden from caring for the elderly increased. On the other hand, the Japanese government has been making a number of other efforts to stem the decline in co-residence across generations and informal forms of support for the elderly. These include heavy government subsidies to promote elderly day-care centers and limited stays at nursing homes to provide a respite to informal caregivers (Ogawa and Retherford 1997).

As an example of a policy designed to promote relatively cheaper home-based or informal care, the Australian government, which subsidizes long-term care for the elderly in institutional settings as such nursing homes and hostels, has tight controls on the number of such slots, and methods to restrict referrals to such institutions. In addition, the magnitude of the subsidies provided to people who wish to stay in the community is higher than for those wishing to stay in hostels (Carey 1999). In the United States, the use of DRG (diagnostically related groups) to regulate payments for hospitalizations under Medicare, and in Japan the use of co-payments ranging from 10-30 percent for medical expenses covered by the various insurance schemes have played a crucial role in curbing the rate of increase in medical expenditures (Fuchs 1998a; Ogawa and Retherford 1997). Garber, MaCurdy and McClellan (1998, p.1) also note that the emergence of the DRG system for hospital-based care was an important reason for the increasing popularity of home-based care for Medicare patients. Another example of public policy seeking to influence care use patterns comes from Norway that has lower rates of co-payments for home-based care than institutional long-term care (Antolin and Suyker 2001). Cutler and Meara (1999, p.13) suggest that one of the reasons for the rapid increase in post-acute care expenses among the elderly in the United States is the relaxation of Medicare rules for the use of these services in the late 1980s.

Finally, public policy can substantially influence the process of development and diffusion of new technology and consequent impacts on health care expenditures (Fuchs

1998a). For instance, coverage of care under Medicare and Medicaid in the United States appears to have had a direct influence on the medical technology used – and presumably also on the direction of research and development.   Fuchs also goes on to note the contribution of government subsidies to the training of medical specialists who play a key role in the development and spread of medical technology. Finally, the government also funds medical research (Fuchs (1998a) thinks this to be not an important contributor to the development and spread of medical technology). Cutler and McClellan (1996) use United States hospital data for heart attack related treatments to demonstrate that the adoption and diffusion of technically advanced procedures (which explain much of the price increase in heart attack treatment in their United States sample) was negatively associated with the degree of regulation (e.g., certificate of need requirements) exercised on such technology by states.

In an increasingly interconnected world, policies that promote the emigration/immigration of skilled medical personnel, or imports of modern medical equipment can also have major effects on health spending, but such effects have hardly received any research attention. Recent work on suggests the role of migrating doctors returning to India in the setting up of high-tech health treatment facilities (Baru 1998). Moreover, the Indian government's relaxed policies on imports of modern medical equipment such as CT-scans and MRIs appears to have played a key role in the spread of expensive diagnostic technology and treatment procedures, although little systematic analyses of these issues has been undertaken thus far (Baru 1998; Sanjay Chaudhary, Sujatha Rao personal communication).

F. Per person health spending and technological change

By all accounts, technological change is a major explanatory variable for increases in health expenditures per capita. Early work that highlighted the importance of technology in driving health expenditures was based on an accounting approach whereby the researchers explained the change in per capita health spending as the sum of the effects of the change in age distribution, income, moral hazard and the like, and a residual element

(Newhouse (1992), Cutler (1995)). The residual, which accounted for half or more of the change in per capita health spending in the United States, was taken to represent the effect of technological changes in the health sector. Later work has tried to focus more directly on health expenditures associated with specific forms of technological change. This work has also emphasized the two-way relationship of technological change with ageing – as a means of reducing mortality and so in postponing and reducing health expenditures per capita; and also as a means to address the treatment requirements of people who are sick.

Fuchs (1998a) states that there is consensus among health care experts that the major element underlying increasing age-specific health expenditures in the United States is new technology – new methods of diagnosis, new drugs, new surgical procedures, and so on. Fuchs (1998b) also states, "…the development, refinement, and diffusion of technology results in large increases in spending." (p.2). In trying to explain the rapid increase in age-specific health spending among the elderly in the United States due to technological change, he considered the utilization of seven frequently used procedures (Angioplasty, Catheterization, Hip Replacement, Knee Replacement, Laminectomy, and so on) and showed their rapid increase over the period from 1987-95. In his analysis he emphasized the diffusion of medical technology rather than the sudden emergence of a new technology as being a driving force of increased health sector expenditures.

A related finding is that there are age-specific differences in the rate of change of per capita health expenditures, which is directly linked to the nature of technological change that has occurred in the health sector (Cutler and Meara 1997). Cutler and Meara found extremely rapid increases in per capita medical care spending among infants and among the elderly for acute care in the United States post-1960. They argue that the spread of technology in the treatment of cardiovascular disease among the elderly drove much of this spending growth. For instance, they found that the share of Medicare patients with heart attacks receiving angioplasty, bypass surgery and catheterization grew rapidly during 1984-91, similar to Fuchs' findings. The growth of technology to treat babies born prematurely and its application to prematurely born babies appeared to explain the

increase in per person spending among infants, with devices such as the development of neonatal intensive care units after the mid-1970s.

What governs the spread of medical technology itself? Cutler and McClellan (1996) analyzed the determinants of technological change (diffusion and adoption of new procedures), by examining data on heart attack treatments in the United States. They found generous insurance payouts, state regulation of technology and the degree of provider interaction act to influence the diffusion of new treatment technology. Cutler and Sheiner (1998) cite evidence that managed care has slowed technology diffusion in the United States. This set of findings echoes Weisbrod's argument that insurance coverage had a lot to do with the increased pace of technological change in the health sector in the United States (Weisbrod 1991).

While medical advancements cost more, they also help in promoting health. Indeed, Cutler and Meara (2001; also Cutler and Sheiner 1998) suggest that declines in mortality from cardiovascular disease during 1960-90 in the United States were largely the result from improvements in medical technology, with a significant role also attributed to primary and secondary interventions such as prevention, early diagnosis and treatment (for a similar assertion and references, see also OECD (1998)). This last relationship potentially has implications for econometric methods used to project health expenditures over the long run, since some of the ageing may itself be an outcome of higher health expenditures. In developing countries, "demonstration effects", international aid and import policies are additional factors that can play a crucial role in the process of technological change, and would need to be accounted for in projecting health expenditures.

III. Projecting Health Expenditures

The previous discussion suggests that projecting health expenditures for the elderly is, to say the least, a complicated exercise. It requires collecting data on a range of demographic, social, economic and other variables, while accounting for and estimating

the interrelationships among them. Moreover, the method of projection would require an understanding the process of technological change in the health sector. Existing projection methods typically skirt these complexities. Most take into account one or more of the relationships highlighted in the previous sections, but few deal with several at once. Table 1 summarizes some of the major studies that have projected health expenditures. These can be conveniently divided into <u>six</u> main groups:

1. Projections based on an "actuarial" approach (Variant I)

The simplest of these analyses starts out with the following relationship:

(3) $H(t)$ $=$ $N(t)*u(t)*P(t)*[P_m(t)/P(t)]$

Here $H(t)$ are total health expenditures (often broken by type of service) at time 't', $N(t)$ is the population, $u(t)$ is per capita utilization of the service, $P(t)$ is an indicator of the general price level in the economy, and $[P_m(t)/P(t)]$ is the ratio of the indicators of prices in the health/medical sector $P_m(t)$ and the general price level. Because of possible measurement errors, or because utilization indicators and the like do not fully capture per capita "utilization" of care, independent observations of variables on the right hand side may not multiply to equal the left hand term. Hence, a typical approach is to add an error term $\phi(t)$ to equation (3) so that we have an identity (Arnett, McKusick, Sonnenfeld and Cowell 1986; The Harvard Team 2000)

(3*) $H(t)$ $\equiv$ $N(t)*u(t)*P(t)*[P_m(t)/P(t)]*\phi(t)$

If $H(0)$ indicates health expenditures in period '0' and if all the variables grow at constant rates with continuous compounding, we can write

(4) $H(t)$ $=$ $H(0)* e^{tr_n}\ e^{tr_u}\ e^{tr_p}\ e^{tr_r}\ e^{tr_\phi}$

Where r_n is the rate of growth of total population, r_u is the rate of growth of care utilization per capita, r_p is the rate of growth of the general price level, r_r is the rate of growth of the ratio of the medical price level to the general price level, and r_ϕ is the rate of growth of the "residual" term. In sum, the rate of growth of health care spending is the addition of the individual growth rates of population, utilization per capita, the general price level, the ratio of health sector to general price levels, and the residual term. Forecasting the growth of health expenditures then becomes a problem of forecasting the rates of growth of individual terms on the right hand side on (4). This is typically done by using past time series data on each of the variables in question. Given that the medical price index is not readily observable, unlike the general price index, many of the approaches that use this method subsume the term $[P_m(t)/P(t)]$ in the error term.

This above method is user friendly but has the obvious drawback that it does not directly address the interrelationships among the variables that underlie the terms in equation (3) as described in previous sections. Rather, past rates of growth of per capita health care utilization, the general price level, and the error term are used to predict future trends in a mechanical way. While it is the case that past trends represent the cumulative effects of various influences associated with ageing, technological change, social reorganization and the like, it is not obvious that the same would also hold true in forecasting several years into the future.

Another problematic issue stems from the fact that measurement errors and other missing variables simply get transferred to the residual term by construction, so forecasts of the rate of growth of the error term have to be made with some care. In its work on Hong Kong, the Harvard Team (2000) used a variety of techniques to arrive at future projections of the magnitude of the residual term. These included straightforward regressions with a trend, as well as time series analyses with different assumptions about the structure of the residual term, choosing the set of projections with the least magnitude.

2. *Projections based on an "actuarial" approach (Variant II):*

Some studies have used the type of actuarial model used above to highlight the role of an additional set of factors in influencing health expenditures. Specifically, these studies use a modification of the model in (3) to assess the impact of changes in population, and the *age-distribution* of the population in favor of the elderly on aggregate health spending (Denton, Gafni and Spencer 2001; Mayhew 2000). The simplest framework of the type of models in this set of analyses can be found in Mayhew (2000). Although not explicitly stated in this fashion, the Mayhew equation essentially takes the following form:

(5) $H(t)$ = $\phi(t)*N(t)*[P_m(t)/P(t)]*P(t)*u_r(t)\Sigma_a c_a(t)n_a(t)$

Here, $P_m(t)$ is an indicator of changes in prices in the medical sector for a *reference* age-group, $P(t)$ is the general price level, $u_r(t)$ is the per capita health care utilization of the same reference group, labeled "r" for convenience, $c_a(t)$ is the age-specific per person expenditure in age group 'a' relative to the age-specific per person expenditure for the reference group, and $n_a(t)$ is the share of age-group 'a' is the total population at time 't'. In Mayhew's setup, age-specific health spending (relative to the reference group) can change over time, due to the fact that ageing reflects mortality rate declines, which in turn imply that some of the acute care expenditures are delayed. As used in her model, this was further simplified by lumping together all items except $N(t)$ and $\Sigma_a c_a(t)n_a(t)$ under the residual category, given the paper's predominant focus on the effects of "… population and ageing" (Mayhew 2000, p.1). The rate of growth of this residual category is referred to as the "underlying rate" (Mayhew 2000, p.11). Thus, the projection model takes the form

(5′) $H(t)$ = $\psi(t)*N(t)*\Sigma_a c_a(t)n_a(t)$

Here $\psi(t)$ is the "underlying rate." Assuming constant rates of growth for the residual term and the population, we can write

(5″) $H(t)$ = $H(0) \; e^{tr_n} \; e^{tr_\psi} \; [\Sigma_a c_a(t)n_a(t)/\Sigma_a c_a(0)n_a(0)]$

The last term on the RHS of (5″) is an indicator of changes in the age-distribution. This is best seen if we assume that relative per-person expenditure weights are constant during the period of projection so that we have

$$(5^*) \quad H(t) \quad = \quad H(0) \; e^{tr_n} \; e^{tr_\psi} \; [\Sigma_a c_a(0) n_a(t) / \Sigma_a c_a(0) n_a(0)]$$

Now the term can be clearly interpreted as the Laspeyre's index indicating changes in age distribution of the population with base year weights of relative per-person age-specific health expenditures. As noted above, the clubbing together of all terms except the rate of growth of total population and the index of age-distribution of population into the residual implies that any influences linked to changes in medical technology (except in so far as these raised survival rates at higher ages and reduced per person health expenditures at those ages), social organization of the family, and the like, were subsumed in it. Indeed the major drawback in projection method adopted by Mayhew is the little attention that is paid to the terms that are subsumed into the residual, at least as far as projecting health expenditures for acute care is concerned.[11] Moreover, Mayhew does not address the issue of changes in age-specific differences in the use of medical technology in acute care over time, even though her paper acknowledges this possibility.

Mayhew did, however, try to project expenditures on long-term care for the elderly provided in the formal sector. The basic model used was the same as in (5″) above with the following additional inputs. The projection strategy assumed that age-specific disability prevalence rates were fixed over time, as also the distribution of the severity of disability within each age-category. The disabled within each category were allocated to specific care-options using data on the distribution of care-type for each severity category, based on published studies on the subject. Combined with population and age-distribution projections over time, and cost estimates for each type of care (also assumed to be constant over time in real terms) this yielded projections of long-term health care expenditures for the disabled elderly. As used, the projection model was limited in its

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[11]Although not used in the projections, this deficiency is explicitly noted by her (Mayhew (2000, p.11).

approach to developed countries, given that data on disability and long-term care use patterns in developing countries were not as reliable. Moreover, projections for developing countries would also have raised additional concerns, because of the need to forecast policy changes, changes in organization of the family, disability prevalence rates, technological changes, and the like.

Analyses of the type reported by Cutler (1995) and Newhouse (1992) essentially amount to being special cases of (5*), although the intention in these cases was not to project health spending but to assess the role of technological change in the past growth of health expenditures. In their papers, the authors inquire into the growth of additional factors that might explain changes in the residual term left over after accounting for growth in the size of the total population and an index of the age-distribution of the population. These factors included the impact of increases in insurance coverage, rising real incomes, relative medical price inflation, "avoidable" administrative expenses to provide health (including expenditures linked to risk selection by insurance firms), and any increases on account of "supplier induced demand". The residual was allocated to technological change. As described, these models provide additional ways to incorporate some of the components relevant for forecasting health expenditures for the elderly, particularly rising incomes and insurance coverage.

Some of the other approaches in the literature that have forecast health care spending (Fuchs 1998a; Dang, Antolin and Oxley 2001; Micklin *et al.* 1993) can be thought of as essentially minor extensions of the methods in (5), (5′) and (5″). Fuchs (1998a) assumed *differential* rates of growth in age-specific expenditures per person across age groups, in addition to increases in population, changing age distribution and rising age-specific per person expenditures on health. That has the following implication for the projection method outlined above. It implies that the relative size of $c_a(t)$ will change over time for various age groups 'a'. In (5*) this would entail modifying the equation to enable the introduction of a further index number that captures this process of changing relative per-person expenditures, which would enter the equation multiplicatively.

Perhaps the most comprehensive approach of the type described above can be found in the projection methods used for forecasting the United States of Hospital Insurance and Supplementary Medical Insurance expenditures in Medicare Trustees Reports (see Technical Review Panel 2000, Appendix A). As executed, the method used is most similar to that adopted by the Harvard Team (2000) and Fuchs (1998a). It is, however, different in the sense that the projections are made on a much broader classification of health care service used, and differentiates by age-sex categories and by costs per unit of care provided. Moreover, for purposes of projections of expenditures, the method distinguishes between individuals who are enrolled in managed-care organizations and those who are not. The Medicare Trustees' reports also allow for two sets of projections – short term and long-term. The longer-term projections essentially allow the rate of increase in the unit costs of care to converge from a trend rate to the average increase in hourly wage rates for Supplementary Medical Insurance expenditures, and from the trend rate to the rate of real GDP growth, for Hospital Insurance expenditures.

3. "Superior" Variants of Actuarial Approaches (Version III)

The classic in this third category of models used for projecting health expenditures is presented in Cutler and Sheiner (1998). The projection method used by the authors to forecast Medicare spending and use of long-term care is essentially based on the formula in (2), and captures several of the linkages that make forecasting health expenditures a particularly challenging exercise. Many features of their analysis are worth noting. First, they incorporate declining disability and mortality rates in projected health expenditures, acute and long-term. For acute care, they do so by examining carefully the factors influencing per-person age-specific expenditures at any given point in time, separating out the relative importance of age and disability status, and proximity to death. For example, they also were able to econometrically estimate the link between disability, age and health expenditures among survivors for different age groups (Cutler and Sheiner 1998, Table 12). Separately, information on health expenditures in the last year of life was collected for decedents and trends estimated. This information was combined with assumptions of declining trends in disability and mortality rates from other published

studies (a direct consequence of increased survival rates) to project acute health care expenditures under Medicare. For long-term care, a separate exercise was conducted that took into account proximity to death, marital status and other variables likely to influence the use of formal institutional care.

The work of Cutler and Sheiner certainly implies a significant advance over previous research for forecasting purposes. However it also highlights a number of challenges that emerge for forecasting health expenditures on the elderly in developing countries. For one, it raises the bar for informational requirements related to current disability rates, mortality rates, health expenditures by age group, disability condition and proximity to mortality, as well as their future trends. But their framework, because of its focus on the OECD countries, potentially underemphasizes factors that are likely to be particularly significant for developing countries. Thus, for instance, longer-term projections one would need to also consider the association between ageing and economic growth, and economic growth and social organization of care for the elderly for forecasting purposes. Also relevant would be public policy that may influence the emergence of social insurance schemes in these countries, as well as technology changes that could occur rapidly in the future as the information age makes possible its rapid transfer from the developed countries to the developing.

Another method with the flavor of the "actuarial" approach was used by the World Bank to forecast acute health care expenditures in China (World Bank 1992). Formally, the model amounts to a version of (2) with age-specific health status being indicated by age-specific disease prevalence. Health care expenditures, conditional on a specific disease, were based on actual cost-data from selected Chinese hospitals. The method projected curative health expenditures as a proportion of GDP by first projecting disease patterns, age distribution and the size of the Chinese population based on an epidemiological model. In this way it was able to take account of the long-run pattern of declining prevalence of communicable diseases and increasing prevalence of communicable diseases likely to occur in China. Per-person cost data for these illnesses was obtained by surveying a small set of hospitals. In this setting, with no change in unit costs over time,

the impact of ageing and epidemiological influences was projected to increase health expenditures at an annual rate that is 2 percentage points higher than the annual rate of growth of GDP. If changes in unit costs were considered, the impact could conceivably be much greater, but no systematic evaluation of this situation was undertaken (World Bank 1992, pp.52-3).

The model's strength lies in its ability to take account of the epidemiological transition occurring in developing countries. The focus on disease patterns is not necessarily at odds with the other projection methods discussed above if, as is likely, specific diseases are correlated with greater prevalence of disability. There is room for improvement, however, in that there is little focus on the impacts of ageing on long-term care, the dynamics of social organization with increased longevity, migration issues, technological change in the health sector, and their links to health expenditures.

A model that takes account of both the approaches of Cutler and Sheiner (1998) and World Bank (1992) and even goes a little further is that recently used to forecast health expenditures of the National Health Service (NHS) of the United Kingdom (Wanless 2002). In forecasting NHS spending for a 20-year period from 2002-2022, the Wanless model emphasizes the role of both demand and supply side factors in influencing health expenditures. Demand-side factors include the changing age-structure and size of the population, the differences in health care use by age- and sex-categories, and the need to satisfy expectations about superior quality of service from the NHS in the future, whether in terms of waiting times, better food and accommodation, or high-tech care. The forecasting model they used for projecting health expenditures also differentiates (along the lines of Cutler and Sheiner) among health care use by decedents and survivors. The model is also enhanced by assumptions about disability patterns, declining mortality in age-category in the future, and the likelihood of seeking care, once one is sick. Supply side factors include improvements in infrastructure, changes in the number of people in the workforce, changes in worker productivity and in pay and allowances over time on the one hand, and changes in technology on the other. In some cases, the projections relied on assumptions that appeared reasonable albeit exogenously specified (as in

productivity growth of workers). In other cases, such as technology change and its impact of health expenditures, the review used cost estimates for improved procedures for five specific conditions (heart disease, diabetes, cancer and the like) as a basis for projected impact on expenditures. In this sense, the projection model is an advance over the World Bank (1992) model, where technology change was determined independently of treatment practices.

4. Other Versions of the Actuarial Model

A final type of the "actuarial" class of models used for projection purposes can be found in Jacobzone *et al.* (1998) who seek to forecast long-term care health expenditures on the elderly. This rather simplistic model focuses primarily on the role of changing dependency ratios in influencing aggregate long-term health care spending, with the principal driver of expenditures being the relative rates of growth of potential wage earners, and persons who need long-term care -- that is, the elderly. The model essentially amounts to the following: (Jacobzone *et al.* 1998, p.18)

(6)   L(t)   = $L(0) \, e^{-tr_w} \, e^{tr_d}$

Here L(t) is the ratio of long-term care expenses to GDP in year 't', r_w is the rate of growth of potential wage earners in the economy and r_d the rate of growth of the disabled population in need of long-term care. The derivation of the equation in (6) assumes that there are no productivity gains in long-term care after some time (that is, in the long run) and that the wages of potential caregivers keep pace with the average wage growth in the economy.[12]

While useful in highlighting the role of the number of workers relative to the numbers of the disabled, the model is rather simplistic– effectively saying that as the proportion of disabled increases in the population, the share of long-term care expenditures also

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[12]Also assumed is that any productivity gains (changes in total factor productivity) in the economy are translated into wage growth (p.18, Jacobzone *et al.* 1998).

increases, *all else remaining the same*. What is needed – especially for projection purposes -- is a better story about the "all else", such as the role of public policy in influencing long-term care, economic growth, changing composition of care-giving patterns (institutional versus home-based formal and informal care), and the like. To be sure, one could argue that in developed countries some version of a steady state in care-giving patterns may have been reached. But there is little to support to similar assertion for developing countries, which are likely to experience massive changes in age-distribution, social organization and patterns of care-giving in future years.

5. Micro-simulations in a Two-Sector Model

Warshwasky (1999) projects health care spending in the United States up to 2040 in a two-sector general equilibrium model, with health sector being one of the sectors, and all other activities being the other, with two inputs – capital and labor. The model, essentially an updated version of a previous model by the same author (Warshawsky 1994), takes savings to be a constant proportion of income, and labor supply to be a function of demographic and sociological factors. Population projections are essentially those of the Social Security Administration in the United States. The author makes assumptions about price and income elasticities of the demand for health care based on existing empirical studies. Sensitivity analyses were conducted under different assumptions about HMO coverage. The main implication of HMO coverage (apart from influencing health care consumption by individuals) was a reduced rate of capital deepening in the health care sector.

The advantage of the model is its usefulness in being able to explicitly take into account some of the inter-sector relationships relevant for projecting health care spending. However, a static model of the type used by Warshawsky cannot fully capture the effect of interrelationships that play out over the longer run such as between ageing and savings rates, without additional modifications. Thus, it is well known that the age structure of the population is associated with savings rates and economic growth (Bloom and Williamson 1998). Nor is the model able to consider the effects of ageing on the

organization of the family, or of the impact of technological change on health, whether disability or mortality rates. For instance, the model is essentially calibrated to allow for capital deepening exogenously (the rate of change depending on HMO coverage), but there is no implication for improved health in this framework. It is also far too aggregate in scope to capture individually the influences of the factors that influence health care spending and to distinguish between different types of health care spending linked to the elderly – long-term care versus acute care, informal care and the like. In a developing country, the distribution of income may also be relevant to determining expenditures but the model appears not to be equipped to differentiate across individuals, a problem that appears common to most of the methods discussed above.

6. Econometric/Statistical Approaches

Getzen and Poullier (1992) forecast aggregate health care expenditures in a large number of OECD countries using six different methods – a naïve approach that assumed the rate of growth of health spending to be the same as in the previous year; moving averages, exponential smoothing and regressions on historical data; projecting each country's growth rate as the average growth rate of health expenditures for all the countries combined, econometric models that use additional information on macroeconomic variables such as income per capita and inflation. They also tried combinations of these projection methods, and it turned out that the averages of the projections turn out to be the most satisfactory.

The major problem with this approach is first that it is difficult to apply in many of the developing countries with a paucity of national health accounts data stretching over many years. Moreover, such methods are likely to be more effective for short-term forecasts. Long run forecasting would, as seen above, require taking careful account of the dynamics of and interrelationships across a number of variables that these methods are not equipped for.

IV. Projecting Health Expenditures in Developing Countries

The above discussion highlights several methodological challenges to projecting health expenditures associated with ageing populations in developing countries. Four appear to be of particular importance.

The first is the issue of information availability. Even the most elementary projection models require baseline estimates on health expenditures, broken down by age categories, preferably over a number of years, and population age-structure. If one leaves aside the simplest models, then reasonably acceptable forecasts would also, at the very least need information on projected population trends, mortality, disability, real income per capita, public policy especially relating to the introduction of insurance schemes, demand for health care including the impact of changes in family structure, and medical technology adoption and use in developing countries. It is easy then to see that the first step has to be to create a large body of information in developing countries related to health care spending, the demand for care, disability and mortality patterns and indicators of technological change.

At present, it is difficult to imagine any one developing country with the comprehensive database called for in the preceding paragraph, but significant pieces of information are available from many countries that have National Health Accounts, from household level health surveys and national censuses. Considerably less information is available about disability rates, medical technology use and diffusion, and factors such as insurance, family structure and the like that influence the demand for health care. A key element that forecasters must consider is the potentially rapid decline in intergenerational cohabitation and the need to provide formal long-term care for at least some segment of the population. Unlike Europe and the United States where co-residence is already quite low and so further declines in it limited, intergenerational co-residence is still extremely high in the developing countries of Africa and Asia, and significant declines in it extremely likely (for some trends in Asian countries, see Mason *et al*. 2001). Even less is

the certainty about directions that government policies towards social insurance might take.

Second, even assuming the requisite baseline data were available, there are other issues of potential concern. Forecasters of health spending would have to contend with the possibility that the rapid process of ageing in developing countries may not necessarily be accompanied by rapid advances in social security and/or insurance coverage for a large majority of the population. This will likely result in a dual regime with respect to health care and treatment expenditures, whereby the poor elderly and those unable to migrate from rural areas where access to health care is poor will not be able to afford care and consequently become worse off, whereas the well-off groups see advances in spending on health. In these settings, projections about not only the extra financial burden of spending but also about "excess" mortality, in the absence of necessary care, among the poor elderly may be of policy interest. Also of relevance would the effect of increased needs on use patterns of subsidized public health services, and in turn on public policy towards the provision of subsidized health care.

A third important set of facts to be considered in forecasting is the likely implications of the HIV/AIDS epidemic. In sub-Saharan Africa, for example, the AIDS epidemic could impact in terms of increasing the financial burden of health expenditure on the elderly given the shortage of young adults in a transition period, with obvious implications for their financial and physical well being. Women who are often the primary caregivers in the family may be particularly vulnerable given their longevity (and potential widowhood) in addition to other forms deprivations they face in these countries. This calls for forecasting some of the expenditure implications separately for men and women.

A fourth key issue of importance is technological change, whose influence on health spending suggests the need for a more careful look at the diffusion of modern technology in the health care sectors in developing countries. Topics of obvious importance would be to understand the pattern of technological transfers across countries, and the assessment of the impact of trade in health services, import policy, and intellectual

property protections on the spread of medical technology and its direct consequence, health spending.

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