FACTORS AFFECTING THE DISTRIBUTION OF PRIMARY CARE PHYSICIANS IN RURAL COUNTIES OF VIRGINIA: 1970-1990.

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Abstract

In this study, county level data for three time periods (1970, 1985, and 1989) are examined to determine the factors affecting the distribution of primary care physicians in rural counties of Virginia. Consistent predictors of proportions of physicians to the population were identified: golf holes per capita and the ratio of hospital beds to population were the most consistent predictors. Per capita income and the elderly population were only significant for some of the years. Variables deemed to be controllable by the community (in the short run) were generally more consistent in predicting the proportions of physicians to population.

Policy implications are discussed, and several strategies for improving access to health care in rural areas, thus altering the massive imbalance in physician to population ratio in urban and rural areas are suggested.

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Chapter I

INTRODUCTION

Introduction

Health care is a very large and important industry in the United States. The industry has changed in recent decades, in part due to technological, demographic, and other demand-related changes. There exist multi-million dollar corporations that manage and provide health care services. A considerable amount of financial resources is now required to obtain the technology needed to practice modern medicine effectively. This high cost of entry is particularly true for highly specialized fields of medicine.

Health care availability has been a matter of concern for health planners, policy makers, and governments, because, among other reasons, certain geographic areas and demographic groups do not have the same access to health services as others (Lapierre,

Leonardson, and Hollingsworth, 1985). This inequality is partly due to the rising costs of providing medical care and related health services, and shortages, or unequal geographic distribution of health care personnel. In the 1960s, the public and private sectors took steps to improve access to medical care, especially for the uninsured, the unemployed, and people with low-incomes. A majority of people with inadequate access to health care services are poor inner-city, and rural, residents. It was hoped that these steps would lessen some of the more egregious inequalities affecting access.

The issues of availability of, and accessibility to, health care services are closely related; thus, it is important to distinguish between them. Availability is defined in terms of supply of health care personnel and services. Access relates to affordability, which includes costs of services, costs of insurance, time cost of reaching a service point, and especially the disposable income of the prospective patient. Access may also be called "effective demand" for health care. The issue of access is of paramount importance because it is of little use to have high priced health care services in low income communities where patients do not have the financial resources necessary to purchase the services.

As a response to documented need of special population groups, the federal government began in the 1960s to address both the supply and demand sides of the access issue. Under the Social Security Amendments of 1965, the federal government introduced the medicare and medicaid (health insurance) programs, for elderly and poor younger people, respectively. These health insurance programs pay for about 52

percent of the cost of health care services for patients. This third party payment resulted in increased demand for non-emergency care, especially for those who had previously been able to afford only emergency care (Stewart, 1973). This government-stimulated increase in demand coincided with a widespread growth in private and especially employment-based insurance programs, which also stimulated service demand. The pressure of increased demand caused an increase in the price of medical care, especially as reflected in physician fees and hospital charges.

On the supply side, advances in technologies led to increased use of computer technology in many ways, ranging from continuously monitored cardiovascular parameters to billings and medical-record keeping (Kellog,1988). As a result of these costly technologies, the cost of providing medical services has increased dramatically in recent years.

Also in the 1960s, the federal government introduced policies intended to expand the pool of health care personnel. Class size was expanded in existing medical schools, new medical schools were created, curricula were developed to train new health providers, such as nurse practitioners and physician assistants, and policies were adjusted to open in-migration and licensure for foreign medical graduates (Crandall et al. 1990, Freun and Cantwell, 1982: Stewart, 1973)

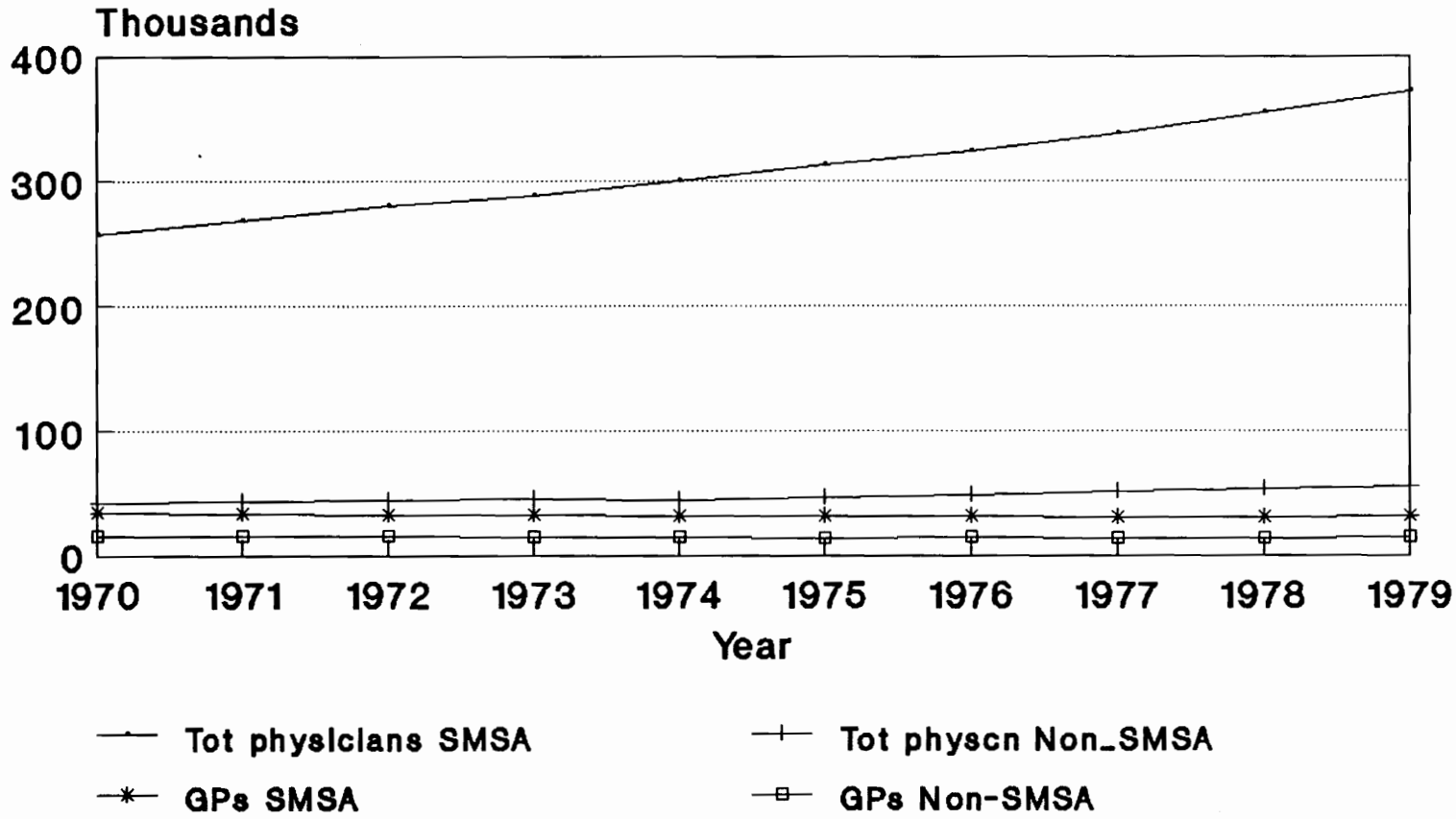
In 1963, Congress enacted the Health Profession Education Act (HPEA). This legislation provided a six-year program of loans to students pursuing doctoral degrees in medicine, dentistry, and osteopathy (Stewart,1973). This Act also provided a three-

year program of matching grants for construction of medical schools, and improvement of schools for doctors and other professional public health personnel. The Nursing Training Act (NTA) of 1964 authorized matching grants for construction, expansion and rehabilitation of nursing schools and for curriculum improvements for the years 1966 through 1969 (Stewart, 1973).

In 1968, the federal government enacted the Health Manpower Act (HMA). This Act extended federal financial support to medical schools, to improve construction of facilities needed to train medical personnel, and enlarge enrollment, in order to improve manpower supply. In 1971, the government legislated the Comprehensive Health Manpower Training Act (CHMTA) and amended the NTA with the intent of accelerating the increase in number of medical personnel.

The Manpower Training Acts were effective in increasing the supply of health personnel (Schwartz et al.). In 1971, the number of graduating physicians was 23 percent greater than in 1963 (Stewart, 1973), and enrollment in medical schools had increased by 30 percent during the period. Sixteen new medical schools were opened in the 1960s (Stewart, 1973). These numbers represented a significant improvement over the six that opened in the 1950s. A report by Graduate Medical Education Advisory Committee (GMEAC) indicated a sufficient supply of physicians through the 1970s and 1980s, and a possible physician glut in the future (Freun and Cantwell, 1982; Cooper and Johnson, 1983).

Trends in the Distribution of Physicians
By SMSA and Non-SMSA, 1970-1979.



Federal physicians were not included.

Figure 1.1

Distribution of Health Care Personnel

As the supply of medical personnel increased, the physicians and nurses were expected to diffuse into different geographic areas of the nation. However, severe problems in the geographic distribution of health care personnel persisted (see Fig 1.1). Despite the total increase in the number of health care personnel, some areas remained unattractive to physicians (Langwell, Nelson, Calvin, and Drabek, 1988). This geographic maldistribution was particularly true for the specialized professions. Results of studies on physician distribution found that most physicians settle in urban areas (Parker and Tuxill; Busch and Dale, 1977; Bible, 1970; Leonardson, et. al. 1985; Parker and Sorrensen, 1978; Kindigh and Movassaghi, 1989; Freun and Cantwell, 1982; Hines and Givener, 1983 etc).

As a response to the continuing problem of geographic maldistribution of physicians, several programs were initiated. In 1971, Congress amended the Comprehensive Health Manpower Training Act, to increase the supply of physicians to unattractive areas. The Preceptorship Training program was introduced, in which medical students are exposed to rural practice. The impact of this program has been minimal because training represents a primarily passive influence on location decisions by physicians (Yett and Ernst, 1985).

Other programs were introduced to decentralize medical education; one is the Area Health Education Center (AHEC) program. The primary goal of this program was

to extend medical school services to rural areas in order to promote rural participation in medical practice. The program involved providing graduate and undergraduate medical education in rural areas. Like the preceptorship program, the impacts of this program are not clear.

The Hill-Burton Hospital Act (1947), which was reactivated in 1971, provided federal subsidies for construction of hospitals in rural areas. It was primarily intended to provide hospital services, as distinguished from physician services, to rural areas lacking such services. Hill-Burton was expected to indirectly attract physicians to rural areas, since physicians generally prefer to locate near hospitals. Results of studies (conducted in the 1960s, 1970s, and 1980s) on the impact of the Hill-Burton Act are mixed. Some areas with Hill-Burton hospitals were successful in attracting physicians, while some areas lost physicians (Yett and Ernst, 1985).

The largest federal effort to recruit physicians to practice in underserved areas was the National Health Service Corps program (NHSC), which was created by the Emergency Health Personnel Act of 1970. The NHSC scholarship program was initiated in 1972. The scholarship includes tuition, and a lump sum of money covering reasonable educational costs for four years of undergraduate medical education. One year of scholarship is swapped for one year of service in a MUA[1] following graduation. The

[1] Medical Underserved Areas (MUAs) are designated based on the percent of the population living below the federal poverty level, the infant mortality rate, the percent of the population that is age 65 and older, and the number of primary care physicians per population (Virginia Department of Health and Human Services, 1989).

physicians are allowed to chose an MUA to serve in.

The number of scholarship recipients rose to 1,300 in 1979, and to 1,772 in 1980. In a similar fashion, the number of physicians trained, and available for service, rose from 190 in 1977 to 1,100 in 1980. However, the impact of the NHSC scholarship is inconclusive. Only 25 percent of the NHSC physicians remain in their practice sites after completion of their obligations, and fewer than 10 percent plan to remain at the site (Family Health Care, 1977). The physicians who leave their practice sites cite, among other reasons, professional isolation, lack of medical facilities, inadequate health care personnel, and lack of opportunity for economic growth as the major deterrents to staying. The US General Accounting Office (GAO), reported that at the end of 1975, 261 of 497 MUAs and HMSAs[2] were not staffed. These areas were the most remote and least desirable practice locations.

In 1966, the federal government introduced the Neighborhood Health Center (NHC) program which was designed to provide health services to the poor. The Community Health Center (CHC) program was established in areas where private practicing physicians were unavailable. The CHCs provide a medical care system for all socioeconomic groups (Crandall et. al. 1989). They are funded by the federal government and managed by community members. This program relies heavily on the NHSC program for medical staffs. It has been very effective in providing medical care

[2]Health Manpower Shortage Areas (HMSAs) are designated based on health manpower personnel to population ratio, and the availability of adjoining or nearby area health resources (Virginia Department of Health and Human Services, 1989).

services to MUAs and the indigent.

In the late 1980s, the problem of insufficient supply of health care personnel has re-emerged, and there have been reports of a decreasing pool of primary care medical personnel[3] (Crandall et. al. 1989). Rural areas are hard hit by this problem because they are unattractive to physicians for a number of reasons. Among other factors, rural areas often suffer from poor facilities, rural hospitals and physicians receive less reimbursement for medicare services than their urban counterparts, effects of professional isolation, reduced access to technology, and lower projected incomes (Bishijirian, 1990; Leornardson et. al. 1985; Kindigh and Movassaghi, 1989; Parker and Tuxill). Many rural hospitals have closed, or will close in the near-future partly because of increased difficulty in attracting physicians. These isolated rural hospitals cannot compete with most urban hospitals for physicians (Overstreet, 1990; Bishijirian, 1990). There are two major effects associated with rural hospital closure: less access to certain types of health care (especially emergency services) in the short run, and longer-term declines in health care availability because of reduced physician location in area.

The number of rural physicians nationwide could drop as much as 25 percent in the next five years, aggravating existing shortages of physicians in sparsely populated areas (National Rural Health Association). The current shortage of medical personnel in isolated rural areas is already acute. Rural counties with more than 2,500 and fewer

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[3]Primary care physicians include general practitioners, family practitioners, internist, pediatricians, and in some cases obstetricians and gynecologists.

than 10,000 population had an average of one doctor per 1,855 people, while counties with fewer than 2,500 population had one physicians per 3,344 people in 1988 (National Rural Electric Corporation Association, 1989). As the above trends influencing the location decisions of health care personnel continue, shortages of health services in rural areas will be aggravated.

Distribution of Health Care Services in Virginia

In 1979, the state of Virginia was ranked 19th in the nation according to the rank of physician population ratio (American Medical Association,1979). In the 1980s Virginia, like the rest of the nation, experienced a shortfall, and a continuing geographic maldistribution of health care providers. Of Virginia's 136 counties and cities, 52 were MUAs in 1989 (Virginia Department of Health (VDH), 1989). Many Virginians do not have the access to a physician in their own or a nearby community. This means that they are often not able to obtain primary health care services.

Sixty-six percent of the underserved population in Virginia reside in Non-SMSAs (VDH, 1989). Medicaid and Medicare patients in Virginia and the rest of the country have less access to health care services because of low-fee reimbursement policies. The state of Virginia adopted a fixed rate fee schedule since the inception of the Medicaid program. According to a report by the Virginia Department of Medical Assistance Services (VDMAS), fee reimbursement was increased only three times between 1965 and

1988. This low level of reimbursement reduces the current medicaid payment level for physician services to an amount comparable to a very small percentage of physician charges. Because of these low repayment rates, only six percent of all Virginia primary care physicians participate in the program, and of participating physicians, more than 50 percent submit fewer than 25 claims each year. All these statistics indicate low involvement in the medicaid program (VDH, 1989), and translate into inadequate access to basic medical services for the rural poor.

State Government and the Distribution of Health Care Personnel

Studies conducted by Virginia's Rural Affairs Commission in the late 1930s and early 1940s, found a shortage and severe maldistribution of physicians. Most rural areas were medically underserved at the time. The results of these studies led to the establishment of the Virginia Medical Scholarship Program in 1942. Recipients were expected to practice in underserved areas for the same period as the period of the scholarship received. The original amount of the scholarship was a grant of $500 annually (Rural Affairs Study Commission, 1970).

In the early 1970s, the Virginia state government took further steps to improve the access to medical care for the underserved population. The government restructured its medical school scholarship program with the intent of filling the gaps in the areas deemed medically underserved. The scholarship grant was increased to $2,500 per year (VDH, 1989). A total of seventy scholarships were available for the three medical

schools in Virginia (Medical College of Virginia 33, University of Virginia 27, and Eastern Virginia Medical School 10). It is not apparent how effective this program is in alleviating the maldistribution problem. Critics report that the program was not successful for a number of reasons. First, goals and objectives of the program were not clearly specified. Second, placement criteria do not ensure placement of those physicians who receive scholarships into high-need areas. Finally, the scholarship award level of $2,500 is too low for the average medical school tuition cost of $7,750. A majority of the recipients of the scholarships buy back their loans instead of fulfilling their obligation to serve in MUAs (VDH).

Statistics show that a majority of the state scholarship recipients who chose to practice in a MUA left the practice site soon after completing the service obligation. Reports showed that from 1977 through 1983, some 64 percent of the recipients paid off the loan monetarily, rather than through practice (VDH, 1989).

In addition to the state scholarship, the state of Virginia has received 147 physicians through the NHSC program from 1977 through 1988 (VDH,1989). These NHSC physicians have helped to reduce the MUA primary care physician to population ratio from 1:3,400, to 1:3,000. However, the NHSC physician supply is unreliable, because the majority of NHSC physicians do not remain in the underserved areas after completing their obligation years.

In addition to the current maldistribution, in many near-shortage areas (areas that barely have more than 1 primary care physician per 2,500 people), physicians upon

whom the people depend as their sole source of medical care are nearing retirement age (Ronoake Times and World News, p.11 1989). These areas will eventually become medically underserved if those physicians are not replaced. A majority of these near-shortage areas are rural.

Efforts by Non-Government Agents to Provide Health Care Services.

Over the years, non-governmental organizations and humanitarian groups had made efforts to provide basic health care services to the medically indigent. There are 12 free clinics in Virginia that do not receive any funds from the state or federal government. These clinics are staffed by volunteer workers with the exception of one or two paid managers.

The New River Valley Free Clinic was established in 1981 by a group of physicians (mainly primary care physicians). The clinic provides health care services to residents of Montgomery, Floyd, and Giles Counties. Approximately 12 physicians visit the clinic weekly, and a total of 60 physicians accept referrals from the clinics and provide medical services at physician offices outside the clinic for free. About 50 nurses and 7 pharmacists volunteer over a year period.

In 1991, about 1,300 patients visited the clinic, a 23 percent increase from the previous year. Most of the patients were below the national poverty level, and do not have personal health insurance.

Problem Statement

Many rural counties in Virginia are medically underserved or will be medically underserved in the near-future. Statistics show that physician/population ratios in rural areas are much lower than those in urban areas. The number of Virginians without access to, or with less access to, health services will be increasing, particularly in rural areas as the stock of primary care physicians ages.

Some characteristics of rural areas make them inherently undesirable areas for a physician to locate. Physicians who leave rural practice complain about inadequate medical facilities, work overload, relatively lower income compared to urban counterparts, and professional isolation, as well as other professional and personal reasons. These factors are particularly acute in rural areas and combine to make rural areas less attractive to most physicians. Rural communities that want to obtain the services of a primary care physician might attempt to develop recruitment programs in order to attract physicians. There are a number of ways in which a community can attract a physician.

Some communities have used a subsidy oriented-approach, which includes providing clinic facilities for the physician at a reasonably low price, free housing, and a guaranteed income for a certain period of time (Brierly,1973). A community could pay for the medical training of a physician under a contract that guarantees that the physician will practice there for a certain period of time. There are other attributes of rural living that could possibly appeal to physicians, for example nearness to nature,

close interfamily relationships and the opportunity to participate in community activities. Most physicians in rural communities do not drive long distances to work. Other advantages include the amenities of rural life.

It is very important that every citizen have access to primary health care services, since inadequate access is detrimental to community well-being and hinders efforts directed toward community development. Access to medical services improves the local human capital; enhanced human capital in turn complements community development programs such as industry recruitment.

Because of these externalities associated with the provision of medical services, and the nonexclusive[4] nature of health services, access to health care may be considered a public good. It is well known that private market leads to a supply of public good that is lower than the social welfare maximizing level. Thus, the government may need to intervene to modify the inadequate supply of public goods caused by the free market operations (Nicholson, 1978). Governments in these communities need to know what kinds of community characteristics attract physicians to rural areas. With this knowledge, these government can design more effective physician recruitment programs by highlighting their favorable attributes, or possibly invest in ways of changing the community to make it more desirable.

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[4]Once provided it is difficult to exclude a member of the society from deriving benefits from it.

Research Objective

The first objective of this research is to determine the effects of community controllable characteristics and community non-controllable characteristics on the number of primary care physicians[5]. The second objective is to determine the effects of these characteristics on the changes in levels of primary care physicians in the community. By examining these factors, information can be provided to these communities that will assist them in developing effective physician recruitment programs.

Research Hypothesis

The problem statement and research objective suggests the following basic research hypothesis: Communities can attract physicians by controlling certain factors that influence the location decisions of physicians. These controllable community characteristics include: supportive medical facilities (hospitals/clinics, beds in the hospital, CHCs), infrastructure (roads, public transit, etc.), socio-cultural considerations (Colleges and Universities, educational expenses, entertainment centers, and recreational facilities), and socio-economic considerations (industrial mix, local tax rates, income level of patients, etc.).

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[5]This study will focus on primary care physicians. Primary care physicians are considered the gateway to medical services; they are often consulted first, and they recommend specialists if there is the need to see one.

Research Methods

This study analyzes data on the population to primary care physician ratio (PPR) by county in Virginia for 1970, 1985, and 1989/90. A model of the physician location decision is developed. The variables used to estimate the PPR models are identified and operationalized based on this model.

Data on the supply of primary care physicians have been collected in a consistent manner by the Medical College of Virginia on an annual basis since 1970. County-level data of other key variables for the same years are obtained from other sources. These data include community characteristics such as socio-economic and demographic composition, socio-cultural considerations, existence of supportive facilities, etc.

Factors affecting the levels, and changes in levels of primary care physicians in rural counties will be evaluated, using econometric techniques.

Study Organization

The determinants of physician location are discussed in the next chapter. The third chapter discusses the study's theoretical framework, the statistical methods employed and the variables chosen to estimate the model. The statistical analysis and results are presented in the fourth chapter. The summary, conclusion, implications, and recommendations of the study are presented in the fifth chapter. And chapter six contains a retrospect to health care.

Chapter II

FACTORS AFFECTING PHYSICIAN LOCATION

Introduction

The purpose of this chapter is to review the literature related to trends in the supply of health services, particularly in rural areas. Economic models of location/migration are discussed. The results of analyses of the economic and social determinants of physician location and of the types of communities that physicians prefer are presented.

Economics Models of Location/Migrartion

Many studies have been conducted that try to measure the determinants of the location decisions of firms, migrating individuals, and even physicians. Firms are generally assumed to be profit maximizers or cost minimizers; this implies that they

are likely to locate in areas that provide low cost inputs. Footloose[1] firms tend to locate in areas with relatively inexpensive labor, access to essential support services, and nearest to their final market. On the other-hand, individuals are utility maximizers, so they are assumed to locate or migrate to areas that maximize their expected lifetime utility.

The models used to investigate individual migration decisions coupled with the concepts of the firm location models will be helpful in understanding the concepts of physician location.

Firm Location

Studies of firm location try to understand where, and why firms locate in certain areas. In economic studies, the motivating factor behind these decisions is usually assumed to be cost minimization. Weber (1984) in his classical location model, stated that because of the considerable spatial variation in input costs, such as transportation and labor, footloose industrial firms tend to choose their location so as to minimize cost. There are different types of firm location studies. The differences in the form and methodology of these studies mean that it is difficult to compare their results. It is thus difficult to draw general conclusions about the relative importance of particular factors in location decisions.

In industrial location studies by Kriessel,(1984), and Smith, Brady, and Kelch

[1]Free to move or choose a location site.

(1981), classical economic location theory was tested. Kriessel used a logit analysis to explain manufacturing locations (during 1978-81) in non-SMSA counties in Virginia. The model used a dummy dependent variable with county level data (=1 if the county experienced in firms during 1978-81, =0 otherwise). Smith, et al used a linear probability model to estimate probabilities of a rural community attracting at least one manufacturing firm. Both of these studies found industrial site quality to be a significant factor in attracting firms. Estall (1966) examined the location pattern of aircraft parts industrial firms in New England. The Estall study confirmed the usefulness of some aspects of least-cost theory. The study found that although transportation costs were not significant determinants of firm location, the availability of labor and agglomeration economies were relatively important (Weber 1984. pp 86.). Smith (1981) studied the location of an electrical appliance company in the Great Lakes. Rather than apply statistical techniques, he used a case study approach designed to determine how firms make their relocation decisions. A comparative-cost analysis of possible alternative locations was performed by the company seeking to relocate. The result may be generalized to imply that firms try to locate in areas that minimize their cost of doing business.

Individual Location/Migration

In contrast to industrial migration where firms locate in areas where their costs are low, human migration usually represents an attempt at self-improvement.

The decision to migrate is usually motivated by the need to satisfy self-interest. Schultz (1968) noted that the incentive to migrate increases when individuals or families have expectations of improving their condition following relocation. This expectation may be realized in the form of higher real income, or a better place to live, and additional monetary or non-monetary satisfaction. Schultz concluded that the decision to migrate depends on a combination of net gain (expected income minus costs of migration) and non-monetary satisfaction. This combination varies given different human attributes and economic conditions of the potential location cites. He further claimed that migration behavior of better educated laborers is more efficient than less educated laborers in that educated laborers are better able to properly calculate the real costs of migration (McNiel and Adams. pp383).

In Todaro's (1969) model of rural urban migration, which was developed to explain rural to urban migration in developing countries, potential migrants to urban areas are assumed to incorporate the element of risk and uncertainty by discounting the higher urban wage by the probability of remaining unemployed in that area. Many applications of the Todaro model have found that migration is stimulated by the rational economic consideration of relative costs and benefits, mostly financial.

In Tiebout's theoretical discussion of public expenditure (1956), it was hypothesized that people "vote with their feet". It follows that people will locate or migrate to communities that best provide the types of public services (and public goods in general) suited to their tastes and preferences. Tiebout's theory assumes

perfect mobility, and perfect information; these conditions do not often exist in real life situations. The ability of laborers to obtain information on better job opportunities in different locations, and properly calculate the real costs of migration (incorporating the risk of unemployment at the new location) varies with different endowments of human capital.

The underlying concepts of these migration models are expectations of self-improvement. Applied studies continuously support the theoretical notion that people migrate to areas with the highest potential to maximize their lifetime utility. The following section of this chapter will explore the economic and social relationships of physicians and the communities to which they migrate.

Studies of Physician Location

The focal point of many physician location studies is the distribution of physicians between urban and rural areas. Freun and Cantwell (1982) analyzed the national geographic distribution of physicians, seeking to provide a clear overall picture of physician distribution trends. They concluded that overall physician/population ratios (PPR) increased in the 1970s, but they found acute shortages of medical personnel in rural and inner city areas. In 1978, the PPR ranged from 1:395 in populous urban counties to 1:2,324 in less populous rural counties (Freun and Cantwell). The authors claimed that the increased supply of physicians resulting from the expansion of the 1970s did not necessarily improve their

geographic distribution, most likely because the market for physician services is not competitive. Fees for similar medical services vary more between areas than would be expected in a normal competitive market. Fees tend to be higher in areas with higher physician density. Freun and Cantwell state that the ability of physicians to unilaterally determine prices and create demand for their services could lead to increasing number of physicians clustering in already adequately served areas. This clustering will ultimately lead to increasing costs of physician services in such areas, and create more shortage in underserved areas.

Frenzen, P. D (1991) studied the national distribution of physician in nonmetro counties in the late 1980s. He found that total physician supply as well as the physician to population ratio increased in the United States (164:100,000 in 1981 to 195:100,000 in 1988). He also found that physicians diffused into nonmetropolitan areas with more physician settling in urbanized nonmetro counties rather than rural counties.

Aring (1972) claimed that the physicians will always congregate in large cities for economic reasons. He further stated that merely increasing the number of physicians will not solely solve the problem of maldistribution due to the agglomeration effect. He advocated subsidization of medical education because it will serve to attract the socially-minded and the under-privileged into medicine.

Types of Physician Location Studies

Several studies have examined the factors underlying physician location decisions. Different models, methodologies, and hypothesis have been used to examine the physician motivation in choosing a place of practice. Some models postulate that location decisions result from a maximization of profit; the physician is assumed to choose among different locations based on expected financial rewards. Monetary rewards are smaller in rural areas because of lower incomes, higher percentage of medical indigent, more dispersed population, (Kindigh and Movassaghi 1989; Crandall, et al 1990; Aring, 1972), and lower service rates (Freun and Cantwell), so lower rates of physician location in rural as opposed to urban areas should be expected.

Other studies employ models that postulate that location decisions result from a maximization of utility where the physician decides to locate based on community attributes which include economic, cultural, social, environmental, and geographic/climatic factors. The utility maximization model implies that physician location is a function of both economic and non-economic gains expected in the practice area (Parker and Sorensen, 1978; Yett and Sloan, 1974). In contrast, a profit maximization model contains the assumption that monetary rewards alone affect the decision to locate.

The results of these studies are different, and can not be generalized mainly because of differences in the data employed in the analyses. Some studies employed

physician-specific data. These data include surveys of groups of physicians to determine their place of birth, place of internship, spouse's influence on choice of location, etc. Other studies employed community-specific data to examine the physician population ratio (PPR) or the absolute number of physicians in an area. Studies employing community-specific data try to determine the relationship between the levels of physicians (either PPR or the absolute numbers of physicians) and economic and non-economic factors in a community. These factors can be divided into controllable[2] and non-controllable[3] factors. The results of these studies could influence policy decisions because they indicate the effects of certain community-related factors on the levels of physicians in an area.

The rest of this section discusses studies that employ different types of data in the statistical analysis, and the subsequent policy implication of the studies.

Studies Employing Physician-Specific Data

Parker and Tuxill (1967) studied the factors that influence health professionals to locate in rural areas. Questionnaires were sent to 1,475 physicians located in 11 counties in New York. Ninety percent of the physician population responded, and 76

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[2]These are factors that could be changed in the short run by local governments, such as expenditure on education, health facilities, recreational facilities, etc.

[3]These are factors that cannot be controlled in the short run by the local government, such as per capita income, population, age distribution of the population, etc.

percent of the initial sample was deemed suitable for analysis. Two personal factors were found to significantly influence practice location decisions: the idea of rural living and the possibility of developing a busy practice earlier. Poor social life, poor hospital facilities, spouse influence, isolation from practice support facilities were among the factors found to deter physicians from locating in rural communities. These results are consistent with the results of a similar study of general practitioners in the state of Washington (Cordes, 1974).

Parker and Sorensen conducted another study to examine the flow of physicians into and out of rural areas in upstate New York. Among other things they found that physicians who moved out of rural practice were mainly specialists who were raised in urban areas. Physicians who move into rural practice were mainly general practitioners, and over 40 years of age.

Bond (1970) and Champion and Olsen (1971) conducted similar studies. Bond surveyed physicians in private practice who reside in non-metropolitan areas, while Champion and Olsen surveyed physician from both metropolitan and non-metropolitan areas. Both studies found a direct relationship between the size of the place where the physician was reared and the size of the place of practice. Other findings include the importance of availability of hospital facilities in the practice area, and the existence of a community physician recruitment program.

Yett and Sloan (1974) and Cooper et al (1975), developed and estimated models that sought to explain the location choices of recent medical school

graduates. This group was assumed to represent the most mobile component of the stock of physicians and was expected to be more responsive to external stimuli relating to practice location. Yett and Sloan employed data that included information on state of birth, medical school, internship, and residency training. The existence of previous connections to a state was an extremely important determinant of location within that state. These connections include: being born in the state, attending medical school or having an internship or residency in the state.

Yett and Sloan used a multiple regression model to explain physician location in relation to previous contacts. Certain state-level measures related to income growth, and general conditions such as the proportion of the population residing in urban areas (which measures population density), and the average temperature of the area were found to be influential in the location decisions of this group. The study did not stratify the physicians by specialty. One can thus not conclude that these factors would have similar effects on all types of physicians.

Cooper et al. specifically studied factors affecting the location choice of primary care physicians, taking into account personal, social, and professional factors. Graduates of U.S medical schools and their spouses were surveyed. Most of the respondents made their location decision during internship, residency, or other forms of staff training. The implication for communities regarding the timing of the decisions might be important, especially for those communities seeking to recruit potential physicians.

Cooper et al. hypothesized that the practice location decision is a function of background characteristics of the primary care physician, his/her assumed decision influences, background characteristics of the physician's spouse, and the locational factors important to the spouse.

A multiple regression analysis was performed to better understand the relationships among these personal, social, and professional factors. The first stage of the analysis included only physician characteristics and confirmed that programs that pay or forgive loans, community recruitment programs, social opportunities, and place of rearing are very significant factors in physician location. The second stage of the analysis confirmed that the opportunity for the spouse's career, the availability of good social services and home care services, and the place of rearing of the spouse were very significant factors in physician location decisions.

Hostetter and Felson (1975) studied the various motivations involved in the recruitment of physicians for the Indian Health Services (IHS). A summary of the physician application forms and employment for the period 1970-74 showed that previous contact with IHS personnel, previous contact with IHS facilities, interest in IHS or Indian culture, and advertisement in news papers were all important influential motivating factors in recruiting physicians for IHS.

Korman and Feldman (1977) studied the factors that led to the successful recruitment of 60 physicians in three northern New York counties in 1974. It was not apparent why the physicians left their previous locations, but recruiting success were

attributed to income guarantees, strong local recruitment program, and the presence of community hospitals.

Miller and Holmes (1985), provided a more recent study of the factors affecting the practice location decisions. Questionnaires were sent to 305 graduates and their spouses from nine classes in the University of Oklahoma Tulsa Medical College. Of the respondents, 139 became certain of their practice location during their internship training. Those who grew up in large communities tend to locate in communities of similar sizes, and all were found to be highly influenced by their spouse's desires.

Leonardson, Lapierre, and Hollingsworth (1985) conducted a study similar to that of Miller and Holmes. They surveyed 182 graduates from the University of South Dakota School of Medicine. Following a multiple regression analysis, certain individual factors were found to help determine the physician's choice of location. The size of communities where both physician and the spouse were raised and the distance between the prospective practice location and their home town were both important factors. In addition, the number of contacts with other physicians in the area where they locate, the availability of professional growth opportunities, continuing medical education, and the availability of medical facilities were found to be important.

Coombs et. al.(1985) obtained results different from that of Leonardson et. al. They surveyed medical school students from Alabama in order to understand the

factors that help determine where they wish to locate. Questionnaires containing forced choice (which means that you must only choose among the answers given in the questionnaire) and open-ended questions were given to 396 students and 103 medical school faculty members at the University of Alabama School of Medicine. Spouses preference, proximity to relatives, and financial incentives were not related to their practice location preferences. Most of the students indicate a preference to practice in areas of 20,000 to 100,000 population irrespective of the size of their hometown.

Dento et. al. (1989) analyzed the practice location of Texas family practice residency graduates. Data on graduates of state-supported family practice residency were obtained from the Texas Higher Education Coordinating Board file. A distribution of the physicians by the size and number of residency program cities was constructed. Most graduates located their practice in the areas where they served their residency. However, when the non-mobile group[4] were removed from the sample it was found that most of the graduates who left the city where they served their residency located their practices in communities of less than 25,000 population.

Day and Rhodes (1989) conducted a study of factors which most influenced doctors decisions to locate their practice in rural North Carolina. Factors examined in the analysis included the location of the physician's medical school, the

[4]Physicians who locate their practice in areas where they served their residency.

characteristics of practice area, and the physicians' own characteristics. The study found that rural physicians choose to locate their practice in rural areas for the following reasons: medical needs of the practice area, preference for community size, and climate of the area. The "size of community of upbringing" was the most powerful discriminatory factor. The study also found that urban physicians place more emphasis on professional and practice criteria than their rural counterparts who place more importance on the medical needs of the area.

Generally, the studies that employed physician-specific data had consistent results. A majority of the studies found personal and professional factors such as the size of hometown, spouse influence, opportunity for spouse's career, opportunity for professional growth, presence of medical facilities, and others to be very influential factors. There were a few differences in the ranking of important influential factors, and these differences could have been caused by the differences in sample population. The surveys were conducted at different time periods of the physician's career, and there was a variation depending on the specialty of the physicians surveyed (some of the physicians studied were specialists and some were primary care physicians). One of the greatest short-coming of this type of study is that these studies do not always take into account the fact that certain types of physicians could be structurally constrained from locating in certain areas. For example, it is not feasible for a surgeon to locate in a rural area where the medical facilities for surgery are inadequate.

Studies Employing Community-Specific Data

Clark et. al. (1973), and Rushing and Wade (1973) studied factors that affect the distribution of physicians between urban and rural areas at the state and county level, respectively. Explanatory variables were chosen from the socio-economic characteristics and health facilities of the area. Clark et. al. found the third-party (for example, medicaid) reimbursement system to have a negative impact on the distribution of physicians. Fewer physicians locate in areas with high numbers of medicaid patients. They also found the hospital bed to population ratio was not to be significantly related to the PPR. This result implies that the redistribution of hospital beds, one goal of the Hill-Burton Act of 1946, had no appreciable impact on physician redistribution in the early 1970s. Income differences were not found to be strong determinants of the variation in PPR. In contrast to Clark et. al, Rushing and Wade (1973) found PPR to be directly related to community wealth, and a direct relationship between the number of professionals[5] in a county. They also found that the hospital bed to population ratio does not have a significant impact on PPR. Rushing and Wade concluded that physicians gravitate towards areas with large population size because of the potential for large clientele base. Physicians also consider the income of their prospective patients because of increasing costs of health services due in part to increased specialization. The authors speculated that a third-party payment system (such as universal health insurance) may increase

[5]Technically trained persons.

community inequities in PPR mainly because physicians may be able to find an effective demand for health services in areas with already a high number of physicians. This demand would lead to a clustering of health service providers.

Both studies concluded that the increase in the total supply of physicians has had little impact on the redistribution of physicians. The studies did not, however, take into account the differences in specialties among physicians. These differences might cause the results to be unreflective of all types of physicians.

Hynes and Givener (1976) conducted a study to determine the predictors and trends in physician numbers in a predominantly rural state. They studied 93 counties in Nebraska. Data on community-specific variables were obtained from the Area Resource File for the years 1970 through 1976 (Hynes and Givner, 1976 pg 186). A regression analysis was performed using the absolute number of practicing physicians in a county as the dependent variable. The authors found the number of applicants to medical school from a county to be a more dominant predictor of physician numbers than income, educational attainment, and the presence of hospitals. The implication of the study is that rural counties have fewer physicians because few medical school applicants come from rural areas. This results affirms the validity of the "place of origin theory"[6].

Dale and Busch (1977) analyzed the community characteristics affecting the

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[6]The theory states that most physicians locate their practices in areas similar to their place of origin.

distribution of physicians among 120 Kentucky counties. County level data were collected to facilitate a cross-sectional and longitudinal analysis. Regression equations were used to explain the physician population ratio(PPR). The presence of medical school, and high family income had positive impacts on PPR. Higher proportions of houses without electricity, houses without toilets, and higher percentages of low income families had negative impacts on the PPR. The clear implication is that physicians concentrate in areas with higher standards of living.

Cooper and Johnson (1983) analyzed the distribution of physicians in Kentucky. They concluded that physicians concentrate in urban and sub-urban areas because rural areas lack hospitals, medical centers, and access to urban amenities. The general population was migrating away from the urban areas in the 1970s due to the improved rural life; however, the physician population was not migrating at the same rate.

Langwell et. al. (1984) studied the characteristics of rural communities which influence the location decisions of physicians. The study focused on young physicians (under 35 years of age). Counties in the northern region of the United States were very successful in attracting physicians, counties in the central region were not successful, while the counties in the southern and western region were fairly successful in attracting physicians.

The study used data obtained from the Area Resource File on factors such as population, health resources, environmental characteristics, economic status, cultural

alternatives, and crime rates. A statistical comparison of the values of the factors was performed for the counties with net gain, net loss, and no change of young physicians. Generally, health resources (hospitals, hospital facilities, nurses, other health personnel, etc) were the most consistent variables distinguishing between areas that lost physicians and those that gained. Population was consistent in most part, but economic variables, climate/environmental variables, and wealth status measures failed to distinguish between areas that gained or lost physicians.

Wright and Jablonowski (1987) analyzed the rural-urban distribution of physicians in Georgia using data obtained from the State Examining Board. The results showed a maldistribution of physicians in the state, with the most severe cases found among specialized physicians. The authors used comparable historical data on the growth of physicians and registered nurses in rural and urban areas. The number of physicians/nurses increased as the size of the county population increased. The authors concluded that one of the factors contributing to the distribution of physicians in the state is the socio-economic differences between rural and urban areas. Physicians and other medical professionals are found to gravitate towards areas of high socio-economic standards.

Kindig and Movassaghi (1990) claimed that the literature on physician location has provided aggregate statistics but has failed to provide a better insight as to the different characteristics of the communities where physicians locate. They surveyed physicians practicing in sparsely populated counties of the United States in

order to determine the factors associated with satisfaction, or dissatisfaction with rural practice. The study focused on counties under 10,000 in population. They found that the factors associated with dissatisfaction with rural practice were: the long distance to referral center, low annual income (below $59,999), high percentage of patients with inadequate health insurance coverage, competition from other physicians located in the same practice area, possibility of local hospital closure, and work overload (more than 60 hours per week). Factors not associated with dissatisfaction were: lack of intense competition and absence of hospital within the area (25 miles radius).

Generally the results of these studies found socioeconomic factors such as income to be influential in the distribution of physicians. The results were not consistent on community-specific factors such as health facilities. Differences in the level of significance among the variables varies with the specialties of physicians. The results of studies that stratified the physicians by specialties were consistent over the years. The main shortcoming of this type of study is the possibility of measurement error due to the use of wrong proxies. This could could lead to incorrect results, thus false conclusions.

Other Descriptive Studies of Physician Location

It is evident that certain factors have a strong influence on the location of physicians. Some of these factors are related to individual characteristics (place of

origin, spouse influence, age, etc) and others related to community characteristics. It is not apparent how these various factors could be synthesized and included in an operational recruitment program. Knowing how to effectively recruit physicians is important because several studies found that the existence of a recruitment program had a positive effect on the location decisions of some physicians (Cooper et al; Bond; Fein,1956; Charles,1971). Some studies particularly focused on ways rural communities could attract and retain physicians.

Crandall et. al. (1990) developed four broad types of models to recruit and retain physicians in rural practice. These models were developed based on assumptions about the health care delivery system and the behavior of the health care professionals. The recruitment models are:

Economic incentive models: these models stress attempts to reduce the urban rural economic inequities, for example changing the current health care financing system in United States providing equipment and financial assistance for rural physicians, guaranteed salary for rural physicians, etc. The impetus for these changes should come from Federal, State, and local government levels.

Affinity models: these models try to expose medical trainees to rural practice, and to recruit people with rural background into medical schools. There is a well established positive relationship between rural practice and rural origin (Rhodes and Day; Leonardson et al; Miller and Holmes; Yett and Sloan).

Practice characteristics models: these models try to create a support system

for rural physicians by providing opportunities for hospital practice, continuing education, clinical support personnel, arrangements for after-hour coverage, etc.

Indenture models: these models try to recruit physicians to meet the needs of the undeserved areas temporarily while awaiting permanent solutions. These include loan repayment programs, and licensure conditional on practicing in undeserved areas. This is the approach employed with the National Health Service Corps scholarships.

Madison (1973) cited similar conditions to that of Crandall et. al. as necessary in recruiting physicians for rural practice. The practice characteristics models are very important because the absence of the above-mentioned factors will probably cause the economic incentive models and the affinity models to be less effective.

Implications of The Studies, and Conclusions

There is a maldistribution of physician between urban and rural areas. Merely increasing the number of physicians will not necessarily solve the problem because most physicians locate in areas with certain amenities and economic conditions.

The key individual determinant of physician location is the size of the community where the physician grew up. Physicians that grew up in rural areas tend to locate in rural areas. Most physicians decide where to locate their practice during residency programs and medical school. Influences encountered during medical school education affects the location preferences. The distribution of physicians in

the United States could be influenced through certain medical school recruitment policies and residency programs.

Despite the heavy influence of those individual specific characteristics, physician location decisions are influenced by certain controllable (Fein; Charles; Marr 1972; Kane et all 1975; Korman and Feldman; Jones) and non-controllable community characteristics. Among the controllable factors are: the existence of community hospital, clinic, medical facilities, the existence of recruitment programs which entails financial assistance in the forms of guaranteed salary, payment for medical tuition, and providing medical equipment etc, improvement of social and recreational facilities. The non-controllable factors are; population (population growth rate, etc), economic factors (per capita income, household income),environment (geography/climate), etc. Most of these factors are more favorable in urban areas. However, increasing the admission of medical school applicants from rural areas, creating an economic incentive to practice in the rural area, and improving the professional aspects of medical practice in rural areas could help redistribute physicians. For example, providing financial assistance, and extending the continuing medical education programs for physicians practicing in rural communities, has had an effect (Kane et. al).

The literature has been silent about certain community health resources such as Community Health Centers (CHC); the presence of recreational facilities such as

golf courses; percent of high school students that drop out or percent of high school students that attend college; the local property tax rates and local government expenditures on education, health, community development, etc. The presence of a medical facility such as CHC in a community could have significant effect on the location decision of a physician recruit because it might undermine his expected income. It will be important to fully explore the effects of factors such as local government expenditures, and some of these other community-specific factors on the distribution of physicians.

Chapter III

METHODOLOGY

Introduction

The methodology used in the study is outlined in this chapter. The estimation procedure is discussed, the dependent variables defined, and the independent variables and the likely sign of their coefficients are discussed. The study hypotheses are logically connected with the objectives, methods, and procedures of the study.

The principal study hypothesis is that "communities can attract physicians by controlling certain factors that influence the location decisions of physicians". This hypothesis implies that the flow of physicians into an area changes in response to either the pecuniary or psychic attractiveness of the area. Physicians consider a number of personal, social, and professional factors when making their practice location decisions. Therefore, a community can become more attractive by improving or developing its amenities or by increasing the monetary returns to prospective

physicians. Alternatively, if a community provides more information about existing amenities, say as a part of an advertising campaign, more physicians could be attracted to the area. Based on these assumptions, the elements of the individual physician location decisions can be modeled under a utility maximizing framework.

Individual physician location model

A simple individual physician location model could be mathematically represented as follows;

$$\text{Max } U = u(Xi;Zi)$$

$$\text{st } PiXi = Yi(Inc,Pd,Md)$$

where:

Pi = prices in ith location

Yi = expected income in the ith location, which depends on area income (Inci), population density (Pdi), and medical service demands of the area (Mdi).

Xi = a vector of consumption possibilities in ith location

Zi = a vector of non-market goods affecting utility in ith location[1]

The first element of the utility function (Xi) considers the lifetime goods consumption of the physician in the ith location. The second element considers the present value of expected psychic and other non-pecuniary benefits to the physician

[1]Zi might include leisure, public goods, school etc in ith location.

of locating in community i. Elements of Zi include the social amenities of the ith location (such as social entertainment, recreational facilities, etc).

Physicians are assumed to calculate the maximum utility with whatever information they have about the I communities they are evaluating. Therefore, a physician will be expected to choose the ith location when Ui(max) > Uj(max) (for all $j \neq i$) in order to maximize utility.

The physician utility functions are expected to differ depending on differences in specialties and other characteristics. For example, a surgeon and a general practitioner are not expected to have the same utility function nor are the arguments (determinants) of their utility expected to be the same. This difference in the determinants of utility is partly due to the structural constraints on physicians based on their specialty choices. Surgeons require certain hi-tech equipment in order to perform their tasks, and their fees are often higher than those of general practitioners. This affects the Yi and the Zi in the model. General practitioners and other specialized physicians have been found to have different social origins (Champion and Olsen). This implies that these two types of physicians may consider different socio-economic factors when making their practice location decisions. Hence it is very important to divide the physicians by specialties to ensure a reasonable degree of within group homogeneity in order to develop a model that accurately predicts physicians location behavior.

General statistical physician location models have been developed based on

the concepts of these types of individual physician location models (Cooper et. al; Watson, 1980). In particular, the maximization problem outlined can be solved to produce a number of estimable relations. The first relation would be one that says that the probability that a particular physician locates in a particular area is a function of Pi, Zi and expected Yi. In this case, the individual attributes of each physician searching for a place to locate should be measured in order to estimate the relationship.

A second relationship, and one that is employed in this study, says that the number of physicians in a particular geographical area is a function of the area-specific attributes affecting Pi, Zi and expected Yi. Thus, physicians or physicians per capita may be used as a dependent variable and made to be a function of these community-level attributes (Pi, Zi, Yi).

Other physician location models

There have been several studies of physician location and these studies have employed a wide variety of analytical models. Differences in theoretical bases, estimation procedures, and data used in these analyses all contribute to the diversity of the results obtained. Most physician location studies borrow from the theory of population migration in that they employ the same basic determinants of location choices and, hence, use theoretical frameworks which are similar to that outlined above (Yett and Ernst, 1985). The major differences are in emphasis. There are

three fundamental types of physician location studies.

The first type uses models of the choice of the first practice location. The independent variables (Xs) include data on personal and professional factors obtained from attitudinal surveys. Attitudinal surveys are useful in that they examine the personal dimensions of physician location; however, these surveys fail to consider the fact that physicians could be structurally constrained in their choice of practice location by their specialty (Busch and Dale). Also the response of physicians on the questionnaires may be different from what they actually do.

The second type of models is the group of aggregative models explaining the stock of physicians in a particular geographic area. The dependent variable in these studies is either the number of physicians in an area or the physician to population ratio. The independent variables are usually community-specific data.

The third type of model is an aggregative model of the change in the distribution of the stock of physicians. The dependent and independent variables employed are community-specific.

Estimation Procedures

The most common type of statistical location model is the single equation regression estimated by OLS in which a measure of the number of physicians or the physician to population ratio (PPR) in an area is used as the dependent variable. Area specific exogenous variables (Pi;Zi) which are entered on the right hand side,

and linear (or log linear) equations are estimated. Following the same procedure, one can estimate a model in which the dependent variable is the difference between the PPR of an area in different time-periods: Yi-Yit-1. A mathematical representation of these models will be as follow:

(1). $Yi = ßo + ß1Xi1 + ß2Xi2 + ...ßnXin + \epsilon n$

(2). $Yit\text{-}Yit\text{-}1 = ßo + ß1Xi1 + ß2Xi2 + ...ßnXin + \epsilon n$

where ϵn is the error.

The signs, magnitudes, and statistical significance of the estimates of the betas then tell you in what direction, how strongly and how importantly the exogenous variables (Xs) affect the number of physicians. The study will estimate these two types of model. The first model estimates the relationship between PPR and the independent variables at particular points in time.

Specification of the Dependent and Independent Variables

The dependent variable for the study is total population in a county divided by the total number of primary care physicians (PPR). The reason PPR is chosen over absolute number of physicians in a county is because the absolute number of physicians in a county is obviously expected to vary with population. This does not imply that a smaller county with a smaller number of physicians is undeserved or worse off than a larger county with a larger number of physicians. The PPR indicates level and time-quality of medical services obtained in a county. Because of the way

this variable is constructed, an increase in PPR means that the county is worse off.

Nineteen community-specific factors are being considered for estimation as independent variables. These variables represent certain community-controllable and non-controllable characteristics. The community controllable characteristics include the variables that could be controlled by the local government or community effort in the short-run. The non-controllable community characteristics include the variables which local government or community actions may not cause a change in the value or the size of the variable in the short-run. A list of the variables under consideration in this study is presented in table 3.1.

Community Non-controllable Variables

Per capita income (INC) is the measure of affluence most commonly used by researchers in physician location models. It is expected to have a negative sign. That is as incomes rise, more physicians should be expected to locate in an area, and, hence, the PPR should fall. Most of the studies using stock measures of physician supply have indicated significant positive relationships between these income measures and the physician stock or the physician population ratio (Busch and Dale; Steele & Rimlinger,1965).

Table 3.1 Controllable and Non-controllable Variables in the Model.

Community Non-controllable Variables		
Variables	Definition	Source
IN	Per capita income	A,B
PMEDC	Percent of the population on medicaid	D
POP	Population size	A,B
PERMILE	Population density	A,B
PCT65	Percent of the population age 65 and above	A,B
PCTB	Percent of the population black	A,B
DR	Percentage of high school students that drop out	E
HGAC	Percent of high school graduates that attend college	E
Community Controllable Variables		
PTR	Property tax rate (Effective True Tax Rate)	C
HW	Local government expenditure on health and welfare	F
EDUC	Local government expenditure on education	F
PKRECUL	Local government expenditure on parks, recreation and culture	F
COMDEV	Local government expenditure on community development	F
EPP	Expenditure per pupil from local funds	E
CL	Number of colleges	H
RGOLF	Ratio of golf holes to county population	B,G
HP	Number of hospitals	D
HPBR	Hospital beds to population ratio	D
CMHC	Free clinics and community health centers	D

Source:
A = Virginia Statistical Abstract; B = County Data Book.
C = Tax rates in cities, counties, and selected towns of Virginia.
D = Virginia State Department of Health.
E = Facing Up.
F = Comparative Report of Local Government Revenues and Expenditures.
G = Department of Soil and Environmental Science, Virginia Tech.
H = National College Book.

Several studies have explored the fact that general practitioners and specialists respond differently to population income levels. Most studies found that the stock of both types of physicians are positively related to area per capita income. Some studies found the specialists to be somewhat more attracted than general practitioners to high income areas (Ball and Wilson,1968; Benham,1968; Coleman,1976). Because high-income communities are usually associated with relatively large population, they contain the types of support (e.g large clientele base) that narrow specializations require. It is rational to expect physicians to gravitate towards the areas where the effective demand for their services is highest.

The percent of the population on medicaid (PMEDC) is expected to carry a positive sign in the model. Physicians have been known to avoid or turn down patients with medicaid health insurance. Poor reimbursement policies have caused physicians to reject medicaid patients; therefore areas with more medicaid patients should be expected to have fewer physicians per capita.

The coefficients of the population variable (POP) and population density (PERMILE) are expected to carry negative signs, since these variables reflect an increase in demand and, generally higher prices of services in rural areas. Previous studies have found population to be positively correlated with the number of physicians in an area (Korman and Feldman; Langwell et. al; Wright and Jablonowski; Freun and Cantwell; Hines and Givner).

There are reports of medically undeserved cities with relatively large

populations. The Virginia Health Report of 1989 classified the city of Newport News (VA) as a MUA. Coombs et all (1985) found that big cities (501,000 or more population) and small towns (or rural areas more than sixty miles from a large city) were the least popular practice locations of Alabama medical students. This implies that the variable POP might not be a strong predictor of the variation in PPR, or that the variable might not have a linear relationship with the dependent variable.

The percent of the population age 65 and over (PCT65) is expected to be negatively related to PPR. This age group needs frequent health care services, so they create a good clientele base for primary care physicians, especially general practitioners and internists.

The variable representing the percent of the population black in the total population (PCTB) is expected to be positively related to PPR because most black communities are not affluent, also a majority of the physicians in the state of Virginia were not raised in black communities. The affinity model of physician recruitment would predict that physicians (who are mostly white) would be in short supply in areas with large black populations.

The percentage of high school students that drop-out (DR) is expected to carry a positive sign in the model because physicians are expected to be attracted to areas with high levels of educational attainment. In a similar fashion, the number of high school graduates attending college (HGAC) is expected to carry a negative sign in the model. People with higher educational levels are perceived by physicians to have

increased awareness of preventive health care measures, and a better understanding and appreciation of the clinical setting. Areas of higher education usually reflect sociocultural characteristics of a community which are attractive to physicians (Busch and Dale).

Community controllable variables

Community-controllable variables are important because policy changes are effected through these variables, which in the long-run determines the size or value of the non-controllable variables.

The property tax rate (PTR) is expected to be positively related to PPR. Because taxes raise the cost of living in an area, higher taxes, ceteris paribus, should attract fewer physicians.

Local government expenditures on health and welfare (HW) may carry a positive or negative sign, because high expenditures on health and welfare could indicate poor or low standard of living. Conversely, high expenditures on health and welfare could indicate the presence of adequate health facilities and services. Local government expenditures on community development (COMDEV), and parks recreation and culture (PKRECUL), and on education (EDUC) are expected to carry negative signs in the model. These expenditures help determine the quality or standard of living in the community and increase amenities.

Golf holes per capita (RGOLF) is expected to carry a negative sign, because

physicians have cited lack of recreational facilities as a deterrent to rural practice (Rhodes and Day). Golf is a high status sport so the presence of a golf course also creates an ample opportunities for socializing with those of similar socio-economic status.

Expenditure per pupil (EPP) and number of colleges (CL) are expected to have negative signs. Past studies have demonstrated that physicians are influenced by the quality of education that their children will receive when making their practice location decision (Kindig and Movassaghi). The number of colleges in a community (CL) is expected to have a negative relationship with PPR because it reflects a positive sociocultural characteristic which may attract physicians (Busch and Dale).

The number of hospitals (HP), and hospital beds to population ratio (HPBR) are expected to have negative signs. Several studies have found the lack of adequate medical facilities to deter physicians from rural practice (Champion and Olsen; Leonardson et. al; Kindig and Movassaghi). A well equipped hospital is expected to attract specialists to locate their practice around the area because they can benefit from using the hospital facilities to provide the types of diagnostic and therapeutic services they cannot otherwise produce efficiently in their office (Yett and Ernst). This increased supply of specialists is expected to spill over and create an increased supply of primary care physicians.

Rushing & Wade (1973) advanced an interesting economic explanation of the relationship between hospitals and physicians. They argued that most hospitals were

built in urban areas as a result of the overall process of economic and social progress. Physicians as well as other professionals were attracted to those areas due to the agglomeration effects of economic activities. They concluded that community hospital facilities are important in attracting and retaining physicians, however the hospitals' explanation of a portion of the variation in the number of physicians is not independent of population size, urbanization, and socioeconomic factors. The authors concluded that specialists tend to cluster around hospitals while general practitioners do not due to competition effects.

The presence of free clinics and community health centers (CMHC) are expected to carry positive signs in the model because of the competition effect, and the indication of poor standard of living. Community health centers are located in areas that have few health care personnel. Residents in these areas are often poor, and are likey to obtain free or cheaper health services from the free clinics rather than the physicians office.

Choice of explanatory variables

Some of the explanatory variables used in this study have been explored and employed in the various analyses of geographic physician distribution, some of the substantive implications of these studies for physician location have been discussed in the previous section. It is necessary to draw attention to two major problems relating to the types of explanatory variables used in the statistical studies of

physician location decisions and also in this study.

The first such problem is the inaccuracy introduced by inadequate measurement caused by the use of proxies rather than conceptually correct variables. This problem arises mainly because some of the influences affecting physician location choices are difficult to measure empirically. Moreover it may often be difficult to obtain data that can be quantified. Several studies used attitudinal surveys to deal with the problem of physician distribution; however, among the other shortcomings of these types of studies, one can argue that the responses of physicians on the surveys might be inaccurate. This inaccuracy arises because of misinterpretation of questions and answers, or dishonesty on the part of respondents.

Researchers analyzing the spatial distribution of physicians often use certain socioeconomic traits (e.g per capita income, population density, degree of urbanization, etc) as substitutes for area-specific lifetime earnings expectations of physicians. Each of these substitutes approximates physician's true lifetime earnings expectations with an error which is unobservable and hence causes measurement errors (Yett and Ernst,1985). There is always a risk of measurement error when modeling a long term decision with short-term variables as is the case with the model and analysis employed in this study. For example if the income variable is high in a particular year (1970), then decreases in the other year (1980), this means that 1980 income may not be a good measure of expected earnings for physicians. This problem may lead to empirical results that are not totally reliable. The stock of

physicians may be slow in adjusting to the areas of higher earnings opportunities. Also the use of different proxies for the same locational influence can produce different qualitative results. The model employs some community specific variables such as RGOLF, CL as proxies symbolizing the recreational and cultural status of the community. These variables have not been widely used in other studies.

Although researchers are aware of the fact that these measurement errors tend to bias the estimators of the regression coefficients, often neither the degree nor even the direction of the bias can be determined a priori (Yett & Ernst,1985).

The second problem in studies of this sort is the high intercorrelations among the explanatory variables. Multicolinearity inflates estimates of the standard errors of the coefficients of the correlated variables. This causes the statistical significance of the variables to be understated. In physician location models, when explanatory variables are highly interrelated one may conclude falsely that one or more of the variables do not affect physician location choices, while actually any one or more of the correlated variables may explain variations in area physician supply.

This implies that one can select one or more of the correlated variables as predictors in a location model, eliminate the others, and conclude that the selected location influences are significant while the others are not, thereby causing error in obtained results. The best known and common way to deal with this problem is to impose restrictions. Assuming that X1 and X2 are highly collinear, then we could say that $\beta 2 = 0$ (which deletes X2 from the model) or $\beta 2 = \beta 1$ (which means that we use

X1+X2 instead of X1 and X2 separately).

Data used in this analysis were collected from various reliable sources for the years 1970, 1985, and 1989 (see table 3.1.). These data include community characteristics such as socio-economic and demographic composition, socio-cultural considerations, need for medical services, existence of supportive facilities, etc. Data on the supply of primary care physicians was obtained from Medical College of Virginia.

Summary

In summary, this chapter discussed how the model that was employed in this study was derived, and critiques the alternative models. The dependent and independent variables were specified. The strengths and the potential weaknesses of the model employed in this study were discussed. The next chapter analyzes the data and discusses results of the statistical analysis, which includes the result of regression analysis for three different time-periods, and the result of the regression analysis for the change in PPR.

Chapter IV

ESTIMATION RESULTS

Introduction

This chapter contains both the descriptive and statistical analysis of the physician manpower data for rural Virginia counties for 1970, 1985 and 1989. County maps are used to compare and contrast the difference in the distribution of primary care physicians and income over the years. Also the variable means are compared for low and high-physician ratio counties to examine the nature of differences between these counties. Then the statistical results of the various models discussed in chapter three are presented and analyzed.

Data from sixty-nine counties are employed in this study. All counties with an independent city are eliminated because the physician data could not be separated according to place of residence or of practice within the county. For the purpose of the following descriptive analysis, the counties are divided into two groups based on the population to physician ratio (PPR)[1]. Counties with a PPR of 2500 or less are called low PPR counties (high number of doctors per person), while the counties with the PPR above 2500 are high PPR[2] counties (those with few doctors per person).

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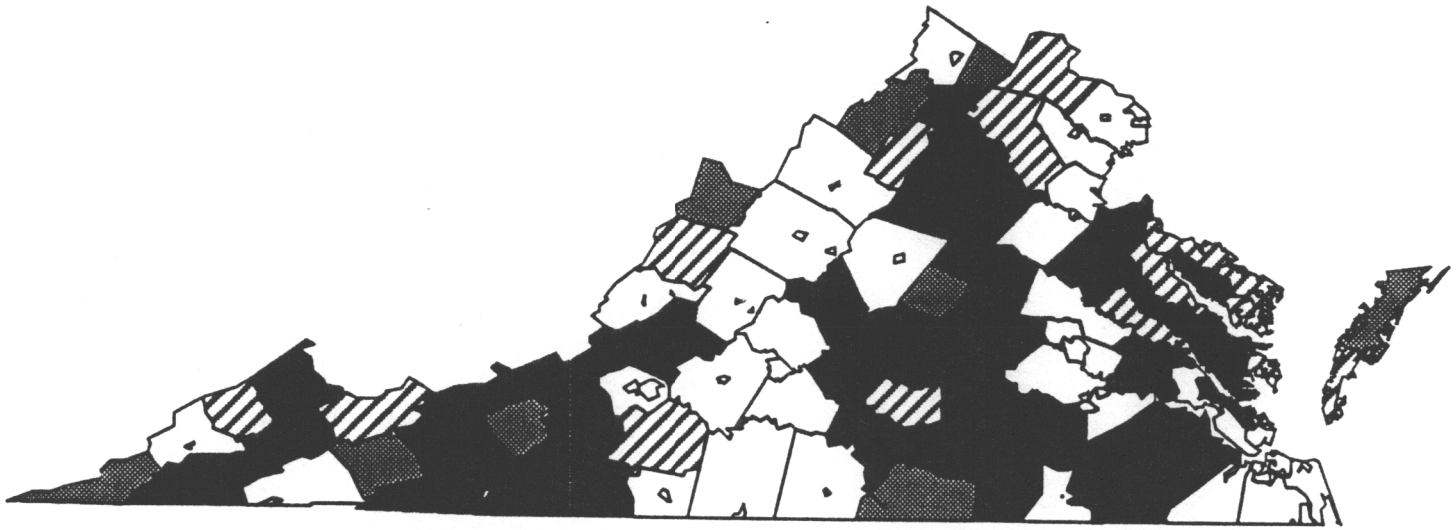
[1]PPR is the total population divided by the number of primary care physicians.

[2]High PPR counties are not necessarily medically underserved according to the Health and Human Services definition; the county may contain other non primary care physicians, or other health services.

Distribution of Primary Care Physicians.
In Selected Counties of Virginia, 1970.



Relevant ranges
- not included in the study
- Low PPR (below 2500)
- High PPR (above 2500)
- High PPR (above 3000)

Fig 4.1. Source: Medical College of Virginia.

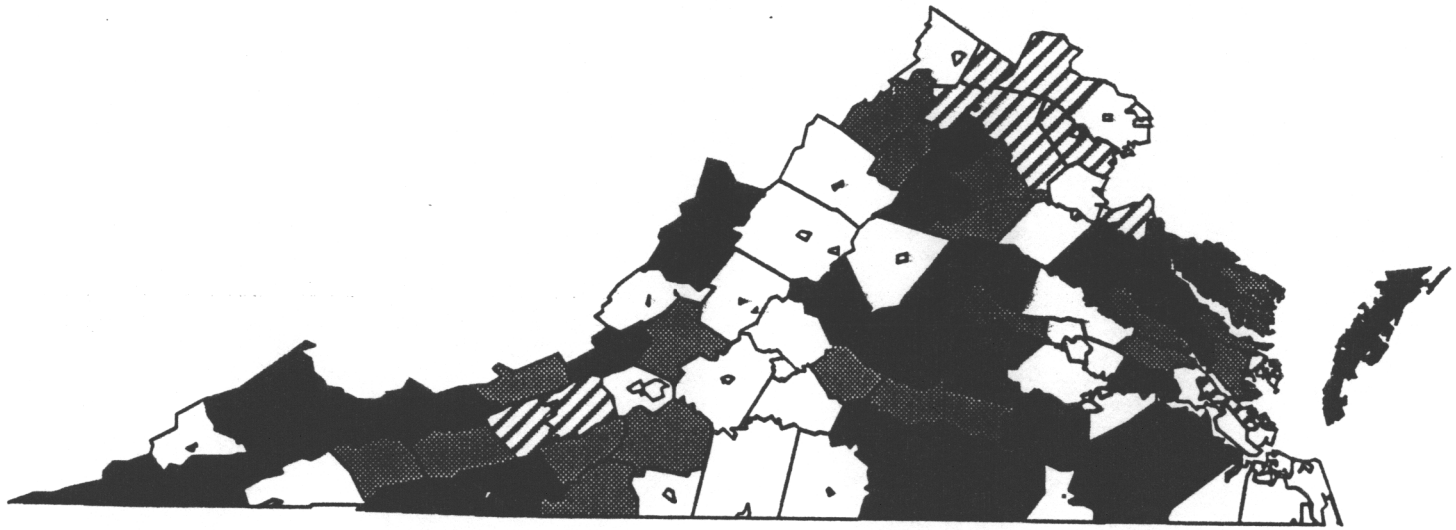
Distribution of Primary Care Physicians
In Selected Counties of Virginia, 1989.

RELEVANT RANGES

- Not included in the study
- Low PPR counties
- High PPR counties (above 2500
- High PPR counties (above 3000

Fig 4.2. Source: Medical College of Virginia.

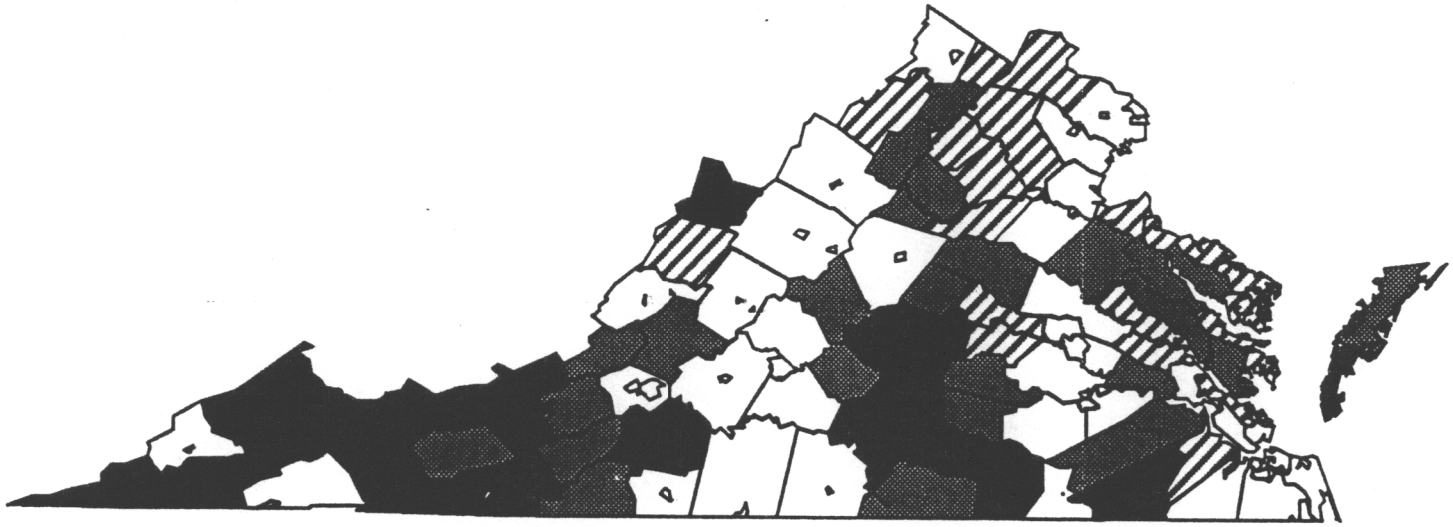
Distribution of Per Capita Income
In Selected Counties of Virginia, 1970.



Relevant ranges
- not included in the study
- Low income counties
- Medium income counties
- High income counties

Fig 4.3. Source: County Data Book, 1972.

Distribution of Per Capita Income
In Selected Counties of Virginia, 1989



Relevant Ranges
- Not included in the study
- Low income Counties
- Middle income counties
- High income Counties

Fig 4.4. Source: Virginia Statistical Abstract, 1991.

Planning Districts of Virginia.

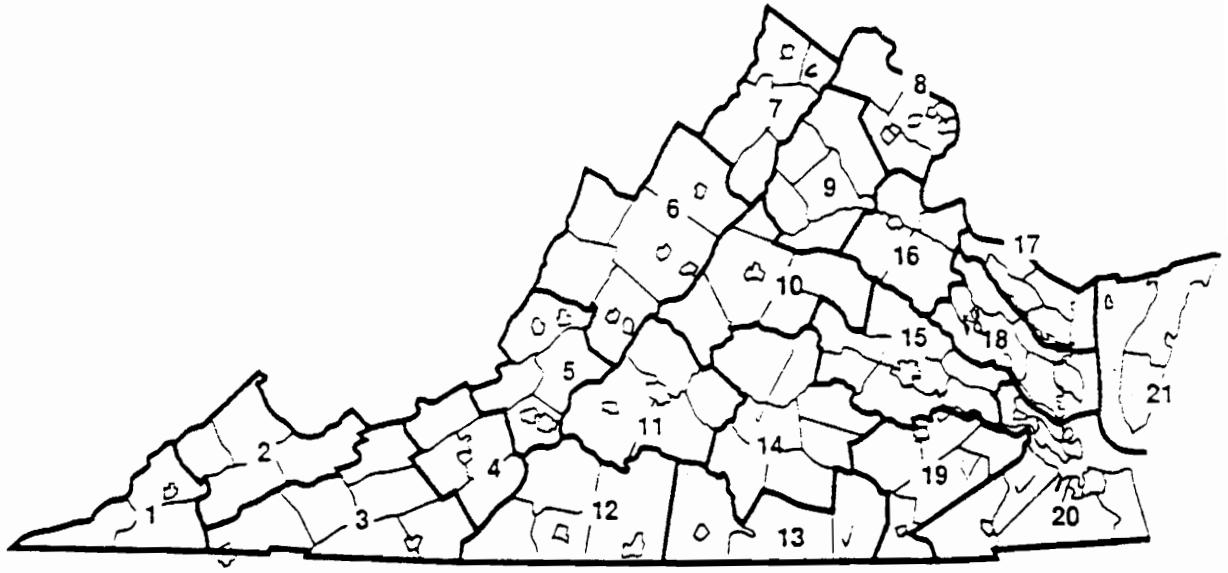


Fig 4.5.

Summary Statistics

The distribution of high-PPR rural Virginia counties for 1970 is shown in Figure 4.1. For the purpose of this analysis, the high-PPR counties are further divided into two groups: counties with PPR above the national standard of 2500:1 but below 3000:1, and counties with PPR above 3000:1. The purpose of this grouping is to distinguish between the degree of medical underservice (among the high-PPR counties). However, this does not totally eliminate the possibility that some counties with high-PPR may have other non-primary care physicians that provide the necessary medical services.

The high-PPR counties were almost always clustered (figures 4.1 and 4.2). This clustering has implication for recruitment and retention policies that will be discussed in detail later. The clustering makes it easier to discuss issues in terms of planning districts[3], thus these districts are shown in figure 4.5. A list of planning districts along with the counties in them is presented in Appendix table A.

There are several planning districts in the state with clusters of high-PPR counties in 1970: Lenowisco, Mount Rogers, New River Valley, West Piedmont, South Side, Piedmont, and Middle Peninsula had most counties with high PPR. Fifth, Rappahannock-Rapidan, Thomas Jefferson, and Crater planning districts also had moderate numbers of high-PPR counties.

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[3]Planning districts are created by the state government. Counties in the same district are encouraged to work together on developmental issues. There are four counties on average in each planning district. See appendix table A. for the table of Virginia planning districts.

The situation in 1970 may be contrasted with that of 1989 by comparing figure 4.1 to figure 4.2 which shows the distribution of high-PPR counties in 1989. The planning districts with large concentrations of high-PPR counties in 1970 continued to have large numbers of high-PPR counties in 1989. Cumberland Plateau, Middle Peninsula, and Accomack-Northampton district were worse-off in 1989 compared to 1970. It is reasonable to assume that certain area characteristics were responsible for the consistent pattern of primary care physician maldistribution among the districts and its deterioration from 1970 to 1989.

The distribution of per capita income[4] in the state for 1970 is shown in figure 4.3. Counties with per capita income lower than 70 percent of the state mean per capita income for that year are considered to be low income counties. Counties with income higher than 70 percent but below 85 percent of the state mean are considered middle income counties, while counties with income higher than 85 percent of the state mean are considered high income counties. There, in general, is a close correspondence between low levels of income and high-PPR. The low-income and medium-income counties were, in general, clustered in the same way as the low manpower counties. In 1989, there continued to be a fair correspondence between low levels of income[5] and high-PPR (figures 4.2 and 4.4). Some counties with higher income joined the high-PPR ranks.

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[4]County per capita income for the years 1970 and 1989 were obtained from the County Data Book (1972), and Virginia Statistical Abstract respectively (1991).

[5]The same criteria used to classify the counties for 1970 is also used for 1989.

A look at figures 4.1, and 4.2 shows that the distribution of primary care physicians has not changed significantly among the counties studied over the years; however, figures 4.3, and 4.4 show that although some counties moved from the lower income category in 1970 to the higher income category in 1989 these counties remained in the same high-PPR category in 1989. The general conclusion drawn from this analysis is that the distribution of primary care physicians has not changed among the rural counties in Virginia. Counties that had few primary care physicians in 1970 continued to lack primary care physicians in 1989. Lenowisco, Cumberland Plateau, and Piedmont planning districts are consistently both low income and without an adequate supply of primary care physicians. The next section discusses the results of statistical analysis of the mean and standard deviation of various independent variables that are believed to affect the distribution of physicians.

Results of Other Descriptive Analysis

The means and standard deviations for the variables in the models are broken down according to whether the county is high or low PPR[6] for the years 1970, 1985, and 1989 in tables 4.1, 4.2, and 4.3, respectively. The discussion of these variables is broken down into two groups: community non-controllable, and community controllable characteristics[7].

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[6]PPR is the total population divided by the number of primary care physicians.

[7]The variables along with their hypothesized impact on physician supply were discussed in chapter III.

Table 4.1. Summary statistics for low and high PPR rural Virginia counties, 1970[a].

Low PPR counties			High PPR counties		
Variables	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Prob>T**
Health & Welfare (HW)	26.01	11.74	22.89	9.70	0.3562
Exp on Education	139.13	28.07	144.11	18.67	0.4194
Population	16609	11000.2	15082	9382.3	0.6292
Population per square mile	49.86	20.03	42.74	35.84	0.4642
% age 65+	11.53	3.50	10.57	2.48	0.3335
% black	25.84	17.67	26.21	20.86	0.9466
Per capita income	2228	409.38	2078	335.16	0.2095
Property tax rate	0.62	0.15	0.59	0.12	0.5044
% on medicaid	4.1	0.031	3.3	0.019	0.2614
Expenditure per pupil	291.13	77.94	248.92	61.69	0.0678
% of high school drop outs	4.5	1.60	5.0	1.78	0.3275
% of high school grads in college	38.06	7.26	38.03	8.97	0.9895
Ratio of golf holes	.002	.0031	.008	.0009	0.1874
Number of colleges	.33	0.617	.16	0.423	0.2292
Number of hospitals	.73	0.617	.29	0.500	0.0114
Hospital bed ratio	.002	0.002	.0009	0.001	.0035
General Practitioner	6.5	3.50	3.5	2.67	0.0058
Internists	.73	1.22	.18	0.47	0.0094
Pediatrics	.26	0.59	.12	0.33	0.2512

[a] Counties with a ratio of 2500 persons or less per primary care physician are considered to have low-PPR, while counties with more than 2500 persons per primary care physician are considered high-PPR. Sixty-nine counties are included in this observation.

Table 4.2. Summary statistics for Low and High PPR rural Virginia counties, 1985[a].

	Low PPR counties		High PPR counties		
Variables	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Prob>T**
Health & Welfare	32.94	6.60	35.56	11.73	.3618
Exp on education	373.60	48.95	384.27	89.56	.6250
Exp on parks,rec, and culture	4.07	3.22	5.71	5.73	.2448
Exp on community development	5.68	4.40	5.87	4.99	.8743
Population	16097	9640.5	19176	13215.7	.2934
Person per square mile	56.30	23.75	52.21	46.74	.7177
% of population 65+	13.85	4.24	12.24	2.73	.0671
% of population black	25.7	13.22	21.69	20.45	.4276
Per capita income	11093	1342.5	9492	1565.4	.0001
Property tax rates	.42	0.094	.43	0.158	.8764
% of population on medicaid	5.4	0.016	5.9	0.025	.3877
Expenditure per pupil	1105	381.10	840	350.06	.0129
% of high school drop outs	5.1	1.68	5.2	1.54	.8098
Number of colleges	.15	0.37	.22	0.50	.5817
Golf holes per capita	.002	.0027	.0008	.0006	.0016
Community health centers	.05	0.229	.48	0.614	.0044
Hospitals	.42	0.507	.44	0.704	.9021
Hospital bed ratio	.0017	.0023	.0016	.0027	.9468
General Practitioners	7.0	3.42	4.66	4.00	.0206
Internists	2.3	2.44	0.9	1.37	.0027
Pediatricians	.68	1.38	.52	0.96	.5803

[a] Counties with a ratio of 2500 persons or less per primary care physician are considered to have low-PPR, while counties with more than 2500 persons per primary care physician are considered high-PPR. Sixty-nine counties are included in this observation.

Table 4.3. Summary statistics for Low and High PPR rural Virginia counties, 1989[a].

	Low PPR Counties		High PPR Counties		
Variable	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Prob>T**
Health & welfare	70.99	35.48	65.16	20.78	.4190
Expenditure on education	705	156.15	650	95.19	.0947
Exp on parks, rec and culture	14.78	21.68	11.37	7.88	.3422
Exp on community development	16.07	16.18	11.18	10.22	.1575
Population	23473	34087.9	19966	13495.3	.5434
Population density	58.4	33.67	56.6	48.23	.8945
% of population 65+	15.7	5.25	14.17	3.42	.1758
% of population black	17.4	14.98	20.65	17.41	.4882
Per capita income	8517	1284.2	7602	1142.6	.0211
Property tax rate	.55	0.153	.50	0.120	.2540
% of population on medicaid	6.2	3.31	6.5	2.63	.7318
Expenditure per pupil	2019	1089.37	1519	702.09	.0357
% of high school drop-outs	4.2	1.21	4.1	1.39	.6987
Ratio of golf holes	.003	.0045	.0008	.0009	.0570
Number of Colleges	.13	0.351	.22	.501	.5229
% of high school grads in college	49.2	11.33	48.33	10.09	.7913
Community health centers	.20	.560	.40	.566	.2190
Hospitals	.60	.507	.33	.549	.0897
Hospital bed ratio	.004	.007	.001	.002	.0048
General practitioners	6.6	3.26	3.5	2.68	.0037
Internists	2.13	2.60	.79	1.27	.0068
Pediatricians	.83	2.11	.44	.940	.3003

[a] Counties with a ratio of 2500 persons or less per primary care physician are considered to have low-PPR, while counties with more than 2500 persons per primary care physician are considered high-PPR. Sixty-nine counties are included in this observation.

This division is somewhat artificial because only the variables that could be changed in the short-run are considered controllable. Variables that might be changed in the long-run are considered non-controllable. For example, per capita income, percent of the elderly population, percent of high school graduates attending college and percent that drops out, are all variables that in the long run might be influenced by county policies; these variables are all, however, for the purpose of this study considered to be non-controllable.

Community Non-controllable Characteristics

The variable per capita income (IN) performed as expected and the differences in the mean of this variables across the two groups of counties are significant[8] for most years examined. The low PPR counties have higher per capita income on average than the high PPR counties for all years analyzed. The size of the difference in mean income between the two groups for the year 1970 is not very large ($150) nor is it significant. In contrast to 1970, the size of the differences in the mean income of the two groups of counties is relatively larger in both 1985 and 1989 ($1601 and $1841 respectively). The t-statistics show that these differences are statistically significant for both years. The variables percent of the population above 65 years of age (PCT65) and high school graduates attending college (HGAC) are

[8]The level of confidence for the study is $\alpha = .05$, this means that any difference in mean with P-value less than or equal to .05 will be considered significant.

positively related to primary care physician supply for all years but are not significant.

Other community non-controllable variables such as percent of the population black (PCTB), population (POP), population density (PERMILE), percent of the population on medicaid (MEDICAID), and percent of high school students that drop out (DR) all performed erratically and were not significant for any of the years.

Community Controllable Characteristics

The following community characteristics are judged to be controllable by the community: local government expenditures, property tax rates (PTR), hospitals(HP) and hospital beds (HPBR), colleges (CL), golf courses (RGOLF), and expenditure per pupil (EPP). The means of EPP and RGOLF are consistently higher in low PPR counties, and also significantly different for the two groups for all the years analyzed. Local government expenditures and property tax rates are not significant in any of the years. The variable CL did not perform as expected for all years and was not significant.

The health infrastructure variables included in the analysis are the number of hospitals (HP), and the hospital bed ratio of the population (HPBR). For 1970 and 1989 the low PPR counties have significantly higher HP and HPBR than the high PPR counties. The health resource variables employed in the analysis are the stock of primary care physicians by specialty: family practitioners and general practitioners (FPGP), internists (INTERN), and pediatricians (PED). The low PPR counties consistently have more general practitioners than the high PPR counties. The

difference in the mean FPGP between the two groups is relatively large for all years (low PPR counties have approximately twice as many FPGP than the high PPR counties in all years). Both groups have few internists and pediatricians. The difference in the means of these variables for the two groups were relatively small (see tables 4.1-4.3). Both groups had more general practitioners than both internists and pediatricians. Studies have found that more specialized physicians (the internists and pediatricians) tend to choose non-rural practice; however, this study does not have enough evidence to support the argument since the ratio of primary care physician by specialty nationally is not known. The results are consistent with the expected pattern for all the variables for all years. Only the differences in means for FPGP and INTERN were statistically significant in each of the years analyzed.

Although some of the results were not expected, (such as the lower number of colleges and certain lower local government expenditures in low-PPR counties) and a majority of the differences in the means of the variables were not statistically significant, the overall results are consistent with expectations. The relationship between variables such as per capita income (IN) and expenditure per pupil (EPP) and the adequacy of primary care physicians was as expected, and the differences in the means were significant for all years. Other variables such as high school graduates attending college (HGAC), percent of the population age 65 and over (PCT65), and the ratio of golf holes to the population (RGOLF) were positively associated with proportions of primary care physicians. A second type of analysis was performed to further examine the nature of differences between these two counties.

Descriptive Analysis of Changes in PPR

The counties were divided into two groups based on the difference in PPR from 1970 to 1985 and from 1985 to 1989: one group experienced a reduction in the population to physician ratio, and the other group experienced an increase in the population to physician ratio[9]. The mean 1970 values of the "independent variables" for the two groups were calculated to determine relationship between these community characteristics and the "flow" of physicians between the years. Similarly the mean 1985 values of the variables were broken down according to either a county experienced an increase or a decrease in PPR between 1985 and 1989. Virtually all the differences in the means of the variables for the two groups were not statistically significant. The results are briefly discussed below, and the summary statistics of the results are presented in tables 4.4 and 4.5.

Non-controllable Community Characteristics

Counties that experienced a reduction in PPR had lower drop out percentage of high school students (DR), a higher percentage of high school graduates attend college (HGAC), larger population size (POP), and lower percentage of population on medicaid (PMEDC) (see tables 4.4 and 4.5). These results are consistent for both the 1970 to 1985 and the 1985 to 1989 periods. However, the differences in the means of these variables are neither large nor statistically significant.

---

[9]An increase in PPR means that the county is worse off, and a decrease means that the county is better off in terms of number of primary care physicians.

Table 4.4. Summary statistics for 1970 variables broken down by whether county experienced an increase or a decrease in PPR from 1970 to 1985.

Counties That Experienced a Decrease in PPR			Counties That Experienced an Increase in PPR		
Variables	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Prob>T**
Health & welfare	22.86	9.37	24.54	11.29	.5175
Expenditure on education	143.40	17.56	142.51	25.19	.8643
Population	16451	9639.8	13983	9747.7	.3012
Person per square mile	48.37	39.56	38.65	20.38	.2306
% of population age 65+	10.52	2.73	11.13	2.74	.3632
% of population black	27.28	19.44	24.53	21.19	.5840
Per capita income	2150	335.59	2056	378.99	.2918
Property tax rate	.58	.123	.62	.142	.2058
% of population on medicaid	3.1	.016	4.0	.027	.1233
Expenditure per pupil	265.20	62.09	248.31	73.80	.3209
% of high school drop-outs	4.8	1.60	5.1	1.93	.5985
% of high school graduates that attend college	38.77	7.95	37.03	9.42	.4230
Colleges	.15	.361	.27	.591	.2776
golf holes per capita	.0009	.001	.0012	.002	.5859
Hospitals	.27	.452	.55	.736	.0578
Hospital bed ratio	.0009	.0018	.0019	.0024	.0950
General practitioners	3.8	2.74	4.5	3.56	.3546
Internists	.25	.588	.37	.902	.4740
Pediatricians	.15	.361	.17	.468	.8303

Table 4.5. Summary statistics for 1985 variables broken down by whether county experienced an increase or a decrease in PPR from 1985 to 1989.

	Counties That Experienced a Decrease in PPR		Counties That Experienced an Increase in PPR		
Variables	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Prob>T**
Health & welfare	34.98	12.21	34.76	9.76	.9393
Expenditure on education	387.33	63.93	378.14	88.21	.6217
Expenditure on parks, rec and culture	5.75	5.73	5.0	4.93	.5944
Expenditure on community development	6.02	5.20	5.72	4.63	.8145
Population	19421	14013.2	17745	11482.3	.6179
Person per square mile	45.93	26.07	57.29	47.62	.2828
% of population age 65+	12.08	2.55	13.01	3.57	.2192
% of population black	16.24	19.56	26.30	17.51	.0410
Per capita income	9512	1918.10	10158	1482.12	.1591
Property tax rate	.47	.190	.41	.105	.0765
% of population on medicaid	5.83	.027	5.84	.021	.9867
Expenditure per pupil	883.95	414.56	929.26	256.91	.6527
% of high school drop-outs	4.9	1.50	5.2	1.61	.4480
Colleges	.16	.481	.22	.471	.6478
Golf holes per capita	.0011	.0021	.0011	.0013	.9704
Community health centers	.58	.653	.24	.484	.0317
Hospitals	.66	.816	.31	.514	.0300
Hospital bed ratio	.002	.0027	.001	.0025	.1266
General practitioners	3.9	3.28	6.0	4.15	.0291
Internists	1.0	1.53	1.5	1.97	.2289
Pediatricians	.5	1.14	.6	1.07	.7253

Counties that experienced a reduction in the PPR over the years 1970 to 1985 and 1985 to 1989 had lower percentages of elderly people. The proportion of blacks to total population was higher in the group of counties that experienced a reduction in the PPR between the years 1970 to 1989. The results for changes from 1985 to 1989 show that counties that experienced reductions in PPR had lower proportion of blacks to total population in 1985. The differences in means of these variables for the two groups are statistically significant for both time periods analyzed.

The variables per capita income (IN), and population density (PERMILE) performed erratically and are not statistically significant for any of the periods.

Controllable Community Characteristics

The counties that reduced their PPR (became better off in terms of primary care physician availability) between the years 1970 and 1985 spent less money on health and welfare in 1970. These counties also spent more money on education. The group of counties that experienced a reduction in PPR between the years 1985 and 1989 spent more money in 1985 on all four categories of local government expenditures which includes health and welfare (HW), education (EDUC), parks recreation and culture (PKRECUL), and community development (COMDEV). The differences in the means of these variables are neither large nor statistically significant. The results of the other variables are inconsistent for the two periods, and the differences in the means of all the remaining variables for the two groups are not

statistically significant.

Some of the results in the analysis are consistent with the expected trends and pattern, while others are not. The reasons for the inconsistency in some of the results are unknown. It will be useful to consider the multivariate analysis which has more power than this type of analysis because it controls for the influences of other factors. The results of the multivariate analysis are discussed in the next section.

The Regression Analysis

The multiple regression models discussed in chapter three were estimated. The model employed was the simple double log equation:

$$\ln(PPR) = \log XB + e$$

Where PPR is an n-vector of county PPRs, X is a matrix of regressors, B is a vector of parameters to be estimated, e is a vector of errors assumed to be normally distributed with homoskedastic variance. Because the equation is log-linear, the B parameters may be interpreted as elasticities.

Nineteen independent variables were initially employed (see table 4.6) based on a priori reasoning, and the results of other related studies. Not all the variables were employed in the initial regression analysis. Several variables (POP, HP, PKRECUL, COMDEV, and HGAC) were not entered in the analysis because they duplicate the effects of other variables[10] in the group.

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[10]Population is correlated with the population per square mile; hospitals are to the hospital bed to population ratio; local government expenditures on parks, recreation and culture and local government expenditure on community development

Following preliminary regressions, the weaker (non significant) explanatory variables were systematically deleted (within the groups) from the models. These deletions included variables such as the local government expenditure on education (EDUC); expenditure per pupil (EPP); and drop-out percent of high school students (DR). The rest of the variables were included in the analysis.

Results of the cross-sectional regression analysis.

Prior to conducting formal tests of significance, the models were examined to see if the statistical assumptions underlying estimation were met. Tests of normality, homoskedasticity, and functional form all revealed no violations of these assumptions. For further reading on misspecification tests see Spanos (1986) pages 451-473. The normality test employed was the Bera-Jarque Skewness-Kurtosis test (see p454 in Spanos). The test for functional form was the RESET test (p.460-1 in Spanos). The test for heteroskedasticity was a white test (p.466-7 in Spanos).

The regression results for each of the three years are presented in table 4.8. Each model performed well in explaining the variation in the PPRs. The R^2 were reasonable, and approximately 80% of the variables had their expected signs for each of the years analyzed[11]

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are correlated with the local government expenditure on education; percent of high school graduates attending college is correlated with the percent of high school students that drop out.

[11]Because of the way the dependent variable was derived a positive sign on an independent variable means that the number of physicians declines as the independent variable increases.

Table 4.6. Description and classification of independent variables used in regression analysis.

Variable	Description
Amenity-Related	
PKRECUL	Government expenditures on parks, recreation, and culture.
COMDEV	Government expenditures on community development.
HW	Government expenditures on health and welfare.
RGOLF	Ratio of golf holes to county population.
Education-Related	
EDUC	Government expenditures on education.
EPP	Expenditure per pupil from local funds.
DR	Percent of high school students that drop out.
HGAC	Percent of high school students that attend college.
CL	Number of colleges in the county.
Income-Related	
IN	Per capita income of the county.
POP	Population size of the county.
PERMILE	Population density of the county.
PMEDC	Percent of the population on medicaid.
PTR	Property tax rates.
Professional	
HP	Number of hospitals in the county.
HPBR	Hospital beds to population ratio.
CMHC	Government sponsored free clinics and community health centers.
Non-categorized	
PCT65	Percent of the population age 65 and over.
PCTB	Percent of the population black.

Table 4.7. Misspecification tests results for the cross sectional regression analysis.

Test	Test Value		
	PPR 1970	PPR 1985	PPR 1990
Normality	1.139 (5.99)	.794 (5.99)	1.922 (5.99)
Homoskedasticity	1.428 (3.145)	.604 (3.141)	.212 (3.161)
Functional Form	.002 (1.885)	.234 (1.948)	.142 (1.993)

Critical values of the tests at the $\alpha = .05$ level of confidence are found in parenthesis. Normality Test is X^2, the tests for homoskedasticity and functional form are distributed F.

Table 4.8. Regression results for physicians models, 1970, 1985, 1990.

Independent Variables	**Dependent Variables** PPR70	PPR85	PPR89
Constant	12.208 (4.375)	23.742 (6.543)	12.371 (2.673)
Health & Welfare(HW)	.073 (.250)	-.041 (.225)	.337 (1.89)
Hospital Bed Ratio	-.077 (-2.414)	.035 (1.129)	-.160 (-4.389)
Community Health Center	-	.237 (2.320)	.097 (.871)
Ratio of golf holes	-.067 (-2.181)	-.109 (-3.043)	-.0854 (-2.159)
Colleges	-.166 (-1.784)	-.074 (-.712)	-
Property Tax Rate	-.082 (-.407)	.057 (.339)	-.329 (-1.457)
% of population black (PCTB)	.003 (.104)	.030 (1.009)	.014 (.341)
% of population age 65+ (PCT65)	-.802 (-4.538)	-.933 (-4.815)	-.525 (-2.181)
Population per square mile	-.175 (-1.703)	-.096 (-.875)	.072 (.693)
Per capita income	-.020 (-.047)	-1.257 (-3.230)	-.531 (-1.095)
% of population on medicaid	-.052 (-.224)	-.233 (-2.366)	-.196 (-.861)
N	66	60	60
R^2(adjusted)	.4451	.4507	.5074
T-statistics in parenthesis			

There were differences in the results from year to year; some of the variables changed signs, and the magnitude and significance of some variables changed. Generally, the community controllable variables were more consisitent predictors of the stock of physicians than the community non-controllable variables.

Three variables were significantly related to PPR for the year 1970 (table 4.8). The percent of the population aged sixty-five and older (PCT65) was negatively related to PPR. This result conforms with expectations, and is consistent with the findings of past studies. The result was expected because elderly people are high users of primary care services. Thus, higher percentages of elderly are associated with a greater stock of physicians. PCT65 was also significant and negatively related to PPR in the years 1985 and 1989 (table 4.8). The magnitudes of the coefficient for the years 1970, 1985, and 1989 were -.802, -.933, and -.525 respectively. In 1970, a one percent increase in the percent of population age 65 and over (in a county) is associated with a 0.8 percent decrease in the PPR of that county. A one percent increase in PCT65 for the years 1985 and 1989 is associated with .93 and .52 percent decreases, respectively. The elderly people are high users of primary care, and studies have found physicians to consider the need of the people when making location decisions (Rhodes and Day 1987).

Per capita income (IN) was negatively related to PPR though not statistically significant in 1970. The variable was, however, significantly related to PPR in 1985. The magnitude of the coefficient was the largest of all the regressors in the 1985

analysis (-1.2). This result indicates that a 1 percent increase in county income in 1985 is associated with a 1.2 percent decrease in PPR. This implies that poor rural counties found it difficult to attract and retain physicians and that there was a clear association between income and primary care physician access by county. The variable was weaker and not significant in 1989, however its t-statistic was fairly close to 2 (see table 4.8). Although the variable performed erratically in terms of statistical significance, it maintained its expected negative sign for all years.

The percent of the population on Medicaid (PMEDC) was negatively related to PPR for each of the years. This sign was not expected because past studies have found physicians to be less attracted to areas with high PMEDC. The variable was statistically significant only for 1985. The magnitude of the estimate for 1985 indicates that a 1 percent increase in the percent of the population on Medicaid is associated with a .2 percent decrease in PPR. It is worth noting that a majority of Medicaid recipients reside in more populous counties. It is quite possible that population density variable is not effectively controlled for, thereby causing the dependent variable (PPR) to be negatively related to the percent of the population on medicaid.

The ratio of golf holes to population (RGOLF) was significantly and negatively related to PPR for each of the years. The magnitudes of the coefficients indicate that in 1970, 1985, and 1989, respectively, a one percent increase in the number of golf holes per capita will lead to a .6, 1.1, and .8 percent decrease in the county PPR. Thus more golf holes, ceteris paribus, leads to more primary care

physicians per person in a county. The result was expected based on a priori reasoning. Physicians have cited poor social and recreational facilities as a deterrent from rural practice. A golf course is a status recreational facility that promotes social relationships among members, and creates ample opportunities for professionals such as physicians to interact with their peers. It is worth mentioning that in this analysis, the effects of income variable are controlled for, yet the variable RGOLF proved to be a strong predictor of the variation in PPR.

The hospital bed ratio to population (HPBR) was significantly and negatively related to the PPR in 1970. A one percent increase in HPBR is associated with a .7 percent decrease in PPR for 1970. The result is expected since past results have found a correlation between medical facilities and the number of physicians. Physicians tend to locate and remain in areas with hospital facilities. The influence of the variable became weaker and not significant in 1985. The reasons for the change are unknown. One possible explanation could be the fact that virtually every county in the state had at least on primary care physician in that same year. The mean PPR of all counties for 1985 was the lowest of all three years. The variable became the strongest predictor variable in 1989. The magnitude of the estimate increased, and a one percent increase in HPBR led to 1.6 percent decrease in PPR. This result has important implications for rural health policy in Virginia. Unless efforts are made to retain physicians, as rural hospitals close there could be a corresponding decline in primary health care manpower.

The property tax rate (PTR) was not significant for any of the years analyzed.

The sign of the coefficient changed among the years. Also, the number of colleges (CL) was not significant for any year, however it had its expected sign (negative) for 1970 and 1989.

The population per square mile (PERMILE) was not statistically significant for any of the years. It was negatively related to PPR in 1970 and 1985, which is consistent with the expectations. The percent of blacks in the population (PCTB), consistently maintained its expected positive sign, but it was not statistically significant for any of the years analyzed.

The variable representing the existence of community health centers/free clinics (CMHC) is considered to be community controllable. It was not included in the analysis for the year 1970, because the CHC program did not begin until 1972. The variable was statistically significant and positively related to PPR for the year 1985. This positive sign indicates that the presence of a free clinic is negatively related to the stock of physicians in a county. Though it was only found to be significant in 1985, the coefficient also had the expected positive sign in the 1989 equation. These results were expected because the goal of the program was to provide basic medical services to the medically indigent. Thus, these clinics are by design located in areas deemed to be medically underserved. The reason for employing the variable (CMHC) in this analysis is to determine the effects of the existence of free clinics on future recruitment of physicians into the area. This could have important policy implications for rural health care in Virginia. A proper evaluation of the effects of these variable on PPR is beyond the scope of this study.

The reasons are discussed in the following chapter.

Generally, the variables employed in the models had their expected association with PPR, especially the community controllable variables such as HPBR, and RGOLF. Other variables, such as IN, performed well, but did not have a consistent impact over all the years evaluated. However, such results are useful to the governments and policymakers of rural counties of Virginia in terms of future plans to improve health care availability mainly because these results suggest that other non-monetary rural factors account for the shortage of primary care physicians in rural areas.

Some of the variables in the model did not perform as well as expected. Some studies found the population density (Rushing and Wade, 1973) to be significantly associated with high number of physicians and the percent of blacks in the population (Rhodes and Day) to be significantly associated with fewer physicians. Although these variables maintained their expected signs in almost all cases, they were not significant for any of the years. Government expenditures were weakly associated with the stock of primary care physicians. Surprisingly, the number of colleges did not perform very well in the model. Although this variable carried its expected sign (negative), it was never significant.

A plausible explanation for these unsatisfactory results is that the sample size is relatively small. More observations (perhaps a pooling of cross sectional and time series data) would perhaps, lead to more satisfactory results.

Results of the models examining changes in PPR over time

The cross-sectional analysis employed above examines the relationship between the stock of primary care physicians and certain community characteristics at a particular time period. In order to examine physician flows over time, a second type of model was estimated in which in which the difference between the PPR of a county for two time periods was employed as the dependent variable. The following regression was run

$$\text{Change in PPR} = \log XB + e$$

where change in PPR is the difference in PPR by county across two time periods (i.e, PPR1985 - PPR1970 and PPR1989 - PPR1985), X is a matrix of regressors, which includes the 1970 and 1985 levels of the relevant variables, B is a vector of parameters, and e is a vector of errors assumed to be normally distributed and the variance is homoskedastic once again. The models were examined to see if the statistical assumptions underlying them were met. Tests of normality, homoskedasticity, and functional form revealed no violations of these assumptions (see appendix table B). The models did not perform as well as the models used in the cross-sectional analysis. Few of the variables were significant, None of the variables was significant for both time periods, but a few variables had the expected signs. The results of the longitudinal analysis are presented in appendix table C.

Summary

The results of the descriptive and statistical analysis suggest that there are

notable differences in community-related factors between counties that have high proportions of primary care physicians and counties that have low proportions of primary care physicians. Counties with fewer primary care physicians are almost always clustered, and have lower income levels, and poorer amenities. The next chapter contains the summary and conclusions of the study.

Chapter V

SUMMARY AND CONCLUSIONS

Introduction

This chapter contains a summary of the results and a discussion of policy implications of this and other studies on the distribution and practice location choices of physicians in rural areas. Information on the relationships between the level of primary care physicians and the characteristics of the practice area in rural Virginia are presented. Ways to improve health care access in the medically underserved counties of Virginia are suggested.

What is Known About Health Care Services and Physicians

There is a maldistribution of physicians between the urban and rural areas in Virginia. A majority of rural residents do not have access to adequate health care services. The reason for this inadequacy is two fold. First, the supply of health care personnel (primary care physicians) per person is low in rural areas. The mean

primary care physician to population ratio for the rural counties for the year 1989 was 4404 persons per primary care physician, which is almost twice as high as the national standard of 2500 persons per primary care physician. As many as five counties had no primary care physician in the same year; thus, primary health care services were not available in these counties during this period. Second, many rural residents can not afford the relative high cost of medical services. Efforts have been made at the federal and state government levels to improve access to basic health care services. The federal government has provided medical insurance for the poor citizens and the elderly. Both federal and state governments have taken steps to increase the pool of health care personnel through scholarship programs and expansion of existing medical schools. This increased supply of health care personnel has not solved the problem of maldistribution nor reduced the costs of medical services. Apparently, some characteristics of rural areas make them undesirable areas for a physician to locate.

The objective of this study was to examine the effects of community controllable and non-controllable characteristics on the proportions of primary care physicians in rural Virginia counties for the years 1970, 1985 and 1989. By examining these factors, information can be provided for policymakers to improve the availability and accessibility of primary health care in rural Virginia.

Relationship Between Physicians and The Characteristics of Practice Area

This study employed both descriptive and statistical analysis to examine the effects of community related-factors on the levels of primary care physicians in rural counties. The Virginia county maps (figures 4.1 and 4.2 in chapter 4) show a continuing pattern of primary care physician (PCP) maldistribution, especially in the poorer rural counties for the past 20 years. The descriptive analysis which compared the means and standard deviations for the variables (of the two groups of counties: low-PPR and high-PPR) found that per capita income and local educational expenditures are significantly related to adequacy of primary care physician. Other variables representing recreational amenities in the area (ratio of golf holes per person), quality of education (percent of high school graduates that attend college), and demographic composition of the area (percent of the population 65 and above) were positively associated with proportions of PCPs. Multivariate analysis was performed to further examine the relationship between community factors and the levels of PCP.

The models effectively delineated the area characteristics that significantly explain the variation in PPR. Community controllable variables such as the ratio of hospital beds to population, and the ratio of golf holes to population were most consistently and significantly related to PPR. These variables were associated with high numbers of primary care physicians in a county. Community health centers included as a variable only in the 1985 and 1989 equations, had a significant negative effect on primary care physician supply only for the year 1985. Percent of the

population age 65 and above was significant for the years 1970 and 1985. Per capita income was significant only for the year 1985.

The results thus indicate that the variables ratio of golf holes per capita (RGOLF) and hospital bed ratio (HPBR) are more consistent predictors of the variation in PPR than the variable per capita income (IN). This result means that structural facilities in an area affects the distribution of primary care physicians more than the income levels of the residents. There is enough evidence to conclude that fewer primary care physicians locate in rural areas partly because of poor rural infrastructure. Medical facilities and amenities that affect the quality of living standards are often inadequate in rural areas.

However, one can argue that the relevance of the variable per capita income should not be overlooked or underestimated because it is related to the structural characteristics of an area. Areas with high levels of income usually have high numbers of professionals with affluent life styles. These areas often have adequate medical, social, and cultural facilities. Thus high numbers of golf holes per capita and high hospital bed ratios is expected. But, since this study and other studies found income not to be highly associated (once the other factors are controlled for) with the proportions and location decisions of primary care physicians, it is appropriate to conclude that improvement in selected rural facilities will likely improve the supply of primary care physicians to rural areas.

Improving local medical facilities, for example increasing the number of

hospital beds (as indicated by this study), may influence primary care physician distribution. Policy makers and health care providers should be careful not to interpret this information at face value because the relationship between primary care physicians and hospital beds is more complex than represented. The hospital bed ratio does not always reflect the variety or quality of medical services offered. However, since the variable is influential in the distribution of primary care physicians, the impact of rural hospital closures on physician distribution should be considered when making hospital closure decisions, especially, in areas such as Southwest Virginia, South Side, Piedmont, and the Middle Peninsula planning districts, and also inparts of North Central and Central Virginia. These areas already have fewer primary care physicians and further closure of hospitals may lower the numbers of primary care physicians serving in the area. More specific ways of improving existing rural hospitals to make them more attractive to primary care physicians should be sought.

The findings of this study are somewhat consistent with the hypothesized fact that the flow of physicians into an area changes in response to either the pecuniary or non pecuniary attractiveness of the area. The distribution of primary care physicians in rural Virginia counties is intertwined with a complex of community related social and economic factors. The effects of one independent factor do not operate in isolation from the effects of other independent factors.

Problems Facing Local Governments/Groups Trying to Recruit Physicians Into a Rural County.

This study did not examine physician recruitment, but there is evidence that recruitment programs have proved to be effective (Crandall et. al; Hostetter and Hassinger; Korman and Feldman). It has been advocated that underserved counties desiring the services of physicians should make efforts on their own behalf to attract these physicians. The level of expenditures of time, and financial resources by counties to attract new physicians is significant. A major short-term problem facing the local recruiters is the fact that fewer medical students are going into primary care (Bishirjan, 1989). This increases the competition among rural area (and possibly urban areas) to attract these type of physicians.

Improving general living conditions in a community in order to attract physicians requires long periods of time and significant investments. To do so often includes providing adequate medical and recreational facilities, cultural, social and entertainment centers (for example, well equipped hospital or clinic, recreational facilities such as country clubs or public sports clubs, that would provide amicable social and cultural environment that enhances camaraderie among physicians and their peers, parks and play grounds, movie theaters, public libraries, etc). Other dimensions of community living could be improved to give physicians and their spouses more flexibility; day care centers are one example. All these will improve the quality of living standard and at the same time may help attract physicians. This

approach would be a poor investment strategy by a community that wishes to obtain the services of one or two primary care physicians. However, most communities should strive to improve the quality of living standard because this might attract professionals and businesses, thus, creating long-term snow ball effects on economic and social activities in the areas.

Ways to Improve Access to Basic Health Care in Rural Areas

The clustering of counties with high-PPR (see figures 4.2 and 4.3) suggests that region-wide solutions (for example planning districts) should be sought, rather than county-wide solutions to the provision of health care services. A viable solution to improving immediate access to health care in areas with severe medical underservice would be to set-up well equipped low-fee or free clinic with local funds. Nurses and other non-physician health care personnel could be employed to provide services in these clinics under the supervision of a physician (or physicians) who practice in nearby areas (county or city) with adequate medical services. Paid physician could make scheduled visits to the clinic depending on the medical needs of the area, and his/her salary could be paid by the local governments or the community. This solution will better suit medically underserved areas located within a region that has high number of physicians. For example, Charles City, Goochland, New Kent, and Powhatan counties, all in Richmond Regional planning district, could jointly benefit from this type of health care service scheme.

Medically underserved areas adjacent to a county (or counties) with high number of physicians and existing hospitals need not build extensive medical facilities since unfair competition might arise between their facilities and other hospitals within the region. One could argue that setting up a free or low-fee clinic could further deter primary care physicians from locating in such areas, because potential clients would rather obtain health care services from cheaper or free sources. An investigation of this assumption is beyond the scope of this study because the data required to examine the changes in the levels of primary care physicians in an area following the establishment of free clinics were not available. Low-cost or free clinics are necessary since they provide immediate basic health care services to the medically indigent. This health care provision plan could be phased out (while alternative health care service provision plans are sought) if it is found to deter physicians from locating in the areas. Flexibility should be encouraged and maintained.

Medically underserved areas located in regions with few physicians, for example parts of Southwest Virginia, Piedmont and South Side, should adopt a more rudimentary approach to providing health care services. Cooper et al, found that most primary care physicians make their location decisions during internship, residency, or other forms of staff training. Local recruiters will need to contact physicians (especially primary care who are interested in rural practice) during these periods of staff training and present them with the medical service needs of the area

and the opportunities and benefits of practicing in the area. They could design incentives to locate in the community by providing personnel to assist the physician in the office, guarantee salary for a certain period of time, or provide other subsidies (for example local tax exemption) to enhance pecuniary satisfaction for practicing in the area. This subsidy approaches are documented to have been successful in the past (Korman and Feldman, 1977).

Correcting Physician Maldistribution

Factors underlying physician location decisions have been examined by this study and several authors. Studies that stratified the group of physicians by specialty had relatively consistent results. Specialized physicians are more influenced by economic and professional factors than primary care physicians, partly because of the structural constraints associated with specialized medical practice. Both groups are influenced by place of origin. Specialized physicians tend to have affluent backgrounds and grew up in more populous areas than primary care physicians. Physicians in general are influenced during the course of their education (either during medical school or residency); however, this influence is not as strong as the influence of background or structural factors. Despite the influence of individual specific characteristics, physician location decisions are also influenced by certain community controllable and non-controllable characteristics.

Federal and state governments efforts will be required to create effective

policies to correct physician maldistribution. Past efforts which focused on an indiscriminate increase in the pool of physicians have not been very effective. Governments should adopt programs that seek to increase the pool of primary care physicians (which is shrinking already) because primary care physicians are more likely to go into rural practice. The federal and state scholarship programs should be revised to target potential medical students from rural areas especially areas that are medically underserved. The reasons for this retargeting are two fold: this group of students will likely go into primary care, and a majority if not all would remain in rural practice sites after completion of service obligation periods. Governments could provide additional income subsidies or tax incentives to induce rural practice.

It is evident that the problem facing rural areas in recruiting and retaining physicians is related to the structural constraints associated with rural practice. Governments should make efforts to improve the rural facilities (medical, social, cultural) and infrastructure necessary to make rural living less isolated from urban areas. Future studies should focus on the specifics of the relationships between primary care physicians and structural facilities such as hospitals equipments, recreational facilities and other amenities. An understanding of these relationships will further enhance policymakers in ways of correcting physician maldistribution.

Finally, the results, conclusions and recommendations of this study supports the four types of models (to recruit and retain physicians in rural practice) developed by Crandal et. al. (see Ch 2, p36). This study found that the existence of hospitals in

rural areas is associated with high number of primary care physicians. This is affiliated with the "Practice characteristics model" which emphasizes the importance of support system for rural physicians by providing opportunities for hospital practice, etc.

The "Economic incentive model" emphasizes the importance of reducing urban versus rural inequities by improving the medical infra-structure in rural hospitals, and an adjustment of current health care financing system so that rural physicians/hospitals will get equitable share of payment for providing services to medicaid or medicare patients. The inequities in rural/urban medical infra-structure corresponds to the finding of this study that high numbers of primary care physicians is associated with high ratios of bed to population ratio in a county.

The "Identure model" and the "Affinity model" stress ways to provide temporary health care services in rural areas, and recruit people with rural backgrounds into medical schools respectively. These two models are consistent with the recommendations of this study for providing immediate health care services and correcting primary care physician maldistribution.

Chapter VI

RETROSPECT ON HEALTH CARE

Introduction

For the past two decades health care availability in rural areas has been in constant flux. Rural residents generally face the barriers of distance and institutional arrangements as they seek health care services, and some face an additional barrier, which is the barrier of cost. Access to health care should be treated as a public good, because the private market often leads to a supply of public goods that is lower than the social-welfare maximizing level. To achieve the social-welfare maximizing supply of public goods, government intervention is necessary. Health care services are not exempted.

The demand for primary care services is fairly inelastic, but the supply of these services has been and continues to be inequitable across different geographic locations. The maldistribution of physicians documented for Virginia in this study occurs partly because the market for health services can not be characterized as competitive. Several aspects of monopoly exists. Fees for similar medical services

vary by geographic location, and tend to be higher in urban areas with high numbers of physicians and lower in rural areas with fewer physicians. Thus there is no mechanism by which the market corrects itself and encourages physicians to locate in rural areas. The supply of medical services in the rural areas of Virginia is clearly a case requiring government intervention .

Policies affecting health care access

The federal and state governments have adopted policies intended to improve access to health care services. Federal policy has had three principal objectives. The first objective has been to enlarge the total supply of health care personnel, especially physicians. This action resulted in many new medical schools being opened in the 1960s. The second objective has been to induce medical school graduates to locate in medically underserved areas (MUA); the National Health Service Corp (NHSC) has been the principal means of attaining this objective. The third objective has been to increase the pool of primary care physicians, based on the fact that several studies found that primary care physicians are more likely than specialists to practice in rural areas. To achieve this objective, special institutions were put in place to produce more primary care physicians. In particular, admission policies that favored students going into primary care practice were introduced in medical schools.

The implicit assumption behind these policies was that increasing the number of health care personnel would result in a diffusion of physicians, physician assistants,

and nurses into areas where these personnel are in short supply. These policies failed. This study and numerous other studies have found increasing clustering of physicians in urbanized areas. The reasons why physicians and other health care providers have continued clustering in urban areas are both personal and professional.

In principle, the price of a service determines the quantity of service supplied; thus health care providers should be expected to cluster in urban areas because the prices of medical services are higher there. This means important economic forces are creating incentives for physicians to settle in urban locations. Medical service providers rarely compete on a basis of price. As a consequence, the market does not respond to the rural/urban supply differential by increasing prices in rural areas relative to urban areas.

Other reasons why physicians tend to gravitate towards urban areas include the fact that most medical research and treatment facilities are located in those areas. Professional workloads are heavier in rural areas because there are fewer physicians and physician assistants. Physicians with rural practice often feel professionally isolated. Physicians leaving rural practice generally cite these reasons and a range of social and cultural factors as deterrents to rural practice.

This study focused on the supply of health care services existing in rural areas. This work found that the government-sponsored programs designed to provide adequate primary health care services to all residents of Virginia have not been

successful . In the 1990s, many rural areas in the state still face geographic and institutional barriers to health care services. The same counties that were medically underserved in 1970 remained medically underserved in 1989 which is 20 years later. A majority of these counties are rural, and they lacked the medical infrastructure and the cultural and social amenities necessary to facilitate rural practice. State and federal government programs dealing with underservice tend to continue focusing on the supply-side of health service, with emphasis on increasing the pool of health care personnel. The demand-side has received little emphasis.

Necessary public policy

The need is clear. It is necessary that government adopt policies that will ensure access in rural areas to comprehensive health care services. These policies should address the following five dimensions of access to health care service: supply of health care personnel, distribution of health care personnel, distribution of health infrastructure, the affordability of health care services, and provision of information on health care. Each of these dimensions is discussed below.

Supply of health care personnel: The first and most vital dimension of access to health care service is the availability of the personnel necessary to provide the services. Government programs have been successful in increasing the number of health care personnel. Frenzen (1991) reported that the number of nonfederal

physicians in the United States grew more rapidly than the population in the 1980s. The total number of physicians rose from 376,000 to 472,000 between 1981 and 1988. This represents a 26 percent increase. The number of primary care physicians grew from 168,000 to 208,000 during the same period, an increase of 24 percent.

More importantly, the physician population has not diffused into rural areas as anticipated; thus, governments should consider shifting or rather extending their focus on alternative health service providers; registered nurses (RNs) and nurse practitioners are examples. This group of providers is capable of providing the vast majority of primary care services, and should be allowed to do so since it can provide health care in some areas where physicians are not, and are not likely to be available.

Distribution of health care personnel: The second vital dimension of access to health care service is the equitable distribution of the health care personnel. Some studies have reported that rural areas are gaining physicians (Newhouse et. al.) but the physician to population ratio in rural area still lags behind that in urban areas (Frenzen, P.D). Even though the total supply of personnel is increasing, it does not necessarily follow that the supply increase is reducing inequities in physician distribution. Virginia like the rest of the nation has been plagued by maldistribution of physician population. This study found that the proportions of primary care physicians to populations are higher in more urbanized counties than rural counties.

As many as five rural counties in the state of Virginia did not have one primary care physician in 1989. There are reports of rural hospitals and rural areas in general having difficulty in recruiting physicians. This inability to recruit physicians has caused health care services to continue to be unavailable in these rural communities.

Government policies intended to influence practice location choices of physicians have only met with limited success. The preceptorship training program and other programs, such as decentralized medical education, were introduced to expose medical students to rural practice and possibly stimulate their interest in rural practice. The impact of these programs has not been great. Yett and Ernst (1985) reported that these programs had minimal impacts on the distribution of physicians because place of training represents a primarily passive influence on location decisions.

Other government programs have only temporarily redistributed the physician population. These programs include the NHSC scholarship programs and other scholarship programs in which one year of scholarship is swapped for one year of service in a MUA. The impact of the NHSC scholarship program has been inconclusive. Critics report that the Virginia state scholarship program has not been effective in redistributing the physician population. The general conclusion is that scholarship/loan-forgiveness programs have not been effective in redistributing the physician population, and consequently, many rural areas still lack physician services. Government should adopt policies that would place health care providers in areas

of high need for a long-term so that these residents will have reliable and stable sources of health care.

Distribution of medical infrastructure: After ensuring the distribution of health care personnel in areas of high need it is important to take necessary measures to guarantee that the providers remain in these areas. Rural communities that succeed in recruiting a physician or physicians often have had difficulties retaining their recruits. Similarly, government programs that have placed physicians in areas of high need have had problems retaining these physicians in these areas after they complete their terms of obligation. Only 25 percent of NHSC physicians remain in their practice sites after completion of their obligations. A majority of Virginia state scholarship recipients who chose to practice in MUAs left their practice sites soon after completion of service obligation. Between the years 1977 and 1983, as many as 64 percent of the recipients of Virginia state scholarships paid off their obligation monetarily, rather than through practice in an MUA (VDH). Physicians who leave rural practice sites cite, among other reasons, lack of opportunity for economic and professional growth, inadequate medical facilities and health care personnel, and professional isolation as the major deterrents to staying.

This study found medical facilities to be very influential in the proportions of primary care physician in the county. Rural areas lack adequate medical, social, and cultural infrastructure necessary to attract and retain physicians. Government should

take necessary measures to avoid further rural hospital closures, since hospitals is so closely related to physician numbers in rural counties. Efforts should be made to improve the rural facilities and infrastructure necessary to make rural living less isolated from urban areas.

Affordability of health care services: The fourth vital dimension of access to health care services is making it affordable to a majority of the population. Many rural residents face financial barriers to health care services due to their high costs. Private health insurance has became unaffordable to many working people. Rural residents are hard hit by high costs of medical services because they are more likely than urban residents to purchase health insurance policies outside the workplace. These policies often are more expensive and provide fewer benefits than insurance policies obtained through employment. These reasons mean that rural residents tend to have less comprehensive health insurance than do urban residents (Frenzen, 1991).

Many rural residents who can not afford private health insurance have to rely on government health insurance as their source of payment. Medicaid and Medicare patients in Virginia (and the rest of the country) have less access to health care services because of low-fee reimbursement policies. In addition, and possibly more important, lower proportions of rural than urban physicians accept Medicare and Medicaid patients. Government should consider subsidizing rural physicians since they have heavier workloads and lower incomes than their urban counterparts.

This subsidy approach should be designed to increase the participation of rural physicians in Medicare/Medicaid programs.

People who reside in rural areas also face geographic barriers, and often travel long distances to obtain health services. Traveling in rural areas can be expensive and difficult due relatively to poorer transportation facilities. The time-cost of traveling to obtain health care often translates into wage losses to rural residents who are employed on an hourly wage basis. All these factors make health care less affordable to rural residents.

Government should consider introducing a work-release program for physician visits, especially in rural areas so that employees located there will not incur wage losses on visits to physicians. Alternatively, the government could introduce mobile health care units. These health care providers might visit rural areas that lack health care services on a schedule based on the medical need of the area. These arrangements will help reduce the geographic barriers to health care faced by rural residents.

Information on health care: This dimension of access is related to the demand for health care services, but it has not been fully explored by studies on health care. How much knowledge consumers of health services have about health and its determinants is not apparent. However, it is reasonable to assume that a majority of the health service consumers do not have adequate knowledge of either the

services available or the services consumed. Given this situation, it is reasonable to suggest that some consumers of health care services are subjected to manipulation by health care providers.

Physicians have considerable monopoly power on health care information. Like other monopolistic markets, the sellers are price givers while the buyers are price takers. Physicians have been known to make unnecessary referrals and medical appointments, thus inflating the cost of health care to consumers. If consumers are adequately informed about health and its determinants, it is possible that some of these unnecessary purchases of medical services could be avoided, thereby reducing costs to consumers.

It is necessary that the government adopt and implement this policy of providing health care information to the public because it will improve the general well-being of the society. Society will be healthier and will need visit physician offices and, possibly, emergency rooms less often. This healthier population will have fewer days missed at work due to illness, increasing productivity. In addition, workers will have more disposable income to spend on consumption of goods and services from other industries.

Conclusion

In conclusion one can see that many government programs that are currently being considered have been tried, and that they will not solve the problems of access

to health care in rural areas because they are one dimensional. These programs tend to focus only on the supply of health care, particularly increasing the pool of health care personnel. The problems of rural area health care provision will likely persist until governments adopt policies that incorporate all five dimensions of access to health care. Most importantly, governments should consider eroding the monopolistic power of the physicians by providing health care information to the general public and authorizing medically-instructed nonphysician health care personnel to provide primary health care services. This action will help reduce the cost of health services in all geographic areas, and serve to improve the health and general well-being of the society without regard to place of residence.

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Appendix table. A. Composition of Virginia's Planning Districts

1. Lenowisco
Lee
Scott
Wise
Norton

2. Cumberland Plateau
Buchanan
Dickenson
Russell
Tazewell

3. Mount Rogers
Bland
Carroll
Grayson
Smyth
Washington
Wythe
Bristol City
Galax city

4. New River Valley
Floyd
Giles
Montgomery
Pulaski
Radford City

5. Fifth
Alleghany
Botetourt
Craig
Ronoake
Clifton Forge City
Covington City
Ronoake City
Salem city

6. Central Shenandoah
Augusta
Bath
Highland
Rockbridge
Rockingham
Buena Vista City
Harrisonburg City
Lexington City
Staunton City
Waynesboro City

7. Lord Fairfax
Clarke
Frederick
Page
Shenandoah
Warren
Winchester

8. Northern Virginia
Arlington
Fairfax
Loudoun
Prince William
Alexandria City
Fairfax City
Falls Church City
Manassas City
Manassas Park City

Appendix Table B. Misspecification tests results for the longitudinal analysis.

Tests	Test F value	
	Change in PPR 1985-1970	Change in PPR 1989-1985
Homoskedasticity	.074 (3.152)	1.299 (3.142)
Functional Form	.137 (1.983)	.028 (1.989)
Normality	2.173 (5.99)	1.847 (5.99)

Critical values of the tests at the $\alpha = .05$ level of confidence are found in the parenthesis. Normality test statistics is distributed X^2, the tests for homoskedasticity and functional form are distributed F.

Appendix table. A. continued..

9. Rappahannock-Rapidan
Culpeper
Fauquier
Madison
Orange
Rappahannock

10. Thomas Jefferson
Albemarle
Fluvanna
Greene
Louisa
Nelson
Charlottesville City

11. Central Virginia
Amherst
Appomattox
Bedford
Campbell
Bedford City
Lynchburg City

12. West Piedmont
Franklin
Henry
Patrick
Pittsylvania
Danville City
Martinsville City

13. Southside
Brunswick
Halifax
Mecklenburg
South Boston City

14. Piedmont
Amelia
Buckingham
Charlotte
Cumberland
Lunenburg
Nottoway
Prince Edward

15. Richmond Regional
Charles City County
Chesterfield
Goochland
Hanover
Henrico
New Kent
Powhatan
Richmond City

16. Radco
Caroline
King George
Spotsylvania
Stafford
Fredericksburg City

17. Nothern Neck
Lancaster
Northumberland
Richmond
Westmoreland

18. Middle Peninsula
Essex
Gloucester
King and Queen
King William
Mathews
Middlesex

19. Crater
Dinwiddie
Greensville
Prince George
Surry
Sussex
Colonial Heights City
Emporia City
Petersburg City

20. Hampton Roads
Isle of Wight
James City County
Southampton
York
Chesapeake City
Franklin City
Hampton City
Newport News City
Norfolk City
Poquoson City
Portsmouth City
Suffolk City
Virginia Beach City
Williamsburg City

21. Accomack-Norhtampton
Accomack
Northampton

Appendix Table C. Results of longitudinal analysis for 1985-1970 and 1989-1985

Independent Variables	**Dependent Variables**	
	Change in PPR 1985-1970	Change in PPR 1989-1958
PCT65	-1096 (1.176)	-
PERMILE	-753 (-1.340)	-
HPBR	325803 (2.674)	-
IN	4334 (2.082)	-
PMEDC	1066 (1.850)	-
RGOLF	-56070 (-.369)	-113564 (-.690)
CMHC	-	-911 (-1.825)
PCTB	-	153 (.869)
PCT65	-	1146 (1.123)
HW	-	945 (.921)
N	61	61
R^2 (Adjusted)	.1282	.0100
T-statistics in parentheses		

Vita

Joseph Chinedu Obidiegwu was born in Nigeria, on November 9th, 1967. He obtained primary and secondary education in Nigeria. He attended Franklin Pierce College in Rindge, New Hampshire in 1985, where he obtained his baccalaureate degree in Economics in 1989. Upon the completion of his undergraduate studies, he joined the Department of AGEC at Virginia Tech to pursue his Masters degree in Agricultural Economics. He completed his studies in December of 1992.