THE UTILIZATION OF MEDICAL CARE BY THE ELDERLY:

DETERMINANTS OF PHYSICIAN VISITS

by

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Abstract

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The main purpose of this research is to understand the determinants of physician visits by the elderly – care rendered to the elderly by all physicians. The theoretical model of this research is based on the Grossman's human capital model of the demand for medical care. Multivariate techniques have been employed to examine two measures of medical care utilization for the elderly aged 65 and over.

The major findings from this research indicate that variations in the income level affect significantly only the elderly's decision to use any medical care in the physician office. Income level is not a significant determinant in the number of visits to the physician's office, probably because of Medicare and Medicaid insurance. The Medigap insurance coverage has a significant effect on the probability of contacting a physician. The price elasticity of the elderly at the mean is slightly higher than those of the rest of age groups. Further, the elderly aged 65 and over are highly price sensitive

to the medical care utilization in the physician's office (the number of visits) compared with prior researches. The health status measures of the elderly have significant effects on the medical care utilization. The hypothesis of differential usage of medical care by sex is only confirmed in the probability of contacting a physician. The elderly women have a higher probability of contacting a physician than the elderly male. The hypothesis is rejected in the number of visits equation. This research confirms that there are structural differences in the demand for physician visits among three age groups, the elderly aged 65 and over, adults between the ages 40 and 64, and adults between the ages 18 and 39.

On the basis of these results, especially considering lower income level and higher price elasticity, I recommend that recent debates on the Congress to overhaul the nation's Medicare and Medicaid should consider not only the new cost-effective public health care system but also its effect on the low-income elderly. The new system should not preclude the health insurance protection for the low-income elderly that is guaranteed by the current welfare system.

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TABLE OF CONTENTS

	Page
Copyright	ii
Approval	iii
Abstract	iv
Acknowledgments	vi
Table of Contents	viii
List of Tables	x
Chapter	
I. Introduction	1
II. Literature survey	8
1. Theoretical Models of The Demand for Health and Medical care	8
2. Empirical Research Related to The Demand for Medical Care by The Elderly	14
III. Theoretical Model	20
IV. Description of Data	27
V. Empirical Implementation	30
1. The Empirical Model and Estimation Techniques	30
2. Definition of Variables Used and Expected Effects	39
VI. Empirical Results	54
VII. Demand Functions by Age, Sex Groups and Tests of Structural Change	71
1. Demand Functions by Age Groups	72

2. Demand Functions by Sex 80

3. Tests of Structural Change 87

VIII. Summary and Conclusion 93

Appendix

A. Empirical Results from The Sample Selection Model 101

B. Appendix B 108

References 115

LIST OF TABLES

Page

Table 1: Variable definitions 42

Table 2: Means and standard deviations for age groups 43

Table 3: Regression coefficient of price and price elasticities of the number of visits 57

Table 4: Regression coefficients of the time price variable and time price elasticities 59

Table 5: Coefficients of family income and income elasticities 60

Table 6: Means and regression coefficients of the variable VALUEMED 68

Table 7: Regression results: Probit analysis of use/non-use in physician office visits by the elderly 69

Table 8: Regression results from the two-equation model: Utilization, the log value of the number of visits, conditional on use by the elderly 70

Table 9: Regression results: Probit analysis of use/non-use in physician office visit by adults between the ages 40 and 64 76

Table 10: Regression results from the two-equation model: Utilization, the number of visits, conditional on use by adults between the ages 40 and 64 77

Table 11: Regression results: Probit analysis of use/nonuse in physician office visit by adults between the ages 18 and 39 78

Table 12: Regression results from the two-equation model: Utilization, the number of visits, conditional on use by adults between the ages 18 and 39 79

Table 13: Regression results : Probability of contacting a physician by the male elderly 83

Table 14: Regression results: Probability of contacting a physician by the female elderly 84

Table 15: Regression results from the two-equation model: Utilization, the number of visits, conditional on use by the male elderly 85

Table 16: Regression results from the two-equation model: Utilization, the number of visits, conditional on use by the female elderly 86

Table 17: Regression results from the sample selection model: Utilization, the log value of the number of visits, conditional on use by the elderly 107

Table 18: Marginal effect of the probabilities of contacting a physician by age groups 108

Table 19: Elasticities of the probabilities of contacting a physician by age groups 109

Table 20: Elasticities of the demand for the number of physician visits: The two equation model 110

Table 21: Marginal effect of the number of visits: The sample selection model 111

Table 22: Elasticities of the demand for the number of physician visits: The sample selection model 112

Table 23: Compound elasticities of the demand for physician visits by age groups: The two-equation model 113

Table 24: Compound elasticities of the demand for physician visits by age groups: The sample selection model 114

I. Introduction

The United States stands today at a significant demographic turning point. For the first time in America's history, there are more Americans aged 65 and over than teenagers.[1] There is much more going on than simply the growing numbers of older Americans. What we are witnessing is the growing assumption by a majority in the society that they can expect 10 to 20 years of life after work, in relatively good health and with adequate secure retirement income. The most severe problems associated with growing old—chronic illness, poverty, and social isolation—persist, but for many they are being delayed until beyond ages 75 or 85. The widespread emergence of this new period of healthy, financially secure retirement promises great opportunities for both individuals and for the society, if only we can learn to reap the full social, economic, and personal dividends of this new time of life.

The great increases in the number of old persons, however, poses tremendous challenges, especially to the systems of health care in the U. S. That is, while Americans are inevitably maturing as a population, the process will not be a smooth or gradual one. Instead, the postwar baby boom generation now in adulthood will bring very sudden and dramatic transformations to each decade as it matures. When this generation nears retirement age, beginning around the year 2010, the dislocations could be severe if the U.S. does not plan for this event well in advance. In effect, there are only 15 years to

[1] U.S. Bureau of the Census, Current Population Reports, Special Studies, P23-190, '65+ in the United States,' U.S. Government Printing Office, Washington, DC, 1996. pp. 2-1 - 2-27.

prepare for major, yet foreseeable, changes in this society. Already, the aging of the population contributes significantly to the increase in health care expenditures.

The rate of increase in health expenditures today constitutes perhaps the single most destabilizing elements in the Federal budget on the domestic side. Federal health insurance programs, mostly Medicare and Medicaid, are the fastest-growing portions of its budget. Spending on these programs has grown from about 1 percent of GDP in 1970 to 3.0 percent in 1991.[2] According to Congressional Budget Office under current policy, these programs will eventually rise to 6.1 percent of GDP by the year 2002. Projections of this magnitude make clear that the principal domestic challenge facing the U.S. today is controlling rising health care costs. Prior to the mid-1970s, the cost of health care in the United States was not a major issue. Instead, the nation's health policy agenda concentrated on the expansion of access and improvement of quality of care. However, health care expenditures began an upward spiral in the 1970's. Policy makers realized that controlling these increases had became a national priority, and much more attention was paid to increasing health care expenditures and to the adequacy of the return that the U.S. was getting for its enormous investment in health care. The amount of such increases in expenditures is influenced by a number of factors, including the advance of medical technology, size and composition of the population, general price inflation, changes in health care policy, and changes in the behavior of both health care providers and consumers.

According to Health Care Financing Administration (HCFA), the fastest growing payer of health care was the Federal Government in 1993. The Medicaid and Medicare

[2]Congressional Budget Office. 'Economic Implications of Rising Health Care Costs.' October 1992. p. 7.

programs spent $272.1 billion for health care in 1993, accounting for 30.8 percent of health spending and 70.2 percent of all public funding for health care. Nearly 3 of 5 (58 percent) public health-care dollars were spent in 1987 for the elderly, up from one-half (51 percent) in 1977, according to HCFA. In both 1987 and 1977, per capita public expenditures on personal health care were about 17 times greater for the elderly than for children and youth under 19. During that period, per capita public expenditures on personal health care for the elderly increased 49 percent.[3] Per capita personal health-care expenditures for persons 65 years and over in 1987 were $5,360. Hospitalization accounts for most of the bill. The services of physicians are the next most costly component for the elderly. The cost of nursing homes takes the third place. However, there are very few studies on the demand for medical care of the elderly living in the community (care in the hospital and the physician's office) while a lot of studies have focused on nursing home care.

The purpose of this paper is to understand the determinants of utilization of medical care by the elderly - especially care rendered to the elderly by all physicians. Appropriate medical care for the elderly is a vehicle for maintaining their health and is an object of government policy via programs such as Medicaid and Medicare to eliminate substantial variations, especially according to race and socio-economic class of the elderly, in utilization of medical care services. I examine how the differences in socio-economic variables, such as age, education, race, health status, and consumer's taste or perception concerning the value of medical care, affect the utilization of medical care. In particular, this study will show whether or not there is a significant difference in medical

[3]U.S. Bureau of the Census, Current Population Reports, Special Studies, P23-190, '65+ in the United

care utilization between the elderly and ordinary adults between ages 18 and 64. Also this study will investigate whether or not there is a differential use of medical care (physician visits) by sex. A price elasticity is important in determining the effects of changes in health insurance practices or policies. The time-price elasticity affects the effectiveness of public policies that improve the accessibility of medical care. The response of demand to rises in income would show whether medical care is normal good, a necessity or luxury. In addition, consumer responses to changes in insurance coverage (a big component of price changes) are important because insurance coverage has grown dramatically in the past 30 to 40 years and we must consider possible changes in social insurance in the future (for example changes in Medicare and Medicaid or national health insurance system). Cross-price elasticities will tell us whether hospital care, hospital outpatient department care, and physician office care are complements or supplements for each other.

In this paper, I use multivariate techniques to identify the main sources of variation in the decision to obtain medical care by the elderly, as measured by the number of visits to physicians' offices. My research addresses a basic question: "What basic forces influence the use of medical services by the elderly?" This question must be answered in order to improve the primary-care system for the elderly. The selection of variables to analyze is guided by models of utilization of physicians' services that have been developed by economists and sociologists. The resulting estimates of demand functions for medical care by the elderly are based on Grossman's (1972) human capital model of the demand for health and the resulting derived demand for medical care.

States,' U.S. Government Printing Office. Washington. DC. 1996. pp. 3-23 - 3-25.

Similar studies of the demand for medical care by the elderly like this study are done recently by Cartwright et al (1992), Wilcox-Gök and Rubin (1994), and Vistnes and Bantin (1996). However, the unique contributions of my study are that finding out-of-pocket price elasticity in the number of physician visits by the elderly and comparing the price elasticity with those of two different adults age groups.

To analyze those determinants of medical care for the elderly I use data from the 1987 National Medical Care Expenditure Survey (NMES), collected by the Center for Health Services Intramural Research, Agency for Health Care Policy and Research of the U.S. Department of Health and Human Services. The 1987 NMES provides information on health expenditures by or on behalf of families and individuals, the financing of these expenditures, each person's use of services, and socioeconomic characteristics like household composition, employment, and insurance characteristics. The universe for the sample is the noninstitutionalized civilian population of the U.S. The sample design was constructed to provide statistically unbiased estimates that were representative of the civilian population of the U.S. in 1987. A stratified multistage area probability design with a total sample of roughly 35,000 individuals in 14,000 households who completed all rounds of data collection was used. The sample includes poor and low-income families, the elderly, the functionally impaired, and Black and Hispanic minorities, groups for which there has been a special public policy focus.

The major findings from this research are as follows. First, variations in the income level affect significantly only the elderly's decision to use any medical care in the physician's office. The income level is not a significant determinant of the number of visits to the physician's office, perhaps because of Medicare and Medicaid. Thus, the goal of

Medicare and Medicaid to reduce the effect of variations in wealth on medical care utilization (visits to physicians conditional on some use) by the elderly is achieved except for the variation in the probability of the utilization by income level. Second, the Medigap insurance coverage has a significant effect on the entry visit to the physician office (the probability of contacting a physician). Third, the elderly are more price-sensitive than adults between ages 18 and 64. Their price elasticity is significantly higher than that of each of two other young adult age groups. Fourth, measures of health status of the elderly have significant effects on medical care utilization. Fifth, the hypothesis of differential usage of medical care by sex is only confirmed for the probability of contacting a physician. Elderly women have a higher probability of contacting a physician than do elderly men, whereas both men and women behaves similarly with regard to the number of visits. Finally, this research confirms that there are structural differences in the demand for physician visits among three age groups, adults aged 65 and over, adults between the ages 40 and 64, and adults between the ages 18 and 39. On the basis of these results, especially considering lower income level and higher price elasticity, I recommend that recent debates in the Congress about overhauling the nation's Medicare and Medicaid should consider not only the new cost-effective public health care system but also its effect on the low-income elderly. That is, the new system should not preclude health insurance protection for the low-income elderly that is guaranteed by the current welfare system.

Chapter 2 surveys the literature related to this research. Chapter 3 develops the theoretical model of the demand for medical care which is basically the same as Grossman's human capital model. Chapter 4 discusses the data used for the analysis of the determinants of medical care by the elderly. Chapter 5 specifies the empirical model, estimation techniques, and definitions of variables used. Chapter 6 presents the results of an empirical investigation of the determinants of physician visits by the elderly. Chapter 7 presents the demand for medical care in the physician office by other age groups, adults between the ages 18 and 39 and adults between the ages 40 and 64. In addition, the demand for physician visits by each sex is presented in chapter 7. Also this chapter presents results from the tests of structural differences among age groups and those between the female elderly and the male elderly. Chapter 8 summarizes the major findings of the study and presents some concluding remarks.

II. Literature Survey

1.Theoretical models of the demand for health and medical care

It is often said that since Kenneth J. Arrow's famous seminal article in 1963, "Uncertainty and the Welfare Economics of Medical Care," health economics has emerged as a distinct field but in the territory of welfare and applied welfare economics.[4] However, the most important breakthrough in economics of health, especially in the theory of the demand for health and medical care, has been Grossman's (1972) development of a formal framework to analyze consumer's health behavior. Grossman's pioneering work on the demand for health and the resulting derived demand for medical care applied human capital theory to consumer's health behavior and, thus, provided the foundation for much of the work which has been published subsequently. Although several researchers have suggested that health can be viewed as one form of human capital (Mushkin 1962, pp. 129-49; Becker 1964, pp. 33-66; Fuchs 1966, pp. 90-91), Grossman has initially constructed a model of the demand for health capital itself and its derived demand for medical care. Grossman's theory provides a framework for analyzing issues such as socioeconomic inequalities in health and medical care, the design of prevention policies and the impact of unemployment on health and medical care (Wagstaff 1986).

The following summary is based on Grossman's model of the demand for health and its derived demand for medical care. First, Grossman argues that health capital differs from other forms of human capital. That is, while a person's stock of knowledge affects his/her market and nonmarket productivity, his/her stock of health determines the total amount of time he/she can spend producing money earnings and commodities. Second, what consumers demand when they purchase medical services are not these services per se but, rather, "good health." Third, consumers produce commodities, for example health, with inputs of market goods, for example medical services, and their own time. Since goods and services are inputs into commodities, the demand for these goods and services is a derived demand. Thus, the demand for medical care is a derived demand for an input to produce health. Fourth, health is demanded by consumers for two reasons. As a consumption commodity, it directly enters their preference functions, i.e., sick days are a source of disutility. As an investment commodity, it determines the total amount of time available for market and nonmarket activities. That is, health is demanded since it increases the number of healthy days available for market and nonmarket activities. Finally, in his theory, the law of downward-sloping demand curve governs the quantity of health demanded, i.e., he assumes that there is a negative correlation between health and its shadow price. In his theory, he shows that the shadow price of health rises with age if the rate of depreciation on the stock of health rises over the life cycle, and it falls with education if more educated people are more efficient producer of health. One important conclusion of his model is that, under certain conditions, an increase in the shadow price may simultaneously reduce the quantity of health demanded and increase the quantity of medical care demanded. Mathematical expression of the Grossman's model is presented in chapter 3.[5]

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[4]Shakoto (1977) and Folland, Goodman, and Stano (1993).

[5]Notations are from Wagstaff (1986).

Grossman's work has been viewed as the first truly economic explanation of health decision-making, but there have been some criticism of his basic model. The major criticisms of Grossman's model are as follows.[6] First, the model has been argued to be unduly unrealistic as a description of the inherently uncertain area of health and utilization behavior in that its main part is based on the assumption of complete certainty. Second, even though the dichotomy of health stock benefits, i.e., consumption benefits of health and investment benefits of health, have been necessitated by the analytical problems caused by handling both aspects of health simultaneously, on the conceptual level, the view of health benefits as alternative specifications seems to be intuitively wrong. These should be treated not as alternative but as explicitly complementary.[7] Third, the justification of the positive education-health correlation is somewhat unsatisfactory. Grossman's model is based on the view of education as a productivity factor in household production in general. According to Muurinen (1982), it is desirable to demonstrate that a different, intuitively more plausible justification for the inclusion into the basic framework should be given, not restricted to the household production approach to health behavior. Based on the second and third criticisms, Muurinen (1982) generalized Grossman's original model in the sense that her model of health investment did not rely on the acceptance of household production theory and time prices.

According to several authors (Welch (1970), Michael (1972)) education is not just assumed to operate as a purely technical effect at the level of the specific production relationships (i.e., raising marginal product per input), but enhances allocative ability such

[6]See Muurinen (1982).

as the innovative impact of education consisting of life-style selection, diet and exercise decisions, and the more technical benefits as showing up in more efficient production of health from better medical knowledge, more information about alternative sources of care etc. Muurinen (1982) introduced the concept of use-related depreciation of health by analogy with the firm's investment theory to incorporate the allocative benefits of education. In her model, the rate of health depreciation δ then becomes a function, not only of age, but also of intensity with which this stock is used. The concept of use-related depreciation has an advantage that education as well as so-called environmental variables can then be operative on health in periods without health investment production framework. The traditional household production framework and the role of time inputs and wages as time prices have been dispensed with the model. Despite the claim of superiority of her model over Grossman's, the comparative static results with respect to each variable, for example education, are very similar to Grossman's predictions. The only advantage of Muurinen's model is that the model does not require the assumptions of input or commodity neutrality and the hypothesis that education affects household productivity in general (Muurinen 1982, p. 19).

The other major criticism of Grossman's model is that the major part of the model is based on the assumption of complete certainty. Grossman (1972) made some suggestion as to how uncertainty could be introduced into his model. It could be postulated that the consumer faces a probability distribution of depreciation rates. Using the state-preference approach to choice under uncertainty, some results can be reached, none of which, however, tend to alter the major conclusions of his deterministic

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[7]In fact, Grossman explicitly noted that he is reluctant to label health as either a pure investment good or a

framework. However, no formal derivation is given in Grossman (1972). In fact, it was Arrow who first recognized that 'virtually all the special features of industry (the medical care industry) stem from the prevalence of uncertainty' (Arrow 1963, p.946). Arrow distinguished between two types of uncertainty: uncertainty with respect to health status and uncertainty with respect to the effectiveness of medical care.

Phelps (1973, 1976) developed a theoretical model where uncertain health was considered in a static framework to derive some predictions regarding the demand for health insurance. Keeler et al. (1977) derived an optimal coinsurance rate and maximum payment amount and examined the effects of deductibles and coinsurance rates on the demand for medical care under all possible states of illness. Cropper (1977) incorporated endogenous uncertainty in health in a lifecycle model of health investment. An optimal path of investment and health capital is derived in the model. One of the surprising results is that investment in health is likely to decrease steadily with age after early adulthood compared with Grossman's result of increasing investment in health over time. This striking result is due to the preventive nature of medical care expenditures in the model which yield returns over a shorter remaining period of life at higher age. Dardanoni and Wagstaff (1987) introduced uncertainty into Grossman's pure-investment model, especially uncertainty in the function of periodic income. They contend that if individuals display decreasing absolute risk aversion, wealthier individuals will invest more in health than persons with small initial stocks of financial capital. Their uncertainty version of the pure investment model provides some useful insight into the way in which inequalities in wealth become translated into inequalities in health.

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pure consumption good (1972, pp. 8-9).

As pointed by Arrow (1963), uncertainty with respect to the effectiveness of medical care is one of serious aspects to be considered in modeling the demand of health and medical care. Pauly (1980) has pointed out the widespread recognition of consumer ignorance in medical matters. His model assumes that the marginal health product of medical care to be uncertain or a random variable with a known probability distribution. He adds the possibility for the consumer to obtain additional information on the marginal health product of medical care from a physician. Pauly, in his model, assumed that patients behave as Bayesian decision-makers in order to combine the physician's advice about the effectiveness of medical care in a particular health stage with the individual's own prior belief. He contends that the demand for and supply of information should be an integral part of modeling consumer's health and medical care utilization. His empirical work focuses on the proposition that the more (less) informed are less (more) responsive to information than the ignorant (the availability effect). Dardanoni and Wagstaff (1990) analyzed the effects of uncertainty on the demand for medical care using a simplified version of Grossman's human capital model of demand for health. Distinguishing between two types of uncertainty, namely the uncertainty surrounding the incidence of illness and the uncertainty surrounding the effectiveness of medical care, they examined the effects of changes in the extent of both types of uncertainty on the demand for medical care and undertook two types of comparative static analysis. The first was a Rothschild-Stiglitz increase in risk: the mean of the variable in question (the marginal product of medical care) remains unchanged but its riskiness alters. The second was a second-order stochastically dominating shift: an increase in the mean of the variable in question is accompanied by a reduction in its riskiness. Their results are as follows. A Rothschild-

Stiglitz increase in uncertainty surrounding the incidence of illness results in an increase in the demand for medical care under plausible assumptions assuming that consumption is normal good and the individual is risk averse. The same result is obtained when the increase in uncertainty is accompanied by a reduction in the expected basic level of health. An increase in the expected effectiveness of medical care is found to be reduce the demand for medical care in the plausible case where the elasticity of demand for health with respect to its shadow price is less than one. In this case, the demand for medical care will increase, providing the two-good index of relative risk aversion is non-increasing in medical care consumption. The same result is obtained when the increased uncertainty is accompanied by a reduction in the expected effectiveness of medical care.

2. Empirical research related to the demand for medical care by the elderly.

Most of the studies on medical care utilization by the elderly have been focused on the role of supplemental insurance coverage to Medicare enrollees (Medigap), noticing that approximately 78 percent of the elderly and 7.6 percent of the elderly have some type of private health insurance coverage and Medicaid coverage, respectively. One of the major reasons for the elderly to have supplemental coverage to Medicare is that Medicare enrollees must pay deductibles, coinsurance fees, and other costs of medical care not paid by Medicare. Also, the elderly choosing nonhospital Medicare coverage (Part B) must pay a premium.

Except for the famous Rand Health Insurance Experiment, which used random assignment to investigate the impact of differential health insurance coverage on the level of health care services utilization, most of empirical studies on the medical care utilization have used nonexperimental, retrospective data from surveys that ask the household or individual about its insurance and use of services. One of the major advantages of using data from the controlled experiment like the Rand Health Insurance Experiment over that of the nonexperimental, retrospective data is that random assignment of insurance coverage to household or individual would allow the determinants of medical care use to be estimated without bias by eliminating endogeneity of insurance or price variables. However, the Rand HIS excluded the elderly aged 65 and over from its sample.

Some studies have examined the factors that determine the purchase of private health insurance by Medicare enrollees. Most of previous studies has indicated the importance of individual characteristics in the determinants of Medigap insurance ownership. Long et al. (1982) analyzed variation in the supplementation decisions across Medicare enrollees using the data from the 1976 Survey of Income and Education (SIE). They specified separate reduced form estimating probit equations for the two general forms of supplementation: private and Medicaid. Important findings were reported for three key determinants of supplementation: income, race, and age (serving mainly as a proxy for health status). Using data from the National Medical Care Expenditure Survey (NMCES), Cafferata (1985) found that, in 1977, private health insurance held by the Medicare population was more likely to cover inpatient than outpatient services and cover short-term than long-term hospital stays. Multivariate logistic analyses show that the distribution of Baucus-like insurance policies is highly associated with health status, source of insurance, region, and place of residence.[8] Garfinkel et al. (1987) investigated how personal and community characteristics affect coverage by private insurance to supplement Medicare. Data from the 1980 National Medical Care Utilization and Expenditures Survey were used. Their finding was that supplemental coverage was positively associated with education, income, number of self-reported chronic conditions, being white, being married, and having a regular source of care. Private coverage was negatively associated with Medicaid coverage and age. No effects were found for community characteristics, except for U.S. Census Region. Regional variation with measures of local medical resource availability and cost of living had no effect. Wilcox-Gök and Rubin (1994) examined the decision to have private health insurance by elderly Medicare enrollees. Data for the analysis was the 1984 Survey of Income and Program Participation (SIPP). Models allowing both simultaneity and a joint error structure between health insurance and use of medical care are considered. They found that common unobserved variables underlying the joint errors are important determinants in the decision to purchase private health insurance. Simultaneity is present only between the decision to have private health insurance and the probability of visiting a doctor.

A few studies focusing on utilization and expenditures for medical care indicate that health insurance coverage and other economic variables play a significant role in the decision to seek medical care. Christensen et al. (1987) estimated the effect of Medigap insurance coverage on aged Medicare enrollee's use of services with a multivariate model

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[8]Public concern about the level of benefits in relation to premiums, duplicative coverage, the complexity and difficulty of insurance and marketing abuses resulted in the passage of section 507 of the Social Security Amendments of 1980, also known as the Baucus legislation. This legislation provides for federal supervision of state certification of private insurance sold to Medicare beneficiaries. Cafferata, G. L. (1985), pp. 1086 - 1087.

of health services utilization. They compared the utilization behavior of Medicare enrollees having private insurance supplements to those with no supplementary coverage, statistically controlling for other determinants of utilization. A two-part model of utilization behavior was used. Data for the study came from the 1984 Health Interview Survey (HIS). Medicare enrollees having Medigap coverage use 24 percent more inpatient hospital and physician's services than enrollees having no supplementary coverage, holding all other determinants of use at their mean values. In the case of inpatient hospital services, Medigap increases the probability of one or more admissions by about 27 percent, while having a small and statistically insignificant effect on the number of inpatient days among users. Finding Medigap's effect limited to admissions and not extending to length of stay was because Medigap pays Medicare's large first-day hospital deductibles. However, their study disregarded possible simultaneity between health insurance coverage (Medigap) and utilization of medical care.

McCall et al. (1991) examined the impact of supplemental health insurance policy ownership on the use of health care services by the elderly. The data on the utilization of Medicare services was taken from the Medicare Automated Data Retrieval System (MADRS), which is a summary file of data of Part A and Part B Medicare paid claims. The data base consists of Medicare claims data from over 2,000 beneficiaries in six states, actual copies of their supplemental insurance policies, and detailed survey information. Their main findings was that ownership of supplemental insurance has a large effect on utilization and cost experience of Medicare beneficiaries. Other findings of their study were, first, perceived health status was an important factor in determining the magnitude of the utilization and cost, second, people owning policies with first-dollar coverage appeared to have substantially greater Medicare use and cost experience.[9] Major problems on their study, in addition to not controlling for the possible simultaneity of the insurance variables are; first, the sample is limited to six states; second, the MADRS data set used a stratified sampling method, that is, not a random sample. Regression results would be biased if not corrected, especially the standard errors of the regression coefficients.

Wolfe and Goddeeris (1991) have attempted to separate the moral hazard effect of Medicare supplementary (Medigap) insurance on health care expenditures from the adverse selection effect of poor health on Medigap coverage, and identified some important empirical regularities using the data from the Retirement History Survey (RHS). The RHS was conducted by the Social Security Administration between 1969 and 1979 and was designed to provide a longitudinal profile of a cohort moving into retirement. One major finding was that they found evidence of adverse selection, but its magnitude was unlikely to create serious efficiency problems. Accounting for selection effects in the demand for insurance reduced the estimated moral hazard effect of insurance on the demand for health care. Another result was that residuals from equations for lagged health expenditures - equations that include insurance status as an explanatory variable - had a statistically significant effect on the demand for insurance. They interpreted this effect as an indication of a particular form of adverse selection. In addition, they found a strong positive wealth effect on the demand for supplementary insurance.

Cartwright et al. (1992) estimated the demand for Medigap insurance and for expected total medical care expenditures. They used the 1977 National Medical Care and

[9] About 77.3 percent of the elderly on their sample had First-Dollar Coverage (hospital or physician) which is supplemental health insurance, such as a Medigap, HMO, or major medical policy or an employer group policy.

Expenditure Survey (NMCES). It was found that higher levels of coverage were associated with increased expenditures through higher probabilities of incurring a medical expense and increased levels of expenditures. Those with poor health had a smaller likelihood of having insurance than those with better health status, contrary to the notion of adverse selection. Non-whites were at a disadvantage in terms of the probability of having Medigap insurance and expected medical expenditures. A specification test on the simultaneity of the model was performed using the test by Wu (1973) to examine the independence of error term of the equation and the theoretical endogenous regressors in the model.[10] The simultaneity of the model was rejected by the data set.

Vistnes and Banthin (1996) analyzed the role of attitudes toward medical care and risk in the Medicare supplemental market. In addition, they investigated the factors affecting the demand for any supplemental insurance, specific Medigap benefits and medical care. The data used in their analysis were from the 1987 National Medical Expenditure Survey (NMES) and from the Health Insurance Plan Survey (HIPS). Their results indicated that consumer's attitudes toward medical care significantly affected beneficiaries' decision to purchase supplemental insurance and medical care, thus, supported the presence of adverse selection in the demand for Medicare supplemental insurance.

Overall, these studies suggest that; first, the importance of individual characteristics in the determinants of Medicare supplemental insurance ownership is confirmed; second, health insurance coverage and other socio-economic variables play a significant role in utilization and expenditures of medical care by the elderly.

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[10]Simultaneity between the demand for Medigap health insurance and the demand for medical care

III. Theoretical Model

The model used in the present paper is basically the same as that of Grossman(1972). Following the interpretation and notation of Wagstaff (1986), the model is as follows. The individual is assumed to derive utility according to the function U(s(t), Z(t)), where s = s(H(t)) is sick time, H(t) is the stock of health capital and Z(t) is a composite consumption commodity: $U_1 \leq 0$, $U_2 > 0$, $U_{11} \geq 0$, $U_{22} < 0$, $s'(.) < 0$ and $s''(.) > 0$. Z(t) has a marginal (and average) cost equal to $\pi^z(t)$. At time 0 the individual inherits an initial stock of health capital, H_0: thereafter the stock evolves according to the relationship

$$\dot{H}(t) = I(t) - \delta(t)H(t), \quad (1)$$

where $\dot{H}(t)$ denotes net investment, *I(t)* gross investment and $\delta(t)$ the rate of depreciation. The latter is assumed to depend on the individual's age and on a vector of exogenous determinants of use-related depreciation, such as work environment, housing conditions, etc. (Cropper (1981), Muurinen (1982)). I(t) has a marginal (and average) cost equal to $\pi^H(t)$, which is assumed to be independent of I(t) and H(t). The independence of $\pi^H(t)$ and I(t) rules out adjustment cost - i.e., costs associated with the 'acquisition' of new health capital over and above the basic cost of health investments. The absence of adjustment costs means that individuals will adjusts to their desired stocks of health capital instantaneously (Grossman 1972).

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measured in expected medical expenditures was specified in the test model.

The individual faces an asset accumulation constraint

$$\dot{A}(t) = rA(t) + y(s(t)) - \pi^{H}(t)I(t) - \pi^{Z}(t)Z(t), \tag{2}$$

where *A(t)* is the stock of financial assets, $\dot{A}(t)$ its rate of changes over time and *y(t)* earned income. The boundary conditions are $H(0)=H_0$, $A(0)=A_0$, $H(T)\geq H'$ and $A(T)\geq 0$, where H' is the 'death stock'. If ρ is the rate of time preference, the individual's problem is to choose time paths for H(t) and Z(t) so as to maximize the life time utility function, i.e.,

$$\text{Maximize} \int_0^T e^{-\rho t} U(.)dt, \tag{3}$$

subject to $\dot{H}(t) = I(t) - \delta(t)H(t)$,

$$\dot{A}(t) = rA(t) + y(s(t)) - \pi^{H}(t)I(t) - \pi^{Z}(t)Z(t),$$

The equilibrium condition for health capital is

$$[\{U_I(.)/\lambda(0)e^{(\rho-r)t}\}+y'(.)]s'(.)=\{r+\delta(t)-\tilde{\pi}^{H}(t)\}\pi^{H}(t), \tag{4a}$$

where $\lambda(0)$ is the shadow price of initial assets and $\tilde{\pi}^{H}(t) = \dot{\pi}^{H}(t)/\pi^{H}(t)$ is the percentage rate of changes of $\pi^{H}(t)$. Following Grossman the model assumes $y(t)=w(t)[\Omega(t)-s(t)-T^{z}(t)-T^{H}(t)]$, where w(t) is the wage rate, $\Omega(t)$ total time available and

$T^z(t)$ and $T^H(t)$ are the time inputs in the production of Z(t) and I(t), respectively: thus y'(.) = -w(t).

The equilibrium condition for Z(t) and the lifetime full wealth constraint are as follows.

$$[U_2(t)/\lambda(0)e^{(\rho-r)t}]=Z(t), \tag{4b}$$

$$A(0)+\int_0^T e^{-rt}\left[Y(t)-\pi^H(t)I(t)-\pi^Z(t)Z(t)\right]dt=0, \tag{4c}$$

Based on equations (4a) and (1) and taking logarithm, imposing the restriction y'(.) gives the equilibrium condition for health capital for the pure consumption model, namely

$$\ln[U_{1i}(t)s'_i(t)-\ln\lambda_i(0)-(\rho-r)t_i = \ln\delta_i(t)+\ln\pi_i^H(t)-\ln\Psi_i(t), \tag{5}$$

where $\Psi(t)\equiv\delta[r+\delta(t)-\tilde{\pi}^H(t)]$ and the subscript i denotes reference to the i th individual.

Imposing the restriction $U_1(.)=0$ gives the analogue for the pure investment model, that is,

$$\ln[-s'(.)]+\ln w_i(t)=\ln\delta_i(t)+\ln\pi_i^H(t)-\ln\Psi_i(t), \tag{6}$$

To estimate, specific assumptions need to be made about the form of the functions s(.), δ(.), π^H(.), and U(.). Following Grossman the model assumes s(.) to be of the form

$$s_i(t)=\beta_1 H_i(t)^{-\beta 2}, \tag{7}$$

where β_1 and β_2 are positive constants. Following Cropper (1981) the depreciation rate function, δ(.), is assumed to be of the form

$$\ln\delta_i(t)=\ln\delta_0+\beta_3 t_i+\beta_4 X_{1i,}, \tag{8}$$

where X_i is a vector of environmental variables. If the stock of health capital depreciates at an increasing rate as the individuals ages, $\beta_3>0$. If the various variables in X_1 are damaging to health, each of the components of β_4 will be positive. Following Grossman, I(.) is assumed to be produced by combining time and medical care according to a Cobb-Douglas, constant-returns-to-scale production function, giving rising to a marginal cost function, π^H(.), of the form

$$\ln \pi_t^H(t) = (1-\beta_5)\ln w_i(t) + \beta_5 \ln P_i^m(t) + \beta_6 E_i, \tag{9}$$

where $P^m(t)$ is the price of medical care at time t, E is a vector of the stock of human capitals like education variables, $0<\beta_5<1$ and the components of β_6 are negative if education increases non-market productivity. To simplify the analysis, U(.) is assumed to be strongly separable-i.e., $U_{12}=U_{21}=0$. The utility function is assumed to be of the form

$$U_i(t)=\beta_7 S_i(t)^{\beta_8}+g(Z(t)), \quad (10)$$

where $\beta_7<0$, $0<\beta_8<1$ and g(.) is some functions.

Using (6) and (8) one can derive a demand for health functions for the pure investment model of the form

$$\ln H_i(t)=\beta_{10}+\beta_5\varepsilon\ln w_i(t)-\beta_5\varepsilon\ln P_i^m(t)-(\beta_3-\beta_9)\varepsilon t_i-\beta_6\varepsilon E_i-\beta_4\varepsilon X_{1i}+u_{1i}(t), \quad (11)$$

where $\beta_{10}=\varepsilon\ln\beta_1\beta_2$, $\varepsilon=1/(1+\beta_2)$ is the elasticity of the 'marginal efficiency of capital' (MEC) schedule and $u_{1i}(t)=-\varepsilon\ln\delta_0$. Providing $\beta_2>0$, and $0<\varepsilon<1$, the term u_{1i} is treated as an error term with zero mean and constant variance - the practice adopted by Grossman(1972). Using (5) and (7) to (10) one can derive a '$\lambda(0)$-constant', the constant shadow price of initial assets, demand for health function for the pure consumption model of the form

$$\ln H_i(t)=\beta_{11}-\gamma\ln\lambda_i(0)-(1-\beta_5)\gamma\ln w_i(t)-\beta_5\gamma\ln P_i^m(t)$$
$$-[(\beta_3-\beta_9)+(\rho-r)]\gamma t_i-\beta_6\gamma E_i-\beta_4\gamma X_{1i}+u_{2i}, \quad (12)$$

where $\beta_{11}=\gamma\{\ln[-\beta_7\beta_8]+\beta_8\ln\beta_1\}$, $u_{2i}=-\gamma\ln\delta_0$ and $\gamma=[1/(1+\beta_2\beta_8)]$ is the elasticity of demand for health capital. Since $\beta_2>0$ and $0<\beta_8<1$, $0<\gamma<1$. The partial derivative of (12) with respect to $\ln P^m(t)$, i.e., $-\beta_5\gamma$, gives the effect of a change in the price of medical care which leaves $\lambda(0)$ unaffected.

Using (1), I(.) and the cost-minimizing condition for health investment one can derive a structural demand for medical care function of the form.[11]

$$\ln M_i(t)=\beta_{12}+\ln H_i(t)+(1-\beta_5)\ln w_i(t)-(1-\beta_5)\ln P_i^m(t)+\beta_3 t_i+\beta_4 X_{1i}+\beta_6 E_i+u_{3i}(t), \qquad (13)$$

where $\beta_{12}=-(1-\beta_5)\ln[(1-\beta_5)/\beta_5]$ and $u_{3i}(t)=\ln\delta_0+\ln[1+\tilde{H}_i(t)/\delta_i(t)]$. The above equation is used as the theoretical model of determinants of the demand for medical care in this paper. Grossman assumed $\tilde{H}_i(t)/\delta_i(t)=0$, while Muurinen(1982) assumed it to be constant across the sample. The present study treats $u_{3i}(t)$ as an error term (Wagstaff, 1986). The interpretation of the parameters of (13) is as follows. Consider, for example, the effect of a wage increase in the pure investment model. To find the total elasticity of the wage increase on the demand for medical care differentiate (13) with respect to $\ln w(t)$ - i.e.,

$$\frac{\partial \ln M_i(t)}{\partial \ln w_i(t)}=\frac{\partial \ln H_i(t)}{\partial \ln w_i(t)}+(1-\beta_5).$$

[11]For specific derivation of the equation, see Grossman's seminal paper, "The Demand for Health: a Theoretical and Empirical Investigation," pp. 97 - 98.

The first term on the right-side is equal to $\beta_5\varepsilon$ from (11): this gives the effect of the wage change operating through the optimal health stock and is expected to be positive. The second term captures the substitution of medical care for time in the production of health investments as time becomes relatively more expensive. The assumption by Grossman that health investments are produced according to a constant returns Cobb-Douglas technology means that the elasticity of substitution between time and medical care is assumed to be one. The coefficients on $\ln w(t)$, $\ln P^m(t)$, t, X_1, and E in (13) therefore indicate the effects of changes in these variables on the demand for medical care which do not operate through the optimal health stock.

IV. Description of Data

The 1987 National Medical Expenditure Survey(NMES) is a research project of the Center for General Health Services Intramural Research, Agency for Health Care Policy and Research, U.S. Dept. of Health and Human Services. The 1987 NMES provides information on health expenditures by or on behalf of families and individuals, the financing of these expenditures, and each person's use of services. The Household Survey is fielded over four rounds of personal and telephone interviews at a four-month intervals. Baseline data on household composition, employment, and insurance characteristics were updated each quarter, and information on all users of and expenditures for health care services and sources of payment was obtained.

The universe for the household sample is noninstitutionalized civilian population of the United States. The sample is designed to provide statistically unbiased estimates that are representative of the civilian population of the United States in 1987. The Household Survey sample is a stratified multistage area probability design with a total sample of roughly 35,000 individuals, in 14,000 households, who completed all rounds of data collection. Oversampling of the population subgroups of special policy interest was based on a separate screening interview conducted in the fall of 1986 with a sample of 36,000 addresses. The special policy interest groups include poor and low-income families, the elderly, the functionally impaired, and Black and Hispanic minorities.

The 1987 NMES surveys intend to yield comprehensive information that will support studies of most population groups of policy interest, including those presently outside the scope of various public and private financing mechanisms. NMES data can be used to analyze all public and private sources of coverage for health care services and out-of-pocket payments by individuals and families.

For my analysis, I use three data sets from the 1987 NMES survey. Three data sets are as follows.

(1) National Medical Expenditure Survey, 1987: Household Survey, Population Characteristics and Person-Level Utilization, Rounds 1-4 Public Use Tape 13.

(2) National Medical Expenditure Survey, 1987: Household Survey, Ambulatory Medical Visit Data Public Use Tape 14.5.

(3) National Medical Expenditure Survey, 1987: Household Survey, Health Status Questionnaires and Access to care Supplement Data Public Use Tape 9.

Public Use Tape13 contains full-year person-level characteristics and utilization data collected in 1987 in Rounds1-4 of the HS. The tape is intended to serve as the base tape for all other public use tapes with full-year HS data. It contains detailed information on eligibility status and survey administration variables for all persons in the HS sample. It also contains both edited and constructed variables describing demographic and family relationships, income, disability, employment, health insurance status, and utilization data for all of 1987. Public Use Tape 14.5 provides three data files containing information on the use of and expenditures for ambulatory medical services reported in the Household Survey. An ambulatory visit is defined as a single contact with a medical provider for one or more services in either a hospital outpatient department or emergency room, a setting other than an inpatient hospital(such as a physician's office, a clinic, or a lab), a nursing home, or a person's home. Public Use Tape 9 provides one data file containing person level data from two Household Survey instruments: the health status questionnaire and the access to care supplement. The health status questionnaire as administered in three versions to obtain age-specific information for adults ages 18 and older and children aged 5 to 17 years and less than 5 years, respectively. Information was elicited on current and past health status, including acute and chronic conditions, vision and hearing, dental status, mental health and functional ability as well as health related behaviors, including care seeking and preventive care. Questions about access to and usual sources of medical and dental care included questions identifying a usual source of care and the characteristics of both the usual source of care and regular medical providers. Availability and convenience measures were obtained for the usual source of care, including hours of practice, travel and waiting time, and related items. Reasons for the lack of a usual source of care were elicited and a final set of questions inquired into sources of care in the face of illness, including reasons why care was needed but could not be obtained.

V. Empirical Implementation

1. The Empirical Model and Estimation Techniques

Since the main purpose of this paper is to find the determinants of medical care by the elderly, the equation (13), the derived demand function for medical care from the theoretical model, should be used for empirical tests. However, the empirical model is specified differently for the following reasons. First, some variables that do not appear in the theoretical model are included. Since the main purpose of the theoretical model is to show the effects of the major determinants on the demand for medical care under a number of simplifying assumptions, the variables shown in equation (13) of the demand for medical care are only health status ($H_i(t)$), wage components ($w_i(t)$), price ($P^m{}_i(t)$), age (t_i), use-related depreciation variables (X_{1i}), and the stock of human capital (E_i). To investigate thoroughly the effect of other possible determinants as well as those major determinants on the demand for medical care, additional variables are included. Additional variables included in the empirical specification are a vector of taste for medical care or attitudes toward the value of medical care (T^m), a vector of relevant regional characteristics (R) that serves as proxy measures of environmental conditions, and a vector of family efficiency characteristics (F). Second, while the theory underlying the demand for health and the demand for medical care specifies marginal price in the first-order conditions and price per unit is assumed to be constant, empirically the true marginal price can not be observed because of the complexity of insurance policies, especially if a deductible is present or if an insurance plan has zero coinsurance rate. In the equation of use/non-use of medical care services, the specification of the price variable is more difficult. The marginal price can not be computed when a person has had no visits. Therefore, in this research, the marginal price is replaced by dummy insurance coverage variables in the use/non-use function. In the conditional visits function, the marginal price is measured as total yearly out-of-pocket price divided by the total medical care expenditures (coinsurance rate). Also, since most of the elderly are not full or part-time workers a wage rate can not be included. Instead, a dummy variable for working status is included.

The empirical specification of the medical care demand model consists of two equations. The decision to obtain care and the number of visits should be treated as separate dependent variables. Equation (14) describes the probability of positive physician visits (V), the decision to obtain care, and equation (15) describes the demand for visits, the number of visits, conditional on any use:

$$Pr(V > 0) = Pr(H_i(t), w_i(t), I_i, t_i, X_{1i}, E_i, T^m, R, F) \qquad (14)$$

$$V(V \mid V > 0) = V(H_i(t), w_i(t), P^m_i(t), t_i, X_{1i}, E_i, T^m, R, F) \qquad (15)$$

where, $H_i(t)$ is health status, $w_i(t)$ is wage, I_i is the health insurance status, $P^m_i(t)$ is price of medical care, t_i is age, X_{1i} is use-related depreciation rate: sex, marital status, and working status, E_i is the stock of human capital like education level, T^m is a vector of taste for medical care or attitudes toward the value of medical care, R is a vector of relevant regional characteristics, and F is a vector of family efficiency characteristics: family income to measure command over resources, family size.

To estimate equations (14) and (15) both the two-equations model (Cragg 1971, Newhouse and Phelps 1976, Colle and Grossman 1978) and the sample selection model (Heckman 1976, 1979) are considered. The rationales for using each model are as follows. The two-equations model assumes that the demand for medical care is a two-part decision-making process: whether to use any care, and how much to use when the individual chooses use to some. These decisions differ because the initial decision of whether to seek care is made entirely by the individual whereas subsequent decisions involve the doctor. The decision as to whether to seek care is estimated by the logit/probit technique. The dependent variables are set equal to one if the individual used medical care, a visit to physician's office, zero otherwise. The amount of care used by those individuals who decide to use care is estimated by ordinary least squares.

Another specification of the medical care demand model considered here is the sample selection model. The model assumes if there are common omitted variables that explains both the decision to use medical care and demand conditional on use, the error terms in equations (14) and (15) will be correlated. The sample selection model explicitly models the correlation between the probability of any use and the level of use. The sample selection model which is introduced by Heckman is based on a dichotomous selection mechanism.[12] In the selected sample,

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[12]The seminal article on the subject is Heckman, J., 'Sample Selection Bias as a Specification Error,' *Econometrica*, January, 1978).

$$E[yi \ xi, \text{in sample}] = E[y_i | x_i, z=1]$$

$$= E[y_i | x_i, \alpha' w_i + u_i > 0]$$

$$= \beta' x_i + E[\varepsilon_i | u_i > -\alpha' w_i]$$

$$= \beta' x_i + (\rho\sigma_\varepsilon\rho_\mu\{\varnothing(-\alpha' w_i)/[1 - \Phi(-\alpha' w_i)]\}$$

$$= \beta' x_i + (\rho\sigma_\varepsilon\rho_\mu\{\varnothing(\alpha' w_i) / \Phi(\alpha' w_i)\}$$

where primary regression, a classical regression model, is

$$y = \beta' x_i + \varepsilon.$$

Observation mechanism, a regression model, but z* is unobserved, is

$$z^* = \alpha' w_i + u_{i.}$$

The probit model for observed z is

$z = 1$ if $z^* > 0$, otherwise $z=0$,

y is only observed when $z=1$.

The stochastic specification is

$E[\varepsilon] = E[\mu] = 0$,

$Var[\varepsilon] = \sigma^2$, $Var[\mu] = 1$, $Cov[\varepsilon,\mu] = \rho\sigma$, where ε and μ have a bivariate normal distribution.

Given the structure of the model and the nature of the observed data, ρ_μ can not be estimated, so it is normalized to 1. Then,

$$E[yi | xi, \text{ in sample}] = \beta' x_i + (\rho\sigma_\varepsilon)\lambda_i$$

$$= \beta' x_i + \theta\lambda_i$$

Heckman's two-step method which is based on the method of moments and is consistent, rather than efficient, is

1. Use a probit model for z to estimate α.

   For each observation, compute $\lambda = \varnothing(\alpha' w_i) / \Phi(\alpha' w_i)$ using the probit coefficients

2. Linearly regress y on x and λ to estimate β and $\theta = \rho\sigma_\varepsilon$.

   Adjust the standard errors and the estimate of σ_ε^2, which are inconsistent.

The correct asymptotic covariance matrix for the two step estimator is

$$\text{Asy. Var}[\beta,\theta] = \sigma^2_\varepsilon(X^{*\prime}X^*)^{-1}[X^{*\prime}(I-\rho^2\Delta)X^* + \rho^2(X^{*\prime}\Delta W)\Sigma(W'\Delta X')](X^{*\prime}X^*)^{-1},$$

where $X^* = [X : \lambda]$,

$\Delta = \text{diag}[\delta]$,

$\delta_i = -\lambda(\alpha' w_i + \lambda_i)$ $(-1 \leq \delta_i \leq 0)$,

and Σ = asymptotic covariance matrix for the estimator of α.

A consistent estimator of σ_ε^2 is

$$\hat{\sigma}_\varepsilon^2 = e'e / N - \hat{\theta}^2 \bar{\delta}$$

In empirical studies in health economics, there have been continuing debates between advocates of the two models, the sample selection model and the two-equation (two-part) model. Duan et al. (1983, 1984, 1985) and Manning et al (1987) criticized against the sample selection model and proposed a two-part non-selection model as an alternative. They rejected the sample selection model for the following reasons. First, the sample selection model usually assumes that the functional form is known a priori and that the functional form must be such as to yield a bivariate normal error. However, they argue that the assumption in the self-selection model regarding the censored part of the distribution is untestable because the censored data are unobservable. Second, the sample-selection model's interpretation is inappropriate for modeling health expenditure data. The sample selection model estimates an unconditional (uncensored) expenditures equation that describes the expenses that all individuals including nonspenders would have if they were all spenders. However, they argue that the unconditional equation is not the equation of interest but, rather, conditional equation is. The zero spenders are not cases with missing expenses, rather, these individuals have zero expenses. Third, the sample selection model has poor numerical and statistical properties. They argue that the likelihood function of the selection model has nonunique local maxima, thus it is difficult to separate selection effects from heteroscedasticity and nonlinearity, and is needed to distinguish selection effects to obtain a consistent estimate of the expected expense.

Manning, Duan, and Rogers (1987) using split-sample validation show that models such as the two-equation model can be more robust, and are no worse than the sample selection model when the data are truly generated by a selection model. The Monte Carlo study was performed to examine the relative performance of sample selection and two-part model for data with a cluster at zero. They assumed that the true model was a selection model where the error terms in the two equations have a bivariate normal distribution with a non-zero correlation. By assuming the true model is of the selection variety, they put the two-part model to a worst-case test by examining the resulting bias in the prediction of the overall outcome from using a two-part model that does not estimate the correlation directly. Three conclusions are drawn. First, if one knows the true specification but does not estimate the correlation, then predictions using a two-part model are nearly unbiased on average. Second, if one does not know the true specification, but uses the data to find a satisfactory specification, then the overall prediction bias in the two-part model is negligible. Finally, the sample selection model is not numerically well behaved, even when it is the true model and the analyst knows the true specification, unless there are non-trivial exclusion restrictions.

To defend the sample selection model, Hay and Olson (1984) argue that the two-part model is built on some unusual assumptions and that it can be nested in the sample selection model. That is, the two-part model's likelihood function is nested in the more general sample selection model likelihood function. They argue that the two-part model may generally be interpreted asymptotically biased and inconsistent since the model is isomorphic to a restricted parameter likelihood function for a sample selection model.

Leung and Yu (1986) try to resolve the debates between advocates of the sample selection model and the two-part model. They conduct a set of Monte Carlo experiments to compare the performance of the sample selection and two-part models. Their results show that the relative merits of the two models depend on different conditions. That is, when the sample selection model is the true model, it performs substantially better than the two-part model as long as there are no collinearity problems between the inverse Mills' ratio and the regressors. When the two-part model is the true model, the sample selection model is inferior, but it is still reasonably close to the two-part model. Leung and Yu contend that Manning, Duan, and Rogers' negative results regarding the sample selection model are caused by a critical design problem. They demonstrate that Manning et al.'s data generating process produces serious collinearity problems that bias against the sample selection model. They show that, when the regressors are drawn from U(0, 10), the collinearity problems vanish and the sample selection model behaves much better than the two-part model.[13] Leung and Yu also find that Heckman's two-stage estimator is susceptible to collinearity problems. They show that models with few exclusion restrictions, a high degree of censoring, a low variability among the regressors, or a large

[13]U(0, 10) denotes a uniform distribution with range [0, 10].

error variance in the choice equation can all contribute to near collinearity between the regressors and the inverse Mill's ratio, rendering the two-stage estimator ineffective. Their final suggestion is that researchers should check for high collinearity in the level of equation whenever they implement the Heckman's two-stage procedure.

In this research I decide to implement the two-equation model (two-part model) as a primary empirical model and to analyze and include the results in the text. The results from the sample selection model are included in appendix for purpose of comparison. The reasons for using the two-equation model as a primary empirical model are as follows. First, according to Leung and Yu (1986) the two-equation model may be better than the sample selection model when some variables that enter the probit are not omitted from the equation determining the primary variable (the number of visits equation). In this research every variables that enters the probit also enter the number of visits equation. Second, the inverse of the Mills ration is highly correlated with the regressors in this research. There have been a number of diagnostic statistics for detecting mulicollinearity. Many researchers including Leung and Yu believe that the condition number is the best available collinearity diagnostic.[14] A condition number greater than 30 is considered serious and indicative of collenearity problems. Here, I employed the diagnostic tool of the condition number to test the collinearity problem between the inverse of the Mills ratio and right-hand side variables of the two age groups, adults ages 18 and over and the elderly ages 65 and over. The condition numbers are 50.57 and 73.64, respectively. Since we can conclude that the inverse of the Mills ratio is highly correlated with right-hand side variables the two-equation model may outperform the sample selection model. Third, as

Duan et al. mentioned the sample selection model pertains to a case when a variable (visits in this research) is not observed for some variables. However, here, visits are observed and equal to zero for nonparticipants.

The two dependent variables are the probability of a visit to the physician's office, and the number of visits for those who visit at lease once. These measures are selected as the most meaningful and reliable measures available. Also I estimate separate demand functions by age groups; the elderly aged 65 and over, adults between ages 40 and 64, and adults between ages 18 and 39. Since, in the preliminary analysis, age variables to measure the depreciation of the health stock are significant factors in the demand for medical care assume that the elderly's demand for medical care is different from that of ordinary adults.

2. Definition of Variables Used and Expected Effects

Equations (14) and (15) are estimated using the 1987 National Medical Expenditure Survey (NMES) data for the elderly ages 65 and over. Separate estimates for adults between the ages 18 and 39 and adults between the ages 40 and 64 are presented for purposes of comparison. Observations are deleted if there are missing data. Table 1 contains definitions of all of the dependent and independent variables for the regression. The final sample size of the elderly is 3,514. Table 2 contains the mean and standard deviation values for the sample of each of three age groups, i.e., the elderly, adults

[14]The condition number is defined as the square root of the ratio of the largest to the smallest eigenvalue of the moment matrix X'X.

between ages 40 and 64, and adults between ages 18 and 39. The final sample sizes of adults between the ages 18 and 39 and adults between the ages 40 and 64 are 7,052 and 4,992, respectively.

The Dependent Variables

The dependent variables can be various measures of the volume of physician office care. In quantifying demand (the medical care utilization) two different measures are possible - expenditures and physical units of utilization. Expenditures provide a ready metric for aggregating disparate services, but they suffer from two potential disadvantages.[15] First, insofar as prices do not reflect marginal cost, variation in expenditures has ambiguous welfare implications. Second, if the gross price for a given medical services changes when insurance changes, induced variation in expenditure need not closely correspond to induced variation in real resource use. Alternatively, demand in physical units such as physician visits can measure real resource use. However, this measure also has problems. Measuring in physical units may suffer from incompleteness. That is, visits can differ markedly in their intensity and a simple count of visits does not capture such variations. With the above mentioned pros and cons for each of the measures, as well as the limitation of the data used in this research, demand in physical units is employed as dependent variables in this research. The use of physician office visits is explained with DRVISITS and LOGVISIT. DRVISITS is a dichotomous variable that equals 1 if a person had at least one physician office visit in 1987 and equals zero if a person had no

[15] See Newhouse (1981).

visits. LOGVISIT is the logarithm value of the number of physician office visits during the year 1987. Since the distribution of visits among users is highly skewed, the logarithm transformation of total visits practically eliminates the undesirable skewness in the distribution of visits among users and thus yields nearly symmetric and roughly normal error distribution (Duan et. al., 1982 and 1983).

Price and Insurance Variables

In the physician office visit equation, the variable PRICE represents the price paid for a marginal unit (net of insurance benefits) measured in dollars. The theory underlying either an investment model (Grossman, 1972) or a consumption model (Grossman, 1972; Phelps, 1973) specifies marginal price in the first-order condition; excluding the Giffen good case, a negative sign is expected. However, the theory assumes that price per unit is constant, and this assumption is violated if a deductible is present in the health insurance policy. Due to data limitations on the individual insurance policy, I have to disregard deductibles in the insurance policy in calculating marginal price. Then, the measure of price defined here is the ratio of total yearly out of pocket expenditures to total yearly charge or imputed price (total yearly expenditures whether or not paid by the consumer or the third party including the insurance company) for care they got in the physician office.[16] This is the definition of PRICE I employed.[17]

[16]Disregarding deductibles the measure of price used here is the same as the coinsurance rate. That is, cM/M = c, where c is the coinsurance rate, cM is out-of-pocket expenditures, and M is total yearly medical care expenditures.

[17]Newhouse and Phelps (1976) and Wedig (1988) used the similar definition of price.

Table 1
Variable definitions

Variable	Definition
DRVISITS	equals 1 if a positive visit to the physician's office in 1987
LOGVISIT	log value of the number of visits
VALUEMED	self perceived degree on the value of the medical care; the higher score the lesser value
FULLABOR	equals 1 if worked full year
EDUCAT	number of yeas in formal education
LASTAGE	age at the end year of the interview
FEMALSEX	equals 1 if female
NONWHITE	equals 1 if race is nonwhite
FAMSZALL	the number of people living in the same household
MARRIALL	equals 1 if married
WIDOWED	equals 1 if widowed
SMSA19	equals 1 if reside in one of 19 largest SMSA
SMSOTHER	equals 1 if reside in other SMSA
NOTHEAST	equals 1 if census region is northeast
MIDWEST	equals 1 if census region is midwest
SOUTH	equals 1 if census region is south
TIMEVAL	sum of reported round-trip travel and waiting time
FMINCALX	total family income
SQRTDAY	SQRT of restricted activity days
EXCEL	equals 1 if perceived health is excellent
GOOD	equals 1 if perceived health is good
FAIR	equals 1 if perceived health is fair
LIMITALL	equals 1 if had any physical activity limitation
CARECAID	equals 1 if had both Medicare and Medicaid
CAREPRIV	equals 1 if had both Medicare and private insurance
ONLYCARE	equals 1 if had Medicare only
ONLYPRIV	equals 1 if had private health insurance only
ALLINS	equals 1 if had Medicaid, Medicare, and private insurance
PRICE	total yearly out of pocket expenditures divided by the number of visits weighted by charge price.

Table 2
Means and standard deviations for age groups

Variable	Ages 65 and over		Between ages 40 and 64		Between ages 18 and 39	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
DRVISITS	0.85	0.35	0.73	0.44	0.63	0.48
LOGVISIT	1.55	0.90	1.20	0.92	1.00	0.88
VALUEMED	15.70	4.65	15.97	4.21	16.67	3.92
FULLABOR	0.08	0.26	0.64	0.48	0.73	0.44
EDUCAT	10.51	3.65	11.90	3.49	12.60	2.70
LASTAGE	73.61	6.60	51.36	7.60	28.70	6.04
FEMALSEX	0.61	0.49	0.58	0.49	0.56	0.50
NONWHITE	0.13	0.33	0.24	0.42	0.29	0.45
FAMSZALL	1.99	1.03	3.02	1.54	3.47	1.69
MARRIALL	0.57	0.50	0.73	0.45	0.52	0.50
WIDOWED	0.34	0.47	0.07	0.26	0.00	0.06
SMSA19	0.25	0.43	0.28	0.48	0.27	0.44
SMSOTHER	0.47	0.50	0.47	0.50	0.48	0.50
NOTHEAST	0.20	0.40	0.21	0.40	0.19	0.39
MIDWEST	0.27	0.44	0.26	0.44	0.26	0.44
SOUTH	0.35	0.48	0.36	0.48	0.37	0.48
TIMEVAL	45.02	36.58	46.34	40.90	44.95	37.04
FMINCALX	26,207	29,779	40,696	33,300	36,032	28,485
SQRTDAY	2.77	4.14	2.00	3.17	1.56	2.27
EXCEL	0.08	0.27	0.22	0.41	0.33	0.47
GOOD	0.44	0.50	0.51	0.50	0.56	0.50
FAIR	0.37	0.48	0.21	0.41	0.11	0.31
LIMITALL	0.77	0.42	0.42	0.50	0.15	0.35
CARECAID	0.076	0.260	0.012	0.110	0.003	0.054
CAREPRIV	0.780	0.410	0.019	0.130	0.0013	0.036
ONLYCARE	0.099	0.300	0.014	0.120	0.002	0.039
ONLYPRIV	0.016	0.130	0.790	0.410	0.750	0.430
ALLINS	0.020	0.140	0.001	0.032	0.00057	0.024
PRICE	0.44	0.37	0.49	0.41	0.48	0.43
Total number of observation	3,514.00		4,992.00		7,052.00	
DRVISITS=1	2,999.00	85.3%	3,655.00	73.2%	4,411.00	62.5%
DRVISITS=0	515.00	14.7%	1,337.00	26.8%	2,641.00	37.5%

Price can not be employed as an independent variable in the probability of getting any physician office visit (DRVISITS). Net price can not be computed when a person has no visits.[18] Therefore, in the probability of any use function, price is replaced by dummy variables that equals 1 according to each person's health insurance possession status (CARECAID, CAREPRIV, ONLYCARE, ONLYPRIV, ALLINS). CARECAID is a dummy variable equal to 1 if an individual has both Medicare and Medicaid in 1987. CAREPRIV is a dummy variable equal to 1 if an individual has both Medicare and a private insurance policy. ONLYCARE, ONLYPRIV, and ALLINS control for those who have Medicare only, private insurance only, and all of Medicaid, Medicare, and private insurance, respectively.

Considering that Medicare and Medicaid are integral parts in the welfare system for the elderly in the U.S., analyzing the effect of both programs on medical care utilization is another rationale for using insurance status variables here. Medicare began in 1966 as an insurance program for the elderly over 65 years of age. Medicare consists of two parts. Part A is primarily insurance for hospital services and is financed through payroll taxes.[19] It requires no premium payments by the elderly and is nearly universal among the elderly. Part B, an optional program largely for physician services, was initially financed half from general revenues and half from beneficiary premiums. The Congress has raised the share of general revenue financing to 75 percent attempting to keep down premium increases to the elderly. Because of the large subsidy, most of the Part A holders

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[18]For those who had no visit, Newhouse and Phelps (1976) used the coinsurance rate of the insurance policy as price and Chang-sup Lee (1994) calculated the virtual coinsurance rate for each person as price.
[19]Newhouse (1996), p. 160.

purchase Part B coverage.[20] The price system for hospitals was altered markedly in 1984 to pay a lump sum fees (prospective system) that varied by diagnosis, using Diagnosis Related Groups (DRGs) with government specifying the lump sum. The price system for physicians was markedly altered in 1992 to give the government greater control over total spending and to change relative prices among various physician services.[21] Medicare does not provide for full coverage or shares cost after a certain amount of out-of-pocket spending. In 1987, the Part A deductible is $520 that amount to the average cost of one day hospital stay.[22] Days 2 through to 60 of a hospital stay are covered in full, while days 61 through 90 require a copayment of 25 percent of the deductible per day. Any continued hospital stay after 150 days must be paid for in full by the beneficiary. Part B covers 80 percent of Medicare-allowed charges for physician services and some other services, after an annual deductible of $75 in 1987. Therefore Medicare opened a private market for supplemental "Medigap" insurance. Nowadays Medigap insurance is widespread in the U.S. In this research, more than 81 percent of the sample has Medigap insurance coverage.[23]

Medicaid provides for low-income people. Medicaid began as a federal-state partnership, for which Title XIX of the Social Security Act spelled out the overall structure of "eligible" Medicaid programs, and provided for federal support of state

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[20] 99 percent (Moon, 1983) or 95 percent (Newhouse, 1996) of the Part A holders have Part B coverage.

[21] Newhouse (1996), p. 161.

[22] The following specifications for Medicare deductibles and co-payment schedules are from Vistnes and Banthin (1996).

[23] About 90 percent of the Medicare holders has some kinds of Medigap insurance coverage in the data for this research.

programs. The Medicaid programs are run by individual states to finance health services for certain categories of the needy whose economic status is seen as largely beyond their control. These eligible poor include dependent children, the elderly, the blind, and the disabled. The states, in return for conforming to federal requirements, receive federal matching grants to underwrite their costs. Medicaid benefits cover hospital and physician services, in addition to other services like nursing home services (long-term care). Medicaid plans, by federal law, had no copayments for recipients, and may contain "nominal" copayments only under current law. In the data for this research, only 10 percent of the elderly sample has Medicaid coverage, of which 76 percent has both Medicaid and Medicare coverage.

The cost of the individual's time has become an important concept in models of medical-care demand because of expansion of health insurance coverage and discussions of a national health insurance plan for the U.S. For Canadians the amount of time required to obtain medical care rose after implementation of a national health insurance plan (Enterline et al. 1973). Acton (1976) showed that the time price elasticity of medical care may become stronger the less relevant the money price to the full price (money plus time price) of a physician visit. Expansion of health insurance coverage is expected to lessen the relevance of money price for obtaining care. Assuming no significant decline in average travel, waiting, or treatment times, expansion of health insurance coverage will increase the relative importance of the cost of time. For this research it is very interesting to include time price variables for the elderly's utilization of medical care functions. I expect that the effect of the time price on the demand for medical care by the elderly is different from that of the ordinary adults between ages 18 and 64 due to different opportunity cost and physical health status between two age groups. There are two time-price measure variables (TIMEVAL, FULLABOR) in my analysis. A variable TIMEVAL is total minutes required to get to the unusual source of care; round-trip travel time and waiting time. Because most of the elderly have no wage rate, do not work, or are not willing to work again after retirement, it is extremely difficult to calculate the true opportunity cost of time. TIMEVAL can be a substitute for a certain group of people like the elderly most of whom do not work in the market. According to Acton (1976) the specification with time weighted by the opportunity cost of time, the wage rate, will bias the regression coefficients when the wage rate has to be imputed to non-working persons and even for working persons is not entirely precise because of measure errors. He found that, after comparing the elasticities of demand with respect to time and time weighted by the opportunity cost of time, the bias resulting from the error in measuring the opportunity cost of time is greater than the bias caused by omitting it from the specification. The expected effect of the time price variable should have a negative effects on the demand for medical care. Another variable to control for time price is an employment dummy variable indicating full-time work (FULLABOR). The proportion of part-time worker of the elderly is too small to be included in regression. The opportunity cost of time for working persons is higher than non-working persons. Thus, a negative relationship between full-time employment and the use of medical care is expected.

Income Variable

The income variable used is a measure of the total family income (FMINCALX) in 1987. In the initial analysis, yearly earned income, hourly wage rate, and total family income of the year 1987 (FMINCALX) variables was presented. Since only 1.3 percent of the elderly are full-time or part-time workers and the data does not show the level of their life-time earned income, it is meaningless to include those yearly earned income and hourly wage rate variables. In the Grossman's theory, the expected sign of the earned income including wage rate (summing its effect over all medical services) is positive in the investment model; no predicted sign in the consumption model. There should be no relationship between non-earned income and demand in the investment model, and a positive relationship in the consumption model. The hypothesis of no relationship is difficult to test because while the theoretical prediction relates to a lifetime, in a one period model, non-earned income in any single year may be only weakly related to the present value of all non-wage income flows.

Census Region and Place of Residence

The regional and size of place of residence variables can be understood, at least partially, as controls for the effects of physician supply on observed demand. Also these variables may provide estimates of the size of the availability effect in the market for medical care. Pauly (1978) argues that the availability effect is due in part to demand manipulation by physicians in the presence of imperfect information. It follows that the availability effect should be larger in large metropolitan areas where consumers have more physicians to choose among and less information about any given physician. In addition, these variables also supply useful insights concerning the effects of policies to reallocate the existing stock of physicians or to increase the stock in certain areas. The regional variables used are NOTHEAST for the northeast region, MIDWEST for the midwestern region, and SOUTH for the southern region. The variable for the western region is omitted. The place of residence variables are SMSA19, SMSOTHER. SMSA19 equals 1 if the place of residence is one of the nineteen largest SMSAs. SMSOTHER controls for other SMSAs which are not 19 largest SMSAs. The omitted variable is the variable for rural non-SMSA areas.

Age, Sex and Race

The age term is entered as a continuous variable (LASTAGE). LASTAGE is measured in years. Grossman (1972) suggested a positive correlation between age and the depreciation rate on health. If so, the effect of age on utilization is expected to be positive. However, if depreciation rates are fully captured in health status variable, age should have no effect.

Sex and race variables (FEMALSEX, NONWHITE) are dummy variables that take the value of 1 for females and nonwhite, respectively. They are included to standardize for possible underlying differences between the sexes in demand for care and differences in access that may confront persons of different races, respectively. The expected effects of these variables on utilization are that females will be more intensive users of the health care system, and nonwhites will be less intensive users. The possible offsetting effect of the race variable is that since many of the factors expected to affect demand are already entered (especially, income and health status), the coefficient on the variable may just reflect differences owing to preferences for a particular type of provider or to discrimination faced by members of particular races. Sindelar (1982) found that women spend about 50 percent more on average on medical care than men, although men who are hospitalized stay 50 percent longer than women. This difference was explained by the fact that men may be more able to substitute home for market medical care and men may have a lower return to prior use of medical care because men are more likely to suffer from causes against which medical care is not effective.

Education

Education is measured as a continuous variable (EDUCAT) by the highest grade in school completed. The effect is negative the higher grade completed in the investment model with certain assumptions (Grossman 1972); the consumption model yields no simple prediction on the sign.

Family Size and Marital Status

This variable (FAMSZALL) is the number of individuals in the family unit, which is defined as the group of related individuals living together. Family size is expected to have a negative effect if non-earned income has a positive effect, although it may also have an effect if non-earned income has no effect (Grossman, 1972). All other things being the same, larger households will have a lower income per capita, reducing the demand for care at non-free sources and increase the cost of raising their average level of health and lowers the quantity of medical care demanded. Taking a lifetime view of family decision making, the number of children is an object of choice, making total family income the relevant variable and causing FAMSZALL to be relatively insignificant.

Marital status (MARRIALL) presumably measures the opportunity to produce medical care at home. Marital status can be treated as an indicator of the sources of potential informal caregivers in the analysis of the elderly's medical care utilization.

According to Headen (1993), from the aspects of opportunity costs, more family members and having a spouse may mean that the more caregivers there are to provide any given amount of total caregiver time, the lower the time contribution required of each caregiver and each individual's cost of caregiving is lowered, then, a reduction in the price of informal caregiver time reduces demand for the medical care.

People whose spouses are dead (WIDOWED) is included to capture the possible effects of transfers in wealth or emotional and physical changes in the way of life due to the death of spouse on the medical care utilization.

Health Status

In order to measure health status, or health stock loss, a wide range of variables are employed, including measures of perceived health status (POOR, FAIR, GOOD, EXCEL), disability days (SQRTDAY), and activity limitations (LIMITALL). All of these variables except disability days are dichotomous variables that equal 1 or 0 according to health status. Square root of disability days is used to allow for possible nonlinearity in the demand for physician office visits. The nonlinear specification of disability days may detect variations in the short-time (yearly) depreciation rate on health. As self-perceived health status decreases, disability days rise, and activity limitations increase, demand is expected to rise.

Perceptions of the Value of Medical Care

The measures of consumer's perceptions of the value of medical care (VALUEMED) is constructed using answers to a supplementary interview instruments questionnaires in the 1987 NMES data. The questions are as follows. "I can overcome most illness without help from a medically trained professional." "Home remedies are often better than drugs prescribed by a doctor." "If I got sick, my own behavior which determines how soon I get well again." "I understand my health better than most doctors do." "Luck plays a big part in determining how soon I will recover from an illness." "Doctors never recommend surgery (an operation) unless there is no other way to solve the problem." Responses that indicate favorable perception on the value of medical services are scored lower, and unfavorable responses are scored higher. Each question has possible values of 1 through 5. The maximum possible total score on the six question is 30 and the least possible total score is 6. The expected utilization is lower the higher score on VALUEMED (more unfavorable responses).

The individual's perceptions of the value of medical care can be viewed as an inverse price variable. If people view medical care as ineffective, they will view the true price as higher than actual price. I predict that the VALUEMED variable is more important for determining whether or not one goes for a first visit than for subsequent visits because the doctor has a larger role to play in determining whether or not one needs to return for follow-up work. Also it is possible to relate the VALUEMED variable to the degree of adverse selection in the market for Medigap heath insurance and the demand for medical care.[24]

[24]Vistnes and Bantin (1996) argue that the presence of adverse selection is confirmed by finding factors like health perceptions and attitudes toward risk that increase the probability of purchasing insurance also increase medical expenditures.

VI. Empirical Results

This section presents the basic results for the determinants of medical care utilization by the elderly in the physician's office using the 1987 NMES data. For the purposes of comparison, some regression results from the other age groups, adults between ages 18 and 39 and adults between ages 40 and 64, are presented. The discussion of the results is organized around groups of independent variables, in order to highlight the similarities and differences found for medical care utilization. The following results in the text are from the two-equation model. The results from the sample selection model and analyses are presented in the Appendix. The results estimate the effect of one independent variable on utilization, statistically controlling for all other differences. The results are contained in Tables 3 through 14.

Physician office visits

In the equations for the use or non-use of physician office visits, the dependent variable (DRVISITS) takes the value of 1 if there is any physician office visit. In this sample the probability of consulting a physician is about 85 percent, where telephone consultations are not considered a visit. In comparison, 62 percent of adults between the ages 18 and 39 and 73 percent of adults between the ages 40 and 64 has at least one visit to physician's office in 1987. OLS is used to estimate the conditional-upon-use equations (LOGVISIT). Adjusted R-squared value on conditional visits equation (LOGVISIT) equation for the elderly is 0.17. Adjusted R-squared values on conditional visits equations for the non-elderly age groups are much higher than the elderly, i.e., 0.23 for adults between the ages 40 and 64 and 0.21 for adults between the ages 18 and 39.

Price and Insurance Effects

In the use-nonuse equation (DRVISITS), since the insurance status variables are used instead of the net price variable due to data limitation and the fact that 99 percent of the elderly in the sample has some kinds of public or private insurance coverage, the main focus of the analysis is to find possible differences in the probability of contacting a physician among different insurance policy holders and the resulting policy implication for the elderly's medical care utilization. According to summary statistics, about 97.8 percent of the sample for the elderly has Medicare of which 80 percent has also private insurance coverage and 10 percent has other type of second insurance coverage including Medicaid. A regression analysis for the elderly shows that all insurance status variables have a positive coefficient in the probit equation. However only the variable for both Medicare and private health insurance holders (CAREPRIV) is statistically significant. It is not surprising that the elderly with private Medigap insurance coverage have higher probability of contacting a physician than other single or multiple health insurance coverage. Expected lower costs or full coverage due to Medigap health insurance coverage do have a significant effect on the initial decision making to contact a physician. In contrast, for adults between the ages 18 and 39 and adults between the ages 40 and 64 the variable for persons holding only private health insurance (ONLYPRIV) has a most significant effect among insurance variables. In a preliminary regression analysis, however, a variable for persons with Medicaid only (ONLYCAID) which is not included in here because the number of people in the sample with this coverage is small has a surprising negative coefficient in the probability of contacting a physician even if the coefficient is statistically insignificant.

For the amount of medical care services demanded (LOGVISIT), conditional on any use, a price variable which is a computed coinsurance rate (computed as the actual total out of pocket expenditures divided by the total charge price for the medical care utilization in the physician's office during 1987) is used. The price variable (PRICE) in the regression of conditional visits equation of the elderly has a negative and statistically significant coefficient in the OLS estimates. The result is consistent with the theoretical model. In comparison among age groups, the regression coefficient of the price variable and the price elasticity by each of the three age groups are presented in Table 3. As Table 3 shows, the price elasticity of the elderly at the mean in the number of visits equation is –0.15, which is greater than found in Newhouse and Phelps (1973, 1976) but which is comparable to Manning et al. (1981) and Wedig (1987). The data used for the analysis by Newhouse and Phelps is restricted to adults under 65. The analysis by Wedig is restricted to adults, defined as those 17 years of age and older. In my analysis the price elasticity of the elderly at the mean is slightly higher than that of the rest of age groups. It is possible to conclude that the elderly the aged 65 and over are highly price sensitive to the medical care utilization in the physician's office (the number of visits).

From the public policy perspective in revising the America's welfare system for the elderly, mainly the health care system of Medicare and Medicaid, the above results have important implications. While the elderly have less income and are less healthier than

Table 3

Regression coefficient of price and price elasticity of the number of visits[25]

	Ages 65 and over	Ages 40-64	Ages 18-39
Coefficient	-0.36 (-8.54)	-0.271 (-8.02)	-0.273 (-9.57)
Elasticity	-0.15	-0.133	-0.130

ordinary adults ages under 65, an effort to curb the ever increasing Medicare and Medicaid financed expenditures may have significant and severe effects on the medical care utilization by the elderly. The financially and physically unsecured elderly will use less medical care than they need, and America's welfare system, which is already not one of the best among industrialized countries may become worse. From the regression analysis, two major findings are accomplished. It is doubtful that they consume minimum level of medical care they need. First, the empirical results show that individuals facing a lower expected price of medical care because of private or public insurance of expenditures on medical care are more likely to purchase medical care. It is implied that the health insurance status is of important determinants in the initial decision making to contact a physician. Second, the effect of price on the medical care utilization, conditional on any use, is different from the other age groups. The elderly are more price sensitive than other age groups. In consideration of more rapid health stock depreciation and lower health status of the elderly than ordinary adults, the above results have important policy implications. Recent debates on the Congress to overhaul Medicare and Medicaid should consider the fact that the elderly are no less price sensitive than adults ages under 65. An effort to contain the health care costs by increasing out of pocket costs of the elderly will have significant effects on the ambulatory medical care utilization (the physician office visits), especially for the low income elderly.

Time price variables (measuring the cost of the individual's time) used in this study are TIMEVAL and FULLTIME. TIMEVAL is the total minutes required to obtain care excluding treatment minutes. Table 4 shows the regression coefficients for TIMEVAL in each of the demand equations and its elasticity at the mean value of the independent variable. For the sample of the elderly, the coefficients of TIMEVAL are negative and statistically significant in both entry demand of the use/nonuse equation and the log valued visits equation (LOGVISIT). A dummy variable indicating full-time employment is included as an independent variable (FULLABOR). The coefficients of FULLABOR are positive and statistically insignificant in both the entry visit and conditional visits equations. The negative time price coefficient (TIMEVAL) shows that the time price of medical care demand negatively affects both the probability of contacting a physician and the number of visits demanded in the year of 1987. The magnitude of time price elasticity of the elderly is lower than that of adults between the ages 40 and 64 but higher than adults between the ages 18 and 39. It is quite noticeable that adults between ages 40 and 64 are most sensitive to time price effect on the demand for physician's office visits. It is concluded that the higher time price elasticity of adults between ages 40 and 64 are due to their higher opportunity cost of time.

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[25]The dependent variable is the log value of the number of visits. Elasticities are computed using price coefficients from each of the age groups and relevant means of the variables of the elderly, ages 40-64, and ages 18-39 samples, respectively.

Table 4

Regression coefficients of the time price variable and time price elasticities[26]

	Ages 65 and over	Ages 40 and 64	Ages 18 and 39
Coefficient in the probability of seeking care[a]	-0.0016 (-2.14)	-0.0022 (-4.362)	-0.0020 (-4.363)
Coefficient in conditional visits	-0.0013 (-3.10)	-0.0018 (-4.679)	0.00010 (0.286)
Elasticity of the probability of seeking care[b]	-0.014	-0.034	-0.045
Elasticity of conditional visits	-0.058	-0.079	0.0044
Compound elasticity	-0.072	-0.113	-0.0406

a t-ratios are in parentheses.

b Elasticities are equal $\phi(\beta'x)\beta x$, where $\beta(.)$ is the standard normal density function, x is the mean value of the explanatory variables. In addition, the predicted probability of the dependent variable is used.

Income Effects

The income variable used in this study is total family income (FMINCALX). The coefficient of FMINCALX is positive and statistically significant in the probit equation. The above regression results imply that the family income level (FMINCALX) is one of important determinants in the probability of contacting a physician. In a conditional visits equation with a dependent variable of LOGVISIT, the total family income level has a positive but insignificant coefficient. In summary, family income is one of important determinants only in the decision of the entry visit to the physician's office. In the

[26]The variable for calculating the time price elasticity is TIMEVAL which is an aggregate of average round-trip travel time and waiting time per visit to usual source of care.

Table 5

Coefficients of family income and income elasticities

	The elderly ages 65 and over	Between the ages 40 and 64	Between the ages 18 and 39
Mean family income	$26,207	$40,696	$36,032
Coefficient in the proba -bility of seeking care	0.0000040 (2.724)[a]	0.00000099 (1.321)	0.00000076 (1.136)
Coefficient in conditional visits	0.00000067 (1.236)	0.00000056 (1.177)	0.00000078 (1.680)
Elasticity of the proba- bility of seeking care[b]	0.021	0.014	0.014
Elasticity of conditional visits	0.018	0.013	0.029
Compound elasticity	0.039	0.027	0.043

a t-ratios are in parentheses.

b Elasticities are equal $\phi(\beta'x)\beta x$, where $\beta(.)$ is the standard normal density function, x is the mean value of the explanatory variables. In addition, the predicted probability of the dependent variable is used.

conditional number of visits demand, the effect of family income is not significant. Table 5 shows that the income elasticity of the elderly is larger than that of adults between ages 40 and 64. The demand for physicians visits by the elderly is more responsive to income than that of adults ages 40 and 64. The results is noticeable in consideration of significantly lower family income level of the elderly than adults between ages 40 and 64.

When the earned income level, which is not in included here, is used instead of the yearly family income even if very few individuals worked, the variable (TOTEARND) has a positive but statistically insignificant regression coefficient in the use/non-use equation and positive and statistically significant coefficients in visits equations. Generally the theoretical model predict that the coefficient is expected to be positive in the investment model and is indeterminate in the consumption model. Earned income if any is an important determinant of physician office visits conditional on some use by the elderly.

Age, Sex and Race

A positive relationship between the use of medical care (physician office visits) and age is expected, since objectively the health stock decreases with age due to the increasing depreciation rate with age. In the regression analysis of the sample for the elderly, the continuous age variable (LASTAGE) has a positive and statistically significant coefficient, thus shows increasing use of medical care in the probability of making a visit equation. However, in the number of visits equations, the coefficient of LASTAGE in the equation with a dependent variable of LOGVISIT is surprisingly negative and insignificant. This may result from a selectivity effect: older people still not in nursing home are probably healthier than average. In the regression of the sample for adults between the ages 40 and 64, the continuous age variable (LASTAGE) has positive and statistically significant coefficients in both the entry visit and conditional visits equations. In comparison, for the age group between the ages 18 and 38 the coefficient of the age variable is positive but statistically insignificant in the probability of contacting a physician and is surprisingly negative and statistically significant in the conditional visits equation. Following the above regression results of the elderly, the effects of age on the demand for physician office visits shows that age is one of important determinants of the entry demand function, the use non-use demand function, but age is not simply one of important determinants of the conditional demand function, the number of visits conditional on some use. The significant effect of a continuous age variable (LASTAGE) on the entry visit equation may mean that the elderly are highly concerned about their health by aging itself. However, the deriving force of continuous visits to physician's office is not aging itself but individual's health status or the degree of health stock depreciation. In chapter 6, regression results by each of the age groups and tests of structural changes to see whether a separate regression by each group is needed are presented.

A dummy variable for female (FEMALSEX) has a positive and statistically significant coefficient in the use-nonuse equation of the elderly sample. But for the conditional visits (LOGVISIT) the coefficient is positive and statistically insignificant. From these results my interpretation is that the elderly women have higher probability of having a initial contact with doctors at physician office than men. However, after an initial contact, there are no sex differences in the number of visits. In chapter 6, separate regressions are applied in each of the female elderly and the male elderly. Also tests of structural changes are applied between sexes in both the entry visit equation and the conditional visits equation to see whether a separate regression is needed by each sex..

A race variable (NONWHITE) which equals one if race is nonwhite and zero if not has a negative but statistically insignificant coefficient in the use/nonuse equation. In the number of visits (LOGVISIT) the race variable (NONWHITE) has a negative and statistically insignificant coefficient. My interpretation of these results is that once many of the factors expected to affect demand are entered (i.e., income and health status), race itself may not be one of important determinants of medical care (physician office visit) for the elderly.

Census Region and Place of Residence

There are three regional variables (NOTHEAST, MIDWEST, and SOUTH) and two place of residence variables (SMSA19, SMSOTHER) in this study. The omitted variables are West for the regional variable and rural non-SMSAs for the place of residence variable. In the use/nonuse equation coefficients of all three regional variables are statistically insignificant whether these are positive or negative. In the number of visits equation, all of three regional variables have statistically insignificant coefficients. The regression results show that the census region in which one lives is unrelated to both the probability of contacting a physician and the number of visits conditional on any visit. The research can not support the common notion that in the South less medical care is demanded in the physician's office.

Both of the place of residence variables (SMSA19, SMSOTHER) have negative and statistically significant coefficients in the probability of contacting a physician by the elderly. Both the nineteen largest standard metropolitan statistical areas (SMSA19) variable and the other SMSAs which is not part of the nineteen largest SMSAs (SMSOTHER) have negative and statistically insignificant coefficients in conditional visits (LOGVISIT) equation of the elderly sample. According to these results, persons living in urban areas have a lower probability of contacting a physician than persons living in rural non-SMSAs. As for the number of visits, there is some weak evidence of fewer visits to the physician's office by the elderly living in metropolitan areas.[27] These results may be interpreted as seriousness of the urban poverty in the U.S. Even with the system of Medicaid and Medicare there remains evidence a regional difference of the medical care utilization in the physicians office, but the meaning of regional difference has changed from the past north vs. south to the urban vs. suburban and rural.

As far as the availability effect (i.e., physicians manipulate the demand curve for their services in the presence of imperfect information) is concerned, the results of SMSAs coefficients do not support the hypothesis in the demand for physician visits by the elderly. In contrast, however, for the group of adults between the ages 40 and 64, this research has found an evidence of availability effect in the demand for physician visits. The variable SMSA19 has a negative coefficient in the entry visit equation but, in the conditional visits equation, has a positive and statistically significant regression coefficient suggesting that some possible role of physicians in the medical care utilization after entry visit to physicians. The above results are not shown in the analysis of physicians office visits by adults between the ages 18 and 39.

Family Size and Marital Status

The family size variable (FAMSZALL) has a negative and statistically significant coefficient in the use/nonuse equation as expected. In the number of visits (LOGVISIT) equation, the family size variable also has a negative and statistically significant coefficient. Two interpretations are possible from these results. First, these results may be

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[27]Regression results show that t-values for coefficients of the variables. SMSA19 and SMSOTHER, are -

interpreted that the larger family size can substitute informal home care for medical care services in the physicians' office. Second, more family members may mean less family income to use for medical care, thus leading to less visits to the physician's office.

A dummy variable for married people (MARRIALL) has a positive and statistically significant coefficient in the probability of contacting a physician. The variable has a negative and statistically insignificant effect in the number of visits equation (LOGVISIT). Following the regression results, my interpretation is that the married elderly have a higher probability of contacting a physician than non-married persons or persons without spouses. However, in the number of visits, the marital status has no effect. As far as the opportunity cost hypothesis of whether to produce home care or buy medical care at the physician's office is concerned, i.e., having more family size and being married may mean higher opportunity cost in the physician office and less opportunity cost for home care, the results from the family size variable support the hypothesis and the results from the marital status variable do not support the hypothesis since the expected signs of both coefficients are negative.

In the sample of the elderly, significant portions of the elderly are widowed (about 34 percent). The variable for persons whose spouses are dead and not married again during 1987 (WIDOWED) has a positive coefficient in the probability of contacting a physician while the variable has a negative and statistically insignificant coefficient in the conditional visits equation. Widowed people are more likely to contact a physician than people who live alone. There is no evidence of more visits by the widowed after an initial to the physicians office in this research.

1.575 and -1.466, respectively.

Education

The continuous variable for the level of education attained (EDUCAT) is coded in years of the highest grade completed. The hypothesis is that more highly educated persons are more efficient producers of health (only if the elasticity of the MEC schedule were less than unity), then there should be a negative coefficient in all equations. On the contrary, the variable EDUCAT has positive and statistically significant coefficients in the use/nonuse equation and in the number of visits conditional on some use (LOGVISIT) equation. The effect of the level of education attained (EDUCAT) on the medical care utilization in the physicians office by the other age groups (ages 18-39 and ages 40-64) are not different from that by the elderly. According to Grossman (1972), if the percentage increase in gross investment supplied by a one unit increase in education were negative and the elasticity of MEC schedule were less than one, the demand for health would be negative and the demand for medical care would be positive.

Health Status

The health status variables (SQRTDAY, EXCEL, GOOD, FAIR, LIMITALL) are the most significant predictors of demand for physician office visits by the elderly. Square root of restricted activity days (SQRTDAY) has a positive and statistically significant coefficient in both the use/non-use equation and the number of visits equations. Self-perceived health status variables (EXCEL, GOOD, FAIR) have also statistically significant coefficients in the number of visits equations conditional on any utilization. As self-perceived health status decreases, both the probability of contacting a physician and the number of visits rise. The dummy variable (LIMITALL) for persons with activity limitations has a positive and statistically significant coefficient in both the use/non-use equation and the number of visits equation conditional on any visit.

Perceptions of the Value of Medical Care

In contrast to other studies, a strong relationship is found between the demand for medical care and consumer's perceptions on the value of medical care (VALUEMED).[28] In the use/non-use equation, the coefficient is negative and statistically significant at 1 percent significance level. In the conditional visits equations, the variable (VALUEMED) has a strong negative effect in explaining LOGVISIT. The expected sign of the variable is negative since the higher score on VALUEMED means more unfavorable responses on the value of medical care. The empirical result supports the hypothesis that the utilization of physician office visits is lower the higher score on VAUEMED. Comparing with other age groups, the regression results from ages between 40 and 64 are similar to the above results from the elderly. But, the regression results from ages between 18 and 39 somewhat interesting since regression coefficients are less than those of the elderly and between the ages 40 and 64. Further, the regression coefficient in the conditional visits equation is not statisticaliy significant. It is

[28]Don Kenkel (1990) found that consumer's health beliefs had no effects on both use/non-use equation and conditional visits equations. Colle and Grossman (1978) found that the parents' taste for medical care never is significant in equations of use, prevent, visits, and qual.

Table 6

Means and regression coefficients of the variable VALUEMED

	Ages 65 and over	*Bet.ages 40 and 64*	*Bet.ages 18 and 39*
Mean	15.699	15.968	16.671
Coefficient:Entry Visit[a]	-0.033 (-5.436)	-0.027 (-5.455)	-0.011 (-2.620)
Coefficient: Conditional visits	-0.019 (-5.51)	-0.016 (-4.822)	-0.0043 (-1.390)

a: t-values are in parentheses. Elasticities are equal $\phi(\beta'x)\beta x$, where $\beta(.)$ is the standard normal density function, x is the mean value of the explanatory variables. In addition, the predicted probability of the dependent variable is used.

thinkable that the variable VALUEMED is related to health status or age (depreciation of health stock). That is, young adults between the ages 18 and 39 have less preference for medical care (higher score on VALUEMED) and are healthier than the elderly and adults between 40 and 64. Table 6 shows that mean and regression coefficients of the variable VALUEMED. As the table shows, the younger age group the less effect of VALUEMED on the medical care utilization in the physicians office. On the other hand, it may be argued that this variable (VALUEMED) is less important for younger people because they are advised in medical matters by their parents – so their own views of effectiveness are less relevant.

Table 7
Regression results: Probit analysis of use/non-use in physician office visit by the elderly

Observations = 3514
Mean of LHS = 0.8534434 Std.Dev of LHS = 0.3537137

Variable	Coefficient	Std. Error	t-ratio	Prob.|t|≥x
Constant	-0.11537	0.4835	-0.239	0.81142
VALUEMED	-0.32691E-01	0.6013E-02	-5.436	0.00000
FULLABOR	0.12933E-01	0.1045	0.124	0.90150
EDUCAT	0.15720E-01	0.8549E-02	1.839	0.06594
LASTAGE	0.11838E-01	0.4606E-02	2.570	0.01017
FEMALSEX	0.25516	0.6113E-01	4.174	0.00003
NONWHITE	-0.12047	0.8589E-01	-1.402	0.16077
FAMSZALL	-0.15440	0.2884E-01	-5.354	0.00000
MARRIALL	0.38535	0.9329E-01	4.131	0.00004
WIDOWED	0.18138	0.9395E-01	1.931	0.05354
SMSA19	-0.21266	0.8021E-01	-2.651	0.00802
SMSOTHER	-0.14373	0.6908E-01	-2.081	0.03747
NOTHEAST	-0.16502E-01	0.9224E-01	-0.179	0.85802
MIDWEST	0.11859E-02	0.8813E-01	0.013	0.98926
SOUTH	-0.93690E-01	0.8279E-01	-1.132	0.25781
TIMEVAL	-0.15532E-02	0.7244E-03	-2.144	0.03203
FMINCALX	0.40329E-05	0.1481E-05	2.724	0.00646
SQRTDAY	0.39648E-01	0.8399E-02	4.721	0.00000
EXCEL	-0.31804	0.1433	-2.219	0.02650
GOOD	-0.17183	0.1110	-1.548	0.12159
FAIR	0.35839E-01	0.1070	0.335	0.73762
LIMITALL	0.29102	0.6805E-01	4.277	0.00002
CARECAID	0.43085	0.3068	1.404	0.16020
CAREPRIV	0.58416	0.2979	1.961	0.04990
ONLYCARE	0.13604	0.3021	0.450	0.65250
ONLYPRIV	0.46201	0.3603	1.282	0.19976
ALLINS	0.29220	0.3442	0.849	0.39589

Table 8
Regression results from the two-equation model: Utilization,
the log value of the number of visits, conditional on use by the elderly

Dep. Variable	= LOGVISIT		
Observations	= 2999		
Mean of LHS	= 0.1550201E+01	Std.Dev of LHS	= 0.8961467
StdDev of residuals	= 0.8184716	Sum of squares	= 0.1993610E+04
R-squared	= 0.1719619	Adjusted R-squared	= 0.1658406

Variable	Coefficient	t-ratio	Prob|t|≥x	Mean of X	Std.Dev.of X
Constant	2.3260	10.420	0.00000		
VALUEMED	- 0.18621E-01	-5.511	0.00000	15.444	4.5386
FULLABOR	0.12235E-01	0.204	0.83868	0.072691	0.25967
EDUCAT	0.10125E-01	2.135	0.03273	10.641	3.6103
LASTAGE	-0.35878E-02	-1.448	0.14753	73.774	6.5753
FEMALSEX	0.18538E-01	0.544	0.58642	0.62321	0.48466
NONWHITE	-0.77187E-01	-1.491	0.13586	0.11070	0.31382
FAMSZALL	-0.83724E-01	-4.487	0.00001	1.9430	0.93613
MARRIALL	-0.23621E-01	-0.424	0.67150	0.57519	0.49440
WIDOWED	-0.65507E-01	-1.181	0.23766	0.33711	0.47280
SMSA19	-0.67880E-01	-1.575	0.11525	0.24408	0.42961
SMSOTHER	-0.53053E-01	-1.466	0.14276	0.47282	0.49934
NOTHEAST	0.41274E-01	0.833	0.40506	0.19473	0.39606
MIDWEST	-0.22982E-01	-0.499	0.61747	0.27309	0.44562
SOUTH	-0.24533E-01	-0.548	0.58377	0.34345	0.47494
TIMEVAL	-0.13219E-02	-3.098	0.00195	44.178	35.745
FMINCALX	0.67051E-06	1.236	0.21638	26640.	30994.
SQRTDAY	0.48026E-01	12.204	0.00000	2.9739	4.2065
EXCEL	-0.41545	-5.108	0.00000	0.067689	0.25125
GOOD	-0.29603	-5.334	0.00000	0.42848	0.49494
FAIR	-0.15505	-2.977	0.00291	0.38179	0.48591
LIMITALL	0.22640	5.513	0.00000	0.79527	0.40358
PRICE	-0.35744	-8.543	0.00000	0.43821	0.36991

VII. Demand Functions by Age, Sex Groups and Tests of Structural Differences

To test the hypothesis that the depreciation of health stock by aging is a significant factor in demand for medical care, it would make sense to estimate my model separately for different age groups, like 18-39, 40-64 and 65+. I expect that the pattern of the demand for medical care by the elderly is different from non-elderly ordinary adults. Thus, it is likely that the same inputs in a health production function will have very different marginal products for someone 35 years old than for someone 65 years old.

In this analysis, I estimate the determinants of medical care separately for three age groups, 18-39, 40-64 and 65+, from the point of my interpretation on the depreciation of health stock. After finding demand determinants by age groups, I test whether there are structural changes in demand functions among age groups. For the classical multiple regression models, standard Chow Tests are applied. For the probit model, Likelihood Ratio tests are used.

Besides differences by age, there are well-known differences in utilization of health services by sex. Empirically, for example, Sindelar (1982) found that women spend about 50 percent more on average on medical care than man, although men who are hospitalized stay 50 percent longer than women. In his sample, women are more likely to visit a doctor and spend more when they go to the doctor. Even if both men and women spend about the same average number of days hospitalized per year, men who enter the hospital spend over 15 days per year and women spend only 9 on average. Sindelar's empirical evidence supports two hypotheses that explain these differences: (1) Men are more able to substitute home for market medical care, and (2) men expects to suffer larger and more frequent losses of health because of life-style choices.[29] However, only adults ages under 65 are used in the empirical analysis of her study.[30] Thus, her results cannot be generalized to the case of medical care utilization by the elderly. Here I get separate estimates of medical care utilization of the elderly in the physicians office by sex and test to see if there are significant differences by sex. The same likelihood ratio test and the standard Chow-test as for demand functions by age groups are applied.

1. Demand Functions by Age Groups

Tables (9) show the probit regression results from the probability of visiting physician's office and Table (10) present the ordinary least square regression results of the conditional demand functions for the group of persons between ages 40 and 64. The two equation model is used here. As for the analysis of the probability of visiting physician's office, the sample consists of 4,992 adults of which 3,655 persons (about 73 percent) had at least one visit during 1987. The strong relationship is found between the probability function and consumer's perceptions of the value of medical care (VALUMED). Further, I found that the demographic variables, including education, age, sex, race, family size, family income, and marital status conform to a priori expectations. But the coefficients of family income and marital status variables are not statistically significant. The effects of

[29] Jody L. Sindelar, "Differential Use of Medical Care by Sex", Journal of Political Economy, 1982, vol 90, no.5, p. 1018.

time price (TIMEVAL) and health status measures (SQRTDAY, LIMITALL) on the probability of contacting a physician are all significant. Of the insurance variables, persons holding private insurance coverage and persons holding both Medicare and private insurance coverage have positive and statistically significant coefficients in the entry visit equation.

As for the analysis of the conditional visits function with the dependent variable as the log value of the number of visits (LOGVISIT), the coefficients of the consumer's perceptions of the value medical care (VALUEMED), education, age sex, family size, time price (TIMEVAL, FULLABOR), and health status variables (SQRTDAY, EXCEL, GOOD, LIMITALL) are significant and have expected signs. Noticeably, the variable for persons working full-time has a negative and statistically significant coefficient. High opportunity costs of time are revealed for full-time workers. The price variable (PRICE) has expected negative signs and the coefficients are statistically significant.

For the age group between the ages 18 and 39, the probit regression results for the probability of visiting physician's office and OLS results for the number of visits conditional on some visits are shown in Tables (11) and Table (12), respectively. The sample size for the probability analysis is 7,052 persons of which 4,411 persons (about 63 percent) had at least visited physician's office once during 1987. Most of the socio-economic variables have expected signs of which the coefficients of perceptions of the value of medical care (VALUEMED), education level (EDUCAT), female (FEMALSEX), race (NONWHITE), family size (FAMSZALL), marital status (MARRIALL), and value of time (TIMEVAL) are statistically significant. It is worth

[30]The data uses is from the Rand Health Insurance Experiment.

noting that the variable for young female adults between ages the 18 and 39 have a strong positive effect on the probability contacting a physician. This result might be due to maternity care. The regional variable for persons living in the southern census region (SOUTH) has a negative and statistically significant coefficient. Contrary to the elderly, for whom there are no regional differences among census regions, adults between ages 18 and 39 who live in south have a lower probability of contacting a physician than those in other regions. Of the health status variables only two variables (SQRTDAY, LIMITALL) are statistically significant. Among insurance status variables the variable for persons holding private insurance only (ONLYPRIV) has a positive and statistically significant coefficient. Since the Medicare welfare system is mainly aimed to help the elderly, insurance status variables except for the variable for private insurance holders have no significant effect on the probit equation.

For adults between the ages 18 and 39, regression results from the conditional visits equation using OLS is shown in Table (12). Surprisingly, people's perceptions of the value of medical care have no significant effect on the number of visits by young adults while these attitudes have significant effect on the conditional visits by the elderly and adults between the ages 40 and 64. Working full-time, years of education attained, female, non-white, family size, marital status, being widowed, and family income have expected signs and are all important determinants of conditional medical care utilization of the number of visits to the physicians office. In this age group, persons' age has a surprising negative and significant effect on the number of visits equation. No regional differences are found since all of census regions have no significant effect on the visits equation. But a SMSAs variable that is not one of the nineteen largest SMSAs

(SMSOTHER) has a negative and significant effect on the conditional visits. Health status variables (SQRTDAY, LIMITALL) and price variable (PRICE) have expected signs and effects are significant.

As explained in the previous chapter in part for some variables, analyses of marginal effects and elasticities of independent variables show some important and convenient summary of the magnitudes of the effects and differences among age groups. Table (20) and Table (21) present marginal effects and elasticities of the probability of use with regard to a given independent variables, respectively. Table (22) and Table (23) show marginal effects and elasticities of visits conditional on positive visits with regard to independent variables, respectively, in the two part model. Table (24) and Table (25) show marginal effects and elasticities of visits, respectively, in the sample selection model.

Table 9
Regression results: Probit analysis of use/non-use in physician office visit by adults between the ages 40 and 64

Dep. Variable = DRVISITS
Observations = 4992 Weights = ONE
Mean of LHS = 0.7321715 Std.Dev of LHS = 0.4428721

Variable	Coefficient	t-ratio	Prob.|t|≥x	Mean	Std.Dev.ofX
Constant	0.27915E-02	0.011	0.99120		
VALUEMED	-0.26599E-01	-5.455	0.00000	15.968	4.2088
FULLABOR	0.29545E-01	0.568	0.56974	0.63662	0.48102
EDUCAT	0.14908E-01	2.265	0.02354	11.904	3.4920
LASTAGE	0.71041E-02	2.277	0.02281	51.362	7.6046
FEMALSEX	0.32550	7.521	0.00000	0.57532	0.49434
NONWHITE	-0.26883	-5.395	0.00000	0.23638	0.42490
FAMSZALL	-0.37927E-01	-2.485	0.01296	3.0220	1.5428
MARRIALL	0.32105E-01	0.544	0.58631	0.72696	0.44556
WIDOWED	-0.11455	-1.247	0.21229	0.071314	0.25737
SMSA19	-0.69763E-01	-1.209	0.22679	0.27784	0.44798
SMSOTHER	0.22276E-01	0.439	0.66077	0.46915	0.49910
NOTHEAST	-0.19545E-01	-0.294	0.76893	0.20272	0.40207
MIDWEST	-0.52509E-01	-0.832	0.40552	0.25601	0.43647
SOUTH	-0.22720E-01	-0.376	0.70717	0.35697	0.47915
TIMEVAL	-0.21793E-02	-4.362	0.00001	46.336	40.897
FMINCALX	0.99560E-06	1.321	0.18643	40696.	33300.
SQRTDAY	0.12244	13.137	0.00000	1.9955	3.1743
EXCEL	-0.22032	-1.699	0.08924	0.21875	0.41344
GOOD	-0.77974E-01	-0.643	0.52033	0.51482	0.49983
FAIR	0.42342E-02	0.036	0.97136	0.21234	0.40900
LIMITALL	0.32435	6.330	0.00000	0.41887	0.49342
CARECAID	-0.62411E-01	-0.315	0.75300	0.012019	0.10898
CAREPRIV	0.43795	2.386	0.01702	0.019030	0.13665
ONLYCARE	-0.24250	-1.365	0.17232	0.014022	0.11759
ONLYPRIV	0.45142	7.084	0.00000	0.79127	0.40644
ALLINS	3.8005	0.077	0.93886	0.10016E-2	0.031635

Table 10
Regression results from the two-equation model: Utilization, the number of visits, conditional on use by adults between the ages 40 and 64

Dep. Variable = LOGVISIT
Observations = 3655
Mean of LHS = 0.1204683E+01 Std.Dev of LHS = 0.9171929
Std. Dev of residuals= 0.8067279 Sum of squares = 0.2363742E+04
R-squared = 0.2310287 Adjusted R-squared = 0.2263709
F[22, 3632] = 0.4959970E+02
Log-likelihood = -0.4389704E+04 Restr.(á=0) Log-l = -0.4869791E+04

Variable	Coefficient	t-ratio	Prob.|t|≥x	Mean	Std.Dev.of X
Constant	1.2212	7.424	0.00000		
VALUEMED	-0.015968	-4.822	0.00000	15.699	4.1040
FULLABOR	-0.071323	-2.195	0.02817	0.62709	0.48365
EDUCAT	0.013782	3.150	0.00163	12.032	3.4625
LASTAGE	0.0056937	2.737	0.00620	51.765	7.6274
FEMALSEX	0.12599	4.366	0.00001	0.60958	0.48791
NONWHITE	-0.044808	-1.269	0.20445	0.20410	0.40310
FAMSZALL	-0.047308	-4.395	0.00001	2.9343	1.4659
MARRIALL	-0.0017673	-0.046	0.96355	0.73461	0.44160
WIDOWED	-0.097608	-1.630	0.10311	0.071409	0.25754
SMSA19	0.065103	1.666	0.09574	0.26840	0.44319
SMSOTHER	-0.0070999	-0.212	0.83174	0.47880	0.49962
NOTHEAST	0.074867	1.736	0.08258	0.20301	0.40229
MIDWEST	0.052183	1.281	0.20007	0.25828	0.43775
SOUTH	0.018689	0.477	0.63364	0.34829	0.47649
TIMEVAL	-0.0017901	-4.679	0.00000	44.332	35.842
FMINCALX	0.56433E-06	1.177	0.23920	41308.	33355.
SQRTDAY	0.85743E-01	19.446	0.00000	2.4201	3.3720
EXCEL	-0.39884	-5.368	0.00000	0.19754	0.39820
GOOD	-0.25804	-3.905	0.00009	0.51300	0.49990
FAIR	-0.058096	-0.908	0.36401	0.22791	0.41954
LIMITALL	0.11553	3.585	0.00034	0.47114	0.49923
PRICE	-0.27105	-8.022	0.00000	0.49071	0.40988

Table 11
Regression results: Probit analysis of use/non-use in physician office visit by adults between the ages 18 and 39

Dep. Variable = DRVISITS   Observations = 7052
Mean of LHS = 0.6254963   Std.Dev of LHS = 0.4840288
Binomial Probit Model
Maximum Likelihood Estimates
Log-Likelihood -3948.464   Restricted (Slopes=0) Log-L. -4663.552
Chi-Squared (26) 1430.177   Significance Level 0.0000000

Variable	Coefficient	t-ratio	Prob.|t|≥x	Mean	Std.Dev.of X
Constant	-0.45275	-1.828	0.06748		
VALUEMED	-0.11012E-01	-2.620	0.00880	16.671	3.9263
FULLABOR	-0.29168E-01	-0.687	0.49206	0.73227	0.44281
EDUCAT	0.11726E-01	1.731	0.08338	12.603	2.7041
LASTAGE	0.32096E-02	1.058	0.28999	28.702	6.0374
FEMALSEX	0.57176	16.880	0.00000	0.56480	0.49582
NONWHITE	-0.21172	-5.452	0.00000	0.28616	0.45200
FAMSZALL	-0.57976E-01	-5.253	0.00000	3.4688	1.6878
MARRIALL	0.11468	3.015	0.00257	0.52269	0.49952
WIDOWED	-0.16587E-01	-0.054	0.95671	0.003119	0.055771
SMSA19	-0.19786E-01	-0.416	0.67769	0.27014	0.44406
SMSOTHER	-0.17978E-02	-0.044	0.96510	0.48242	0.49973
NOTHEAST	0.34316E-01	0.634	0.52589	0.19314	0.39479
MIDWEST	0.30925E-01	0.613	0.54008	0.25525	0.43603
SOUTH	-0.82271E-01	-1.717	0.08594	0.36529	0.48154
TIMEVAL	-0.19579E-02	-4.363	0.00001	44.950	37.042
FMINCALX	0.75515E-06	1.136	0.25587	36032.	28485.
SQRTDAY	0.23693	22.244	0.00000	1.5589	2.2771
EXCEL	0.11460	0.564	0.57261	0.32728	0.46925
GOOD	0.13810	0.688	0.49132	0.55771	0.49669
FAIR	0.22036	1.084	0.27822	0.10522	0.30686
LIMITALL	0.21050	3.903	0.00010	0.14762	0.35475
CARECAID	0.49170	1.493	0.13551	0.002977	0.054492
CAREPRIV	-0.28347E-01	-0.061	0.95125	0.001276	0.035704
ONLYCARE	0.10134	0.247	0.80513	0.001559	0.039467
ONLYPRIV	0.33627	7.538	0.00000	0.75397	0.43073
ALLINS	-0.99941	-1.504	0.13264	0.000567	0.023811

Table 12
Regression results from the two-equation model: Utilization, the number of visits, conditional on use by adults between the ages 18 and 39

Dep. Variable	= LOGVISIT		
Observations	= 4411		
Mean of LHS	= 0.1000874E+01	Std.Dev of LHS	= 0.8834735
Std Dev of residuals	= 0.7830245	Sum of squares	= 0.2690403E+04
R-squared	= 0.2183872	Adjusted R-squared	= 0.2144684
F[22, 4388]	= 0.5572876E+02		
Log-likelihood	= -0.5168515E+04	Restr.(á=0) Log-l	= -0.5711941E+04

Variable	Coefficient	t-ratio	Prob[t ≥x	Mean	Std.Dev.of X
Constant	0.84087	5.401	0.00000		
VALUEMED	-0.0043402	-1.390	0.16455	16.496	3.8057
FULLABOR	-0.12748	-4.335	0.00001	0.73906	0.43920
EDUCAT	0.018393	3.824	0.00013	12.788	2.7267
LASTAGE	-0.0039967	-1.833	0.06684	29.013	5.9661
FEMALSEX	0.33959	13.423	0.00000	0.64702	0.47795
NONWHITE	-0.12430	-4.214	0.00003	0.24348	0.42923
FAMSZALL	-0.026142	-3.075	0.00211	3.3416	1.5975
MARRIALL	0.14080	5.229	0.00000	0.55362	0.49717
WIDOWED	-0.44346	-2.173	0.02975	0.0034006	0.058222
SMSA19	-0.019872	-0.572	0.56701	0.26683	0.44235
SMSOTHER	-0.055715	-1.865	0.06223	0.48900	0.49994
NOTHEAST	0.037775	0.993	0.32076	0.19927	0.39950
MIDWEST	0.044372	1.254	0.21000	0.26570	0.44175
SOUTH	0.046163	1.344	0.17898	0.34074	0.47401
TIMEVAL	0.000104	0.286	0.77523	42.433	33.034
FMINCALX	0.77749	1.680	0.09299	36668.	28448.
SQRTDAY	0.11785	24.073	0.00000	2.0861	2.5308
EXCEL	-0.16991	-1.502	0.13308	0.31195	0.46334
GOOD	-0.14315	-1.294	0.19566	0.56110	0.49631
FAIR	-0.043035	-0.382	0.70227	0.11426	0.31816
LIMITALL	0.085351	2.503	0.01232	0.18068	0.38480
PRICE	-0.27336	-9.578	0.00000	0.47713	0.42877

2. Demand Functions by Sex

It has been well documented that women generally use more medical care than men.[31] Since no literatures have investigated the elderly's possible differential use of medical care by sex, this research does separate regression analyses by sex to examine the effect of differences in measurable socio-economic variables and health status measures on the differential use of medical care by sex. The two-part model and the same dependent and independent variables as in the earlier chapter are applied. Tables (13) through (16) present regression results by sex.

About 82 percent of the male elderly had contacted a physician at least once while 87 percent of the female elderly has done so during 1987. As for the male elderly, perceptions of the value of medical care, years of formal education attained, age, race, family size, marital status, residing in one of the nineteen largest SMSAs, and family income level are all important determinants of the probability of contacting a physician. Health status variable (SQRTDAY, LIMITALL, EXCEL) are also important in the probability of contacting a physician by the male elderly. However, all the insurance status variables are not important determinant in the entry visit equation (probability of contacting a physician). As for the female elderly, most of socio-economic variables have expected signs and coefficients of variables for perceptions of the value of medical care, family size, time value, and family income are statistically significant. Health status variables (SQRTDAY, LIMITALL) have significant effects on the probability of contacting a physician by the female elderly. As in the case of the male elderly, all the insurance status variables have statistically insignificant coefficients in the entry visit equation.

Major differences of the effects of explanatory variables on the elderly's medical care utilization by sex can be summarizes as follows. While years of formal education attained, age, race, marital status, and place of residence are important determinants in the probability of contacting a physician by the male elderly those are not important determinants in the probability of contacting a physician by the female elderly. On the other hand round-trip traffic and waiting time to the usual source of medical care (TIMEVAL) is one of important determinants in the female elderly but not in the male elderly.

As for the number of visits conditional on any use, the female elderly and the male elderly have on average 4.82 visits and 4.53 visits, respectively, to the physician office. For the sample of the female elderly, regression results using OLS technique show that most of socio-economic variables have expected signs. Person's perceptions of the value of medical care has a strong negative effect on the number of visits. Being widowed, family size, marital status, SMSAs are important determinants in the number of visits by the female elderly. Surprisingly, person's age has negative effect on the number of visits conditional some visits by the female elderly even if the coefficient is not statistically significant. The effects of health status measures (SQRTDAY, EXCEL, GOOD, FAIR, LIMITALL) on the number of visits are strong as expected. The price variable has a negative coefficient and is one of most important determinants in the number of visits conditional on some use by the female elderly.

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[31]See Collins (1944), Fuchs (1974), and Sindelar (1982).

In explaining the number of visits by the male elderly, most of explanatory variables have expected signs. One exception to the expected effects is person's age which has a negative effect as in the case of the female elderly. The effects of perceptions of the value of medical care, marital status, and value of time (TIMEVAL) on the number of visits conditional on some use are statistically significant. Health status measures and price are most significant determinants in the number of visits conditional on some use. Most conspicuous differences in the effects of explanatory variables on the conditional number of visits between the male and female elderly are that family size and SMSAs have important effects on the number of visits in case of the female elderly but not in case of the male elderly. Also, while the value of time variable (TIMEVAL) is an important factor in determining the number of visits conditional on some use in case of the male elderly the variables is not so important in case of the female elderly.

Table 13
Regression result: Probability of contacting a physician by the male elderly

Dep. Variable = DRVISITS
Observations = 1373
Mean of LHS = 0.8230153E+00 Std.Dev of LHS = 0.3817948E+00
StdDev of residuals = 0.3601273E+00 Sum of squares = 0.1748243E+03
Log-Likelihood -556.4607
Restricted (Slopes=0) Log-L. -640.9031
Chi-Squared (24) 168.8848 Significance Level 0.0000000

Variable	Coefficient	t-ratio	Prob.|t|≥x	Mean	Std.Dev.of X
Constant	-1.2935	-1.688	0.09137		
VALUEMED	-0.35533E-01	-3.747	0.00018	15.625	4.6122
FULLABOR	0.47419E-01	0.303	0.76174	0.086672	0.28146
EDUCAT	0.21377E-01	1.653	0.09841	10.602	3.7955
LASTAGE	0.28107E-01	3.790	0.00015	73.371	6.3053
NONWHITE	-0.30705	-2.351	0.01873	0.12090	0.32613
FAMSZALL	-0.10887	-2.379	0.01737	2.1595	0.97493
MARRIALL	0.39487	3.628	0.00029	0.80262	0.39817
SMSA19	-0.33582	-2.700	0.00693	0.24836	0.43222
SMSOTHER	-0.16193	-1.500	0.13363	0.47560	0.49959
NOTHEAST	-0.11579	-0.823	0.41038	0.19956	0.39982
MIDWEST	-0.78895E-02	-0.057	0.95428	0.26438	0.44117
SOUTH	-0.15568	-1.222	0.22188	0.34596	0.47585
TIMEVAL	-0.15943E-02	-1.304	0.19227	44.950	34.246
FMINCALX	0.41007E-05	1.861	0.06279	29263.	30060.
SQRTDAY	0.31754E-01	2.424	0.01537	2.3419	3.8343
EXCEL	-0.47854	-2.136	0.03271	0.075747	0.26469
GOOD	-0.16486	-0.951	0.34170	0.44210	0.49682
FAIR	-0.67767E-01	-0.408	0.68331	0.37291	0.48375
LIMITALL	0.26822	2.587	0.00969	0.74508	0.43597
CARECAID	0.42658	0.863	0.38832	0.037873	0.19096
CAREPRIV	0.66686	1.441	0.14969	0.81355	0.38961
ALLINS	0.39769	0.695	0.48718	0.012382	0.11062
ONLYCARE	0.30536	0.650	0.51538	0.11362	0.31746
ONLYPRIV	0.84515	1.488	0.13678	0.016752	0.12839

Table 14
Regression result: Probability of contacting a physician by the female elderly

Dep. Variable = DRVISITS
Observations = 2141
Mean of LHS = 0.8729566 Std.Dev of LHS = 0.3330994E+00
StdDev of residuals = 0.3212796 Sum of squares = 0.2184148E+03
Log-Likelihood -732.2689
Restricted (Slopes=0) Log-L. -815.1376
Chi-Squared (24) 165.7373 Significance Level 0.0000000

Variable	Coefficient	t-ratio	Prob.|t|≥x	Mean	Std.Dev.of X
Constant	1.0279	1.638	0.10137		
VALUEMED	-0.30324E-01	-3.825	0.00013	15.746	4.6712
FULLABOR	-0.51246E-01	-0.360	0.71911	0.069127	0.25373
EDUCAT	0.10332E-01	0.887	0.37514	10.458	3.5547
LASTAGE	0.14420E-02	0.244	0.80740	73.765	6.7718
NONWHITE	0.38955E-01	0.331	0.74077	0.12985	0.33621
FAMSZALL	-0.18276	-4.810	0.00000	1.8776	1.0524
MARRIALL	0.14203	1.673	0.09437	0.41616	0.49304
SMSA19	-0.11590	-1.085	0.27789	0.24848	0.43223
SMSOTHER	-0.13077	-1.437	0.15063	0.47314	0.49939
NOTHEAST	0.61480E-01	0.496	0.61985	0.19290	0.39467
MIDWEST	0.40678E-02	0.035	0.97201	0.27043	0.44429
SOUTH	-0.33747E-01	-0.306	0.75957	0.35451	0.47848
TIMEVAL	-0.16950E-02	-1.878	0.06042	45.056	38.013
FMINCALX	0.43588E-05	2.134	0.03285	24247.	29437.
SQRTDAY	0.47976E-01	4.242	0.00002	3.0520	4.3149
EXCEL	-0.19115	-1.000	0.31727	0.076600	0.26602
GOOD	-0.18067	-1.224	0.22095	0.43811	0.49627
FAIR	0.12768	0.888	0.37460	0.36618	0.48187
LIMITALL	0.28517	3.116	0.00184	0.78888	0.40820
CARECAID	0.36004	0.902	0.36715	0.099953	0.30001
CAREPRIV	0.59806	1.519	0.12883	0.76460	0.42435
ALLINS	0.27916	0.630	0.52888	0.025222	0.15683
ONLYCARE	0.85509E-01	0.214	0.83033	0.088277	0.28376
ONLYPRIV	0.18682	0.397	0.69155	0.015880	0.12504

Table 15

Regression results from the two-equation model: Utilization, the number of visits, conditional on use the male elderly

Dep. Variable	= LOGVISIT		
Observations	= 1130		
Mean of LHS	= 0.1511768E+01	Std.Dev of LHS	= 0.8917841
StdDev of residuals	= 0.8156951	Sum of squares	= 0.7372171E+03
R-squared	= 0.1789266	Adjusted R-squared	= 0.1633647
F[21, 1108]	= 0.1149776E+02		
Log-likelihood	= -0.1362094E+04	Restr.(á=0) Log-l	= -0.1473480E+04

Variable	Coefficient	t-ratio	PProb.|t|≥x	Mean	Std.Dev.of X
Constant	2.0487	5.647	0.00000		
VALUEMED	-0.16427E-01	-2.888	0.00387	15.315	4.4505
FULLABOR	0.12707	1.395	0.16305	0.08495	0.27894
EDUCAT	0.10205E-01	1.356	0.17504	10.810	3.7459
LASTAGE	-0.32283E-02	-0.789	0.43040	73.683	6.3538
WIDOWED	0.67655E-01	0.580	0.56169	0.11858	0.32344
NONWHITE	-0.13508	-1.459	0.14468	0.092035	0.28920
FAMSZALL	-0.50396E-01	-1.509	0.13131	2.1230	0.82257
MARRIALL	0.18126	1.756	0.07911	0.82832	0.37727
SMSA19	-0.12678E-01	-0.179	0.85776	0.23894	0.42662
SMSOTHER	0.22028E-01	0.373	0.70919	0.47611	0.49965
NOTHEAST	-0.52817E-01	-0.729	0.46610	0.33097	0.47077
TIMEVAL	-0.23768E-02	-3.161	0.00157	43.610	33.112
FMINCALX	0.10391E-05	1.248	0.21220	30291.	31810.
SQRTDAY	0.50128E-01	7.458	0.00000	2.5068	3.8897
EXCEL	-0.53486	-3.947	0.00008	0.062832	0.24277
GOOD	-0.31536	-3.531	0.00041	0.43982	0.49659
FAIR	-0.13845	-1.625	0.10410	0.38053	0.48573
LIMITALL	0.20560	3.178	0.00148	0.77345	0.41878
PRICE	-0.36717	-5.374	0.00000	0.44197	0.36989

Table 16
Regression results from the two-equation model: Utilization, the number of visits, conditional on use by the female elderly

Dep. Variable	= LOGVISIT		
Observations	= 1869		
Mean of LHS	= 0.1573438E+01	Std.Dev of LHS	= 0.8982145
StdDev of residuals	= 0.8189516	Sum of squares	= 0.1238749E+04
R-squared	= 0.1780482	Adjusted R-squared	= 0.1687028
F[21, 1847]	= 0.1905193E+02		
Log-likelihood	= -0.2267635E+04	Restr.(á=0) Log-l	= -0.2450866E+04

Variable	Coefficient	t-ratio	Prob|t|x	Mean	Std. Dev of X
Constant	2.5141	9.015	0.00000		
VALUEMED	-0.19877E-01	-4.704	0.00000	15.523	4.5904
FULLABOR	-0.96531E-01	-1.202	0.22945	0.065276	0.24708
EDUCAT	0.92060E-02	1.491	0.13591	10.539	3.5228
LASTAGE	-0.43054E-02	-1.370	0.17059	73.829	6.7067
WIDOWED	-0.13445	-2.107	0.03508	0.46923	0.49919
NONWHITE	-0.47798E-01	-0.763	0.44545	0.12199	0.32736
FAMSZALL	-0.98178E-01	-4.313	0.00002	1.8341	0.98288
MARRIALL	-0.12496	-1.867	0.06193	0.42215	0.49403
SMSA19	-0.10543	-1.930	0.05358	0.24719	0.43149
SMSOTHER	-0.10283	-2.235	0.02545	0.47084	0.49928
NOTHEAST	0.60034E-01	0.950	0.34228	0.19369	0.39529
MIDWEST	0.51902E-02	0.088	0.92965	0.27127	0.44473
SOUTH	-0.14113E-01	-0.247	0.80489	0.35099	0.47741
TIMEVAL	-0.80252E-03	-1.543	0.12277	44.521	37.251
FMINCALX	0.46222E-06	0.644	0.51974	24434.	30286.
SQRTDAY	0.45863E-01	9.349	0.00000	3.2563	4.3637
EXCEL	-0.36604	-3.578	0.00035	0.070626	0.25627
GOOD	-0.28513	-4.007	0.00006	0.42162	0.49395
FAIR	-0.16954	-2.561	0.01043	0.38256	0.48614
LIMITALL	0.24134	4.515	0.00001	0.80845	0.39362
PRICE	-0.33470	-6.281	0.00000	0.43594	0.37000

3. Tests of Structural Differences

One of the main purposes of this research is to find determinants of medical care utilization (physician office visits) by the elderly. The broad analyses for that purpose are done in earlier chapters of this research. However, in earlier parts of this chapter, two important hypotheses are made to more specifically analyze medical care utilization by the elderly. The first hypothesis is that since the depreciation of health stock by the aging process is a significant factor in demand for medical care, the demand functions by age groups are needed and are going to be different from each other. Following the first hypothesis, the first part of this chapter has estimated medical care utilization by age groups such as adults between the ages 18 and 39 and adults between the ages 40 and 64 to compare these estimates by age groups those with the elderly. The second hypothesis is that there are differences in utilization of health services by sex. Following the second hypothesis, separate estimates by sex of the determinants of ambulatory medical care utilization (physician office visits) by the elderly are investigated in the second part of this chapter. In this section, these two hypotheses are tested. That is, the first hypothesis tests are whether there are structural differences among separate demand functions by age, and the second hypothesis tests are whether there are structural differences between separate demand functions by sex. If those hypotheses are accepted then the need to estimate the demand for physician visits by age and by sex is supported.

Two regression models for empirical tests are used in this research. One is the two-equation model used in the main text and the other is the sample selection model used here in Appendix. Of the two models, whatever the model used, there are two processes in each of the regression models. The first process is finding the probability of any visit to the physician's office using probit. The second process is to find conditional demand function using the classical linear regression technique in the two-equation model and the two-stage regression technique in the sample selection model depending on assumptions of the consumer's decision making process in the demand for medical care. Then, testing structural differences is two-part processes whatever model used of the two models. The first process is, for example, to test whether there is any structural difference in the probability of contacting a physician among different ages groups. The second is to test whether is any structural difference in the conditional demand function among age groups.

To test structural differences in the probability of any visit to the physician's office among age groups, the likelihood-ratio test technique is applied in probit equation of the two-equation model. Under regularity, the large sample distribution of -2λ, the likelihood ratio test statistic, is chi-squared, with degrees of freedom equal to the number of restrictions imposed.[32] The null hypothesis is that the coefficients in the two equations are the same. The null hypothesis is rejected if the value of test statistic exceeds the appropriate critical value from the chi-squared tables. Comparing adults between the ages 40 and 64 with the elderly ages 65 and over, the value of the likelihood ratio test statistic is 98.38 and the critical value, with 26 degrees of freedom and 95 percent confidence interval, is 38.89. Therefore, the hypothesis is rejected. The test conclusion is that the regression coefficients in the two age groups are not the same as each other. Thus, separate regression by the two age groups are needed. In the probability of contacting a physician, comparing adults between the ages 18 and 39 with the elderly ages 65 and over with the null hypothesis of the same coefficients in both age groups, the value of likelihood ratio test statistic is 369.21 and the critical value with a 5 percents significance level is 38.89. Hence, the null hypothesis is rejected. The conclusion is that the coefficients in both age groups are different. Testing structural changes in the regression coefficients of the probability of contacting a physician between adults between the ages 40 and 64 and adults between the ages 18 and 39, with the null hypothesis of the same coefficients in both age groups, the value of chi-square test statistic is 145.92 and the 5 percent critical value from the chi-square table is 38.89. Therefore, the null hypothesis is rejected. The conclusion is that there exist structural differences between two age groups and regression coefficients of probit of the two groups are different from each other. In summary, the likelihood ratio test results show that there exist structural differences among all three age groups in probabilities of contacting a physician.

In testing for structural differences in the conditional demand functions among age groups, the Chow test (F-test) is applied. The null hypothesis is, in the two age groups, that the regression coefficients in

$$\text{Group 0: } y_0 = x_0\beta_0 + \varepsilon_0$$

$$\text{Group 1: } y_1 = x_1\beta_1 + \varepsilon_1$$

are the same. The test statistic is

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[32]The likelihood ratio is $\lambda = L_R/L_U$, where L_U and L_R are the unrestricted likelihood functions and restricted likelihood functions, respectively.

$$F[K, n_0 + n_1 - 2k] = \frac{(e'e - e_0'e_0 - e_1'e_1)/K}{(e_0'e_0 + e_1'e_1)/(n_0 + n_1 - 2K)}$$

where $e_0'e_0$ and $e_1'e_1$ are the respective sums of squared residuals, $e'e$ is the sum of squared residuals of the regression in which the data are pooled, K is the number of restrictions, and n_0 and n_1 are the number of observations in group 0 and group 1, respectively.

The two age groups tested, first, for the structural differences in the regressions of the number of visits conditional on some use are the elderly ages with ages 65 and over and adults between the ages 40 and 64. The pooled dada are adults ages 40 and over. The F calculated statistic is 3.36 and the tabled critical value, F[23, 2999+3655-46], is around 1.8 for 5 percent significance. Hence, the null hypothesis is rejected and the conclusion is that the coefficients are different and need separate regressions for the elderly ages 65 and over and for adults between the ages 40 and 64.

A test for structural differences in conditional demand functions of two age groups – adults between the ages 18 and 39 and the elderly – is applied. In the two-equation model with the dependent variable of LOGVISIT, the calculated F-statistic is 11.41. Since the critical value with 5 percent significance, F [23, 4411+2999-46] is around 1.8, the null hypotheses in the above tests are rejected. The conclusion is that coefficients of conditional demand functions of adults between the ages 18 and 39 and the elderly are different and separate regressions should be applied between the two groups. As for the test of the structural change in the conditional demand for adults between the ages 18 and

39 in comparison with adults between the ages 40 and 64, the test statistics have the F-calculated value of 5.93. The null hypotheses of same coefficients between two age groups are rejected since the critical value with 5 percent significant level is around 1.8.

General pattern of the above tests are that the structural differences exist among three age groups, the elderly, adults between the ages 40 and 64, and adults between the ages 18 and 39 in both the probability of any visit in the physician's office and the conditional demand function (the number of visits). That is, the likelihood ratio tests and F-test statistics are significant among three age groups. However, generally, the test statistics between the elderly and adults between the ages 18 and 39 have higher test scores than those between the elderly and adults between the ages 40 and 64 as well as between adults the ages 18-39 and adults the ages 40-64 implying that structural changes are severe in between the elderly and adults between the ages 18 and 39 than between other age groups. Thus, it is evident that the health stock depreciation by aging process is increasingly severe as individuals age.

To test structural differences in the elderly's medical care utilization (physician office visits) by sex the same test procedures as by age groups are applied, the likelihood ratio test and the standard Chow-test. The likelihood ratio test is applied in investigating possible structural difference in the probabilities of contacting a physician between the female elderly and the male elderly. The calculated chi-square value is 67.28 while the critical value with the degree of freedom 25 and a significance level of 5 percent is 37.65. Therefore, the null hypothesis is rejected and the conclusion is that the coefficients of two probit equations are not equal to each other. So, there exits a structural difference in between the sets of coefficients in the two probit equations.

Standard Chow-test is applied to see whether there is structural difference between two conditional demand functions by sex. The F-calculated test value is 1.21 while tabled F-value, F [22, 1130+1869-44], is about 1.8. Therefore, the null hypothesis is not rejected. The conclusion is that there are no differences in coefficients of two conditional visits equations by sex. The result is surprising since it is been widely assumed that there exists differences in health service utilization (including physician visits) by sex. This research find that, in the entry visit to the physician office by the elderly, the structural difference between sexes exits, but, in the number of visits conditional on some use, no evidence of structural difference is found between two sexes.

VIII. Summary and Conclusion

The main purpose of this research is to understand the determinants of physician visits by the elderly - care rendered to the elderly by all physicians. Understanding what basic forces influence the usage of medical services by the elderly is essential in addressing two seemingly contracting issues, i.e., to improve the elderly's heath and well-being via government policy and to devise the cost-effective health care system for the elderly. First, appropriate medical care for the elderly is a vehicle for maintaining the health of the elderly population and an object of government policy to improve their heath and well-being via programs such as Medicare and Medicaid. Because of these programs, it has been assumed that substantial variations are eliminated, especially with respect to race and socio-economic class, in utilization of medical care services. However, my research has found some evidence of variations in medical care utilization – physician's office visits – by the socio-economic class of the elderly. Second, federal health insurance programs, mostly by Medicare and Medicaid, are the fastest-growing portions of the Federal budget. Policy makers have realized that controlling these increases is a national priority. Thus, more attention has been paid to increasing health care expenditures and to the adequacy of the return that the U.S. is getting for its enormous investment in health care. Further, expected increases in the number of old persons poses tremendous challenges to, especially, the systems of health care in the U. S. While Americans are inevitably maturing as a population, the process will not be a smooth or gradual one. This research gives some useful guides to devise new cost-effective systems of health care in the U.S. by showing the effects of important policy variables on medical care utilization by the elderly.

The theoretical model of this research is based on the Grossman's human capital model of the demand for medical care. Here, I apply the model to the medical care utilization of the elderly. The Grossman model provides a framework for analyzing issues such as socioeconomic inequalities in health and medical care, the design of prevention policies and the impact of unemployment on health and medical care[Wagstaff (1986)]. Despite its theoretical appeal and its wide range of potential policy applications, the model has been the subject of comparatively few empirical studies, especially, for the elderly. Most of empirical researches excluded the elderly from their samples. This research presents estimates of the model of the demand for medical care on the part of the elderly using data from the 1987 National Medical Expenditure Survey.

Multivariate techniques have been employed to examine two measures of medical care utilization for the elderly aged 65 and over. These measures are the probability of contacting a physician and the number of office visits to physicians in private practice by those with positive visits during 1987. For the probability of contacting a physician probit is used. For the number of visits to the physician office the two-equation model and the sample selection model are considered. After comparing the two models by doing a diagnostic test for multicollinearity, the two-equation model is selected as the main empirical model. Regression results and interpretations are included in the main text. The results and interpretations from the sample selection model are included in Appendix. Dependent variables of both models are the log value of the number of visits. The following results are from the two-equation model.

Family income. Family income has a positive and statistically significant effect on the probability of contacting a physician. However, The effect of family income on the number of visits equation is insignificant. This result can lead to a conclusion that the welfare system of Medicare and Medicaid to reduce the effect of variations in wealth on the medical care utilization by the elderly is successful even with an evidence of the variation in the probability of the utilization by income level. When income elasticities by age groups are computed, the elderly appear more responsive to income than adults ages under 65 in the probability of contacting a physician. However, in the number of visits conditional on some visits, the elderly are less responsive to income than both adults between the ages 40 and 64 and adults between the ages 18 and 39. Overall, the income elasticity of visits of the elderly exceed the income elasticity of adults between the ages 40 and 64, but not exceed the income elasticity of visits of adults between the ages 18 and 39.

Price has a strong negative effect on the number of visits. The price elasticity of visits by the elderly appears to exceed the price elasticity of visits by adults between the ages 40 and 64 (-0.15 vs. -0.13) as well as the price elasticity of visits by adults between the ages 18 and 39 (-0.15 vs. -0.13) although statistically not tested. And physician visits by the elderly are highly sensitive to price when compared with some prior researches. In consideration of more rapid health stock depreciation and lower health status of the elderly than ordinary adults, the above results have important policy implications. Recent debates on the Congress to overhaul Medicare and Medicaid should consider the fact that the elderly are more price sensitive than adults ages under 65. An effort to contain the health care costs by increasing out of pocket costs of the elderly will have significant effects on the ambulatory medical care utilization (the physician office visits), especially for the low income elderly.

Considering that Medicare and Medicaid are integral parts in the welfare system for the elderly in the U.S., analyzing the effect of both programs on medical care utilization is important. All of the insurance variables have a positive coefficient in the probability of contacting a physician. However, only the variable for the persons holding both Medicare and private insurance is statistically significant. That is, Medicare supplemental insurance coverage has a significant effect on the entry visit to the physician office (the probability of contacting a physician). This finding corresponds to the earlier finding that family income has a significant effect on the entry visit equation. That is, persons without Medicare supplemental coverage may be significantly affected by deductibles, co-payments, and other costs not covered by Medicaid. According to summary statistics, about 97.8 percent of the sample has Medicare of which 80 percent has also private insurance coverage and 10 percent has other type of second insurance coverage including Medicaid. Most of the low-income elderly have only the single insurance coverage, i.e., Medicare only. Medicare only holders have the lowest value in regression coefficient among insurance variables in probit. Following summary statistics, 78 percent of Medicare only recipients has contacted physicians while 85 percent of the elderly have contacted physicians during 1987 even if self-evaluated health status of Medicare only recipients are noticeably lower than the rest of sample. Also while the average per capita total yearly medical care costs (charge price) of the elderly in the sample with both Medicare and private insurance coverage for the physician office care have spent 435.98 dollars (6.99 visits), the elderly with Medicare only and the elderly with Medicaid only have spent 294.65 (5.69 visits) and 222.14 (7.43 visits) dollars, respectively. As the above summary statistics shows that the elderly who depend on only in the welfare system (Medicare only and Medicaid only) are very conservative in consuming the ambulatory medical care, they can not be blamed for the nation's ever - increasing spending on Medicare and Medicaid programs whether they are actually cost minded or not. The above fact suggest a direction for the welfare system reform. More generous coverage for the low income elderly and more stringent coverage for the elderly who can afford Medigap insurance can be one possible direction to the reform. Both regression analysis and summary statistics show that without Medicaid and Medicare programs the elderly's access to ambulatory care would be reduced especially for the low income elderly.

The education level and age are important determinants of the probability of contacting a physician. The education level is a positive correlate in the number of visits equations and is statistically significant. The elderly's age has a surprising negative effect on the number visits to the physician office even if the effect is not statistically significant. The results can be interpreted that as far as the elderly who live in community and uses ambulatory care are concerned, aging simply does not mean the depreciation of health stock and thus not lead to more visits to the physician's office. Another interpretation is that the negative sign of age may result from a selection effect: older people still not in nursing homes are probably healthier than average.

Variables for sex, race, family size, marital status, and being widowed conform to priori expectations in the probability of contacting a physician equations. Only variables for race has a statistically insignificant coefficient. In the number of visits equation, those variables for sex, race, and family size conform to priori expectations. Family size has a strong negative effect as expected. Possible implications are that first, larger family size means less available income for an elderly person to spend for his/her medical care, and second, the more total available time for caring elderly persons in the family can substitute home care for an ambulatory care for the elderly. Marital status and being widowed have a surprising negative coefficient in the conditional visits equation.

Both SMSA dummy variables have negative effects on both the probability contacting a physician and the number of visits conditional on some visits. However, coefficients of both variables are statistically significant only in the entry visit equation. Among regional dummy variables the variables for south and northeast have negative coefficients in the probability of contacting a physician. The variables for South and Midwest have negative coefficients in the number of visits equation. Every coefficient of the regional dummy variables is statistically insignificant in both equations. The SMSA dummies and a set of regional dummy variables can be understood as controls for the effects of physician supply on the observed demand and/or the regional difference on the medical care utilization. As far as the availability effect is concerned, no evidence is found in the market of physician care for the elderly. The results of the regional variables show no evidence of regional difference in number of visits among different regions. A notion that persons who live in the southern regions consume less medical care than other regions is not supported in this research, at least in the level of physician care for the elderly.

The sum of reported round-trip travel and waiting time for the individual's usual care place is an important determinant having a negative effect on the probability of contacting a physician and on the number of visits conditional on some visits.

Among the health status measures, both the square root of disability days and whether an individual has some activity limitations are important determinants in both the probability of contacting a physician and the number of visits. All the self-perceived health status dummy variables have important effects on the number of visits conditional on some visits while self-perceived excellent health status is significant in the probability of contacting a physician.

In addition to understanding the determinants of physician visits by the elderly a comparison between the elderly and two other age groups, adults between ages 40 and 64 and adults between ages 18 and 39, is made. I estimate the determinants of medical care separately for two age groups, adults between ages 40 and 64 and adults between ages 18 and 39, from the point of my interpretation on the depreciation of health stock. After finding demand determinants by age groups, I test whether there are structural differences in demand functions among three age groups. The test results show that there are structural differences among three age groups in probit coefficients of the probabilities of contacting a physician and that there are structural differences among three age groups in the number of visits conditional on some visits.

Finally, this research does separate regression analyses by sex to examine the effect of differences in measurable socio-economic variables and health status on the differential usage of medical care by sex. Tests for structural differences between the male elderly and the female elderly in physician visits are investigated. Test results show that a structural difference between two sexes is found in the probability of contacting a physician but not found in the number of visits conditional on some visits.

In conclusion, the major findings from this research indicate first, that variations in the income level affect significantly only the elderly's decision to use any medical care in the physician office. Income level is not a significant determinant in the number of visits to the physician's office, probably because of Medicare and Medicaid insurance. This result can lead to a conclusion that Medicare and Medicaid are effective in reducing the effects of variations in wealth on the medical care utilization (visits to physicians conditional on some use). Second, the Medigap insurance coverage has a significant effect on the probability of contacting a physician. Third, in my analysis the price elasticity of the elderly at the mean is slightly higher than that of the rest of age groups. Still, the elderly aged 65 and over are highly price sensitive to the medical care utilization in the physician's office (the number of visits). Fourth, the health status measures of the elderly have significant effects on the medical care utilization. Fifth, the hypothesis of differential usage of medical care by sex is only confirmed in the probability of contacting a physician. The elderly women have a higher probability of contacting a physician than the elderly male. The hypothesis is rejected in the number of visits equation. Finally, this research confirms that there are structural differences in the demand for physician visits among three age groups, the elderly ages 65 and over, adults between the ages 40 and 64, and adults between the ages 18 and 39. On the basis of these results, especially considering lower income level and higher price elasticity, I recommend that recent debates on the Congress to overhaul the nation's Medicare and Medicaid should consider not only the new cost-effective public health care system but also its effect on the low-income elderly. That is, the new system should not preclude the health insurance protection for the low-income elderly that is guaranteed by the current welfare system.

Appendix A

Empirical Results from the Sample Selection Model

The parameters of the sample selection model have been estimated by means of the simple estimator devised by Heckman (1976, 1979). In table 7 the estimation results are presented for the probit equation "use/nonuse of the medical service." In Table 17 the estimation results are presented for the regression-equation explaining the non-zero annual number of visits with Heckman's correction term λ. My estimates do indicate that the coefficient of the correction term λ (the inverse of the Mills ratio) is significantly different from zero in the conditional visits equation with a dependent variable of LOGVISIT. This means that common omitted variables that explain both the decision to use medical care and demand conditional on use do exist, error terms of two equations are correlated, and effects of those omitted variables are statistically significant. But the condition number of an diagonal test for multicollinearity is high enough to accept the null hypothesis of high multicollinearity between the inverse of Mills ratio and the vectors of explanatory variables, thus, invalidating merits of the sample selection model.

Since the probit equation explaining the probability of contacting a physician by the elderly is explained already, here I will focus on the analysis of the effects of explanatory variables on the demand for medical care, the number of visits conditional on any use.

The dependent variable explaining the number of visits is the same as that of the two-equation model, LOGVISIT. LOGVISIT is the logarithm value of the number of visits to control for the undesirable skewness in the distribution of visits among users. Vectors of independent variables are the same as those in the two-equation model except for Heckman's λ.

The effect of the price variable (PRICE) on the number of visits (LOGVISIT) shows that persons facing higher price demand less medical care or less visits than facing lower price since the coefficient of PRICE is negative and statistically significant as expected in the theory. Table 21 and 22 shows marginal effects and elasticities for each age group for the coinsurance rate (PRICE), respectively. Compared to other age groups, the elderly have a largest price elasticity of the number of visits and adults between ages 18 and 39 have the next. This research shows that ambulatory medical care utilization by the elderly is more responsive to changes to price than ordinary adults under 65.

The time price variable (TIMEVAL) has a small but significant negative effect on the number of visits (LOGVISIT). A supplemental variable for the time price variable used is FULLABOR. FULLABOR which represents for persons working full time has a positive coefficient in LOGVISIT but statistically insignificant. Unlike the case of the elderly, the time price variable are a significant determinant of medical care utilization, the number of physician visits, by adults under 65.

The income variables used is the total yearly family income (FMINCALX). In the LOGVISIT equation, the family income variable has a negative and statistically insignificant coefficient. Family income has no significant effect on the physicians office visits by adults under 65 also. The results are the same as those of the two-equation model except the case of adults between the ages 18 and 39, where family income has a small but significant effect on the conditional visits. Following the regression results from the sample selection model, the total family income level (FMINCALX) is not a significant factor in the determinants of the physician' office visits conditional on any visit by the elderly.

A continuous variable for a person's age (LASTAGE) is used in explaining dependent variable, the number of visits (LOGVISIT). In explaining LOGVISIT the age variable has a surprising negative and statistically significant coefficient. In case of adults ages under 65, the age variable has positive and insignificant coefficients. From these statistical results, at least it is possible to conclude that the elderly person's aging does not simply require more physician office visits.

A dummy variable for women (FEMALSEX) has a surprising negative and insignificant coefficient in explaining LOGVISIT. In the elderly sample about 63 percent of the elderly is female. On the other hand, the variable FEMALSEX has a positive effect on the conditional visits by adults under 65, especially, in case of adults between the ages 18 and 39 the coefficient is statistically significant. Thus, in case of the elderly the above statistical results show that women do not consume more ambulatory medical care than that of men.

A race dummy variable (NONWHITE) which equals one if race is nonwhite and equals zero if race is white has a negative and statistically insignificant coefficient in explaining LOGVISIT. The interpretation of this result is that there is no racial difference in the elderly's medical care utilization in the physician's office and being nonwhite is not one of the major determinants of physician office visits. In contrast, being a non-white has a significant negative effect on the number of physicians office visits by adults between the ages 18 and 39.

Three regional variables (NOTHEAST, MIDWEST, SOUTH) are used to control for the regional difference in the demand for ambulatory medical care. The omitted region is west. All of the coefficients of the regional variables are statistically insignificant in explaining LOGVISIT. Common notion that persons living in the south spend less medical care utilization is not supported for the ambulatory medical care utilization by the elderly in this research. As for the place of the residence variables (SMSA19, SMSOTHER), each of the variables has a negative and statistically insignificant coefficient in explaining LOGMED. In the ambulatory medical care utilization by the elderly, the hypothesis of the availability effect is not supported in this sample selection model. However, for the medical care in the physicians office by adults between the ages 40 and 64, there is an evidence of the hypothesis of availability effect. That is, while the coefficient of the 19 largest SMSAs variable (SMSA19) is negative in the probability of contacting a physician, the coefficient is positive and statistically significant in the number of visits equation. The above results are the same as those in the two-equation model.

The family size variable (FAMSZALL) has a strong negative effect on explaining both LOGVISIT. A dummy variable (MARRIALL) for the marital status which equals 1 if the person is married and the spouse is alive has a negative coefficient in LOGMED. But the coefficient is statistically insignificant. More family members and having a spouse mean an increase in the opportunity cost of the time price for the non-free medical care and a reduction in the price of home health or increase in informal care giver's time (less price). Then, an opportunity cost hypothesis is somewhat supported here.

A dummy variable for the widowed (WIDOWED) has a strong negative effect on the number of visits. The widowed spend less ambulatory medical care than non-married single persons. Significant percent (about 34 percent) of the elderly is the widowed. An hypothesis of transfers in wealth from the deceased to the living spouse is not supported here.

As in the two-equation model, health status variables are the most important determinants of the medical care utilization of the physician visits by the elderly. All of the self-perceived health status variables (FAIR, GOOD, EXCEL) have negative and statistically significant effects on explaining LOGVISIT. The omitted self-perceived health status variable is POOR. The number of disability days (SQRTDAY) has a strong positive effect on explaining LOGVISIT. A dummy variable for persons who have activity limitations (LIMITALL) has a positive and statistically significant coefficient in LOGVISIT. These empirical results coincide with the theoretical model that the elderly's health status is one of significant determinants of the demand for medical care, physician's office visits.

The measure of consumer's perceptions on the value of medical care (VALUMED) has a significant negative effect on explaining LOGVISIT by the elderly. Since the higher score on VALUMED means more unfavorable responses, the empirical results coincide with the hypothesis. In contrast, as for adults ages under 65 the effect of the variable VALUEMED on the number of visits is small compared to the elderly and, even for adults between the ages 18 and 39 the coefficient is not statistically significant.

In summarizing the above empirical results, the results obtained in the sample selection are almost the same as those in the two-equation model. For the empirical analysis, I have applied two kinds of empirical model to find major determinants of the demand for medical care for the elderly. Both the two-equation model and sample selection model are used. The dependent variables to measure the conditional medical care utilization at the physician's office are the logarithm value of the number of visits. Generally, the empirical results from the both two-equation and sample selection models are not much different from each other when I used the same dependent variable in each model.

Table 17
Regression results from the sample selection model: Utilization, the log value of the number of visits, conditional on use by the elderly

Variable	Coefficient	t-ratio	Prob.|t|≥x	Mean	Std.Dev.of X
Constant	2.5960	9.855	0.00000		
VALUEMED	-0.12767E-01	-2.882	0.00396	15.444	4.5386
FULLABOR	0.74235E-02	0.119	0.90532	0.07269	0.25967
EDUCAT	0.62329E-02	1.189	0.23445	10.641	3.6103
LASTAGE	-0.54934E-02	-2.014	0.04405	73.774	6.5753
FEMALSEX	-0.27336E-01	-0.662	0.50780	0.62321	0.48466
NONWHITE	-0.28141E-01	-0.485	0.62764	0.11070	0.31382
FAMSZALL	-0.52239E-01	-2.170	0.03003	1.9430	0.93613
MARRIALL	-0.10528	-1.528	0.12643	0.57519	0.49440
WIDOWED	-0.10395	-1.727	0.08410	0.33711	0.47280
SMSA19	-0.37006E-01	-0.786	0.43213	0.24408	0.42961
SMSOTHER	-0.33683E-01	-0.868	0.38544	0.47282	0.49934
NOTHEAST	0.40992E-01	0.793	0.42757	0.19473	0.39606
MIDWEST	-0.28218E-01	-0.587	0.55707	0.27309	0.44562
SOUTH	-0.87635E-02	-0.186	0.85270	0.34345	0.47494
TIMEVAL	-0.99954E-03	-2.140	0.03234	44.178	35.745
FMINCALX	0.18862E-06	0.307	0.75853	26640.	30994.
SQRTDAY	0.42491E-01	8.766	0.00000	2.9739	4.2065
EXCEL	-0.36238	-4.123	0.00004	0.06768	0.25125
GOOD	-0.27553	-4.684	0.00000	0.42848	0.49494
FAIR	-0.16530	-3.020	0.00253	0.38179	0.48591
LIMITALL	0.17080	3.443	0.00058	0.79527	0.40358
PRICE	-0.34860	-8.319	0.00000	0.43821	0.36991
LAMBDA	-0.54289	-2.185	0.02888	0.23919	0.15019

Appendix B

Table 18
Marginal effect of the probabilities of contacting a physician by age groups

Variable	Ages 65 and over	Between the ages 40 and 64	Between the ages 18 and 39
Constant	-0.233133E-01	0.855323E-03	-0.165819
VALUEMED	-0.660633E-02	-0.815019E-02	-0.403321E-02
FULLABOR	0.261357E-02	0.905281E-02	-0.106830E-01
EDUCAT	0.317683E-02	0.456789E-02	0.429478E-02
LASTAGE	0.239216E-02	0.217674E-02	0.117552E-02
FEMALSEX	0.515637E-01	0.997356E-01	0.209408
NONWHITE	-0.243443E-01	-0.823704E-01	-0.775442E-01
FAMSZALL	-0.312007E-01	-0.116211E-01	-0.212337E-01
MARRIALL	0.778730E-01	0.983734E-02	0.420031E-01
WIDOWED	0.366539E-01	-0.350978E-01	-0.607485E-02
SMSA19	-0.429750E-01	-0.213760E-01	-0.724661E-02
SMSOTHER	-0.290447E-01	0.682562E-02	-0.658442E-03
NOTHEAST	-0.333481E-02	-0.598869E-02	0.125682E-01
MIDWEST	0.239647E-03	-0.160892E-01	0.113265E-01
SOUTH	-0.189330E-01	-0.696159E-02	-0.301318E-01
TIMEVAL	-0.313873E-03	-0.667754E-03	-0.717089E-03
FMINCALX	0.814980E-06	0.305058E-06	0.276576E-06
SQRTDAY	0.801208E-02	0.375158E-01	0.867759E-01
EXCEL	-0.642709E-01	-0.675081E-01	0.419741E-01
GOOD	-0.347230E-01	-0.238919E-01	0.505784E-01
FAIR	0.724245E-02	0.129738E-02	0.807089E-01
LIMITALL	0.588099E-01	0.993839E-01	0.770971E-01
CARECAID	0.870665E-01	-0.191232E-01	0.180085
CAREPRIV	0.118048	0.134192	-0.103820E-01
ONLYCARE	0.274919E-01	-0.743039E-01	0.371146E-01
ONLYPRIV	0.933641E-01	0.138320	0.123160
ALLINS	0.590481E-01	1.16449	-0.366036

Table 19
Elasticities of the probabilities of contacting a physician by age groups

Variable	Ages 65 and over	Between the ages 40 and 64	Between the ages 18 and 39
Constant	-0.237891E-01	0.939916E-03	-0.234539
VALUEMED	-0.105829	-0.143015	-0.951029E-01
FULLABOR	0.202636E-03	0.633318E-02	-0.110649E-01
EDUCAT	0.340827E-01	0.597533E-01	0.765602E-01
LASTAGE	0.179682	0.122859	0.477229E-01
FEMALSEX	0.320577E-01	0.630549E-01	0.167290
NONWHITE	-0.313871E-02	-0.213962E-01	-0.313862E-01
FAMSZALL	-0.632852E-01	-0.385928E-01	-0.104181
MARRIALL	0.450678E-01	0.785867E-02	0.310531E-01
WIDOWED	0.126128E-01	-0.275051E-02	-0.268057E-04
SMSA19	-0.108944E-01	-0.652661E-02	-0.276884E-02
SMSOTHER	-0.140512E-01	0.351895E-02	-0.449283E-03
NOTHEAST	-0.665273E-03	-0.133412E-02	0.343335E-02
MIDWEST	0.655535E-04	-0.452636E-02	0.408916E-02
SOUTH	-0.678434E-02	-0.273087E-02	-0.155682E-01
TIMEVAL	-0.144173E-01	-0.340012E-01	-0.455916E-01
FMINCALX	0.217937E-01	0.136425E-01	0.140957E-01
SQRTDAY	0.226836E-01	0.822670E-01	0.191339
EXCEL	-0.500174E-02	-0.162279E-01	0.194306E-01
GOOD	-0.155782E-01	-0.135166E-01	0.398986E-01
FAIR	0.272560E-02	0.302730E-03	0.120114E-01
LIMITALL	0.463140E-01	0.457461E-01	0.160974E-01
CARECAID	0.672520E-02	-0.252578E-03	0.758518E-03
CAREPRIV	0.944048E-01	0.280630E-02	-0.187410E-04
ONLYCARE	0.275420E-02	-0.114497E-02	0.818853E-04
ONLYPRIV	0.154535E-02	0.120272	0.131342
ALLINS	0.121741E-02	0.128171E-02	-0.293665E-03

Table 20
Elasticities of the demand for the number of physician visits: The two-equation model

	Ages 65 and over	Between the ages 40 and 64	Between the ages 18 and 39
Constant	2.32597	1.22122	0.840873
VALUEMED	-0.287598	-0.250682	-0.715962E-01
FULLABOR	0.889373E-03	-0.447257E-01	-0.942136E-01
EDUCAT	0.107743	0.165824	0.235201
LASTAGE	-0.264688	0.294733	-0.115959
FEMALSEX	0.115528E-01	0.768004E-01	0.219722
NONWHITE	-0.854489E-02	-0.914558E-02	-0.302652E-01
FAMSZALL	-0.162675	-0.138818	-0.873576E-01
MARRIALL	-0.135866E-01	-0.129825E-02	0.779464E-01
WIDOWED	-0.220831E-01	-0.697012E-02	-0.150801E-02
SMSA19	-0.165683E-01	0.174737E-01	-0.530253E-02
SMSOTHER	-0.250845E-01	-0.339940E-02	-0.272451E-01
NOTHEAST	0.803743E-02	0.151987E-01	0.752757E-02
MIDWEST	-0.627605E-02	0.134777E-01	0.117895E-01
SOUTH	-0.842571E-02	0.650903E-02	0.157296E-01
TIMEVAL	-0.584006E-01	-0.793574E-01	0.441662E-02
FMINCALX	0.178627E-01	0.233112E-01	0.285091E-01
SQRTDAY	0.142826	0.207507	0.245855
EXCEL	-0.281213E-01	-0.787856E-01	-0.530021E-01
GOOD	-0.126842	-0.132375	-0.803222E-01
FAIR	-0.591956E-01	-0.132405E-01	-0.491716E-02
LIMITALL	0.180048	0.544316E-01	0.154217E-01
PRICE	-0.156635	-0.133009	-0.130428

Table 21
Marginal effect of the number of visits: Sample selection model

	Ages 65 and over	Between the ages 40 and 64	Between the ages 18 and 39
Constant	2.60940	1.71916	1.37238
VALUEMED	-0.896410E-02	-0.233730E-02	0.414030E-03
FULLABOR	0.591905E-02	-0.117976	-0.142731
EDUCAT	0.440424E-02	0.346069E-02	0.118520E-01
LASTAGE	-0.687037E-02	0.172292E-02	-0.515809E-02
FEMALSEX	-0.570176E-01	-0.457439E-01	0.111552
NONWHITE	-0.141275E-01	0.107339	-0.331145E-01
FAMSZALL	-0.342790E-01	-0.252915E-01	-0.143983E-02
MARRIALL	-0.150103	-0.446633E-01	0.862345E-01
WIDOWED	-0.125053	-0.494321E-01	-0.415464
SMSA19	-0.122682E-01	0.103027	-0.126877E-01
SMSOTHER	-0.169639E-01	-0.177721E-01	-0.547718E-01
NOTHEAST	0.429117E-01	0.771752E-01	0.244899E-01
MIDWEST	-0.283562E-01	0.706350E-01	0.313621E-01
SOUTH	0.213510E-02	0.248405E-01	0.763384E-01
TIMEVAL	-0.818867E-03	-0.512610E-03	0.971707E-03
FMINCALX	-0.280518E-06	-0.142603E-06	0.329596E-06
SQRTDAY	0.378790E-01	0.339894E-01	0.426606E-01
EXCEL	-0.325382	-0.309885	-0.255113
GOOD	-0.255541	-0.249736	-0.239599
FAIR	-0.169473	-0.807121E-01	-0.167383
LIMITALL	0.136945	-0.440014E-01	0.143486E-01
PRICE	-0.398722	-0.261984	-0.358312
LAMBDA	-0.542891	-0.694040	-0.459172

Table 22
Elasticities of the demand for the number of physician visits: The sample selection model

	Ages 65 and over	Between the ages 40 and 64	Between the ages 18 and 39
Constant	2.60940	1.71916	1.37238
VALUEMED	-0.138442	-0.366933E-01	0.682985E-02
FULLABOR	0.430262E-03	-0.739817E-01	-0.105487
EDUCAT	0.468655E-01	0.416390E-01	0.151561
LASTAGE	-0.506855	0.891871E-01	-0.149654
FEMALSEX	-0.355340E-01	-0.278845E-01	0.721761E-01
NONWHITE	-0.156391E-02	0.219078E-01	-0.806280E-02
FAMSZALL	-0.666040E-01	-0.742129E-01	-0.481139E-02
MARRIALL	-0.863376E-01	-0.328101E-01	0.477408E-01
WIDOWED	-0.421566E-01	-0.352989E-02	-0.141282E-02
SMSA19	-0.299441E-02	0.276524E-01	-0.338549E-02
SMSOTHER	-0.802088E-02	-0.850928E-02	-0.267837E-01
NOTHEAST	0.835619E-02	0.156673E-01	0.488021E-02
MIDWEST	-0.774379E-02	0.182436E-01	0.833290E-02
SOUTH	0.733300E-03	0.865171E-02	0.260115E-01
TIMEVAL	-0.361759E-01	-0.227250E-01	0.412324E-01
FMINCALX	-0.747300E-02	-0.589062E-02	0.120857E-01
SQRTDAY	0.112648	0.822578E-01	0.889959E-01
EXCEL	-0.220248E-01	-0.612148E-01	-0.795819E-01
GOOD	-0.109494	-0.128115	-0.134438
FAIR	-0.647030E-01	-0.183951E-01	-0.191252E-01
LIMITALL	0.108908	-0.207308E-01	0.259257E-02
PRICE	-0.174724	-0.128558	-0.170961
LAMBDA	-0.129854	-0.272313	-0.233214

Table 23

Compound elasticities of the demand for physician visits by age groups: The two equation model[33]

Variable	The elderly ages 65 and over	Between the ages 40 and 64	Between ages 18 and 39
Constant	2.30218	1.22216	0.60633
VALUEMED	-0.39343	-0.39370	-0.16670
FULLABOR	0.00109	-0.03839	-0.10528
EDUCAT	0.14183	0.22558	0.31176
LASTAGE	-0.08501	0.41759	-0.06824
FEMALSEX	0.04361	0.13986	0.38701
NONWHITE	-0.01168	-0.03054	-0.06165
FAMSZALL	-0.22596	-0.17741	-0.19154
MARRIALL	0.03148	0.00656	0.10900
WIDOWED	-0.00947	-0.00972	-0.00153
SMSA19	-0.02746	0.01095	-0.00807
SMSOTHER	-0.03914	0.00012	-0.02769
NOTHEAST	0.00737	0.01386	0.01096
MIDWEST	-0.00621	0.00895	0.01588
SOUTH	-0.01521	0.00378	0.00016
TIMEVAL	-0.07282	-0.11336	-0.04117
FMINCALX	0.03966	0.03695	0.04260
SQRTDAY	0.16551	0.28977	0.43719
EXCEL	-0.03312	-0.09501	-0.03357
GOOD	-0.14242	-0.14589	-0.04042
FAIR	-0.05647	-0.01294	0.00709
LIMITALL	0.22636	0.10018	0.03152
CARECAID	0.00673	-0.00025	0.00076
CAREPRIV	0.09440	0.00281	-0.00002
ONLYCARE	0.00275	-0.00114	0.00008
ONLYPRIV	0.00155	0.12027	0.13134
ALLINS	0.00122	0.00128	-0.00029
PRICE	-0.15664	-0.13301	-0.13043

[33]The compound elasticity is an aggregate of the elasticity of the probability of contacting a physician and the elasticity of the number of physician visits.

Table 24

Compound elasticities of the demand for physician visits by age groups: The sample selection model

	The elderly ages 65 and over	Between the ages 40 and 64	Between the adults 18 and 39
Constant	2.5856	1.7201	1.1378
VALUEMED	-0.2443	-0.1797	-0.0883
FULLABOR	0.0006	-0.0676	-0.1166
EDUCAT	0.0809	0.1014	0.2281
LASTAGE	-0.3272	0.2120	-0.1019
FEMALSEX	-0.0035	0.0352	0.2395
NONWHITE	-0.0047	0.0005	-0.0394
FAMSZALL	-0.1299	-0.1128	-0.1090
MARRIALL	-0.0413	-0.0250	0.0788
WIDOWED	-0.0295	-0.0063	-0.0014
SMSA19	-0.0139	0.0211	-0.0062
SMSOTHER	-0.0221	-0.0050	-0.0272
NOTHEAST	0.0077	0.0143	0.0083
MIDWEST	-0.0077	0.0137	0.0124
SOUTH	-0.0061	0.0059	0.0104
TIMEVAL	-0.0506	-0.0567	-0.0044
FMINCALX	0.0143	0.0078	0.0262
SQRTDAY	0.1353	0.1645	0.2803
EXCEL	-0.0270	-0.0774	-0.0602
GOOD	-0.1251	-0.1416	-0.0945
FAIR	-0.0620	-0.0181	-0.0071
LIMITALL	0.1552	0.0250	0.0187
CARECAID	0.0067	-0.0003	0.0008
CAREPRIV	0.0944	0.0028	0.0000
ONLYCARE	0.0028	-0.0011	0.0001
ONLYPRIV	0.0015	0.1203	0.1313
ALLINS	0.0012	0.0013	-0.0003
PRICE	-0.17472	-0.12856	-0.17096
AVGMED	-0.12985	-0.27231	-0.23321

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