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Three Essays in the Economics of the Physician Firm

William David Bradford, III
Louisiana State University and Agricultural and Mechanical College

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William David Bradford, III
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Abstract

This dissertation explores three aspects of the physician firm. As such, the current work is concerned with the contribution that quality considerations can make toward our understanding of the medical market. The first of three essays introduces quality into the literature aimed at estimating the supply function of physician firms. This study finds that explicit modeling of quality, both theoretically and empirically, produces results superior to past work in this field and indicates that physicians behave as if they are competitive economic agents. The second essay considers the effect of Medicaid on the behavior of physicians, especially their allocation of quality. As a result of theoretical and empirical exploration, this essay concludes that Medicaid, due to its restrictive reimbursement mechanisms, produces a two-tiered system of health care. This system traps those covered by Medicaid in a tier which allocates not only fewer units of health care, but also provides the minimum possible quality of care. The final essay in this dissertation is an empirical test of the supplier induced demand hypothesis in medical service. Contrary to past findings which support the view that physicians are able to induce demand for their services when faced with competition, this work finds that physicians actually increase the quality of their service in the face of competitive pressure. By ignoring quality as a dimension of service, past work has suffered from specification error which only appeared to support the inducement hypothesis.

CHAPTER I

INTRODUCTION

Concern over health issues is growing in the United States, and few issues arouse more debate. One reason for this debate is the level of our knowledge about the workings of the system which provides health care. In many respects, this knowledge is rudimentary. One issue which this dissertation attempts to explore is the behavior of physician firms given the structural realities in which they must operate. Toward this end, three specific questions are explored. The exploration of these issues is undertaken with the explicit recognition of the role quality plays in the market for medical service. It is this introduction of quality choice by physicians which is the unifying theme of this dissertation.

One primary question which should be asked first is: how do physicians behave in the marketplace? Can their behavior be described using the neoclassical economics of competition, or is some other, less traditional, approach required? This discussion makes up the central thesis for Chapter II. In this chapter physicians are modeled as competitive economic agents who maximize utility. Utility maximization occurs across leisure and income,

with the latter composed of an exogenous income component and profits from the medical firm. One contribution made by Chapter II in the modeling of physician firms is the explicit recognition of quality as an important aspect of physicians' services. Past work in the area has ignored this dimension of physician service, despite the attention quality has received in other fields of economics. By introducing quality, this work demonstrates that many unsatisfying results obtained in past literature results from a mis-specification of the empirical models.

After exploration of the theoretical model, Chapter II proceeds with an empirical study of physician behavior. Development of the model implies quality as well as quantity are important variables in the physician choice set. Therefore, the supply side of this system must be expressed as two equations, rather than the more usual one. Additionally, to avoid an empirical mis-specification which has plagued much past work, both the supply and demand sides of the system are identified empirically. This leads to a three equation model of the physician firm: two supply equations and one representative demand function. This system is estimated with non-linear three stage least squares (NL3SLS). Among several results discussed in detail in Chapter II, this estimation finds that physicians do behave in a manner consistent with that of competitive economic agents.

Once behavior of physicians in the current market is better understood, it becomes possible to ask questions concerning current and potential governmental participation in the market. These

issues are discussed in the Chapters III and IV. Chapter III investigates what role the Medicaid program plays in the allocation of primary health care[1]. While most research of the past has focused on the issue of availability of care for Medicaid patients, chapter III, once again, draws attention to the important question of what effect Medicaid has on the quality of service offered. The approach is similar to that of Chapter II, a theoretical model is proposed, and implications of this model are tested empirically.

The model developed adds one additional variable to the physician choice set, namely the percentage of patients in the practice which are covered by Medicaid. Since Medicaid has not only cost implications different from other forms of insurance, but also different revenue implications, the proportion of Medicaid patients in a practice is an important decision made by utility and profit maximizing physicians. We find that the current structure of Medicaid, which prevents patients under this coverage to demand higher quality care, encourages a two tiered system of care. Specifically, Medicaid patients are afforded a lower quality of service than non-Medicaid patients, and are likely to receive the

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[1] In this dissertation, the term "primary care" refers to health care provided by a physician directly to a patient. This is in contrast to services which are provided by other institutions. For example provision of hospital rooms, or intensive care services, would not be considered primary care.

minimum possible level of care. An empirical test for whether or not Medicaid patients do receive the minimum level is developed.

Empirically, the model is supported. Once again, a simultaneous system of equations (three supply-side choice equations and one demand-side) is estimated with NL3SLS. The results support the hypothesis developed in the model that a two-tiered system of care exists under the current system. Specifically, Medicaid tends to reduce the average quality of service offered to patients. In addition, evidence is presented indicating that Medicaid patients do in fact receive the minimum possible quality of care. This result has significant policy implications.

Chapter IV addresses one potential source for future regulation, that is the hypothesis of supplier induced demand in health care. This question, which argues that physicians are able to influence their patient's demand for medical service and so face no effective demand constraint, has been debated for many years in the literature. Evidence for and against this hypothesis abounds. The current, predominantly empirical, work considers the question in light of the previous discussion of quality. Considering quality as a choice variable, it becomes clear that past efforts to test for the presence or absence of induced demand suffer from a serious mis-specification. Since changes in the general level of quality will affect patient's demand for physician's services, studies which ignore this influence may find that increasing competition leads to increased demand. This finding would not, however, be evidence for supplier induced demand due to this mis-specification. Since all

work to this point has neglected the issue of quality when empirically testing for induced demand, past findings are suspect. Chapter IV tests for induced demand using two models, both of which include quality as a choice variable. Not only do the results fail to support the induced demand hypothesis, direct evidence is presented which demonstrates that induced demand is inconsistent with utility maximization and that the inclusion of quality can produce results which lead to increases in demand with increases in competition. This latter implication follows even when the traditional test for induced demand is included (and fails).

Results obtained in Chapters II through IV are interesting in their own right, and each chapter also contains a section addressing policy implications. However, these results must be considered together before final policy implications can be drawn. Complete policy recommendations should be tempered by political realities, rather than simply presenting optimal theoretical conclusions (as is done in the summaries of Chapters II through IV). Therefore, Chapter V concludes the dissertation with a discussion of the results as they relate to each other and the implications they have for real-world policy, taking current limitations into account.

CHAPTER II

QUANTITY AND QUALITY TRADEOFFS IN THE MARKET FOR PHYSICIANS' SERVICES

I. Introduction

A significant controversy has developed in the United States in recent years over perceived crises facing the health care industry. At the root of this problem is the dramatic increase in real costs associated with providing health care in this country, leading to a call for governmental action to control the situation. This increase in costs is the subject of much debate, both at academic and governmental levels. The trend in these discussions has been toward calls for even more government intervention, via insurance subsidies and direct price controls. This chapter suggests that incomplete theoretical modeling in the past has led to mis-specification of empirical models and, therefore, results which incorrectly place the blame for the rapid increase in costs on the individual physicians. Driving many of these results is the assumption that physicians possess and utilize undue market power

through large information asymmetries and the ability to directly induce demand for their services. However, the current work suggests that these conclusions are in error. With a more complete and systematic exploration of a model of the physician firm, the empirical results suggest that physicians behave in a manner consistent with a competitive marketplace. Further results suggest that the blame for the rapid increase in health care costs can be more directly tied to increases in government subsidization of private demand, increased use of full private insurance, and artificial barriers placed on licensing and immigration of physicians.

Accordingly, this chapter explores one aspect of the medical sector, the market for physician's services. Toward this end, physicians are modeled as profit maximizing, owner-managed firms. The profit decision involves introducing a quality-quantity trade off between the number of visits provided and the time spent with each patient. It is interesting to note that the introduction of quality considerations in past literature has clarified empirical observations which seemed anomalous at the time. In particular, the current approach is compared to quality results found in the fields of fertility and union/non-union wage differentials. In addition, physicians are modeled as utility maximizers. This model allows the physician to choose three variables: visits, time per visit, and total hours of labor to supply. This results in a traditional backward-bending supply curve of labor. One of the two principal points of the current chapter is this explicit recognition that

physicians choose a combination of quality and quantity characteristics to supply rather than some service which is adequately captured by a scalar measure.

The second primary goal of this chapter is to carefully examine empirical questions surrounding estimation of the market. Studies purporting to find a negatively sloped, or backward bending physician labor supply curve have suffered from specification and estimation problems. Therefore, one contribution of this work in providing a more complete theoretical model of supply behavior is the implication this model has for empirical specification. The results indicate that to correct potential specification errors of earlier empirical work, one should estimate a system of at least three equations. An empirical test of the correctly specified model is also provided.

II. Empirical Literature

The market for physician's services has been examined in some detail in the literature, with varying results. Most models are broken down into two basic groups: traditional neoclassical supply and demand models, and supplier induced demand/target income hypotheses. Actual specification of the functional forms have been much less consistent. One area of consistency among the studies is the predominance of approaches utilizing single equations, and multiple equations without correct theoretical identification. Most studies have taken an approach which fails either to attempt a

simultaneous estimation, or if attempted, no effort is made to identify separate supply and demand influences. Still, many of the studies have constructive insights into questions surrounding this issue, insights which are revealed in discussions of the hypotheses, specifications, empirical techniques, and results of this past work.

The earliest work to formally examine the physician supply curve and suggest that this supply response might not behave according to traditional economic intuition was performed by Martin Feldstein (1970). Feldstein argued that the traditional approach is not useful in examining physicians' supply responses. Feldstein assumed the market is characterized by price taking patients and utility maximizing physicians. The utility maximization process implies physicians undertake a labor leisure trade off. He also acknowledged the simultaneity inherent in the system, but due to data problems was unable to compensate for it empirically. He asserted that the simultaneity arises due to influences on the physician (i.e. supply side) of the market; physicians must operate under ethical constraints and they may be unable to refuse to provide their services in certain circumstances (such as when there is only one physician in a community). Additionally, dependant upon the individual's training, certain cases may seem more interesting than others, once more distorting a pure price/quantity relationship.

One important theoretical insight Feldstein made relates to the effect of insurance. Noting the increasing availability and use of insurance, he quite correctly pointed out the significance of this

influence in the market. However, he argued that it is not the mere existence of insurance which encapsulates this effect (and so simply counting the number of insured customers is not a sufficient test). In other words, in this market, there is not one price which impacts the supply and demand side equally. On the supply side, the relevant price is the fee charged by the physician; however, on the demand side, the relevant price is the physician fee net insurance contributions (and premiums, potentially). Insurance's effect is captured by its distortion of the net price paid by the average consumer in his model. So, the relevant supply price is P, and the relevant demand price is kP, where k is some factor of proportionality.

Feldstein estimated his models with OLS, due to very low degrees of freedom. His first attempt was to estimate an equilibrium demand equation. This effort was, however, unsuccessful, since the estimated price elasticities are positive. He argued this is because the demand equation is not identified. Feldstein believed this lack of identification is due to the excess demand which characterizes the market and that "[d]octors choose to provide less than patients want at prevailing net prices." He then proceeded to estimate a disequilibrium model consisting of a wage and supply equation. His formulation imbeds the demand equation within the wage equation, in a reduced form, with the demand parameters recoverable from the estimated wage parameters. Once again OLS was applied to the equations separately. He attempted to capture the insurance effect by introducing an impact ratio as an explanatory

variable on the price adjustment equation[1]. His results on the price equation are, on the whole, significant. Interestingly, insurance appears to have a positive influence on physicians' fees. Government provision of physician services also has a positive effect on the dependant price variable. The supply equation specified performs less well. The parameter estimates are not so often significant. Feldstein did find an elasticity of supply with respect to price which is negative. (This is price entered linearly. Feldstein did not include a squared fee term.) He argued this is evidence of a backward bending supply of physician labor function. As such, he was the first to make this empirical assertion. However, none of his estimated parameters on price are significantly different from zero. His results, though cautiously applied, lead to important policy considerations. If the demand for services is more elastic than supply (a situation which is implied by the assertion that excess demand persists in the market due to physicians price restraint), policies aimed at decreasing the price of physician services will increase the quantity supplied, but also lead to a greater excess demand problem. If supply is more elastic

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[1] The insurance impact variable is the ratio of average to net prices of physicians' services. Also net price is calculated by the method: $NP = \frac{EXP-BEN}{EXP} * AP$, where NP is net price, AP is average fee for the services, EXP is personal expenditure on physician services, and BEN is insurance benefits on the expenditures.

than demand, policies which decrease price will increase services provided, while also ameliorating the excess demand problem. Therefore the relative elasticities of the demand and supply curves is a very important empirical question, one which Feldstein and later researchers, have not addressed.

The next major piece presented on the physician supply function was authored by Frank Sloan (1975). In this instance Sloan utilized cross sectional data (unlike Feldstein) for the years 1959 and 1969 to explore individual physicians' decisions on hours per week and weeks per year of work. Sloan motivated his study with the important policy question of whether to pursue price restrictions or revenue enhancements through Medicare and Medicaid, which would have different effects. In particular, Sloan was concerned with the slope of the supply curve with respect to price. Conceptually, Sloan made a significant contribution in the distinction he drew between the behavioral responses, and wage function differentials, of physician employees and self-employed physicians due to the entrepreneurial component of non-employee physician income. In addition, Sloan argued that solo physician's wages per hour decrease with hours worked since: a) being their own major input, increases in hours worked would tend to lead to decreases in marginal product, and b) increases in hours worked would lead directly to lower fees due to the demand constraint (ignoring the potential, sometimes argued fact, of excess demand).

Sloan, though employing a two equation model estimated by instrumental variables, did not fully identify the market system.

Specifying a wage equation and supply equation, he made no attempt to identify the demand side of the market except on the most superficial level, including variables which contribute to broad differences in regional demand, though no representation was made that the demand side is adequately addressed. His two equations were specified using fairly traditional exogenous variables, with weeks per year and hours per week of physician service as the dependant variable. Sloan found mostly significant parameter estimates in his wage equation, with parameters having the expected signs. He then included the predicted wage and wages squared in his supply equation for an instrumental variables estimation. The estimates on the supply functions (for both weeks and hours worked) are not significantly different from zero for the majority of parameters. In the weeks worked equation the (insignificant) parameter estimate on wages is positive, while the estimated parameter on wages squared is negative (1960 only) . The supply equation defined in hours worked has positive values for the parameters on wages squared, and negative on wages entered linearly. Sloan concluded that the evidence for a backward bending supply curve of physician labor is weak. An earlier piece by Sloan (1973) is nearly identical in content, and arrives at the same conclusions.

Later writers have largely built upon the foundations of the Sloan and Feldstein works. Stephen Vahovich (1977) relied heavily upon Sloan for the theoretical underpinnings of his research. His interests lay in a strictly empirical examination of the physician supply curve. In particular, he wished to investigate the backward

bending nature of the function. Like Sloan he assumed utility maximizing physicians, which leads to a labor/leisure trade off, and he followed Sloan's arguments for the physician wage response to hours worked. Additionally, Vahovich assumed, as do many later researchers, that physicians are price takers. Therefore, even though Vahovich utilized a multiple equation approach, and a Two Stage Least Squares estimation procedure, he did not truly identify the market system. In this he was not different from previous, or later, authors. His discussions of problems with endogenous variables, and motivations for 2SLS, surround the issue of the wage impact on hours worked, and hours impact on real wage.

Vahovich posited three structural equations: an equation for supply of service, an equation for wage determination, and an equation for wages squared, which he erroneously treated as a separate endogenous equation[2]. His major stated goal was to find the

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[2] There is no intuitive or theoretical foundation for treating wages squared as a separate endogenous variable and placing it in its own structural equation. (Vahovich claimed this was done because some of the variables are going to have a greater impact on physicians with higher incomes. This argument is somewhat unclear.) The influences on wages should be explained in the structural equation with wages entered linearly. However, even though there is no reason to supply an additional structural equation, the rules for identification do change when variables enter nonlinearly to a system of simultaneous equations (see. Judge, et al. <u>The Theory and Practice of</u>

wage rate at which the supply of physicians' services bends backward. As such, the specification of the wages and wages squared equations is of little interest; the modeling is consistent with that of Sloan, with no attempt being made to account for demand side influences. In addition, there is no attempt to address the number of hours at which the supply curve of labor bends back, which is the more important question. In the supply equation, Vahovich paid closer attention to modeling at the micro level, including such variables as the number of physicians in the surveyed practice and the percent of income derived from salary. Though the results are not strong, Vahovich did find support for a backward bending supply curve. The predicted wages squared term shows up negative in three of the four specialty groups identified. Given these results, Vahovich maintained that between 21 and 31 percent of physicians earn wages in excess of the critical backward bending level.

Brown and Lapan (1979) joined the discussion with a single equation approach to estimating a supply curve for physician service output. Again, their interests lay primarily in exploring the slope of the supply function, and so they ignored the demand side. As the literature before them, they argued that the physician is a price taker in the market for medical services. They posited a model of physician utility maximizing behavior where the physician has a demand for consumption goods and inputs, and a supply of services,

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Econometrics, pp.582-83.).

both of which are jointly maximized. After this discussion, however, they neglected to apply any simultaneous approaches to estimation. Brown and Lapan used OLS to estimate a simple supply model on aggregate data for 1948-1966. One curious aspect to this model is their dependant variable, which is defined as the aggregate expenditures for physicians' services divided by the CPI for physicians' services, that is, the dependant variable is a dollar amount. Regressing this against the price of physician service introduces clear biases. The actual estimation results are somewhat unclear. A positive relationship between the price level (a proxy for the price of physician consumption) was found which, according to the model developed, implies a negative slope to the labor supply curve of the physician due to an implied large substitution effect by which physicians substitute other inputs for their services. An estimated positive coefficient on their measure of the average fee implies a positive slope to the supply of physician services. So, they found that "the physicians' supply curve of labor is backward bending, but the supply curve of physicians' services is positively sloped."[3] Their study is not applicable for determining the wage

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[3] LaCroix and Getzen (1983) corrected two mistakes by Brown and Lapan. The original authors made an arithmetical mistake which affected their policy conclusions, and also failed to adjust for autocorrelation when the Durban-Watson test they employed implied autocorrelation was a problem. Additionally, LaCroix and Getzen utilized Box-Cox methods to correct for functional for

rate, or number of hours, at which the supply curve of labor bends back[4].

Two studies to date have done a responsible job of attempting to introduce true simultaneity issues into the estimation of supply and demand estimation in the medical market. Unfortunately, both suffer from significant shortcomings. Cromwell and Mitchell (1986) specified a five equation system to identify supply and demand influences. Their primary interests were the demand curve for surgeries, some explanation of the dramatic increase in surgery

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mis-specification. Their results support the backward bending labor supply curve of physicians, but find the physicians' service supply function is vertical. The vertical service supply function is reasonable, they argue, given governmental and professional restrictions on who can practice medicine.

[4] A later work by Brown and Snow (1990) also attempted to estimate a supply function for physicians' utilizing a single equation technique. Although instrumental variables were used in this paper, only one equation is identified, and the demand side of the market is once more ignored. In this later study, which was motivated by explorations into entrepreneurial responses to risk, a negative relationship between office visits supplied and the physician fee is found, once again implying a backward bending supply curve for physicians.

rates over the past few decades, and the geographic heterogeneity in the surgery market. In particular, they wished to find if the Supply Induced Demand hypothesis is useful in explaining these situations. To accomplish this, they reported using a 2SLS method to estimate the five structural equations. However, only the price equation and three specifications of the demand equation are reported, making interpretation of their simultaneous results impossible. Cromwell and Mitchell specified the demand equations very carefully, adjusting for influences ranging from the level of education in the population, the age distribution of the population, length of stay in hospitals (since they are examining surgery), and insurance contributions. About half of the estimated parameters are significant in the demand equations specified, and F-statistics also imply significance[5]. The supply function was not addressed, so the important comparison of elasticities advocated by Feldstein is not possible.

Hu and Yang (1988) have taken the most pains to estimate a true simultaneous system of equations to describe the market for

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[5] Cromwell and Mitchell also attempted some disequilibrium analysis by breaking the sample into high and low surgery utilization areas. They estimated, via OLS, the demand equations to see whether differences surface. They did claim to find different parameter results, implying a disequilibrium approach is useful, but no statistical tests back up these claims.

physician services. They posited a supply and demand equation, using time series data, to estimate these functions. However, their efforts were aimed at demonstrating the necessity of this technique (as well as the needed use of disequilibrium approaches) rather than estimating robust and reasonable functions. As a result, their estimated equations are very simplistic. Still, they have made the best attempt to use techniques which are appropriate and fully identify the system involved. Their results, as limited as the interpretations are, find a positive relationship between the average price of an office visit and the number of office visits supplied. Interestingly, they also found a negative relationship between the number of visits supplied and a time trend, despite the often cited empirical result that the number of physicians has increased since the Second World War. Though they made no significant effort to explain this result, they did mention in a footnote that it might imply some quantity/quality trade off. Again, their results imply that disequilibrium approaches, when time series data is available, may be most appropriate.

The empirical literature offers several important insights into proper exploration of the supply of, and demand for, physicians' services. First, it is plainly evidenced that the empirical approaches taken to date have significant problems. The vast majority fail due to an inability to address the very important issue of simultaneity in this system. When estimating supply and demand functions it is crucial to do so in a manner which truly identifies, and so controls for, the separate effects. This can

only be accomplished by using a simultaneous approach to the problem, be it Instrumental Variables (correctly implemented), Two Stage Least Squares, or some system wide technique such as Three Stage Least Squares. That will be one of the contributions of this work to the literature: careful specification of a system of equations, and then estimation with the appropriate empirical technique.

Beyond the empirical lessons to be learned from past work, several modeling influences can be adopted. First, following the trend in the literature of modeling physicians as utility maximizers is certainly a fruitful approach. Secondly Feldstein made two important modeling contributions. He pointed out that insurance is an important effect, but one which may not be captured by simply accounting for its presence. Rather, he argued that the effect of insurance on price is the relevant issue, a point which leads to different prices for the supply and demand sides of the market. Additionally, Feldstein pointed out that from a policy perspective, the mere existence of a backward bending supply curve of labor is not the important question, but rather the relative elasticities of supply and demand with respect to price. Once again this leads to a simultaneous approach. Additionally, Brown and Lapan pointed out that it may be possible for physicians to substitute other inputs for their own labor, making it important, when exploring supply responses, to distinguish physician inputs from the supply of medical services.

Despite these contributions, other concepts not previously

brought out in the empirical literature need to be explored. Primary among these is the issue of identifying quality/quantity substitutions in the physician supply responses. Equally important is the recognition that the presence of a negative sign on wages squared is not particularly significant. Given that there is an unavoidable time constraint in daily and weekly work decisions, it would be a strange labor supply curve indeed which approached this limit linearly. Rather, the question should be at how many hours per week, or weeks per year, does the curve bend back. These issues, and more, are addressed in the development of the model in the next section.

III. MODELING PHYSICIAN SUPPLY RESPONSES:

This section presents a theoretical model of physician behavior, as a prologue to empirical exploration of the market. The model assumes physicians are utility maximizers and that utility is maximized across income and leisure. Physician income is derived from two sources: exogenous income, and profit from the practice of medicine. Therefore, decisions are made on two levels: utility is maximized simultaneously with profit maximization. In addition, physicians are not assumed to supply a simple quantity of service which can be adequately captured on the supply side by some scalar quantity. Rather, following the discussion by Rosen (1974) and Schmalensee (1979), physicians are assumed to offer a pair of characteristics, implicitly picking a point along a profit surface

which corresponds to some number of visits and the quality of those visits provided.

The introduction of quality considerations into decision processes had led to significant advances in other fields. For example, an often observed empirical relation in fertility studies is the inverse relationship between family size and family income, apparently indicating that children are an inferior good. For many years the observation remained unexplained. However, beginning in the early 1970s, and building on work by Becker [1960], researchers such as De Tray [1973], Becker and Lewis [1973], Becker and Tomes [1976], and Tomes [1981] began introducing quality considerations in the production decision of parents. When models allowing quality as well as quantity were explored empirically, the income elasticity with respect to children appeared positive. The apparent inferiority conclusion was based upon mis-specified models. A second area in which quality considerations cleared unexplained empirical results is the discussion surrounding union/non-union wage differentials. Labor economists had been unable to explain why this differential in pay scales would persist over the very long run, as it observationally does. Again, the introduction of quality considerations by Throop [1968] and Johnson [1970], among others, and the further extension of endogenizing quality by Ashenfelter and Johnson [1972] led to satisfying empirical results. With quality as an argument in the unionization process, the empirics indicate that it is the quality screening ability of unions which lead to higher wages, and not merely the unionization itself. This conclusion

anticipated a pay differential with non-union labor which would be expected to persist through time.

Research discussed above has been consistent in its theoretical treatment of quality as some single, observable variable which either represents quality directly, or serves as a good proxy. The fertility studies typically represent quality as expenditures per child (either general contributions to the child, as in Becker and Tomes [1976], or as specific investments in schooling). In fact, Tomes [1981], by simultaneously estimating the two components of the demand for children, quality and numbers, as separate endogenous variables with a structural equation for each, introduces quality in a manner very similar to the approach taken in this dissertation. In the union pay differential literature, quality is represented generally as educational level (Throop [1968] uses a calculated skill index).

In this chapter, quality choice is represented as the average time spent per patient. Physicians can offer many visits at a low time per visit (and so low quality), or offer fewer visits at a higher quality per visit. Physicians are able to use both quality and quantity as maximizing variables, implying, of course, that both are endogenous and require separate theoretical and empirical treatment. Since the market might perceive that a physician who sees many patients per week, but spends very little time with each patient is providing a lower quality product than a physician who sees fewer patients, but for more extended periods. This implies that manipulation of the visit/time-per-visit mix is a legitimate

means of profit maximization. Therefore, physicians simultaneously choose the number of patient visits, the time spent per visit, and the total number of hours worked per week.

The theoretical model involves a simultaneous process which is illustrated in Figure 1. First it is assumed that the physician chooses a utility maximizing number of hours of labor to supply, $\bar{H}$. Within this context, the physician picks a commodity bundle (a combination of visits and time per visit) which maximizes profits. There is also a profit surface defined across v and h. This surface projects isoprofit curves onto the v-h plane, such as $\bar{\pi}_0$ and $\bar{\pi}_1$. Given that the identity $v \cdot h = H$, $\bar{H}$ is the constraint across which the physician must find the maximum possible profit level. This point occurs at the tangency of the highest possible isoprofit curve achievable within the bundle set defined by $\bar{H}$. The decisions concerning v, h, and H, are made together, maximizing both profits and utility.

To explore the process mathematically, a simultaneous process will be employed. Explanation of the two decision processes will be separate for expository purposes only. The profit and utility maximization decisions are combined for the actual exploration of the system. Therefore the profit maximizing side of the process begins with the assumption that the number of total hours per week is chosen as $\bar{H}$, and the physician must allocate visits and time per visit within this framework. The physician must maximize profits

$$\pi = P \cdot v \cdot h - C(v,h)$$

subject to the constraint

$$\bar{H} = v \cdot h,$$

where C(v,h) represents the costs associated with providing the physician service. The first term together is total revenue. The physician is modeled as a price taker, who provides units of service. This service is a composite bundle of quantity, the number of visits provided, and quality, the time spent on the average visit. The market price, P, will be different for each possible combination of quality and quantity. Intuitively, v and h will have different marginal impacts on the firm's profitability, however even though the physician has knowledge of the existence of these different effects, the only observable market price is P. Still, value is added to the firm based upon how many units of the bundle are provided, v, and value is added to the firm based upon the market perception of the average quality of the bundles provided, measured as h (average time per visit).

Given the number of hours worked per week, H, physicians can therefore control two variables for profit maximization. They set the number of patient visits per week, v, and the average time per visit, h, to spend with each patient. Both of these control variables are valued by the patient and so both will affect compensation. As state above, this is a departure from the traditional approach in the existing literature on physician behavior. In the past, physicians were assumed to supply only "labor," or H in this model. Again, this ignores the quality

component and potential for an optimal mix between v and h since physicians have discretion over how they divide labor time among patients. It would be simplistic to assume that physicians do not choose both the number of patients to see and the time per visit given that patient visits and time per visit give rise to different marginal revenues.

The practice reflected in the profit structure is seen in the triage activities undertaken by clerical workers at the physician reception desk. These workers must fill out the physician schedule based upon a set of broad guidelines specified by the physician. Patients with severe symptoms are typically seen quickly, while those patients exhibiting relatively minor complaints, or conditions which do not require immediate attention are typically scheduled for appointments at some point which is more convenient to physician scheduling. Physicians will also often use interview mechanisms to determine if new patients are to be accepted into the practice. This is particularly true for specialties which often involve long-term relationships, such as pediatrics or obstetrics. Physicians are very careful to regulate the number of patients they service in order to prevent scheduling problems. With these tools the physician is able to establish the number of visits, and simultaneously the time spent per visit, according to his or her predetermined objective function. This is possible since the market will perceive the different combinations as differentiated products. Within certain bounds a greater average time spent per visit by the physician will signal higher quality. The market will value this

increased quality by some amount, implying that the physician should consider this characteristic when defining the bundle to be offered.

Accordingly, the provision of visits and time per visit is argued to have different effects on the cost structure of the physician firm. There are certain costs which are incurred simply by processing a patient through the doctor's office. There is a paperwork load to be borne by the clerical staff, admitting the patient, checking past history, billing and collecting payment, administering insurance payments, and so forth. Non-physician medical staff must often collect information on current complaints, blood pressure, and temperature. There is also a cost of materials, gloves and other sterile tools, which will exist simply because the patient is seen.

There are also real resource uses associated with extending the patient visit. One must assume that doctors would not extend patient time in the office spuriously, since the revenue obtained from additional patient visits is the opportunity cost of spending additional time per patient. The physician must decide which additional tests and therapy should be administered, review the results, and transmit the information to the patient. Resources associated with the two characteristics often overlap and have different effects. Clerical staff may increase the physician's ability to see many patients, yet have little effect upon the costs associated with increasing the length of the visit. On the other hand, nurses may both increase the number of patients the physician can see in a given week, and, by providing a close substitute for

some physician time, decrease the average time the physician must spend with each of those visits. For such reasons the cost structure of the physician firm will not be generally separable.

In light of the discussion above, one half of the physician's decision process involves maximization of the objective function

$$(1) \qquad \bar{\pi} = P \cdot v \cdot h - C(v,h) + \lambda(H - vh);$$

with respect to v and h. The maximization process results in the traditional first order conditions:

$$(2) \qquad \bar{\pi}_v = Ph - C_v - \lambda h = 0,$$

$$(3) \qquad \bar{\pi}_h = Pv - C_h - \lambda v = 0$$

$$(4) \qquad \bar{\pi}_\lambda = H - vh = 0.$$

One implication is immediately apparent. Since there is a constraint that $v \cdot h \leq H$, the Kuhn-Tucker solutions will require $\lambda \cdot (H - v \cdot h) = 0$. If this constraint is to be binding, then $\lambda \neq 0$ so the F.O.C. in (4) results. In addition, since $\lambda \neq 0$, and corner solutions of v, h = 0 are not allowed due to the nature of the binding $\bar{H}$ constraint, it follows that $Ph - C_v = \lambda h \lesseqgtr 0$ and $Pv - C_h = \lambda v \lesseqgtr 0$[6].

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[6] Note that since total revenue (TR) is $P \cdot v \cdot h$, then:

$$\frac{\partial TR}{\partial v} = P \cdot h = MR_v .$$

This means the physician will supply visits and hours per visit at a point where their respective marginal revenues are not equal to the respective market marginal costs. It will become apparent that this is due to the fact that there is a trade off taking place with leisure which distorts what would otherwise be a purely profit maximizing decision. A second implication which falls directly out of the F.O.C. is that ϵ_{cv} must equal ϵ_{ch}, or that the elasticity of costs with respect to visits must equal the elasticity of costs with respect to time per visit at the profit maximizing solution.

Exploration of the second order conditions reveal that they are well behaved for a constrained profit maximizing Lagrange. The determinant of the Hessian is:

$$(5) \qquad |\bar{H}| = h^2 C_{hh} - 2vh\alpha + v^2 C_{vv} > 0,$$

where $\alpha = P - C_{vh} - \lambda$.

The profit maximizing decision is not taken in isolation. It is made within the broader context of utility maximization. In the other half of the process, the physician chooses the utility maximizing quantities of leisure and income. Once again, the physician must choose how many hours per week of "labor" to supply, given a time constraint and an income level which depends on external (to the practice) income and the profit level which must be simultaneously maximized. That is:

(6) $$\max_{H} \bar{U} = U(I_o + \bar{\pi}, T - H),$$

where I_o is external income, T is the time constraint, π is the profit decision discussed above [Equation (1)], and leisure is equal to T-H. This objective function is maximized with respect to total hours worked. The first order condition for utility maximization is:

(7) $$\bar{U}_H = U_I\lambda - U_L = 0.$$

The first order condition (7) provides not only an interpretation for λ, but also a sign on the marginal revenue and marginal cost comparison discussed in the profit maximization process above. It is easy to see that (7) reduces to:

(8) $$\lambda = \frac{U_L}{U_I} > 0.$$

In other words, the Lagrange multiplier from the profit maximizing decision represents the shadow price, or opportunity cost, of leisure since the implicit opportunity cost of income is 1. This interpretation will provide a foundation for interpreting later comparative statics. In addition, the result that $\lambda > 0$, will imply, according to (2) and (3), that $Ph - C_v > 0$ and $Pv - C_h > 0$. That is, physicians will supply visits and time per visit at points different from the usual marginal revenue-marginal cost comparison of competitive models. There is a clear reason for this. The physician engages in two types of activities, firm-based profit

maximization (which from the perspective of the market for medical services should be influenced only by those factors which affect the cost of providing medical services) and personal utility maximization. Since the "firm" in this case is also an individual, there will be an additional cost flowing from the physician's leisure activities which "corrupts" this market decision. This is the cost to the physician (and so the market) of sacrificing an additional unit of leisure time. This is measured in the visits dimension as $v\lambda$, and in the time per visit dimension as $h\lambda$.

The second order condition for utility maximization is:

$$\text{(9)} \qquad \bar{U}_{HH} = U_{II}\lambda^2 - 2U_{IL}\lambda + U_{LL} < 0.$$

Now that the decision processes have been modeled, equations (2), (3), (4), and (7) define the system which must be solved simultaneously to describe the entire physician choice process. The determinant of the system is:

$$\text{(10)} \qquad |J| = \begin{vmatrix} -C_{vv} & \alpha & 0 & -h \\ \alpha & -C_{hh} & 0 & -v \\ -h & -v & 1 & 0 \\ 0 & 0 & \bar{U}_{HH} & U_I \end{vmatrix}$$

$$= U_I[C_{vv}C_{hh} - \alpha^2] - \bar{U}_{HH}|\bar{H}| > 0,$$

where $|\bar{H}| > 0$ from equation (5) and $\bar{U}_{HH} < 0$ from equation (9). A

sufficient condition for $|J| > 0$ is $C_{vv}C_{hh}-\lambda^2 > 0$. For notational simplicity, let $J \equiv |J|$. Once J has been determined to be non-singular, the Implicit Function Theorem will imply that unique optimal values of v, h, H, and λ will exist. Given this, comparative statics can be performed.

Several questions are of interest, questions which can be addressed by implementing comparative statics. Primary among them is what are the effects on v and h which result from changes in their own-price? Before exploring the results which are of immediate interest, comparative statics on exogenous income should be performed. This will facilitate later discussions. Totally differentiating the system of equations by I_o and solving by implementation of Cramer's Rule provides a description of the exogenous income effects:

(11) $$\frac{\partial v}{\partial I_o} = (J^{-1})(\bar{U}_{HI})(v\alpha + hC_{hh}) \lesseqgtr 0,$$

(12) $$\frac{\partial h}{\partial I_o} = (J^{-1})(\bar{U}_{HI})(h\alpha + vC_{vv}) \lesseqgtr 0,$$

and,

(13) $$\frac{\partial H}{\partial I_o} = (J^{-1})|\bar{H}|\ \bar{U}_{HI} = v\cdot\frac{\partial h}{\partial I_o} + h\cdot\frac{\partial v}{\partial I_o} \lesseqgtr 0.$$

Note that $\bar{U}_{HI} = \partial\bar{U}_H/\partial I_o$, or the change in the F.O.C. of utility maximization strictly due to exogenous income. The sign of (13) is asserted negative based upon the assumption that leisure is a normal good. Since there are only two possible uses for time, labor and leisure, their status as substitutes will therefore force labor into

the role of an inferior good by this assumption. As exogenous income rises it follows that the hours of labor supplied, *ceteris paribus*, diminishes.

Given descriptions of the exogenous income effects, the price statics can be more easily interpreted. If the system is totally differentiated by P the application of Cramer's Rule will produce own-price comparative statics. By inserting the income effects embodied in (11) and (12) directly, it is easy to see that:

$$(14) \qquad \frac{\partial v}{\partial P} = H\frac{\partial v}{\partial I_o} + (J^{-1})(U_I)(v\alpha + hC_{hh}) \lesseqgtr 0,$$

and

$$(15) \qquad \frac{\partial h}{\partial P} = H\frac{\partial h}{\partial I_o} + (J^{-1})(U_I)(h\alpha + vC_{vv}) \lesseqgtr 0.$$

The two terms are very similar, both consisting of income and substitution effects. However, unlike traditional substitution effects, the signs of the substitution effects in (14) and (15) are indeterminate. One might expect that as compensation for visits increases, the pure substitution effect would contribute to increases in the numbers of visits provided. In this case, P does not reflect only compensation for visits, but also the quality of those visits. Therefore, a change in P may lead to substitution to or away from visits, depending upon the effects on the v-h mix.

Another question which is crucial to the model at hand is the supply response of hours per week worked to the price received for total service. The comparative statics of hours worked are:

$$(16) \qquad \frac{\partial H}{\partial P} = H\left(h\frac{\partial v}{\partial I_o} + v\frac{\partial h}{\partial I_o} \right) + (J^{-1})(U_I)|\bar{H}| \lesseqgtr 0.$$

In this case, the terms decompose completely into income effects and an unambiguously positive substitution effect[7].

The model posited provides several important insights which can be applied to an empirical study of the physician market. First, and perhaps most importantly, is the realization that physician services should not be modeled simply as hours of work per week provided. The services are more complex, and involve a quantity (number of visits) and quality (average time per visit) trade off. This indicates possible shortcomings in the past literature. First, in assuming no demand side influences existing single equation market models yield supply curves which are negatively sloped throughout, contrary to simple labor/leisure models. The current work indicates that two equations are needed to describe physician supply of service, and at least one equation is needed to identify market demand. This implies that estimates available in past literature are driven by a specification error.

Finally, the model allows for ambiguous price effects,

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[7] It is interesting to note that if the price effects on v and h are asserted to be completely separable, then the separate price effects on total hours of service, H, decomposes completely into income effects, with no apparent substitution component.

particularly in a market system where visits and time per visit are so closely related, and so "backward bending" supply of hours per week, visits per week, and time per visit, are certainly possible. As pointed out in the last section the more interesting questions to answer concern the number of hours at which the bend may occur, and the relative elasticities of the supply and demand functions at equilibrium

IV. EMPIRICAL APPROACH AND RESULTS:

Given the theoretical considerations discussed in the last section, it remains to specify an empirical realization of the theoretical model. Several distinctions can be made at this point between the current, and past work. Not only has it been shown that a single equation approach to estimating these systems can lead to erroneous conclusions, but also a two equation system of simple demand and supply ignores important effects. The main goal of this empirical discussion is to lay out, and report results from, appropriate methods of describing the effects of supply and demand side factors on the physician's labor/leisure and quality/quantity tradeoffs. Toward that end, the section which follows will discuss the empirical model: a three equation model isolating the visits and time per visit aspects of the model developed in Section III. Included is a description of some of the more interesting variables in the model. Following the specification, a discussion of the data will point out many of the strengths of the current data set. The

section concludes with a presentation, and interpretation, of the empirical results.

IV.a, *The specification:*

In the past, most estimation techniques have relied upon single equation approaches, or multiple equation approaches which only identify one side of the market. For instance, estimates such as those appearing in Brown and Snow (1990) identify supply side effects. However, only addressing one side of the market leads to an estimated equation such as represented in Figure 2. By introducing variables which shift only the supply curve, the equilibrium points used for estimating the parameters of their model either estimate demand side price parameters or impact multipliers which do not convey the information they seek. Therefore, it is going to be crucial, not only to include the relevant variables, but also to use the appropriate specification, and estimation.

Toward this end, this paper explores empirically a specification which identifies the demand and supply sides of the market. Additionally a simultaneous estimation technique is employed. The model posited in Section III indicates that the supply curve of services is multiplicative in nature. This implies, empirically, at least two equations will be needed to capture the effects of price changes in the service flow and the quality of that flow from physician firms. Coupled with the two supply equations will be an inverse demand function. This demand function reflects the demand for an individual physician's services, not the total

market demand, or even an individual patient's demand. This demand represents the individual physician's relevant share of the total market demand.

The model is:

$$(17)\ \ln H = \alpha_1 + \alpha_2 P + \alpha_3 P^2 + \alpha_4 EX + \alpha_5 WNP + \alpha_6 URB + \alpha_7 BRD + \alpha_8 CLR + \alpha_9 LAB + \alpha_{10} XRAY + \alpha_{11} IMM + \alpha_{12} PCP + \alpha_{13} PHV + \alpha_{14} POS + \alpha_{15} MTR + \alpha_{16} MALPP + \alpha_{17} AUTO + \alpha_{18} NUR + \sum_{i=19}^{32} \alpha_i SP_{i-18} + e_1,$$

$$(18)\ \ln h = \beta_1 + \beta_2 P + \beta_3 P^2 + \beta_4 EX + \beta_5 WNP + \beta_6 LAB + \beta_7 XRAY + \beta_8 IMM + \beta_9 PCP + \beta_{10} PHV + \beta_{11} MTR + \beta_{12} MALPP + \alpha_{13} AUTO + \beta_{14} NUR + \sum_{i=15}^{29} \beta_i SP_{i-14} + e_2,$$

$$(19)\ \ln P = \gamma_1 + \gamma_2 H + \gamma_3 MIN + \gamma_4 AGE + \gamma_5 WNP + \gamma_6 URB + \gamma_7 BRD + \gamma_8 PUBI + \gamma_9 PRII + \gamma_{10} NAM + \gamma_{11} FRD + \gamma_{12} NE + \gamma_{13} NC + \gamma_{14} SO + \sum_{i=15}^{31} \alpha_i SP_{i-14} + e_3.$$

There are several categories into which these variables fall. First, of course, are the endogenous variables: P = wage rate per hour of labor supplied in a week, H= total hours of service provided in a week, and h= time per visit provided (in fractions of hours). The model developed in section II involved H, h, and v. However, since the identity $H = v \cdot h$ must hold, empirically one can model the supply side as functions of H and h while retaining all the

information on the trade off between quality and quantity.

The exogenous supply variables are broken into two categories, physician activity related and socio-economic variables. The variables which are more specific to the individual practice are: POS= price per square foot of office space, EX= years of experience of the physician, BRD= 1 if physician is board certified, S_i= dummy variables for specialties (Table 1 lists each), MALPP= amount of malpractice insurance premiums paid by the physician expressed as a percent of gross revenues, LAB= percent of office visits for which laboratory or testing procedures were performed, XRAY= percent of office visits for which x-rays were performed, IMM= percent of office visits during which immunizations or injections were performed, PCP= percent of the physician's total hours spent in patient contact, PHV= percent of visits which were in a hospital, CLR and NUR= number of clerical and Registered Nurse employees, respectively. These supply side variables are chosen due to their expected effects on the costs of providing physician services. Supply variables which reflect more locational differences are: MTR= marginal state tax rate, URB= 1 if the physician is practicing in an urban area, and WNP= wages for non-physician employees.

These variables are chosen due to their expected effects on physician cost and the effects on the nature of the service. POS, MALPP, AUTO, CLR, and NUR all fall into this category. These variables all represent a cost to the physician for providing service, and as such are expected to have a major influence on the decision process. Several of the variables mentioned above affect

the nature of the service being offered. PHV, for instance falls into this category since visits provided at a hospital are intrinsically different from those provided in the doctor's office. Therefore the time requirements are expected to be affected. LAB, and XRAY also affect the structure of a visit since additional interpretive time may be required, or even additional visits. Since most visits which involve immunizations are scheduled as such and require much less of the doctor's time, IMM is included. Lastly, MTR, URB, PCP, BRD, and the specialty dummies are all included since they identify individual physician characteristics which should affect the decision process.

Due to the identity of H=v·h, it must be true that the variables which are included in the equation describing h are a sub-set of the total number of variables in the equation describing H. Anything which appears in H, but not h, is exclusively an effect on visits (cost of office space and numbers of clerical workers, for instance). The sub-set of variables on time per visit is chosen due to their expected effects on h. Rationals are the same as given above.

Variables used to identify the demand side of the market include: MIN= percent of patients who are minorities (African American and both white and non-white Hispanic American), AGE= age of the physician, WNP= wages for non-physician employees (used as a proxy for income), PUBI= percent of patients enrolled in Medicaid or Medicare, PRII= the percent of patients enrolled in a major private

insurer or Blue Shield[8], NAM= 1 if physician does not accept Medicaid, FRD=1 if physician ever reduces fees for poor patients, and NE, NC, SO= 1 if the physician is located in the Northeast, North central, or Southern region of the country (Western is the excluded category). Several variables used in the supply side of the model also appear in the demand side (URB, BRD, WNP) due to their expected demand side effects. These variables all have rather traditional economic interpretation in terms of their effects on patient demand. It is important to note that this demand curve is

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[8] The terms for the different insurance categories are entered as if they were completely exogenous. This is not likely to be accurate. Physicians, having the ability to screen patients prior to treatment, and possessing information concerning the insurance carrier employed by the different patients, are able to choose some mix of insurance which maximizes profits. In this sense, the percent of patients in a practice under Blue Cross, Private Insurance, Medicaid, and Medicare are endogenous choice variables. One interesting question which arises at this point is why physicians would not drive the Medicaid percent of their patients to a corner solution (due to the prohibition on collecting portions of the fee not paid by the government from the patients). Answers to this question, and the issue of the endogenous nature of PUBI and PRII are beyond the scope of this chapter. These issues are, in fact, the subject of Chapter III.

not the market demand curve; rather this specifies demand faced by the individual physician firm. Variables are chosen for the demand equation which help identify separate social and economic influences on the decision processes of the patient.

Several variables need more explicit description. The price variable in particular is distinct from those used in past literature. As was noted above, the role insurance plays in the medical provision and demand decisions is complex and would not be adequately captured by simply including a dummy variable in the estimation. On the supply side, insurance has several influences. First, it may affect the cost of providing care by increasing the paperwork required and perhaps increasing the time between services rendered and actual payment. This effect can be adequately captured by variables which indicate the percent of patients under certain coverages. Major insurance policies, Blue Cross- Blue Shield, and Medicare would have no effect on the actual amount received by the physician as payment. Any amounts not covered by the policies are paid by the patient. However, Medicaid is a different issue. When a physician agrees to accept Medicaid as payment for services rendered to patients, the physician agrees to accept this payment as compensation in full. Any percent of the customary fee not covered by Medicaid is a loss to the physician and must be viewed as a forced fee reduction. For this reason, the existence of Medicaid patients must be viewed as a reduction in the average fee received by the physician. Therefore, P must be adjusted downward for the

presence of Medicaid[9].

For certain questions, the demand side price must also be adjusted downward to capture the true effects of insurance. If the question at hand were concerned with the *patient demand only*, then the true demand price should be isolated by assuming that any amount of the customary fee not covered by insurance payments is paid by the patient. This would allow the average reduction in fees to the patient to be calculated[10]. However, for the purposes of this

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[9] The method of adjusting the price for Medicaid is to multiply the raw price by an adjustment factor. This adjustment factor is equal to the percentage of the practice's patients who paid by Medicaid multiplied by the average amount of the customary fee paid by Medicaid. This factor represents the percent that the average fee is reduced due to Medicaid patients. The reductions ranged from a low of 0 percent reduction to a high of 56 percent reduction of the average customary fee.

[10] The calculation of the adjustment factor for the demand side would be very similar to the correction made to the supply side. However, to obtain the patient demand in isolation of the insurers, four insurance programs must be considered: Medicaid, Medicare, Blue Shield, and a major private insurer. The percent of patients in Medicare, Blue Shield, and private insurance programs multiplied by the percentage reduction in fees provide an adjustment factor (assuming that the amount not covered is paid by the patient).

discussion, the demand of patients independent of insurers is not of primary interest. In the market patients and insurers are not separable entities. The market demand curve, which is of principal interest here, is a "joint" decision relationship reflecting not only the patients utility and income, but also the insurer's subsidy into the medical marketplace. Therefore, for this study, the demand side price will not be deflated as discussed above, and the demand curve estimated will be the physician's share of market demand, as discussed above. Still, the percents of patients in the various insurance plans are included separately in the demand equations so that differences in impact might be picked up.

These average reductions can then be added to the 100 percent reduction that Medicaid patients receive (multiplied by the percent in Medicaid, of course). These four measures averaged to arrive at an average fee reduction to the patient due to insurance plans provides a complete demand fee adjustment. This is applied to the customary fee to arrive at the actual demand price paid by the average patient in the physician's practice which is the true marginal price consumers of medical care make decisions across. The presence of insurance, by reducing the demand price to patients, would *ceteris paribus*, increase the amount of medical services demanded. Given this new set of prices, estimating the system of equations produces the actual demand for physician services of the patients "independent" of the insurers. As stated above, this is not the goal of this paper.

Many of the variables listed above should affect the choice variables in directions which can be strongly anticipated *a priori*, while others cannot be anticipated with any certainty. Perhaps most clear are the effects of the number of nurses and clerical workers on total hours and time per visit. One can expect a positive effect of clerical workers on the total hours variable. By aiding the physician in the processing of patients, clerical workers greatly expand the physician's ability to see patients. On the other hand, by serving as a substitute for physician service, nurses are expected to greatly reduce the average time the physician spends with each patient. Again, there are quality concerns involved, but by substituting nursing time for physician time, the physician is still able to offer a bundle of visit and time with medically trained personnel as the composite good. Perhaps further investigation into this substitutability between physician and nursing time is warranted at some later date. Additionally, immunizations are expected to have an uncertain effect on total hours and a negative effect on time. This is due to the nature of the visit in question. Typically patients visit the practice specifically for immunizations and these visits do not usually require diagnostic procedures and are consequently very short. On the demand side, the income, urban, insurance percentage, fee reduction, and board certification variables are all expected to have positive influences on the numbers of the composite good, hours of service, demanded by all the physician's patients. Other variables in the model may have either positive or negative effects.

The identification conditions have been checked and all equations are over identified[11].

IV. b, *Data sources:*

The data from this study is from the *Physician's Practice Cost and Income Survey, 1976*. This is a survey which was conducted by the National Opinion Research Center in 1976 for the Health Care Financing Administration[12]. 4025 physicians were contacted and asked a series of questions concerning their practices. Questions range from issues surrounding patient demographics, cost of business and

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[11] Again, note that the requirements for identification when an endogenous variable enters non-linearly (i.e. squared price terms in the supply relationships). As mentioned in a note above, details about the identification requirements can be found in Judge, et al.(1988).

[12] Though the data is from the survey, the data set used for the current study is an amalgamation from two major sources. One source is the tape copy of the survey available from the National Technology Information Service. The second half of the data was provided by Douglas M. Brown. This data represents the information set used in Brown and Snow (1990). Professor Brown was extremely helpful in providing essential information to round out the data beyond that which is available on the public access tape.

revenue data, hours worked, tests provided, as well as information on insurance and personal characteristics of the individual physicians. Of these 4025 physicians, a sample of 1436 exist with a complete set of information which could be used to estimate the models discussed above. (Physicians and pre-paid practices have been excluded due to the different incentive structures which exist for these organizational mechanisms) From this source the variables previously outlined were drawn. A few of these variables deserve special attention. (For a survey of all variables used in the estimations, see Appendix A).

Gross revenue of the physician firms is divided into the variable P corresponding to the gross payments per hour of labor. It ranges from $13.19 per hour of labor to $119.42, with an average across all physician specialties of $38.50.This measure is expected to reflect different influences on the decision process for providing total hours and the time per visit to supply by each physician. As stated above, the supply side prices are adjusted by the Medicaid effect to arrive at true supply price.

IV. c, *Estimation Technique and Results:*

The semi-log specification described above is estimated using Nonlinear Three Stage Least Squares (NL3SLS)[13]. All three of the

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[13] Although a semi-log specification is used, in part following past literature for comparison, the results are robust to specification. In linear estimation all signs are retained and significant

structural equations are over-identified. One of the shortcomings of the previous work, discussed above, lies in the failure to correctly specify supply and demand equations, and then to estimate them using the appropriate empirical technique. Non-linear 3SLS is one possible solution to the simultaneity problem encountered when estimating systems. NL3SLS is chosen because it not only correctly estimates over-identified equations in a system, but is also an efficient approach, estimating all equations simultaneously and incorporating information available in the covarience matrix. One drawback is that NL3SLS can potentially allow any errors in specifying a single equation to spill over into all equations in the system. Table 2 contains the results from the estimation.

Several results are immediately apparent from the supply side equations. The first is that the signs on the price variables are as expected by theory. Both total hours worked, and time per visit respond in a similar manner to the price proxy. The positive sign on linear price and the negative term associated with price squared will imply that as the wage rate increases, total service (in hours per week) will initially increase, then beyond some wage rate begin to decrease. This produces a backward bending supply curve of physician hours worked. This conforms well to the expectations of traditional utility maximization. These results indicate that

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variables retain their significance, though at a slightly lower level.

physicians behave no differently than any other group is expected to behave. As income (though profits) increases, at some point the physician will begin to value additional units of leisure more than additional units of income, implying less work. This also conforms to the ambiguous sign on (16). Note that there is no need to assert "market failures" or monopoly power for this result to appear.

Similarly, the quality relationship, time per visit, responds in a backward-bending manner. This is perhaps a more significant result that the one above, since it has implications for the average quality of service provided by physicians. The signs on price and price squared implies that as compensation for quality increases, at some point the physician will stop providing more quality and begin to provide less with added revenue[14]. There is some maximum quality level, just as there is a maximum total hours level. While increases in compensation beyond the backward bending wage rate

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[14] It is important to note that, given the relationship $H = v \cdot h$, which must hold, one knows:

$$\epsilon_{HP} = \epsilon_{vP} + \epsilon_{hP},$$

where ϵ refers to the elasticity of H, h, or v with respect to price. So it is entirely possible that either v or h could have a positive elasticity with respect to price, even if total hours worked is negative. However, if total hours worked is in the region of negative price elasticity, then one of the remaining two terms must also be in the negative region.

would lead to fewer hours per week supplied by the average physician, this effect might be countered by increases in the numbers of physicians in the market. (This study does not address this dynamic question directly, however inferences can be drawn using economic theory.) While this would, of course, have a limiting effect upon price increases, it is still possible that the quality of service could be diminished for the average physician even after the total hours supplied in the market has stabilized. Therefore, a policy which has the effect of stimulating patient demand, and so increasing price, has implications beyond simple numbers of hours supplied. One must also consider potential quality effects. Additionally, given the long training periods involved, and the tight restrictions currently in place to control physician immigration, policy changes could have negative quantity and quality effects which extend for a considerable time.

Other significant parameters have the expected signs.Board certification, the number of clerical workers, time spent at professional meetings, and time spent at other activities tend to lead to greater numbers of hours per week, while greater frequency of x-ray procedures tends to depress hours supplied. Contrarily, increased frequency of immunizations, increases in the number of hospital visits, and greater numbers of nurses tend to decrease the time a physician spends with each patient, again conforming exactly to *a priori* expectations. Oddly, the marginal tax rate of the state and time at other professional activities exerts a positive influence on the time per visit taken by the doctor. In addition,

wages paid to non-physician employees encourage greater time per visit. Since nursing labor is a substitute for physician labor, this is expected. Both supply side equations perform well and are consistent with theory, both traditional theory of the firm, and the model developed in the last section.

The inverse demand equation also conforms well to theory. The hours variable is highly significant and negative, giving strong credence to the claim that the correct system has been identified. The proxy for income in the area, weekly salary for non-physician employees, exerts a significant and positive effect upon the number of physician hours of labor demanded, indicating medical care is viewed as a normal good (as would be expected). In addition, patients in an urban setting demand more medical care, and demand greater amounts of health care from physicians who are board certified (certification being an indicator of quality). Age appears to have a negative influence on the demand for physician services, patients apparently preferring younger to older physicians. One result in the demand specification which is somewhat surprising is the positive, though insignificant, impact the dummy variable which equals one if a physician does not accept Medicaid. One would expect this to be negative in sign since refusing Medicaid eliminates a portion of the patient pool.

One test run with this specification attempts to statistically measure whether the approach of the current work differs in any significant way from an approach which takes a double equation tack. To test this a Chi-Squared test is run on the hypothesis that all

parameters in the second equation are equal to zero. In other words, this test attempts to discover whether a two equation model performs significantly different from the three equation approach which is derived from the theoretical model of the last section. In this case, the value of the test statistic equaled 203, rejecting the hypothesis and indicating that the three equation approach is statistically dominant over the two equation model.

One implication of this empirical work which has been explored concerns the backward bending nature of the supply of physician's services described by the equations estimated in Table 2. Again, the relevant question is not whether the price squared term is negative, it almost certainly must be given that there is an insurmountable time constraint facing the physician firm. The relevant question is also not at which wage rate the curve bends back, though it is upon this issue that past empirical work has turned. Rather, given that there is a backward bending curve, the important issue is at how many hours per week will it bend back. This point will differ for different specialties. The estimates imply that the supply of physicians' service curve will bend back, for the average physician, at a wage rate of approximately $30.73 per hour.

Table 3 lists the estimated critical values of total hours, H^c, at which the curve begins to bend back, for all 15 specialties. In addition, 95% confidence intervals are represented by the upper and lower bounds. In all cases, the actual mean value for H falls below the upper bound for H^c. In fact, many of the mean values for H do

fall within the confidence interval, implying physicians are operating close to the critical value, on average. This is significant since, if physicians are operating on the negatively sloped region of supply and are also at a point far below H^c, this implies that the market is supporting both high fees and low work loads for the individual physician. This result would not be consistent with a competitive market. The fact that physicians are observed close to H^c indicates that they may not possess a great deal of individual market power.

In addition, Table 4 presents estimated elasticities of supply and demand (for total hours) at the mean. With only two exceptions, physicians in the 15 different specialties are operating on the negatively sloped region of supply (the two exceptions with positive supply elasticities are on very inelastic points of their supply functions, implying that they are close to the critical point). This evidence is intuitively appealing since, not only does it seem to confirm the widely held view that physicians operate on the negatively sloped portions of their personal supply functions, but the estimates for the backward bending point are at numbers of hours (between 56 and 70 hours per week) which are quite reasonable. The elasticity estimates also conform well to expectations. For example, the four specialties with elastic point estimates are the four whose observed mean H are farthest away from the estimated H^c.

Physicians have often been criticized in the literature and popular press for their behavior with respect to provision of labor. However, if these estimates are accurate, the average physician

behaves in a completely predictable manner and begins to value leisure more than additional hours of work at wage rates corresponding to significant hours of labor per week. However, the fact that physicians are operating on the upper, negatively sloped, portion of the supply curve has specific policy implications. Figure 3 represents the market for one of the 15 specialties, urology (the excluded category). The fact that demand is more elastic than supply at the lower intersection point not only insures stability (as is not the case at the higher intersection), but also implies that policies which attempt to mandate lower medical prices would result in excess demand problems. This result provides no evidence for the often made assertion that demand for medical services is less elastic than supply throughout (due, presumably, to market power on the part of physicians and the medical community) and therefore government mandated fee reductions would not lead to excess demand. In addition, Figure 3 points out that policies which lead to higher patient demand for medical service would lead to higher prices and lower total hours supplied.

To find out what happens to quality as fees rise, critical (backward bending) values of the supply of quality, h^c, are calculated and presented in Table 5. The results, again, are consistent with expectations with all 95% confidence intervals containing the observed mean values for h. In this case, the wage rate at which h^c occurs is of crucial importance, particularly when compared to the wage rate corresponding to H^c. In this model, the back-bending point of quality supplied occurs at a wage rate of

\$51.13, substantially above the market clearing wage rate observed, and above the critical wage rate for H^c. This implies that physicians will begin to economize on visits before they reduce quality. This is borne out by Table 6, which presents estimated elasticities of quality at the mean. For all specialties, the elasticity of quality is positive. Therefore one knows that since the elasticities of total hours are generally negative, and the elasticities of quality are uniformly positive, increases in fees will lead to decreases in the number of visits, for most specialties. This would be one effect of the demand enhancing policies of the government.

V. Conclusions:

One of the more significant results of this work is the contribution made in the theoretical section. In the past literature, the trade off potential between quality and quantity in the supply of physician services has been ignored. The results of this have been supply function estimates which are not well behaved with respect to price. This often supports conclusions which argue that the medical market is subject to distortion from monopolistic influences or other perceived market failures. The theory developed here, by combining utility/profit maximization with a quality/quantity trade off, indicates that the problems in past work may stem from a mis-specification of the models used.

The theory developed in Section III suggests an empirical model which contains three, not two, structural equations. In this way the complete decision process of the physician firm can be modeled. This model also allows inferences concerning quality and quantity choices of the physicians to be made. Not only is the number of visits a clear choice variable to the physician, but the time spent per patient is as well, a process shown to take place in practice.

The second contribution of this work is to utilize a simultaneous approach to estimating the market for physician service. No *a priori* assumptions are made about supplier induced demand, and consequently, a demand function is specified. In addition, two supply relationships are needed to incorporate the hypotheses derived in the theoretical section. Given this system of three structural equations, a 3SLS approach is used to correctly estimate the system. Results indicate that there is indeed a backward-bending supply of physician "service" with respect to wages. This does not flow from a market failure, but straight forward utility maximization. In addition, the demand estimates fit well with the supply estimates to produce a market equilibrium which is stable and informative. From the results one sees that attempts to intervene in the market, either through price controls or provision of subsidized insurance, could lead to unfortunate distortions. In particular, since the market equilibrium falls on the negatively sloped portion of supply for most specialties, a reduction in total hours worked will result from subsidized insurance. This implies either fewer visits per week supplied, a

lower quality per visit, or both. Price controls, on the other hand, would lead to excess demand as traditional supply/demand analysis holds. Perhaps the most encouraging aspect of the current work is that the market for physician's services can be shown to conform to market forces. One need not rely upon assertions of market failures or market power to model the relationship, or to arrive at conclusions which conform to real world experience with rising health care costs and apparent decreased availability.

The ultimate conclusion is that current evidence does not support the hypothesis that rent-seeking behavior and supply side market power on the part of individual physicians has been a major factor in the current crisis in health care costs. Rather, physicians appear to behave in a manner consistent with competitive markets and have been unduly blamed, while the real sources of increasing costs are left unaddressed. The empirical results presented here indicate that more likely causes for the rapidly increasing costs are: 1) government subsidization of private health care demand, 2) trends toward (inefficiently) full medical insurance, and 3) artificial restrictions on the entry of new physicians through license and immigration control. Lessening of these influences would greatly ameliorate the problem of rapidly increasing costs, while increasing the role of government in the medical insurance market or artificially restricting fees might have little cost effect, but have substantially negative effects on both the availability and quality of primary medical care.

CHAPTER III

MEDICAID AND PHYSICIANS' SERVICE: EFFECTS OF BANNING BALANCE BILLING ON QUALITY

I. Introduction:

Since 1965, Medicaid has served as the major source of health insurance for the nation's poor. However, almost as soon as the program was installed, controversy began over its effects. In the economics literature, Medicaid is criticized for two major shortcomings: for supplying governmentally sponsored health insurance at no cost to the individuals covered, and for prohibiting primary care physicians from collecting the balance of a bill not paid by Medicaid from the patient. The free nature of the plan encourages private consumption of health care beyond the point where private marginal benefits are equal to marginal costs. Similarly, the ban on balance billing is likely to distort the physician's quantity/quality choice. This chapter will address both concerns, namely we are concerned with exploring the effects of Medicaid and the ban on balance billing on the primary, office-based market for physicians' services.

In past literature, and in the popular press, most attention is turned to the perceived failure of physicians to accept Medicaid patients[1]. Consideration of quality of service is almost totally lacking in the literature. The current work seeks to emphasize the importance of service quality in the provision of primary, office based, health care. In particular we hope to understand the distortion in the distribution of quality (between Medicaid and non-Medicaid patients) introduced by Medicaid. This chapter will demonstrate that the institutional structure of Medicaid provides no incentive to supply high quality care to patients covered by this type of insurance. In fact, it is shown, through theoretical and empirical exploration that Medicaid provides a *disincentive* to supply high quality care.

Medicaid's structure, in particular the reimbursement mechanisms, lack of a copayment, and ban on balance billing creates a two-tiered system of health care in this country. Evidence is

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[1] In this case, as in so many others, perceived failures in the medical market place are blamed on the individual physician, often based upon presumed market power originating from asymmetrical information. Cursory inspection of the evidence does not confirm this belief. In our sample only 13 percent of physicians refuse to accept Medicaid patients, while the remaining physicians maintain practices in which over 13 percent of their patients are covered by Medicaid.

presented which shows that the low rates of reimbursement discourage physicians from providing service to Medicaid patients. Additionally, lack of any type of copayment (including banning balance billing) circumvents patient's demand for quality care and relegates Medicaid patients into a lower quality tier in the market for health services, as compared to patients insured by other systems. Policy implications are clear. Contrary to measures which are currently enjoying popular support (for instance the measures before Congress to institute fee controls through Medicare and private insurance payment restrictions, and calls to implement a Canadian-styled national health care system), policies aimed at raising the quality and availability of care to Medicaid patients must include implementation of some type of co-payment or limited balance billing. These mechanisms permit patients to exercise their demand for higher quality care in the market place.

The chapter is structured as follows. Section II presents a discussion of the history and implementation of the Medicaid program. Section III reviews the economic literature on the subject. Following, Section IV posits and explores a model of the competitive physician supply, with quantity, quality, and the mix of Medicaid and non-Medicaid patients as choice variables. Section V tests implications of the model using system techniques to control for both demand and supply side influences. Finally, Section VI concludes with a summary of the results and discussion of policy implications.

II. A Brief History of the Medicaid Program:

For many years prior to 1965, the federal government attempted to provide health care assistance to needy individuals and families through the use of matching grants to states[2]. These grants were limited in nature, in that states were only allowed to make payments directly to families based upon the expected average expenditures, not actual expenses. In 1950, the Social Security Administration received authority to provide matching grants to states based upon actual payments made directly to providers of health care for services rendered. Access was expanded once again in 1960, when persons lacking health insurance, and meeting certain age or disability criteria, were brought under the umbrella offered by the federal matching grants. In particular, elderly persons' health care requirements were a focal point for debate going into the 1960s.

Despite the popular support for policies aimed at providing a health care floor for needy individuals, movements toward government provided health insurance ran into formidable opposition, principally from the American Medical Association. The AMA successfully blocked all moves toward national health insurance, until the election of President Johnson in 1964. The following year of 1965 proved to be a watershed in the history of national health

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[2] This section draws heavily from Fein (1986) and Frech (1988).

care. There were three separate proposals in Congress that year, one from the administration, one from the opposition Republicans, and one presented with the sponsorship of the AMA. Through the legislative process, all three proposals were adopted in a compromise package. The administration's policy for providing health insurance to the elderly financed through payroll taxes became Medicare part A. The Republican initiative for subsidized voluntary health insurance to the elderly for physician services resulted in Medicare part B. The AMA proposal for continued subsidization to the States for payments directly to primary care physicians providing care to the needy became the current Medicaid program. It is this latter program which is of immediate interest.

Medicaid is a program structured for state administration. The federal government sets broad guidelines for implementation and for identifying qualified families, but the actual running of the program is left to the individual states. It is, therefore, not strictly accurate to speak of Medicaid as a unified whole, since each state has a program which can be significantly different from other state programs in coverage and provider payment. The overall program is financed through state revenues and federal matching grants, with the federal government contributing as little as 50 percent, to as much as 77 percent. Despite the fact that the guidelines established insure the central government pays the majority of costs of the Medicaid program, many states refused to implement the policy until forced to in 1970.

There are some eligibility requirements common across states.

Individuals covered by Aid to Families with Dependant Children, low income pregnant women, and those covered by the Supplemental Security Income program must have Medicaid supplied to them. Some states insure other individuals as well, based upon need. In particular, some states cover people whose gross income exceeds the eligibility level for Medicaid, but whose income, after deducting medical expenses falls under the specified level. States can, and often do, change the eligibility requirements for Medicaid in order to control expenditures. However, when a person is granted eligibility, certain benefits are mandated by federal law. These mandated benefits include: hospital services, skilled nursing home and in-home care, physician services, laboratory screening, X-rays, and periodic health screening for people under 21 years of age. In addition, aid for prescription drugs and dental coverage is eligible for federal matching grants if a state elects to offer the protection.

Payment for these services is made directly to the provider, based typically upon the Medicare schedules or an explicitly set out fee schedule. One important characteristic of Medicaid is the prohibition against collecting the difference between the provider's fee and the Medicaid payment from the patient. This ban on "balance billing" can be particularly significant when considering the discrepancy that exists between the usual fee and the average Medicaid payment. In our sample the average Medicaid reimbursement across all specialties was approximately 63 percent of the usual fee. Some physicians surveyed reported average reimbursement rates

as low as 10 percent of the usual fee. One important question that might be asked at this juncture is what effect such mandatory fee reductions have on the quality of service offered to patients covered by this Medicaid plan.

III. Literature Review:

The literature in this area can be divided into three broad categories: articles dealing with the issue of access to physician services, articles dealing with Medicaid's effect on physician behavior other than quality choice, and articles dealing with Medicaid payment schedule's effects on the quality of nursing home care. To date, there appear to be no studies which explore the effects of low Medicaid payments and a ban on balance billing on the physician's simultaneous choice of quantity and quality of service. This is a gap which the current work hopes to fill.

One of the first issues to be raised in the literature concerning Medicaid's effects were concerns about accessibility of Medicaid patients to office-based physician care. Sloan, Mitchell, and Cromwell (1978) explored this question of accessibility by examining the participation rate of physicians in the Medicaid program. Lack of physician participation has been a major concern of policy makers since the inception of the Medicaid program. Sloan, Mitchell, and Cromwell (SMC) identified several factors which could discourage physicians from participating, principally complexity of

forms, likelihood Medicaid will return a form for resubmission, length of time it takes to receive reimbursement, and generosity of the eventual reimbursement.

To begin their analysis, SMC modeled physicians as profit maximizers who operate in two markets. In the private patient market physicians face a downward sloping demand curve for service, while demand is perfectly elastic in the Medicaid market. In addition, Medicaid patients produce reimbursement at a fixed rate. On the cost side, administration costs per visit are assumed different. Note that a significant feature of the Medicaid market is the ban on balance billing which results in a *de facto* fee reduction for physicians who accept Medicaid and whose fees are higher than the reimbursement rate (the vast majority of fees are higher). This feature was maintained in the SMC paper. The theoretical results indicate that an increase in the generosity of the reimbursement scheme by Medicaid would lead to greater participation by physicians in the number of visits provided.

In presenting the empirical results, SMC found that in their sample data, of the four types of insurance, Medicaid, Medicare, Blue Cross, and private insurance, Medicaid consistently reimbursed at the lowest rate, ranging from 55 percent to 70 percent of the usual physician fee[3]. The percent of patients covered by Medicaid

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[3] These results are completely consistent with the data used in the current work.

is their endogenous variable to which a Tobit model is applied. In addition, they modeled the binary choice of whether to offer services to Medicaid patients using a Probit model. These models were estimated separately. They found that physicians respond to increased reimbursement rates by increasing the percent of their office visits devoted to Medicaid patients. The authors noted that theirs was the first empirical evidence supporting this long-held belief. The study also found, not surprisingly, that increased difficulty in successfully placing a Medicaid claim discourages physicians from participating. The policy implications of these results are obvious: increasing generosity of reimbursements and decreasing the difficulty in filing a Medicaid complaint would tend to increase access to physician office visits by Medicaid patients. SMC proposed a conceptually appealing theoretical model and used reasonable econometric procedures to test resulting implications. However, the study leaves some room for improvement in two areas: first, no attempt is made to address quality of service concerns or the potential effects of such a choice variable; and secondly, the models are not estimated simultaneously as theory would suggest.

A second example of work conducted on the issue of limited accessibility is Long, Settle, and Stuart (1986). This piece is a purely empirical test of the relationship between Medicaid reimbursement and the level of access to medical care in general. In noting past work on this issue, which uniformly finds a positive relationship between reimbursement rates and physician participation, Long, Settle, and Stuart (LSS) pointed out that this

does not directly imply such a relationship with availability of medical care. Hospital outpatient centers can provide many of the services offered by a physician. In addition, *pro bono* work could mitigate lower participation in states with low Medicaid schedules.

To perform their study, LSS defined two potential dependant variables, the probability a patient will see a physician and the number of times a patient sees a doctor in a given year. These were used separately to investigate the distinction between physician participation and actual accessibility to medical care. Their results indicate that while there seems to be little effect on actual accessibility to health care (from any source, either physician office visits or hospital out-patient services) from changes in the generosity of reimbursement schedules, there is a significant response in the likelihood of obtaining an office visit with a physician. This implies that patients appear to be able to gain access to medical care by substituting away from office based physicians as participation drops. However since most hospital outpatient clinics are run at substantially higher costs, a state's attempts to decrease expenditures by reducing physician reimbursement might be completely counteracted by the increased expenditures at hospitals.

While the LSS study did raise important policy issues concerning the type and costs of primary medical care, the authors noted one shortcoming. The data used were from the Health Information Survey of patients. Therefore they could not probe the structure and incentive system of providers, and so estimate

equations describing provider behavior. They felt this would be an important improvement, which due to data limitations, they were unable to undertake. In addition to this, as in the Sloan, Mitchell, and Cromwell work, quality distinctions between types of care or Medicaid payment regimes were not addressed.

There is also a branch of the literature dealing with Medicaid's effects on physician behavior other than participation. Sloan (1982) explored the effects of health insurance, Medicaid included, on physicians' fees. The issue Sloan investigated is whether the presence of an insurance scheme will lead to increases in a physician's fee schedule. He proceeded with a theoretical, followed by an empirical, investigation. Sloan initially modeled physicians as profit maximizers who face a downward sloping demand curve. By introducing indemnity type insurance he demonstrated that an increase in the reimbursement rate would lead to an increase in the fees charged by the physician[4]. In addition, the theoretical section implies that visits provided would also increase with higher reimbursement rates. Sloan then introduced a Medicaid fixed rate

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[4] Indemnity insurance is when a policy covers a procedure up to a set fee. The difference between the actual fee and the indemnity payment is the responsibility of the patient. With this system, since the patient is able to directly benefit from lower fees, there is still an incentive for the patient to search for a lower fee, down to the level of the provider reimbursement rate.

system with balance billing bans and finds results qualitatively similar to the regular indemnity insurance market. In setting this model up, Sloan assumed constant quality of service across Medicaid and non-Medicaid patients. Sloan's empirical estimates bear out the theoretical implications.

Several points should be made about the Sloan (1982) work. First, as is customary, no attempt was made to identify the effects on quality or treat quality as a choice variable. However, Sloan did discuss this gap in his work. Quality, he noted, is a characteristic of service which has many dimensions, and so is difficult to define accurately. This argument, though technically correct, does not abdicate the responsibility to attempt analysis. With most empirical work, the actual variable desired is rarely available, and reasonable proxies must be employed. Similarly, even though a true measure of quality is certainly not available, proxies do exist, providing at least the potential for constructive inferences. A second point concerns Sloan's treatment of the variable "percent of patients covered by Medicaid". This was not modeled as a choice variable, despite the intuitive and theoretical reasons for doing so. In addition, Sloan took two approaches to including "percent Medicaid" as an explanatory variable. One model used the actual variable, a second used a predicted level. These two empirical models produce significantly different results. Since including the predicted level instead of the actual variable is equivalent to Instrumental Variables, and since different parameter estimates and significance levels for this variable and others are

observed, one might infer that "percent Medicaid" is an endogenous variable. This is clearly not a test for endogeneity, but it certainly adds credence to the argument that patient mix is a choice variable.

Frank and Lave (1986, 1989), in two articles, investigated the effect of Medicaid on the length of stay in hospitals of psychiatric patients. Both works are strictly empirical. Their interests lay mainly in exploiting the inter-state differences between Medicaid reimbursement schemes in order to draw inferences about treatment of psychiatric patients. They justified estimation of the supply response only by arguing that the zero out-of-pocket costs to patients imply there is no demand constraint. The first paper finds that the length of stay in a hospital for a Medicaid psychiatric patient is directly related to the generosity of reimbursement. Additionally, they find that limits on the number of days covered by the Medicaid program will tend to decrease the average length of stay.

The second paper examined the effects of the structure (rather than level) of the reimbursement scheme. The results indicate that implementing *per diem* (with low daily rates), per case prospective, or limits on reimbursement, method of payment will tend to decrease the length of stay. Frank and Lave interpreted these results as an indication that the above-named payment schemes can, by reducing the length of stay, reduce costs. While strictly speaking this may be correct in the short run, Frank and Lave ignored the seemingly large quality implications. Simple cost minimization is not equivalent to

welfare maximization. Reducing costs at the expense of patients' health is not necessarily desirable, and while costs may go down as length of stay decreases, it is at least a viable argument that quality is similarly reduced. Again it is clear that ignoring the quality dimension can lead to policy advocations which are premature at best, and damaging at worst.

A third and, for the current work, more applicable branch of the literature explores the relationship between the quality of care in nursing homes and the percent of patients in the homes who are covered by Medicaid. Medicaid is the dominant insurer of the nation's nursing home residents and so such issues are of crucial importance. Nyman (1988) is one example of the work which has been done in this area. This is a purely empirical exploration of the effects of Medicaid reimbursement, excess demand, and the percent of Medicaid patients on the quality of service offered by nursing homes. Nyman noted that past studies have assumed that low reimbursement rates of Medicaid produce a connection between a lower level of quality and a high percent of Medicaid patients. Contrarily, Nyman's hypothesis was that excess demand persists in the market for nursing home beds, and therefore homes specializing in Medicaid patients do not have to compete in the quality dimension. Homes can attract non-Medicaid patients by increasing quality, and only stock excess beds with Medicaid patients. This implies that only those nursing homes servicing predominantly private patients will provide high quality service.

To test this hypothesis, Nyman used the number of violations of

Medicaid standards of care regulations as the index of quality. Other important variables include percent of residents in a home who are Medicaid patients, average number of empty beds in an area, the private price for a room, and the Medicaid reimbursement rate. It is important to note that the data used are from Wisconsin which employs a "cost plus" reimbursement scheme. Under this approach, nursing homes are reimbursed for the costs of production plus some fixed payment for profit. Therefore, since increasing quality implies increasing costs, and since using a cost plus scheme compensates homes for the higher quality directly, one expects *a priori* to see a positive relationship between percent Medicaid patients in a home and costs. Additionally, given that Nyman was testing the Wisconsin system which provides marginal compensation for quality, the theoretical model he assumed is not strictly applicable. Nyman found that the low Medicaid/high quality relationship is strongest in areas dominated by excess demand. He also found costs increasing with increased Medicaid, which he took as evidence of excess demand (though as pointed out above, a simpler explanation is that homes are responding to marginal incentives). Still, Nyman did emphasize the need to examine the effects that the mix of patients has on the average quality of a nursing home. This has direct implications for the current discussion of physician behavior.

Gertler (1989) offered both a theoretical and empirical look at the effects of Medicaid on access to, and quality of, nursing home care. Gertler treated nursing homes as profit maximizers who, for

cost reasons, do not discriminate in the quality dimension. That is, providers in his model offer the same level of quality to both Medicaid and non-Medicaid patients. However, since Medicaid reimbursement and private fees are different, this implies the nursing homes are price discriminating. Since Medicaid patients pay a zero price, Gertler argued that as long as the quality is above some minimum level the Medicaid demand for care will be perfectly elastic.

For testing the model developed, Gertler noted that input demand functions will identify a quality isoquant. This allowed cross sectional comparisons to be made by adjusting for technology differentials. Within this context input demand functions are proportional to quality and so can be used as a proxy. Therefore, he assumed a cost plus reimbursement scheme and uses adjusted input demand functions as the quality dependant variable. Gertler then posited an empirical model which simultaneously estimates a private price equation, an average quality equation, and a private quantity equation, all reduced forms[5]. From this he found that an increase in the Medicaid reimbursement rate has a negative influence on the average quality of the nursing home care. This is a purely

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[5] This is not a simultaneous system which attempts to identify supply-side and demand-side influences. Gertler modeled the supply side exclusively and did not address demand influences in any fashion.

empirical result, not predicted by the model he explored. He assumed that all patients get lower quality due to the prohibition on quality discrimination. However, he did not include percent of patients that are covered by Medicaid, thereby ignoring a potentially significant influence on the observed negative relationship between Medicaid rates and quality. If high Medicaid rates encourage homes to service more Medicaid patients but offer only minimal quality, as a result of the incentive scheme, this could drive his observed relationship.

A third example of this nursing home/Medicaid research is provided by McKay (1989). This work, like that of Gertler, developed a theoretical model before attempting any empirical specification. McKay explored two distinct models, one imposed homogeneous quality across Medicaid and non-Medicaid patients, and the second allowed quality differences. Given the zero cost to Medicaid patients, he modeled their demand as perfectly elastic up to some quality level (which is determined by community standards) and positively related to quality thereafter. Choice variables are patient mix (between Medicaid and non-Medicaid), quantity of patients, and quality provided. His models predict that the price set in the private market will be unambiguously greater than the Medicaid reimbursement rate. The quality discrimination model assumes differential quality levels but arrives at no substantive theoretical conclusions.

Empirically, McKay estimated a cost function for nursing home care given to Medicaid and non-Medicaid patients. He was interested

in the cost function since, assuming providing more quality involves higher cost, differences in the marginal costs of servicing Medicaid patients and the marginal costs of providing service to non-Medicaid patients will give credence to the differential quality thesis. However, in the estimated cost function the parameter associated with the ratio of non-Medicaid to Medicaid patients is not significantly different from zero. This, McKay argued, is evidence that nursing homes do not discriminate on quality, and provide a homogeneous mix to Medicaid and non-Medicaid patients. This, despite different revenue implications for quality to private residents and quality to Medicaid supported residents.

This brief review of a portion of the literature relevant to the discussion of Medicaid's effect on independent physician behavior has brought several points to light. Foremost among them is the lack of work on this specific issue. Physician behavior is an important element in the functioning of the American health care system, and Medicaid a major governmental program. However, as has been seen, the preponderance of work has been confined to discussions of participation. Quality issues have not been raised. However, as can be seen in the nursing home work, quality effects are significant for that aspect of health care, and so further work into physician behavior is justified.

IV. Modeling Physician Behavior with Medicaid:

This chapter modifies the theoretical model of physician behavior in a competitive market presented in the last chapter to include the presence of Medicaid. As a review, physicians are assumed to be utility maximizers across income and leisure. Income is derived, in part, from the profits of the physician's medical practice. Therefore physicians must simultaneously maximize profits and utility, picking not only the utility maximizing total number of hours to provide, but also the profit maximizing mix of quantity and quality[6]. As in Chapter I, quality is proxied by average time per patient visit, and quantity is the total number of patient visits provided. The current concern is discovering, both theoretically and empirically, what effect Medicaid has on the quality choice of the physician, and the choice of mix between Medicaid and private patients.

Along these lines, physicians in this model are assumed to be price takers in the visits dimension. That is, physicians are operating in a competitive market such that, when the physician makes a quality choice, he or she is then presented with a price

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[6] See the previous essay in this dissertation, **Quality and Quantity Tradeoffs in the Market for Physicians' Services**, for a more complete discussion of the quality framework. The model in the current work is an extension of that effort.

which cannot be affected by the number of visits the individual physician offers. Therefore, the physician faces a vector of quality/price options. The individual physician can move along this price vector by choosing different levels of quality, though the choice of visits does not change either the physician's position on the vector, or the position of the vector itself.

A second component of interest in this model is the introduction of Medicaid. Including the program in a model is not difficult since in most states Medicaid compensates physicians based upon a fixed schedule. This can either be the Medicare schedule, or some independently established fee structure. In either case, balance billing is not allowed, so that the physician receives only some proportion of the usual fee. The fee structure for a visit provided to a Medicaid patient will then be some percent of the fee for a visit charged to a private patient.

However, the effects of Medicaid run much deeper than government sponsored fee reductions. Perhaps more significant than fee restrictions are the effects the Medicaid reimbursement mechanism has on patient's ability to demand quality. The major problem is the inability of a physician to increase the fee received from a Medicaid patient by offering *that patient* a higher level of quality. Since Medicaid payment schemes reimburse physicians based upon either a set schedule or a set percent of the fee charged to private patients, it is not possible for a Medicaid patient to offer to pay a higher price for higher quality. This circumvention of patient's demand for quality is completed by the ban on balance

billing. Therefore, Medicaid can make no marginal payments for improvements in the quality of service to Medicaid patients. In this model then, the price received for a visit provided to a Medicaid patient is a percent of the price received for a visit to a private patient, irrespective of the time spent with the Medicaid patient. The only way, in fact, for a physician to increase the price per visit from the Medicaid patients in the practice is to increase the quality (and so visit-price) provided to non-Medicaid patients. This implies that a physician can increase compensation from Medicaid by substituting quality *away* from Medicaid, and to private, patients. The result, demonstrated in this model, is that physicians are likely to provide the minimum possible quality to their Medicaid patients. The current model allows different quality levels to be provided between the two groups. A principal goal of this work is discovering what happens to the quality distribution between patients as market price, and Medicaid generosity change.

With these issues in mind, the current model is presented below. As mentioned, physicians are assumed to maximize utility across income and leisure. This can be expressed using the following objective function:

$$(1) \qquad \bar{U} = U(I_o + \bar{\pi},\ T - H).$$

In this model I_o corresponds to exogenous income and T corresponds to the time constraint. It is possible to substitute away from leisure and reduce the maximization problem to fewer variables. The total number of hours of service, H, is chosen based upon the

utility maximizing labor leisure trade off.

As in the previous chapter, within this utility maximizing framework, there is a constrained profit maximizing process that takes place. The profit objective function of the last chapter must be modified in several ways. First, time is broken into that devoted to Medicaid and non-Medicaid patients, with different "prices" for each. Secondly, the cost structure is represented somewhat differently. Pure time costs are separated out, with the assumption that the costs of providing a minute of time is the same whether it goes to a Medicaid patient or not (though different *quantities* of time will imply different total and marginal costs for time to the two categories). Additionally, purely visit-related costs are represented, with the assumption that visits cost the same for the two groups but that Medicaid visits incur a separate administrative burden. With these changes in mind, the profit objective function for this chapter is to the form:

$$(2)\quad \bar{\pi} = P(h_1)v_1h_1 + mP(h_1)v_2h_2 - C(h_1)v_1 - C(h_2)v_2 - \alpha(v) - \beta v_2$$

$$+ \lambda(H - v_1h_1 - v_2h_2) + \lambda_1(\bar{h} - h_1) + \lambda_2(\bar{h} - h_2).$$

The new features of this objective function discussed above are now apparent. First, visits and quality per visit are represented as v_i and h_i, with private patients denoted with 1 and Medicaid patients denoted as 2. Therefore the physician is able to choose a mix, not only of the proportion of Medicaid to private patients, but also the quality distribution between the two groups. The demand function,

as discussed above, responds only to changes in quality supplied to private patients. The price per visit, $P(h_1)$, is exogenous once a quality level is chosen. The physician cannot affect the price by offering more or fewer visits, only by offering higher or lower quality. Notice also that the compensation received for service supplied to Medicaid patients does not vary with either the number of visits provided, or the quality provided, to Medicaid patients. The percent of the fee covered by Medicaid is m, such that the compensation per unit of service for Medicaid work is $mP(h_1)$. By assumption, $0< m <1$.

On the cost side, the cost structures for the provision of quality are assumed to be the same for Medicaid and private patients. That is, the total costs of providing time per visit for private patients, $C(h_1)$, is the same as the total costs of providing time per visit to Medicaid patients, $C(h_2)$, if and only if h_1 is equal to h_2. Additionally, $C_1(h_1) = C_2(h_2)$ if and only if time per visit is the same for both groups (where C_i refers to the partial derivative). The objective function also includes an administrative cost for each visit, $\alpha(v)$[7]. There are certainly aspects of admitting

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[7] This might also be written $\alpha(v_1 + v_2)$ to emphasize the assumption that the costs associated with providing a visit are the same, irrespective of the nature of the patient. Again, the differential cost of a Medicaid visit shows up elsewhere in the objective function.

patients for a visit, such as filing insurance forms and taking down symptoms and case histories, for example, which are incurred simply because the patient is seen, regardless of the amount of time spent with the patient. Most of these costs are assumed equal across Medicaid and private patients. However, as noted by Sloan, et al. (1978), doctors often report that there are greater costs associated with supplying Medicaid patients. These costs principally arise from the complexity of filing Medicaid insurance forms. Let $\beta \geq 0$ be the additional administrative cost per visit associated with processing Medicaid forms.

The third set of terms to be discussed are the constraints. The first constraint is simply the imposition that total time spent in the practice cannot exceed the total amount of time chosen to supply in the labor-leisure trade off. The last two constraints impose the restriction that time spent per patient cannot fall below some minimum level, $\bar{h}$. This is reasonable since, by the nature of medicine, it is not possible to see a patient in less than some set time span and still successfully diagnose and treat the complaint[8].

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[8] This does not imply, empirically, a truncation problem, as it might appear on first glance. Truncation arises for two specific reasons. First, the choice in question has a discrete quality. For instance, one cannot buy half of a refrigerator; so if the expenditures for one is too high, even if one possesses some demand for that refrigerator, no purchase will be observed and truncation is a problem. Purchases must be made in bundles of one

These restrictions are imposed to insure that trivial results of zero time spent are not obtained except through supplying no visits.

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unit each (with each unit corresponding to a substantial expenditure) and the choice cannot approach the lower limit continuously. However, with time per visit, even though there is a lower limit, the units are small (minutes) and so a continuous approach to the limit can be approximated (this is why truncation is not considered a problem with small purchases, otherwise *all* economic analysis would be subject to truncation issues). Secondly, truncation occurs because of discreteness in the price-quantity dimension. Truncation is a problem for large consumer durables because one must spend a large amount of money to buy even one. Truncation is a problem in many labor studies because individuals must surrender a large amount of leisure time (20 or 40 hours) to get even one job. However, the lower limit of time per visit is set by physician and technological limitations, which does not lead to truncation problems. One might just as well argue that the distribution of hours per day worked is truncated from above because the earth rotates too quickly. Technical limitations cannot produce truncation because there is no choice involved. One simply cannot work 25 hours a day, irrespective of the economic benefits. In this case, physicians simply cannot spend less that $\bar{h}$ minutes per visit with a patient, irrespective of the revenue or cost implications.

At this point it is worthwhile to reinforce the nature of the current investigation and how it differs from that of the last chapter. In this chapter, the primary concern is evaluating the effects of Medicaid on physician behavior. Therefore, visits and time per visit are picked across Medicaid and non-Medicaid patients, implying that v_1, v_2, h_1, and h_2 are all choice variables. However, since concern is focused on practicing physicians' reactions to Medicaid, evaluation of the first order conditions is somewhat easier than might be expected. First, if v_1 and v_2 both equal zero, then total time, H, must also be zero and the physician does not practice. This group is of no concern, and so the condition of v_1, v_2=0 can be excluded. Secondly, if v_2=0 then the physician sees no Medicaid patients and the model would revert, theoretically, to that presented in Chapter II, where no distinctions are made between the type of patients. Since this contingency has already been explored, the condition of v_2=0 is also excluded. What remains, then, is a situation where v_1>0 and v_2>0. This also implies that h_1 and h_2 must be greater than zero. That is, the physicians in this theoretical model accept both private and Medicaid patients and supply them with some level of service. As a result, it is not necessary to deal with a full set of Kuhn-Tucker conditions, since many revert to simple equalities, given the assumptions of the model.

From the framework discussed above, a number of first order conditions arise. These are:

(3) $U_H = U_I\lambda - U_L = 0,$

(4) $\bar{\pi}_{v1} = Ph_1 - C(h_1) - \alpha_v - \lambda h_1 = 0,$

(5) $\bar{\pi}_{v2} = mPh_2 - C(h_2) - \alpha_v - \beta - \lambda h_2 = 0,$

(6) $\bar{\pi}_{h1} = Pv_1 + P_h v_1 h_1 + mP_h v_2 h_2 - C_1(h_1)v_1 - \lambda v_1 - \lambda_1 = 0,$

(7) $\bar{\pi}_{h2} = mPv_2 - C_2(h_2)v_2 - \lambda v_2 - \lambda_2 = 0,$

(8) $\bar{\pi}_\lambda = H - v_1h_1 - v_2h_2 = 0,$

(9) $\bar{h} - h_1 \le 0, \quad \lambda_1 \ge 0, \quad \lambda_1(\bar{h} - h_1) = 0,$

(10) $\bar{h} - h_2 \le 0, \quad \lambda_2 \ge 0, \quad \lambda_2(\bar{h} - h_2) = 0.$

For notational simplicity, $C_i(h_i)$, P_h, and α_v connote the first derivatives of these functions with respect to their arguments, while U_L and U_I represent the first partials of the utility function with respect to leisure and income. Note that the Kuhn-Tucker conditions (4)-(7) on profit maximization reduce to simple equalities as discussed above.

Several results spring directly from the first order conditions. As demonstrated in the last chapter, λ is equal to the opportunity cost of leisure, or the physician's subjective valuation of his or her own leisure time. This is useful in two respects. First it implies that $\lambda > 0$, so that the Kuhn-Tucker condition in (8) can be reduced to a simple equality. Secondly, for the physician to supply any medical time at all it must be true that $P \ge \lambda$, otherwise the physician would be better off by consuming nothing

but leisure. Therefore any practicing physician reveals that the market price for their service is at least as great as their own valuation of leisure time. The significance of this second point will become apparent below.

These eight first order conditions make up the set of equations which must be solved in order to describe the behavior of physicians in this model. The main issue at hand is what effect the structure of Medicaid has on the quality of care offered to patients covered by this plan. One of the first questions that might be asked is whether physicians will ever supply the same level of quality to Medicaid as non-Medicaid patients. To see how the quality levels will not be the same, assume that $h_1 = h_2$. In this case, (4) and (5) can be written:

(4.a) $$\bar{\pi}_{v1} = Ph - C(h) - \alpha_v - \lambda h = 0,$$

(5.a) $$\bar{\pi}_{v2} = mPh - C(h) - \alpha_v - \beta - \lambda h = 0.$$

By adding and subtracting Ph to (5.a), collecting terms, and substituting (4.a) into the rearranged (5.a), one can see that the result is:

$$\bar{\pi}_{v2} = (m-1)Ph - \beta < 0,$$

(since m is bounded by 0 and 1). This clearly contradicts the first order conditions. This demonstrates that h_1 cannot equal h_2. It is interesting to note that this result will hold even at the limiting case where m=1, or where Medicaid reimburses the physician fully. One might expect that in this instance, quality supplied to Medicaid patients would be the same as quality supplied to private patients.

This is not the case, however, since there is still no mechanism to reward the physician for marginal improvements in quality supplied to Medicaid patients[9].

To pursue this point further, rewrite (4) and (5) to show:

(4.b) $$(P - \lambda)h_1 = C(h_1) + \alpha_v > 0,$$

and

(5.b) $$(mP - \lambda)h_2 = C(h_2) + \alpha_v + \beta > 0.$$

To proceed, divide both sides of these equalities by h_2, and subtract (4.b) from (5.b). This results in:

(11) $$(P - \lambda)\frac{h_1}{h_2} - (mP - \lambda) = \frac{C(h_1) - C(h_2)}{h_2} - \frac{\beta}{h_2}.$$

At this point, the information on $P > \lambda$ and $m < 1$ becomes useful since:

$$m < 1 \Rightarrow -m > -1,$$

so,

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[9] In fact, the only situation which does not lead to a contradiction at this point is when $m > 1$. Therefore, unless Medicaid were to reimburse physicians at a rate greater than the market, quality cannot be the same for the two categories of patients.

$$\frac{h_1}{h_2} - m > \frac{h_1}{h_2} - 1,$$

and,

$$P\left(\frac{h_1}{h_2} - m\right) > \lambda\left(\frac{h_1}{h_2} - 1\right).$$

Using this information and rearranging (11), it is clear that:

(12) $$P\left(\frac{h_1}{h_2} - m\right) - \lambda\left(\frac{h_1}{h_2} - 1\right) = \frac{C(h_1) - C(h_2)}{h_2} - \frac{\beta}{h_2} > 0.$$

Given that the second term on the right hand side is negative, this implies that the first term on the right hand side must be positive. Given the assumptions of the model, for $C(h_1) - C(h_2) > 0$, it must be true that $h_1 > h_2$ at all times[10]. This means that physicians operating in a market which contains Medicaid will always supply service of lower quality to Medicaid patients than to non-Medicaid patients. The structure of Medicaid, by forgoing any marginal incentive to the physician for the provision of higher quality care,

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[10] By this we see that m is a threshold variable. Marginal changes in m will not eliminate the discrepancy between h_1 and h_2. Only an increase in m beyond 1 could theoretically equate the two. This may also indicate adverse selection into the Medicaid market, since physicians who choose to participate will (theoretically) offer lower quality on average than those physicians who do not participate (and so only provide quality equal to h_1). Empirical results presented below tend to bear this out.

insures that a two-tiered system of health care exists: one driven by the market place which allocates visits and time per visit based upon marginal benefits and costs, and the other driven by a governmentally sponsored program which provides lower quality care to patients under that plan[11].

A direct test of this hypothesis is easily performed. One can demonstrate that the average time supplied to all patients can be expressed as:

$$(13) \qquad h = (1\text{-PMA})h_1 + \text{PMA}\cdot h_2,$$

where PMA is the percent of visits which are paid by Medicaid, and h is the average time spent with all patients. Therefore,

$$(14) \qquad \frac{\partial h}{\partial \text{PMA}} = h_2 - h_1 \lesseqgtr 0.$$

Including PMA in a correctly specified empirical equation for average time per visit will then empirically determine the sign of this partial derivative. If the estimated parameter on PMA in the average time equation is negative and significant, then it follows directly that Medicaid patients receive less time per visit than non-Medicaid patients.

Given that time spent per visit for Medicaid patients will

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[11] As far as the distribution of visits between v_1 and v_2 is concerned, the theoretical model affords little guidance. It is possible in this model for $v_1 \gtreqless v_2$. This issue remains an empirical question.

theoretically be less than time spent with private patients (a theoretical finding which, as mentioned above, can be tested), a natural next question might be, how much less? Will physicians spend only the minimum possible time with the Medicaid patient? This remains an empirical question. A test of the hypothesis that physicians will supply only the minimum possible time to their Medicaid patients is possible. If physicians are choosing the minimum possible quality, this quality *level* is determined, not by reimbursement levels or numbers of visits, but rather by the structure of costs (and is therefore, an exogenous factor). Therefore, changes in the reimbursement generosity will not affect the quality choice. If the quality supplied to Medicaid patients is greater than the minimum possible, then it is a choice based upon economic incentives, and changes in the Medicaid payment schedule will result in changes in the chosen quality level. Therefore, including the Medicaid reimbursement rate in the equation for average quality will support inferences about whether Medicaid patients are receiving quality in excess of the minimum possible.

Further exploration of this model reveals that the mix of visits is open. It is possible to have more or less Medicaid patients than private patients without violating the first order conditions described above. What remains, then, is to empirically test the implications for quality of care discussed above, and to explore empirically other behaviors and incentives of physicians which have not been addressed with this theoretical model. This empirical process is undertaken in the next section.

V. Empirical Approach and Results:

The theoretical discussion of the last section leaves a great deal of room for empirical exploration. It is clear that several effects of Medicaid on the market for physician's services must be specified. One of the central questions is what are the effects of the lower fee schedule and balance billing ban on the quality of physician service. How does the fee reduction affect the quality of this service? Is there evidence of a two-tier system of medicine in this country, and if so, does Medicaid contribute to it? Additionally, concerns about the availability of service to Medicaid patients are important. Though arguments can be, and have been, made about substitutability between physician service and hospital out-patient service, there is strong empirical evidence that the cost implications for such substitution are significant[12]. The goal of this section is to specify an empirical structure capable of illuminating these issues. Therefore, a four equation model is presented, including discussions of the relevant variables, their expected effects, and some interesting problems associated with two of the endogenous variables, time per visit and percent of patient load covered by Medicaid.

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12 This is the major thesis of Long, Settle, and Stuart (1986).

Data for this study are drawn from the *Physician's Practice Cost and Income Survey, 1976*. As discussed in Chapter II, a sample of 1436 observations is utilized for the current work. This consists of solo physicians in fee for service practices[13].

V.a, Empirical Specification:

Though past literature has employed simultaneous models in both the physician behavior and nursing home work discussed above, supply and demand systems are not specified. The current work hopes to ameliorate this situation. With this in mind, a four equation model of representative physician supply and demand forces is constructed. Three equations describe the supply choices of physicians, and one equation is reserved for demand side effects. The reasons for this are obvious. By ignoring the demand side of the market in supply explorations, not only is significant information lost, but serious biases are introduced into the estimates. In effect researchers are viewing reduced forms when they want structural parameters.

The current study models several choice variables on the supply side, in particular: total hours of service per week (H), average time per visit (h) as a proxy for quality, and percent Medicaid patients (PMA). The demand curve facing the representative physician is modeled as an inverse demand curve. Consumers are assumed to demand total hours of service per week from physicians.

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[13] See the previous chapter for details of the data source.

The four equation model is specified as:

$$\text{(15)} \quad \log H = \alpha_1 + \alpha_2 P + \alpha_3 P^2 + \alpha_4 IRMA + \alpha_5 PMA + \alpha_6 EX + \alpha_7 WNP + \alpha_8 URB + \alpha_9 BRD + \alpha_{10} CLR + \alpha_{11} LAB + \alpha_{12} XRAY + \alpha_{13} IMM + \alpha_{14} PNCP + \alpha_{15} PHV + \alpha_{16} POS + \alpha_{17} MTR + \alpha_{18} MALPP + \alpha_{19} AUTO + \alpha_{20} NUR + \alpha_{21} COMC + \alpha_{22} COBS + \alpha_{23} COPI + \alpha_{24} OPS + \sum_{i=25}^{38} \alpha_i SP_{i-24} + e_1,$$

$$\text{(16)} \quad \log h = \beta_1 + \beta_2 P + \beta_3 P^2 + \beta_4 IRMA + \beta_5 PMA + \beta_6 EX + \beta_7 WNP + \beta_8 LAB + \beta_9 XRAY + \beta_{10} IMM + \beta_{11} PNCP + \beta_{12} PHV + \beta_{13} MTR + \beta_{14} MALPP + \beta_{15} AUTO + \beta_{16} NUR + \beta_{17} COMC + \beta_{18} COBS + \beta_{19} COPI + \beta_{20} OPS + \sum_{i=21}^{34} \beta_i SP_{i-20} + e_2,$$

$$\text{(17)} \quad \log PMA = \gamma_1 + \gamma_2 P + \gamma_3 IRMA + \gamma_4 EX + \gamma_5 URB + \gamma_6 BRD + \gamma_7 CLR + \gamma_8 LAB + \gamma_9 XRAY + \gamma_{10} IMM + \gamma_{11} PADM + \gamma_{12} PHV + \gamma_{13} MTR + \gamma_{14} NUR + \sum_{i=15}^{28} \gamma_i SP_{i-14} + e_3,$$

$$\text{(18)} \quad \log P = \delta_1 + \delta_2 H + \delta_3 PMA + \delta_4 h + \delta_5 MIN + \delta_6 AGE + \delta_7 WNP + \delta_8 URB + \delta_9 BRD + \delta_{10} NAM + \delta_{11} FRD + \delta_{12} NE + \delta_{13} NC + \delta_{14} SO + \delta_{15} COMC + \delta_{16} COBS + \delta_{17} COPI + \sum_{i=18}^{31} \delta_i SP_{i-17} + e_4.$$

In this notation, P represents the market price for an hour of

physician service (i.e. a wage rate), H denotes total hours of service provided per week, h indicates average time spent per patient, the proxy for quality, and PMA is the percent of patients who are covered by Medicaid[14].

One feature of this model is its similarity to the model presented in Chapter II. The primary differences are the inclusion of an equation on the supply side to describe the choice of Medicaid patient proportion, and the addition of several new variables. For a discussion of the justification for, and expected sign of, those variables in (15), (16), and (18) which are the same as in the previous chapter, the reader is referred to pages 37 through 45 of Chapter II. However, equation (17), and several additional influences in the other equations require discussion.

As mentioned in the previous section, the theoretical model provides no insight into the actual mix of visits chosen by the physician. This is an empirical question. Equation (17) is included in the supply side in order to unravel influences over the patient mix decision. Two obvious variables are those related to compensation, the market price, P, and the percent of the usual fee paid by Medicaid, IRMA. Prior expectations are the strongest for

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14 In addition to the semi-log specification of equations (15)-(18), a linear model is also estimated. Though the results are generally consistent between the two, some differences exist. These are discussed below.

IRMA (with the expected sign being positive), since increases in the generosity of payment per visit should encourage more visits. The sign of P is less clear. While increases in the market price for private patients (P) should lead to increases in the number of visits supplied to these patients (and so a decrease in PMA), the reimbursement method of Medicaid is typically based upon the market price. Therefore as P increases, the net price received by physicians for Medicaid patients also increases, encouraging more service to Medicaid patients. For this there is no strong prior expectation on the sign of P.

Other variables in (17) are included due to their ability to identify influences specific to an individual physician. Board certification (BRD), for instance, is often a mechanism used by physicians to acquire referral business. Physicians typically refer their patients only to physicians who are board certified, in order to limit their own liability. Therefore, a physician who is board certified signals that he or she is interested in referrals, and as such may signal less interest in Medicaid patients. The expectation is that BRD will have a negative effect on PMA. The dummy for an urban setting for the practice, URB, is somewhat uncertain in its sign. Urban environments provide physicians with a larger patient pool from which to draw. If physicians do have a preference against servicing Medicaid patients, then it is likely that those operating in a more densely populated region will choose to see fewer Medicaid patients, reducing PMA. URB is one indicator of physician preference, *ceteris paribus*. The experience level of physicians

(EX) is another method of indicating whether physicians do or do not have strong preferences for Medicaid. As physicians gain experience, practices usually grow, allowing greater flexibility in picking PMA. A negative sign on EX would indicate, like a negative sign on URB, that physicians prefer not to serve Medicaid cases (note, these effects are independent of compensation, which is controlled for with P and IRMA).

The marginal tax rate, MTR, is included since marginal visits, by producing income for the physician, will result in additional tax burdens. This will affect the physician's decision whether to accept a patient on the margin, and since Medicaid patients result in lower revenue per visit, MTR must be included in this equation. As such, one might expect the sign of MTR to be positive, though this is certainly not a strong *a priori* expectation.

The variables on the percent of visits for which laboratory tests (LAB) or x-rays (XRAY) are performed, the percent of visits which involve immunizations (IMM) and the percent of visits which take place in a hospital (PHV) are included due to their impact on the type of visit which the physician supplies. With the exception of PHV, there are no strong expectations on sign, though one might expect LAB and XRAY to negatively affect PMA (since they would tend to increase the costs of providing a visit, both in supplies and time), while IMM may show a positive influence (since less time is required). PHV is expected to have a positive effect since the rules for reimbursement are often different. In some instances, Medicaid services performed in a hospital are reimbursed at a 100%

rate (though the physician does not usually receive all of this)[15]. The variables measuring nursing (NUR) and clerical (CLR) staff are expected to have a positive effect on PMA, insofar as these resources can be substituted for physician time. Lastly, the percent of total physician time devoted to administrative duties, PADM, is included to control for the different administrative burdens imposed by Medicaid, an often-documented observation.

In addition to the equation for PMA, several variables are included in the other equations which do not appear in the model discussed in the last chapter. One of the key variables in this current analysis, PMA is included in the average time per visit equation. This addresses one of the central concerns of this chapter, specifically, what effect Medicaid has on the quality of service offered by physicians. As seen in the last section, theory predicts that less time is spent with Medicaid, as compared to private, patients. Therefore PMA is expected to have a negative and significant effect on the average quality of service, since as the percent of patients in the practice who are covered by Medicaid increases, the average time spent with patients should go down. As noted from equation (14), a negative and significant sign on PMA directly implies that Medicaid patients receive less time per visit

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[15] This may imply that PHV is endogenous in nature. However, modeling the incentives behind PHV as a choice variable is beyond the scope of this chapter.

than their non-Medicaid counterparts.

A second key variable, IRMA, the average percent reduction in the physician's fee due to Medicaid, is added to (16) in order to determine what quality of care is provided to Medicaid verses non-Medicaid patients. As such, this is one of the key variables of the model. As discussed in the last section, the distribution of quality is an empirical question. Theoretically one knows that the quality of care provided to Medicaid patients will be lower than that provided to non-Medicaid patients. Also, there is no incentive to physicians in the Medicaid reimbursement system to change the level quality of service provided. This allows inferences to be made about the quality offering made to Medicaid patients, even though only the average (across Medicaid and non-Medicaid patients) quality offered is observed. The physician has two choices in allocating quality to Medicaid patients, provide the minimum possible quality, or provide some level of quality in excess of minimum. If the choice is made to provide the minimum level, then the determination of the actual amount of quality will be, in essence, exogenous. The minimum quality level possible is determined by structural factors, absent any economic incentives (that is, how fast can the physician assess a patient's condition and complete the required paperwork). Therefore, the significance of IRMA will provide a test of quality provided to Medicaid patients. If the quality choice is supra-minimal, then it must be based upon revenue and cost considerations. Changes in the price for a Medicaid visit will affect revenue, and therefore the quality

choice. If only the minimum (exogenously determined) quality is offered, then changes in IRMA will have no affect on the quality level chosen. Therefore, whether IRMA is significant or not in the equation for average time will provide a test to indicate what level of quality is being provided to Medicaid patients[16].

Another new variable appearing in (16), the number of hours per week devoted to operations or surgical assists, (OPS) is included in order to control for the longer time required per visit for surgeries. In interpreting time per visit as a proxy for quality, it is important to include factors which increase the time per visit proxy without necessarily affecting quality in the *ceteris paribus* bundle. For this reason, the OPS variable appears in the time per

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[16] Since average quality is a combination of quality provided to Medicaid *and* non-Medicaid patients, it might seem that a significant parameter on IRMA could fail to reject the hypothesis that only the minimum quality is provided Medicaid patients, since the physician might be shifting toward, or away from, Medicaid patients in response. In this case the longer time provided to non-Medicaid patients could make it appear as if there is a relationship between IRMA and h. However, this is not the case since the proportion of Medicaid patients in the practice, PMA, also appears in the h equations, and so is included in the *ceteris paribus* bundle. Therefore, a significant sign on IRMA can reject the hypothesis of minimal quality for Medicaid patients.

visits equation, since more operations will imply longer visit times without necessarily reflecting increased quality.

The other new exogenous variables which are included in the equation on average time capture insurance effects. As discussed below, if the effect of insurance is to encourage patients to seek medical care closer to the point of zero marginal benefits, then this effect must be taken into account before physician behavior with respect to quality of care can be explored. This is a particularly significant influence for Medicaid patients who have zero out-of-pocket costs. The Medicaid effect is, unfortunately, uncapturable; however, observations on copayments from other insurance schemes allow these effects to be controlled, and provide information on which inferences about Medicaid can be drawn. Therefore, COMC, COBS, COPI= the copayment percentage for which patients are responsible for Medicare, Blue Shield, and a major private insurer (respectively), are included. These are generally demand side influences, however they are included in the average time equation because of their potential effects on the type of visit supplied. As mentioned above, with a zero copayment, Medicaid patients can be expected, *ceteris paribus*, to consume health care to the point that the marginal private benefit equals zero. This means that such patients will be seeking medical care for more trivial problems as they drive marginal benefit down, and so the visits provided by physicians will be less demanding. This is expected to produce shorter visits, not because quality is diminished, but because the nature of the visit is altered by the lack of a

copayment. Therefore, to attempt to gauge the potential of such effects, these "demand side" variables are included. This is necessary if accurate inferences about *quality* are to be drawn from the average time equation. Also, since these copayment terms are, conceptually, demand side influences, they are included in the demand equation in the place of the percent insured variables utilized in Chapter II.

Another modification is the inclusion of the percent of total time spent in non-patient contact, PNCP, in both the average time per visit and total hours equations. As such, this variable is simply the complement to PCP used in Chapter II. It is included in this form to test whether physicians who perform many non-medical activities themselves tend to work more or fewer total hours. Since the type of activities included in non-contact time (administrative burdens, professional meetings, and other practice-related activities) are not directly revenue generating, it is uncertain as to what sign to expect. PNCP is included in the average time per visit equations in order to determine if physicians treat non-contact time as a substitute for contact time. In other words, will an increase in the physician's non-contact burden reduce the time spent with each patient?

The new exogenous variables added to the average time per visit equation also appear in the total number of hours per week equation. The reason for this, as discussed in the previous chapter, is the identity between total hours per week, visits per week, and average time per visit. Since total hours is just a linear combination of

average time and total visits (even in this expanded model), the set of variables on average time must be a sub-set of the variables influencing total time. For this reason, the variables discussed above, posited to affect the average time per visit, must also be included in equation (15). The expected signs in (15) are uncertain, however, since these variables are expected not only to affect average time but also the number of visits.

The only changes to the demand equation specified in (18) from Chapter II is the treatment of insurance and quality. While in the previous chapter, insurance variables were simply the percents of a physician's practice insured privately and publicly. In this specification, the percent of the practice covered by Medicaid, PMA, is included in the demand equation, with a positive expected influence. Additional insurance variables are COMC, COBS, and COPI, discussed above. These variables are expected to have a negative effect on demand. That is, as the copayment required of patients per visit increases, patients will demand fewer units of service. Additionally, the proxy for quality, h, is added to the demand equation. Patients are expected to place a positive valuation on quality.

V. b, Estimation Technique and Results:

The model discussed above is estimated with Non-Linear Three Stage Least Squares (NL3SLS). Since this model contains four endogenous variables which are simultaneously determined, a method capable of consistently estimating a set of simultaneous equations

is required. NL3SLS is one option, chosen, in this case, due to its potential efficiency gain, since the process takes a system-wide approach to estimating the parameters. One potential problem is that since information from the covariance matrix of all four equations is used in the estimation process, errors in specifying one of the equations will spill into the other three. One advantage, in addition to efficiency properties, is the fact that NL3SLS can handle over-identified equations. In this case, all equations are over-identified.

The results from the estimation conform well to the theoretical expectations discussed in the last section. In fact, this model produces results which support inferences about the effects of Medicaid on the quality per visit distribution between Medicaid and private patients, and also provides interesting policy implications. The results are presented in Table 7.

The second column in Table 7 presents the results from the equation estimating average time per visit, the current proxy for quality, and contains many of the central results of the current chapter. The endogenous variable, h, is average time spent per visit for all patients. The first result of note is that physicians vary the quality of their service based upon compensation. P is positive and significant, while P^2 is negative and significant. This implies a backward bending relationship with quality. As the wage rate increases, physicians initially offer greater quality of service. However, at some point increases in the hourly wage rate will encourage a physician to offer a marginally lower quality of

care. The estimate of the wage rate at which quality begins to diminish is approximately $34.35. All specialties except three have wage rates in excess of this amount. Equally important as the wage rate at which this curve bends back is the time per visit at which this curve bends back. Table 9 presents the estimated critical (h^c) backward bending number of minutes per visit, estimated at the mean. Most estimates of h^c are slightly larger than those presented in the previous chapter, though the confidence intervals are not dramatically different. Another difference is that physicians in this model are operating on the negatively sloped portion of quality. One question that remains is how the quality of care is distributed among Medicaid and non-Medicaid patients.

In the last section the distribution of quality of care was explored theoretically. It was shown that physicians operating under the current structure of Medicaid will offer a lower quality of care to Medicaid than to non-Medicaid patients. Empirically this is indicated. Despite the fact that only average time per patient (for all patients) is observed, inferences can be drawn about the behavior of physicians with respect to the two groups in question. As discussed above, the significance of the parameter on IRMA (the reduction in fee resulting from Medicaid) is of critical importance in evaluating the level of care being offered to Medicaid patients. Table 7 indicates that the parameter on IRMA is insignificant. In addition to this traditional t-test, a likelihood ratio test is run for the system as a whole, with the restriction that the parameter on IRMA in the average time equation is equal to zero. The

resultant test statistic, which has a chi-squared distribution with one degree of freedom, is .78, which cannot reject the hypothesis that IRMA has no effect on average quality. A second likelihood ratio test is run on the hypothesis that IRMA has no supply side effects at all (that is, that the parameter estimates on IRMA in all three supply side equations are not significantly different from zero, jointly). The test statistic in this case is 1.88, again failing to reject the null hypothesis. This implies that as the generosity of Medicaid payments increases, the quality offered to Medicaid and non-Medicaid patients does not change[17]. As discussed above, this indicates that the quality offered to Medicaid patients is the lowest possible level. It seems evident from this result alone that the current Medicaid system not only creates a two tiered system, but also traps those covered by Medicaid into a tier which allows them to receive only the lowest possible quality of care. The results from a more direct test of the existence of a two-tiered system are presented below.

The policy lesson to draw from this result is that the

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[17] An alternative hypothesis which is not rejected by this result is that times per visit to Medicaid and non-Medicaid patients do change in response to IRMA, *but always in equal and opposite directions*. Though this condition would produce the observed insignificance of IRMA on h, this behavior seems unlikely. There is certainly no reason to expect physician's to behave in this manner.

structure of Medicaid completely circumvents the market mechanism which allows patients to respond to higher quality with higher demand. The only way to correct the problem of minimal quality is to restructure the way Medicaid payments are made. Allowing limited balance billing, or a small copayment, would provide patients with a mechanism to acquire higher quality. Physicians who increase their quality offerings to Medicaid patients would receive increased compensation, and so the incentive for some supra-minimal quality level would be established.

A second indicator of the quality of health care provided in response to Medicaid is the estimate on PMA, the percent of the physician's patients covered by Medicaid. Here again, the results are consistent and strong. PMA has a significantly negative impact on average time per visit. That is, increases in the percent of Medicaid patients, *ceteris paribus*[18], encourages the average physician to offer lower quality care, *on average*. As demonstrated in the last section, if an equation for average time has been specified

[18] In fact, using a linear version of the model presented in equations (15)-(18), along with the identity in (14), it is possible to calculate h_1 and h_2 separately using the averages of h and PMA, and the parameter estimate on PMA in the average time equation. The resulting "estimates" show non-Medicaid patients receiving almost 40 minutes of physician time per visit, while Medicaid patients receive only slightly over 7 minutes per visit.

correctly, then a significant negative effect of PMA on average time directly implies that Medicaid patients are receiving less time per visit than non-Medicaid patients, *ceteris paribus*. This supports the theoretical hypothesis presented in the last section, that Medicaid patients will always receive lower quality care than non-Medicaid patients. In addition, as seen above, the quality of care is unaffected by the generosity of Medicaid fee schedules, implying minimal quality offerings to Medicaid patients. Lastly, the demand of private patients will respond to lower levels of quality on the margin, and so discourage quality cutting in the private patient market. Considering these factors, a convincing case can be made that the negative effect of PMA on quality of care supports the theoretical finding that Medicaid patients will receive lower quality care than private patients, and so a two tiered system of health care exists in the United States.

The structural reality which drives these empirical results is the failure on the part of Medicaid to provide necessary incentives. Physicians are reimbursed by Medicaid based upon providing a visit to a patient. However, no mechanism exists, as it does in the private market, to adjust payment to the physician for providing a higher quality of service. Federal law prohibits physicians from billing Medicaid patients for the portion of a bill which is not covered by Medicaid. Additionally, individuals in this program neither pay premiums or any form of copayment. Therefore, Medicaid patients pay no out of pocket expenses, and so the aspect of their demand which responds positively to higher quality is circumvented.

Medicaid patients cannot willingly pay more for higher quality service since the physician is required to accept payment from the Medicaid program as full compensation (no balance billing). The program itself does not pay more for higher quality. Therefore, a two-tiered system results, with Medicaid patients relegated to the bottom tier. They receive a lower level of care (presumably minimal since there is no response in quality to increased compensation for a visit) than their counterparts who are covered by insurance schemes which have a copayment, and so have a mechanism for patients demand for higher quality to be transmitted to the market. The policy implication of this is again clear: institute copayments.

Two other issues can be addressed with the results presented in Table 7. First, as mentioned above, one interpretation of the findings of negative correlations between the percent Medicaid patients and time spent per visit could be driven by the different nature of the visits of Medicaid and non-Medicaid patients. Specifically, the lack of a copayment (any payment whatsoever, in fact) could potentially encourage individuals covered by Medicaid to seek treatment for less significant complaints. Only non-price costs, such as transportation and waiting time, would prevent such patients from driving the marginal benefits from health care to zero. The variables for the copayment percents from three major types of health insurance, Medicare (COMC), Blue Cross (COBS), and a representative private insurer (COPI), are intended to capture some of this effect. Though the one significant parameter, on COBS, is of the expected sign, the other copayment parameters are

insignificant. The estimate on COBS indicates that increases in copayments tend to lead to increases in times per visit[19]. One interpretation (and the interpretation advocated here) is that increasing the marginal costs of seeking an additional doctor's visit discourages patients from seeking health care for more trivial problems. This means that the presence of copayments can significantly reduce the social costs of health insurance which rise

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[19] One might wonder whether the insurance effect were the dominant force in controlling time per visit. This view is a hypothesis at odds with the model presented in this chapter, and can be tested. If Medicaid patients receive less time per visit only because they seek aid for trivial complaints, then the implication is that physicians supply time per visit solely on the basis of patient need. If this is true, then h is simply a random variable dependant upon the flow illnesses into the practice, and is not a physician choice variable. To test this hypothesis, a likelihood ratio test is run across specification of a model with h as a choice variable, and a model with h as an exogenous influence. The test statistic, (which will have a chi-squared distribution with 33 degrees of freedom under the null hypothesis) has a value of 775, rejecting the hypothesis that h is not a choice variable. This implies that the difference in times per visit between Medicaid and non-Medicaid patients is not driven entirely by a lack of copayments.

from excessive consumption[20]. This result must be treated with less confidence, given the generally poor results on the copayment terms.

However, there is at least some evidence that the lack of a copayment for Medicaid patients may, by itself, tend to lead to less time per visit provided. This is not due to the market price, Medicaid fee schedule, or other factors already discussed; these are controlled by other variables. Again, a plausible explanation is that with zero marginal costs, Medicaid patients are seeking health care services too often, and so are more likely to be seen by a physician for less severe conditions which require less time to diagnose and treat. How much of the decrease in time per visit is due to this, and how much due to the incentive problems outlined is unclear. Further study needs to be conducted in order to gain more insight into the quality effects of Medicaid. However, the evidence indicates that the lack of copayments and marginal physician compensation for quality combine to produce a system in which Medicaid patients consume an inefficiently large amount of lower quality service.

Other results on the non-Medicaid variables are completely consistent with the results and interpretations presented in the last chapter.

In addition to the significant results from equation (16), the

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[20] See Freidman, (1973) for a discussion of the potential welfare losses associated with full insurance.

equation on total hours performs well. These results are presented in the first column of Table 7. The parameters on P are positive and significant, while the parameters on P^2 are negative and significant. This result implies a backward bending supply of labor curve, as found in the previous chapter[21]. Table 8 presents the estimated critical value of the number of hours per week (H^c) that the curve begins to bend back. The results indicate a backward bending point for most physicians which is somewhat larger than the estimates of H^c presented in Table 3. The estimates are not dramatically different[22].

However, there are differences in the estimates for both H^c and h^c. This could indicate that the current structure is superior to

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[21] See the first essay of this dissertation, **Quantity and Quality Tradeoffs in the Market for Physicians' Services**, for a more thorough exploration into the nature of the supply of services curve. Evidence is presented there that the curve is backward bending and that the average physician operates on the backward bending portion.

[22] Table 10 presents estimates of the elasticities of demand, supply of total hours, and supply of quality, calculated at the means. Despite the fact that the estimates of the elasticities of total hours are somewhat different. This will be an important consistency in the next chapter.

the model explored in the previous chapter. Though the two models are not directly comparable, since there is inconsistency in the variables used, inferences are possible. A likelihood ratio test was run on the current model with the restriction that the PMA equation not appear. The restricted, three equation, model is not identical to the model from Chapter II, but it is quite similar. The test statistic, which has a chi-squared distribution with 27 degrees of freedom, equals 95.02, rejecting the null hypothesis that all parameters in the third equation (with the exception of the intercept) are equal to zero. This implies that the four equation model is a more correct specification of the market than the three equation model explored in the previous chapter[23].

Signs on the other significant parameters are as expected. Board certification has a positive effect on the numbers of total hours supplied, though the parameter is only significant in the

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[23] This result sheds light on the competitiveness of the market. As such, the support for the model utilized in this chapter indicates that the presence of a regulatory body (in the form of State and Federal control of Medicaid) influences the behavior of physicians and patients in this market. Since such exogenous influences do appear to affect the market, one cannot argue that the market for physicians services is perfectly competitive. How extensive the impact on the market is of this governmental influence remains an important topic of future research.

linear specification. Presumably, a physician obtains board certification in order to present a signal of quality to the market, and also to obtain referral patients (since physicians are much more likely to refer a patient to a board certified colleague in order to limit their own liability). Therefore, though board certification can be considered, in large part, a demand side variable, it does signal a slightly different incentive structure on the supply side as well.

A more interesting result concerns the percent of total hours which are devoted to non-patient contact (e.g. administrative duties). The parameter estimates find that PNCP is positively related to the total number of hours provided. Since we have physicians who are maximizing utility and profits simultaneously, while choosing a utility maximizing number of total hours to work, they must also choose how to devote these work hours. The positive and significant relationship displayed in both the linear and semi-log specifications is interesting since it implies that a higher percent non-contact time provided by a physician will result in more total time supplied. This seems to imply that activities such as professional meeting and administrative duties are not strong substitutes for patient contact time. If they were, then increases in non-contact demands on the physician time would be met by decreasing patient time, not by supplying more total time. This indicates that physicians may be compensating for the added administrative burden of Medicaid by working more and not necessarily by reducing the number of Medicaid patients seen.

Sloan, et al. (1978), in evaluating physician participation in Medicaid, found support for the widely-held belief that Medicaid imposes extraordinary burdens on physician time. In particular, they report that physicians must spend a significantly greater amount of their own time in filing Medicaid forms than in filing forms for any other insurer. The result on PNCP implies that physicians may well be absorbing the brunt of this burden[24].

As far as other issues surrounding Medicaid are concerned, these effects are captured in the parameters on PMA and IRMA. The percent of patients enrolled in Medicaid, PMA, has a significant negative effect on total hours of labor supplied. This is apparently not directly due to the low reimbursement rate (at least as far as the decision on total hours is concerned) since the parameter on IRMA is consistently insignificant. It seems that the presence of Medicaid patients, ceteris paribus, reduces the number of hours worked. In the discussion of the results from the average time per visit equation it is shown that this effect may be traced to the lower time spent with each Medicaid patient. If less time is spent per visit, then holding the number of visits constant, less

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[24] This might seem to imply that some of the effects of PNCP are due to Medicaid. For this reason, a version of the model was run including an interaction term between PMA and PNCP in the total hours equation. However, this parameter was insignificant in sign, and the results from other parameters were not affected.

time is required overall. However, a more interesting interpretation is possible. In the demand equation, the effect of not admitting Medicaid patients to the the practice (captured in the dummy variable, NAM) is positive and significant. This implies that patients place greater value on the services of physicians who do *not* service Medicaid patients. The unwillingness to serve Medicaid patients may serve as a signaling device, and imply that physicians who supply the highest quality service (and who work greater numbers of hours per week) select out of the Medicaid market.

The inverse demand equation also performs well and as expected, as seen in the fourth column of Table 7. The sign on the total hours parameter is negative, and significant. Additionally, board certification has a positive, and significant, effect on demand in two of the three models estimated. This fits well with the results from the total hours equation,which showed a similarly positive effect of board certification on total time spent. This is a very intuitive result, since certification should signal higher quality, *ceteris paribus*. Additionally, one sees that the effect of h, the quality proxy, on price is positive and significant. This implies, as expected, that patients place a positive value on increased quality.

The other variables of interest in the demand curve are the copayment terms for Medicare, Blue Cross, and private insurance (COMC, COBS, and COPI, respectively). These variables are included to capture incentive effects on increasing the marginal cost of seeing a physician. It is, perhaps, surprising that the estimated

parameters display such poor significance (and even more surprising that the one parameter which is significant is positive, an unexpected sign which may reflect income effects). One would presume that as out-of-pocket expenses increase, fewer hours of physician service are demanded, and so price falls. Evidence does not support this, however. More can be said about the copayment effects in the average time per visit equation.

The third column of Table 7 displays the results from the estimation of the percent Medicaid choice equation. Here one finds an interesting result. The parameter on P is insignificant (this is also true in the linear model)[25]. With very broad confidence intervals which encompass zero, the current estimation indicates that the wage rate has no effect on the patient mix. That is, the private patient pay scale does not appear to affect the proportion of private to Medicaid patients. However, while the variable IRMA, or the percent discount the physician must accept when treating a Medicaid patient, is insignificant in the semi-log model, it does show up as significant in a linear specification (with an estimated coefficient of 0.09, and a t-statistic of 2.79, corresponding to a .01 level of significance). This is the only major difference between a semi-log and linear specification. As such, the linear result implies that as the percent of the normal fee covered by

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[25] A model was also estimated with P^2 in the PMA equation, but with similar, insignificant results.

Medicaid increases, the percent of patients in the practice covered by Medicaid also increases. Again, this has a direct policy interpretation. As seen in many empirical studies, there is some indication of a problem with availability of service for Medicaid patients. The current study also indicates that if one wishes to increase physician participation in Medicaid, one option is to increase compensation to the physician. A second option would be to allow balance billing, at least on a limited basis. This tack has the advantages of not only increasing compensation to the physician, thereby increasing participation, but at the same time providing a type of copayment for the Medicaid recipient. This would therefore simultaneously address the lack of availability, high price, and inefficient consumption of service by Medicaid patients (due to the marginal benefit equal to zero effect discussed above).

The consistently negative and significant sign on the dummy variable representing urban or rural location of the practice in the percent Medicaid equation of Table 7 is an indicator that physicians reveal a preference for non-Medicaid patients. Physicians in urban areas are operating in more densely populated regions than their rural counterpart. This implies a larger pool from which to draw patients, and so a greater ability to choose patients with more "desirable" traits. The results imply that, given a wider choice of patient mix, the average physician will opt for fewer patients who are under Medicaid. Note that this result arises even after the effects of wages have been controlled, implying that it is not a price effect which drives this relationship. Physicians apparently

prefer, *ceteris paribus*, fewer to more Medicaid patients. If this is not due to the lower compensation received (this is captured by IRMA, P, and P^2), what could be driving it?

Part of the answer lies in the interpretation of the parameter estimate for PADM, the percent of physician time devoted to administrative duties. The results indicates that higher levels of administrative time are associated with high proportions of Medicaid patients[26]. The increased burden of administration effort associated with increased percentage of Medicaid patients in the practice may be one explanation for the desire to support as few Medicaid patients as possible. Reducing the administrative burden of filing Medicaid forms is therefore expected to increase physician's propensity to accept additional Medicaid patients. A related line of reasoning applies to the sign on the CLR variable. In this instance the estimation finds that increases in the number of clerical workers tends to increase the willingness of the physician to accept Medicaid patients. Once again, this points to the potential burden of paperwork associated with filing Medicaid forms. With more employees devoted to this activity, the physician is

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[26] The positive sign is perhaps an indication of the endogeneity of PADM. Intuitively, it is not the increase in administrative burden that causes physicians to choose to service more Medicaid patients, rather the causality should run in the other direction. Further work toward endogenizing non-contact time is required.

willing to incur larger administrative costs. In this case, the clerical worker time is a clear substitute for physician own-time. There are implications for policy in the parameter estimates on CLR and PADM. Past literature on physician participation in Medicaid has often discussed the potential burden of paperwork. Sloan, et al. (1978) actually find evidence that Medicaid administration costs are higher than for all other forms of insurance. The current work indicates that physicians respond to this burden by displaying a preference for non-Medicaid patients. Increasing participation by physicians in the Medicaid programs can therefore be aided by decreasing the paper burden under which the physician must operate.

One last set of results which are interesting from a policy perspective are the parameter estimates on percent hospital visits, PHV, percent laboratory tests, LAB, and percent immunizations, IMM. Both LAB and IMM have a significantly negative effects on PMA. This may indicate some decrease in testing and preventative medicine associated with higher percents of Medicaid patients in a practice. In addition, one sees that a high PMA is associated with high PHV. That is, physicians with a large percent of their patients covered by Medicaid tend to have a higher percent of their visits in a hospital. This is most likely a result of the incentive structure of Medicaid which often reimburses hospitals and physicians at a higher rate for hospitalization, rather than preventative, office-based, care. From a public policy perspective, this is particularly disturbing, since it appears Medicaid encourages the substitution of more cost effective preventative care, for much more

costly hospital care.

The results of this empirical exploration of the market for individual physician's services generally supports the theory developed in the previous section. Specifically, this study indicates that the current structure of Medicaid tends to encourage a two-tiered system of health care, with Medicaid patients receiving fewer, and lower quality, visits.

VI. Further Extensions:

One of the primary goals of this paper is to explore the effects of Medicaid on the quality of physician service. Though interesting and useful inferences can be drawn from modeling h directly, the effect of Medicaid on time per visit for Medicaid patients (h_m) and time per visit for privately insured patients (h_p) is also of interest. Unfortunately, a problem exists. As an empirical fact, only observations on the average time per visit, $\bar{h}$, are available. We cannot directly observe h_m and h_p which means these important variables cannot be modeled directly. However, these variables can theoretically be estimated.

Assume h_m and h_p can be modeled according to the following structures:

(19) $$h_m = X\beta_m + e_m,$$

(20) $$h_p = X\beta_p + e_p,$$

where the time per visit for Medicaid patients and time per visit for privately insured patients share the same explanatory variable set, but respond in different fashions. In addition, these factors are governed by the identity:

(21) $$h = (1-k)h_p + kh_m,$$

where k is the percent Medicaid patients (PMA in the previous section), an observed variable. By substituting (19) and (20) into (21), one finds:

$$h = (1-k)(X\beta_p + e_p) + k(X\beta_m + e_m),$$

$$= kX(\beta_m - \beta_p) + X\beta_p + v,$$

(22) $$h = Z\delta + v,$$

where $Z = [kX , X]$, $\delta' = [\beta , \beta_p]$, $v = ke_m + (1-k)e_p$, and $\beta = \beta_m - \beta_p$. Using this structure, the parameters β and β_p can be estimated consistently and without bias by using a Generalized Least Squares methodology (within the framework of Three Stage Least Squares, required by the simultaneous nature of the system). Given consistent estimates of these parameters, estimates of time spent per Medicaid and non-Medicaid patient per physician can be obtained simply as:

(23) $$\hat{h}_p = X\hat{\beta}_p,$$

and

(24) $$\hat{h}_m = X(\hat{\beta} + \hat{\beta}_p).$$

This allows inferences to be drawn on not only the effect of Medicaid on average quality, but the extent of Medicaid influence on a two-tiered system and quality discrimination by physicians based upon insurance payment schemes.

Unfortunately, attempts to use the structure discussed above to estimate the time per visit for Medicaid and non-Medicaid patients separately have proved unsuccessful. Though theoretically possible, introducing the structure discussed is unproductive. A high degree of multicollinearity exists among all variables in the time per visit equation, and so parameter estimates are biased and inconsistent. To date, it has not been possible to implement the model required to estimate h_p and h_m directly.

VII. Conclusions:

Since its inception in 1965, Medicaid has been at the center of controversy concerning its effectiveness and impact on the American health care system. Concurrent with this debate, a long-running concern about increased costs and decreased availability of health care has been voiced in the economics literature and popular press.

Many have concluded that the failure of Medicaid to achieve its goals, and the perceived collapse of health care generally in this country, can be blamed on physicians. Physicians are often condemned for having market power, the ability to induce demand, and an unwillingness to treat people covered by Medicaid. Therefore much of the effort in the past has been to explore issues surrounding low participation rates of physicians in the Medicaid programs.

The current work takes a somewhat different approach, focusing primarily on the qualitative effects of Medicaid. Several aspects of the current structure tend to produce less than optimal results. It has been shown theoretically that under the current reimbursement scheme, Medicaid produces a two-tiered system of care, with those individuals covered by Medicaid receiving lower quality care than their privately insured counterparts. Empirically this result is borne out. High percents of Medicaid patients in a physicians practice correspond to lower average levels of quality. Additionally, an empirical test utilizing the generosity of Medicaid reimbursement suggests that patients covered by Medicaid receive the lowest possible quality of care. The argument is made that Medicaid, by neglecting any method to compensate physicians for higher quality, is responsible for this effect. Further results indicate that this quality effect is exacerbated by the fact that no out of pocket expense for Medicaid patients can encourage inefficiently high levels of consumption.

The policy implications from this work are two-fold. First, in searching for culprits in the increasing costs of health care, one

should not ignore the potential role of the government for its structuring and handling of medical subsidy programs. Secondly, in discussing the problems of Medicaid, one should not ignore the problems associated with the quality of service. As it stands, evidence indicates that the lack of any copayment for the patient, and (or) the ban on balance billing on the physician has two unintended, negative effects, namely they decrease the willingness of physicians to service Medicaid patients, and they encourage the provision of lower quality to those patients who are serviced. As a policy, the total ban on balance billing and complete lack of copayment should be questioned.

CHAPTER IV

THE EFFECTS OF QUALITY CONSIDERATIONS ON EMPIRICAL EVIDENCE FOR THE THEORY OF SUPPLIER INDUCED DEMAND

I. Introduction:

Since the early 1970s a debate has raged in the field of health economics concerning whether the market for medical services is competitive, or has monopolistic elements. Coincident with this discussion in the economics literature has been a growing concern over the rising cost of health care in the United States. This dramatic increase in expenditures on medical services has been attributed to many sources, primarily physician monopoly power. Most casual observers, and many serious students, accept without questioning the *a priori* assertion that physicians possess and wield a large amount of market power. This market power is commonly thought to arise from information asymmetries between patient and physician. Physicians, it is argued, not only supply medical services, but also act as an agent for the patient in determining

the quantities of this service that is to be consumed. Many researchers hypothesize the breakdown of this agency relationship such that physicians encourage patients to consume medical care, not based upon medical need, but rather based upon the profit maximizing incentives of the physician firm. This hypothesis is known as supplier induced demand (SID).

Newhouse (1970) begins the modern discussion of this theory when presenting empirical evidence concerning the competitive nature of the physician market. The debate is further shaped by researchers such as Fuchs (1978), Stano (1985, 1987), Evans (1974), and Reinhart (1985) who support the hypothesis, and by writers such as Feldman and Sloan (1988), and Green (1978), who feel the theory is incorrect. Methodologies which produce confirming evidence are as varied as methodologies which tend to reject the hypothesis. There is general, though not unchallenged, agreement over what would constitute support for, or lack of support for the hypothesis. Those supporting SID point to evidence that fees and utilization of physician services are both positively related to the density of physicians in a geographic area. Those opposing the hypothesis generally fail to find these relationships.

Many models are developed in hopes of lending solid theoretical legs to the debate; however one issue is uniformly discussed and simultaneously ignored (in actual theoretical and empirical modeling), that of quality. Many works dealing with SID discuss the importance of quality in the market for physician services, and the potential for quality to influence the observed empirical

relationships. However, no study purporting to test SID has actually incorporated quality as an influencing variable in the empirical tests performed. The possible contribution is easily seen. If one observes that as more physicians move into an area, thereby increasing competition, and the result is increases in price, it would be a serious omission indeed if the potential effects of quality choice are not considered. Physicians could easily respond to increased competition by product differentiation, through increasing the quality of their service. Even in a competitive market this increase in quality will be valued by consumers and may result, ultimately, in an increase in the net price of (higher quality) service. In other words, the market may resemble monopolistic competition.

This essay will examine the role played by quality in the market for physician service, and the contributions this consideration can have on the debate over supplier induced demand. Toward this end, a partial review of the literature concerning this long-standing question is undertaken in Section II. Following this a model of the physician firm is discussed and an empirical test of SID, with endogenous quality choice, is developed in Section III. Section IV contains a discussion of the results and policy implications. Finally, Section V concludes the paper with a summary of the debate in light of this additional information, and discusses the possible future of the hypothesis.

II. Literature Review:

The work performed to date can be categorized into three groups. Earlier work is more empirical in nature. Starting in the 1970s economists began to search for the empirical proof of the SID hypotheses. Beginning in the 1980s, more emphasis on theory led work in the field to combine theory and empirics in almost equal proportion. As this stage of the literature took hold, serious problems with the underlying theory were recognized, stimulating the emergence of a period, during the last half of the 1980s, of a series of articles strictly concerned with exploring potential theoretical underpinnings of the SID hypothesis, or the lack thereof.

Newhouse (1970) was among the first to explicitly discuss and present evidence that physicians can induce demand for their services. The principal stated goal of this work was to evaluate the presence, or lack, of competition in the market for physicians' services. He noted that researchers had assumed either monopoly power or perfect competition in driving empirical specifications. To correct this, Newhouse hoped to provide both a theoretical rational, and empirical evidence for one of the two views. He examined the potential for asymmetric information to endow physicians with market power. He suggested that price is an indicator of quality, physicians have little incentive to reduce fees. This leads to low cross-elasticity of demand and so, he

argued, the individual physician demand has an elasticity nearly identical to the market demand.

Empirically, Newhouse found evidence he felt supports his theoretical arguments concerning physician monopoly power. He noted a positive correlation between patient income and physician fees. This, he said, is evidence that physicians are not only monopolists, but discriminating monopolists. The evidence he cited is, however, a simple correlation, not a regression. If health care is a normal good, as is certainly expected, then increases in patient income will lead to increases in demand, and so higher price, even in a competitive market place. Newhouse ignores this potential interpretation of his evidence. Newhouse did decide, based upon this and other evidence, that the market for physician services is monopolistic in nature. Equally important for the current discussion, Newhouse mentioned that his evidence is also consistent with the view that physicians are satisficers, rather than profit maximizers. He discussed in a footnote the possibility that physicians have a target income and will stimulate demand for their services any time they fall short of this target. Newhouse's evidence and speculations helped set the stage for a great deal of later debate.

A second early paper which was instrumental in forming the debate over supplier induced demand is an article by Evans (1974). This piece also serves well to illustrate the role prior convictions have played in the tenor of the discussion of SID to date. To see such convictions at work, one need only read the first sentence of

this article, which begins:

> "*Everyone knows* that physicians exert a strong influence over the quantity and pattern of medical care demanded in a developed economy."[1]

Despite the opening sentence, this early work was a very influential voice in the chorus of those who support the hypothesis. Evans argued that the roots of this inducement effect lie in two areas. First, physicians must act as an agent for the patient, determining the nature and length of treatment, while simultaneously selling this same treatment as the product of his or her firm, thereby deriving profits. In this instance, Evans saw little possibility that physicians can act as perfect agents. Secondly, and most importantly, this situation is made possible by the vast information asymmetries which exist in this market. Patients are, almost by definition, ignorant of their health status and the best method of treatment. If they had this knowledge, the physician would be extraneous. Therefore, they must relay completely (in Evans' view) on the advice of a physician who suffers from the dichotomy imposed by professional ethics and the conflict discussed above.

Given these issues, Evans argued that it is not valid to discuss supply and demand as separate, independent, influences. Indeed, the concept of a demand for medical services (in the normal neoclassical sense of the word "demand") is meaningless. Evans argued (and he

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[1] See Evans (1974), page 162. Emphasis mine.

was among the first to do so explicitly) that increases in the physician to population ratio is likely to cause physicians to induce demand, thereby increasing fees despite competitive pressure. He noted that consumption is also likely to go up. Additionally, Evans argued that the presence of SID could eliminate any effects on physician work load due to increases in physician density (that is, individual work loads may not decrease even though greater physician density should imply fewer patients per physician).

Evans was not willing to completely abandon the neoclassical framework, however. Therefore, he proposed several potential theories to explain SID behavior by physicians. First, he noted that there is almost certainly going to be some demand frontier beyond which inducement will not be possible. With this recognition comes the responsibility to explain why patients are not always pushed up to this frontier by profit maximizing physicians. Toward this end he proposed two explanations. First, he argued one could consider physicians utility maximizers. The utility function he proposed contains profits, leisure, and "professional discretion." It is this latter maximand which imposes some cost to inducement, since physicians are assumed to feel guilt should they encourage consumption of their services for purely fiduciary reasons. Therefore, argued Evans, inducement will not take place unless the physicians are driven to it by increased competition.

A second possible theoretical foundation for SID was also proposed. This is that physicians choose some target income, which they constantly strive to achieve. This hypothesis also saves Evans

from addressing why demand is not always pushed to the frontier. Under this proposal, physicians insure that they supply only enough service to achieve the desired level of income. When physician density increases and there is downward pressure on fees, this pushes all physicians away from their individually chosen income targets (since fewer visits at lower fees results in lower revenue). One can argue that physicians will respond to competition by increasing fees. This would achieve the target income even at the lower number of patient visits supplied (since with higher physician density, a fixed number of patients must be divided among greater numbers of physicians). Alternately one can argue that physicians will induce demand such that greater numbers of visits result at the new, lower, fee level.

The "physician ethics" and "target income" hypotheses proposed by Evans set the stage for the majority of later debate, both pro and con. Those supporting SID typically relied upon one or the other of the proposals made by Evans. The rigor with which these hypothesis were presented, as will be shown, is not usually strong. Those who criticize the inducement hypothesis often attacked these foundations. Both appear quite *ad hoc*. How "discretion" is determined and how it interacts with utility is a point of contention with many later theorists. Additionally the formation of the specific "target" income is often attacked. Discussion of these two aspects of the debate is presented below.

Evans, like Newhouse, found some empirical support for the hypothesis of SID. This evidence is anecdotal in nature, consisting

mainly of correlations between physician density and work loads. However, the force of his evidence and arguments, coupled with those of Newhouse, are sufficient to fuel two decades of debate.

Fuchs and Kramer (1972) was one of the earliest purely empirical explorations of the issue. Their stated goal was to explain the factors which determine expenditures on physician's services in the medical market place. As such, they examined a number of important factors, insurance coverage, physician locational decisions, and availability of hospital beds, among others. Most importantly for the current discussion were their attempts to test the effects of the supply of physicians on the demand for their services. They found, using two-stage least squares on a six equation system with aggregated data, that the supply of physicians in an area is a significant, positive, influence on the demand curve for medical services.

On the surface their results seem clear: empirical evidence can be found for SID. They did use a simultaneous approach to estimating their model, actually specifying supply and demand curves, and identifying them econometrically. They did include price as an explanatory variable in the demand and supply curves. Lastly, they made physician location an endogenous choice variable. All of these factors strengthen the rigor of their work. However, serious problems persist. First, they utilized variables with questionable origins. In particular, their variable for average quantity in an area is derived in a complex manner from several distinct sources. The potential for biases, especially when one is deriving one of the

major endogenous variables of the system, is enormous. Secondly, an of most concern for the current work, they neglected the issue of quality of service. Though this factor was briefly discussed, no attempt was made to capture it empirically. Particularly when using aggregated data, as Fuchs and Kramer did, failure to account for a variable such as quality which can have significant effects upon the demand curve would seem an egregious error. As demonstrated below, this is an error repeated in every supply and demand estimation testing SID to date.

Contrary to Fuchs and Kramer, Jerry Green (1978) attempted a test of SID and finds no support for the hypothesis. Green reviewed the theoretical incentive for induced demand, target incomes and the constraint of physician ethics. He attempted to compare these to traditional neoclassical approaches. Significantly, he noted that if physicians change the *quality* of their service in response to increased competition from greater numbers of doctors in an area, this would be observationally equivalent to the expected effects of induced demand. What he did not mention is that this is only observationally equivalent if one does not explicitly include quality as a choice variable. Green contended that market data is unlikely to ever separate these effects.

Green did attempt his own test of inducement theory. Using aggregated data (as Fuchs and Kramer), he ran regressions on two endogenous variables, physician work load and price. He included as explanatory variables the physician/population ratio, patient income, and percent insured population. With the results obtained,

he was unable to reject the hypothesis of no induced demand. However it is important to note several flaws in his work. First, he utilized aggregated data and did not treat physician location as endogenous. This is a serious shortcoming. Secondly, as mentioned he included no measure of quality, so his results, by his own reasoning, are suspect. Lastly, he did not estimate supply and demand equations. The most direct test of SID is, *ceteris paribus*, does the supply of physicians in an area affect the demand for medical services. In this respect, Green did not provide a direct test of the hypothesis.

Fuchs (1978) reentered the debate with an empirical study of surgeries intended to cast some light on the presence of supplier induced demand. Fuchs argued that if SID is indeed a problem in the American health care system it is less likely to show up in surgery[2], so any result supporting SID is that much stronger. Additionally, as Fuchs noted, SID is generally indistinguishable from normal market responses to sustained excess demand. However, he presented evidence which indicates that the market for surgeries is most characterized by excess supply; therefore, any evidence of

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[2] Popular opinion often views surgeries as a more likely candidate for SID, however Fuchs argues that due to the monitoring role of hospitals and the high costs imposed on patients by surgery, physicians will find it easier to induce office, or out-patient, procedures than surgeries.

SID can be taken as just that, and should not be confused with neoclassical market mechanisms. To accomplish this task, Fuchs estimated market "supply" and "demand" curves. He utilized a two step process to avoid endogeneity bias, whereby he predicted supply and inserted this predicted variable in the demand curve (i.e. Instrumental Variables). The supply equation itself indicated that taste variables are significant influences on physician's locational choice. When predicted "supply" (numbers of surgeons) was input into the "demand" equation, the results indicated that supply has a positive and significant effect on the quantity of services demanded. This he argued strongly supports the view that doctors can and do induce patients to consume their services for purely profit motivated reasons.

As past studies however, Fuchs' work suffers from some rather serious flaws. Principal among them is the specification of the demand equation. Fuchs, besides including only an extremely limited set of variables, did not include price in his demand equation estimates. Failure to hold price constant when evaluating the effects of changes in physician density on patient demand would seem a significant flaw. He did run a regression of price on only predicted (and actual) supply of surgeons and demand of surgeries per capita, but this does not even approximate a reasonable answer to either endogeneity, or the issue of multicollinearity. Lastly, and as other studies before, he made no attempts to control for quality effects on demand.

A second article which used aggregated data and attempted to

estimate a demand curve without including price is that of Richardson (1981). In this study, Richardson used data from Australia to test the theory of SID. Toward this end, he specified market models with supply, demand, and price equations. However, he used a "search" process to specify the models; that is, when the price variable was initially insignificant in the estimation, it was excluded from the final version of the estimated model. Other variables were similarly treated. As a result, the final estimate of the system included no price variable in a demand equation from which inferences about the effect of changes in physician density were drawn. This is a violation of the traditional *ceteris paribus* assumption. The resulting estimates do find a positive correlation between both price and physician density and quantity of services demanded and physician density. These results are stronger on a sample of physicians segmented into specialists. Richardson cited these results as support for the induced demand hypothesis.

Contrary to Fuchs and Richardson, Stano (1985) did not find support for SID in his testing process. Stano attempted to reconcile the two sides of the controversy and draw unifying strands of the disparate approaches together. He noted that studies using aggregated data are more likely to support the induced demand hypothesis than are studies which utilize micro data. In pointing out weaknesses and strengths of both sides, he focused on the lack of attention placed on intensity of treatment. To correct this shortcoming in the literature, Stano estimated several regressions on utilization and intensity of treatment. These were not market

models of supply and demand, and were not estimated simultaneously. The results indicated to Stano that when intensity is taken into account, SID seems much less likely. In fact, using aggregated data, he found that though there appears to be a positive correlation between physician density and utilization, this takes the form of patients being treated by larger numbers of physicians. He found evidence that indicates the intensity with which each physician treats patients does not respond to physician density. Since he did not estimate demand or supply, Stano was unable to comment on the origin of these results. However, he did conclude the supplier induced demand, even should it exist, is not a significant problem. This work is informative in the current context primarily for its emphasis on the type of service provided. Though Stano focused his study on intensity, it is easy to see that these results give support to the assertion that the quality of service is an important, and not to be ignored, aspect of the physician market.

Cromwell and Mitchell (1986) conducted what some consider the best investigation of supplier induced demand to date. They chose to examine the market for surgeries, admittedly biasing their results against the induced demand hypothesis since inducement is expected to be less likely in surgeries. However, Cromwell and Mitchell noted that the surgery rate has increased dramatically over the past few decades for all age groups. More telling is the significant geographic variation in surgeries, both in rates and types performed. There is little medical rational for such apparent

variations. Cromwell and Mitchell proposed induced demand as one possible explanation, though they noted that the positive observed correlation between physician density and utilization can be explained as well using neoclassical arguments. They utilized the framework in Fuchs' (1978) seminal work discussed above, arguing that their superior data set should provide stronger inferences than Fuchs was able to support.

To test between the neoclassical or inducement paradigms, a simultaneous equations model was proposed. This model contains five equations: per capita surgery demand, surgeon work load, surgery supply per capita, surgeon locational choice, and an equilibrium condition. The specific test in this model to distinguish the two primary approaches was the inclusion of the surgeon to population ratio (which was endogenized in the location equation, as required due to the aggregate nature of some of the data being used). A positive and significant parameter on this variable in the demand equation would be evidence in favor of SID. Further, they separated the sample into elective and non-elective surgeries. Using this equilibrium model they found not only a positive effect of physician density on surgeries demanded (a significant effect for elective and insignificant for non-elective, as would be expected), but also a positive effect on surgery fees from physician density. Unlike other studies mentioned above, price is included in the demand equation, so that true *ceteris paribus* inferences can be drawn from the density parameter. In addition to their equilibrium results, Cromwell and Mitchell tested a disequilibrium model. The results

imply that in shortage areas physician densities are the dominant influence on patients' demand for medical services, while in excess demand areas, more traditional demand variables are significant influences. Again, they viewed this as supporting the inducement hypothesis.

Cromwell and Mitchell undoubtedly conducted the best study to date to directly test the supplier induced demand hypothesis. They carefully specified a market model and included most important economic variables in the specification, maintaining the rigor of their estimates. Additionally, they combined both micro and aggregate data in their estimation technique. However, in one important respect Cromwell and Mitchell fall short. Like all previous empirical work in this area, the quality of service was ignored. Without the inclusion of this important variable, the results obtained with respect to density are potentially flawed. If increases in density stimulate increases in the quality of service, then omission of this variable would produce the positive effect of density on demand and lead to false inferences.

Beginning in the early 1980s, researchers in the field became increasingly dissatisfied with the theoretical underpinnings to the induced demand hypothesis. In addition to articles which question the validity of the concept on both theoretical and empirical grounds, several works were produced which attempted to salvage the inducement theory.

One of the more influential works which attacked prior research on induced demand is Auster and Oaxaca (1981). This piece discussed

serious problems with the empirical work of the past. The primary concern voiced by the authors was that most previous tests of demand inducement suffer from identification problems. In particular, they pointed out that since many tests used physician density as a measure of quantity supplied, and also included this variable in the demand equation, then under equilibrium conditions (and especially with aggregate data) the system cannot be identified. Since simultaneous estimation techniques are instrumental variables, then the inclusion of quantity of physicians in the demand function is equivalent to including *all* supply variables in the demand equation, in which case there is an obvious identification problem.

Though Auster and Oaxaca made extremely valid points for much of the past literature, the current work avoids an identification crisis of this type in two ways. First, the data utilized is firm-level and cross section in nature. Therefore, physicians in the sample are already *in place* in their practices. Changes in physician density result from forces exogenous to the choice variables under the control of the surveyed physicians. For this reason, physician density, with the purely firm-level data employed in this chapter, can be treated as exogenous. Secondly, unlike past tests of the inducement hypothesis, physician density is not the measure of quantity supplied. Rather the current work estimates firm supply and demand functions. Therefore, physician density can be included as an exogenous explanatory variable without damaging the integrity of the instrumental variables approach.

Sweeny (1982) attempted to rescue SID from its theoretical

quandary. Recognizing the problems associated with a set of empirical observations in search of a theory, he proposed to overcome the most commonly cited conceptual problem with induced demand: why physicians do not always induce the maximum possible demand. Sweeny presented a target income hypothesis to explain this lack of maximum inducement. Increases in physician density, he argued, will lead to reductions in the individual physician work load. This, by pushing physicians away from their target incomes, will cause medical suppliers to respond by inducing demand. Based upon his hypothesis, Sweeny advocated abandoning the neoclassical estimation of parameters on supply and demand. Rather, he estimated the actual target income of physicians to make inferences concerning the level of inducement in society. His estimates indicate that physician ability to induce demand is fairly limited.

Several problems exist with Sweeny's work. Principle among them is the *ad hoc* nature of the theory. There is no discussion of how the target is formed. Most authors who subsequently review his work found the theory untenable for this reason (see Feldman and Sloan (1988) for further discussion of the problems associated with Sweeny's model).

McCarthy (1985) addressed issues raised by Auster and Oaxaca, as well as the general failing of the supplier induced demand advocates to propose a solid theoretical foundation. His goal was to evaluate the competitiveness of the medical market place by evaluating the sensitivity of patients to price, quantity supplied, and physician density. Theoretically, he modeled physicians as

utility maximizers across profit and leisure. His model was one of uncertainty, with a random flow of patients into the practice. Interestingly, McCarthy discussed quality quite explicitly in his evaluation of the market, and devotes some time to exploring the effects of quality choice on the market. However, his theoretical model and empirical test neglected quality altogether.

Empirically, McCarthy proposed a five equation simultaneous model. The endogenous variables he included were quantity of office visits, waiting time of patients, supply of office visits, total physician hours, and total aide hours. However, as mentioned he did not attempt to capture quality of service, though he did include waiting room time in the demand equation as a possible shift variable. He also included the physician density in demand in order to test SID. Using this structure, and micro data, McCarthy found that physician density has a negative effect on demand. This he argued supports the hypothesis that physicians cannot, or do not, induce demand for their services[3].

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[3] Interestingly, McCarthy's estimates indicate a quadratic relationship between physician density and quantity demanded per physician. That is, he estimated significant negative signs on physician density and significant positive signs on density squared in the demand function. This implies that for some range as density increases quantity demanded per physician falls, and across a higher range, increases in density would lead to increased in demand per physician. An important question, which McCarthy did not address,

There are several works in the literature which attempted to contribute to the debate over SID in a strictly theoretical manner. Interestingly, despite the fact that these works all took different approaches to modeling the market for medical services, there is a striking similarity in the results. Pauly and Satterthwaite (1981) developed a model of the physician market based upon informational costs. Specifically, they proposed a particular search procedure for potential patients. A patient was hypothesized to pick a physician at random and then ask other people about the reputation of that physician. Given this strategy, as the numbers of physicians increase, the efficiency of the patient search goes down and so monopoly power of each physician increases. This lead to a positive correlation between physician density and physician fee without the need for inducement. Pauly and Satterthwaite offered this hypothesis as an alternative to SID. However, their results are sensitive to the particular form of search procedure. Almost any other procedure leads to the opposite conclusion. That is if instead of picking a physician at random and asking acquaintances about the quality of that physician, patients are modeled as asking acquaintances about which physician they prefer, and then picking

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is at what point does the net relationship between density and demand become positive? Beforé rejecting the potential for supplier induced demand, this important conceptual and policy issue should be explored.

the doctor, the increasing monopoly result does not follow.

McCombs (1984) developed a model of the physician market which incorporates potential substitution between physician and hospital service. If, as he asserted, hospital services are more expensive than those of the physician, and patient demand only initiates visits while doctors solely determine resource use after the visit is initiated, one might observe a positive correlation between physician density and physician utilization without SID. In his model the correlation is completely demand driven as patients seek out lower cost physician service as a substitute for more expensive hospital service. This can occur even without a decrease in physician fees. Again, McCarthy minimized the potential for induced demand, arguing that empirical findings are likely to result from mis-specified models.

Stano (1987) also attempted to place a theoretical foundation under induced demand. Toward this end, he proposed a patient demand which is explicitly a function of price and inducement. On the supply side, he treated inducement as a form of advertising, with non-zero costs associated with positive levels of inducement activity. Additionally, physicians in his model were given monopoly power, with price and inducement as choice variables. The theoretical results presented find little incentive for SID. Specifically, he found that decreases in elasticity, by driving a wedge between marginal costs and price, produce incentives to induce. However, as physician density increases, the elasticity of demand facing each individual physician increases, and so the

incentive for inducement falls. His results indicate that the observed correlations in the past may be due to mis-specification.

Feldman and Sloan (1988) explicitly argued that past empirical work has suffered from specification errors. In reviewing the literature on the subject, they highlighted many issues discussed above: identification problems, weak theoretical foundations, diversity of approaches and data type, and failure to endogenize certain influences, among others. Their conclusions are very interesting for the purposes of the current work. They discussed a model of physician behavior in which quality enters the demand function, and noted that even assuming physicians are monopolists, the inclusion of quality permits almost any result from increased physician density, without inducement. Therefore, Feldman and Sloan argued that quality is such an important variable in the physician market place that omission is a serious mis-specification. In fact, Sloan and Lorant (1976) found evidence that the length of visit for physicians responds in a positive manner to increases in physician density. Though not able to directly test SID in a market model at that time, they noted the importance of the result for researchers exploring inducement.

One of the striking features of the literature which makes up the debate over SID is its diversity. There is little agreement not only on whether induced demand exists, but also on how one should test for it. What consensus does exist points to carefully specified market models of supply and demand behavior as the most fruitful line of attack. Several empirical findings seem to support

SID, primarily a positive correlation between physician density and both quantity of service demanded and fees.

A second lesson from the literature, particularly the later theoretical critiques of early empirical work, is the need, often expressed but never acted on, to include quality as a significant influence on the market. Failure to account for the possible responses of physicians to competition in the quality dimension is a serious mis-specification. It is precisely this mis-specification that the current work seeks to correct. Accordingly, the next section will present an empirical model aimed at unraveling the influences of physician density and quality on the market for physician's services.

III. Empirical Model and a Test for Supplier Induced Demand:

III.a, Lessons Drawn from the Empirical Literature:

Before discussing procedures aimed at testing for the existence of supplier induced demand, it is worthwhile to reconsider the currently accepted form of the hypothesis, and possible alternative hypotheses which could account for the observed empirical relationships. As stated above, the induced demand hypothesis has its origins in the empirical observation that physician fees and utilization are often both positively correlated to the number of physicians in an area. Additionally, geographic differences are often observed in the types and frequency of certain medical

activities. These relationships have been difficult to explain with competitive market models and with medical needs.

An explanation often posited is that physicians are able to exert influence over the demand for their services. Since significantly different levels of knowledge exist between a doctor and patient, and since doctors act not only as suppliers of service, but also as agents for their patients, SID proponents argue that physicians have considerable discretion to increase demand. However, some who accept the SID hypothesis believe that physicians do not always induce demand to its maximum point, either because of "psychic costs" or the existence of some target income. These constraints suggest that physicians will arrive at some equilibrium point below maximum demand. Physicians' equilibrium level of demand inducement may change as a result of increased competition. That is, confronting increased numbers of physicians in an area, and consequently lower demand curves, reduced profits will only then encourage physicians to actively induce their patients to demand more medical service. This inducement activity leads to increased demand which may result in higher fees and increased patient utilization of physician services. This relationship between fees, utilization, and physician density is the empirical foundation of supplier induced demand.

The current chapter has three specific goals for contributing to the debate over supplier induced demand in health care. First, it will discuss the advantages of firm-level data over aggregate data. Second, it will introduce quality of service as an important

factor in the market for health care, and incorporate quality into a traditional neoclassical model. Third, it will directly test SID in a model of the physician firm with quality choice.

Many of the studies discussed in the last section utilize aggregate data for testing whether physicians induce demand in response to increased competition. Most studies which use aggregate data do, in fact, find support for the inducement hypothesis. However, aggregate data is conceptually inappropriate for testing a hypothesis of demand inducement by the individual physician. To see why, consider the two most common tests.

First, several works use the actual numbers of physicians as the supply variable (Fuchs [1978], for example). The "test" of inducement in this case is to include the supply of physicians in the demand equation, in addition to its role as the endogenous variable on the left hand side of the supply equation[4]. A finding that as physicians or physician density increases, the *total market demand* increases, is taken as support for physician induced demand. A second approach using aggregate data is often to define the "supply" variable as numbers of visits for the area. In this case, as the last, physician density is included in the market demand equation, and a positive and significant sign on this parameter is taken to be confirmation of SID. However, notice that a major

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[4] This leads to more serious econometric problems which are discussed below.

logical flaw exists here. These researchers are estimating *market* demand functions and drawing inferences about inducement activities as the density of physicians in the market change. However, SID is a hypothesis about the behavior of *individual* physicians. The real question is not what happens to the entire market demand as physician density increases, but rather what happens to the demand curve faced by the individual physician as density increases. Positive correlations between the market demand and physician density *do not* imply positive correlations between demand faced by the representative physician and physician density. As the physician density increase, the demand curve faced by the representative physician decreases, *ceteris paribus*. However, since there are more physicians as density increases, the total market demand could conceivably increase due to increased availability of medical services, or increases in certain under-represented specialties (i.e. the creation of new markets).

Only through the use of firm level data can one estimate the demand faced by the representative physician, and therefore truly test the SID hypothesis. In this instance, a true test would be if the (correctly identified) demand faced by the representative physician were to increase with increases in physician density. For this reason, one must be careful in interpreting results obtained on correlations between usage and physician density using aggregated data[5].

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[5] However, results concerning positive correlations with fees and

A second problem in some past models, arising with the use of aggregated data to test SID, is raised by Auster and Oaxaca (1981) (as discussed above). Briefly, they point out that a system of equations of the form:

$$Q^s = f^s(X_s),$$
$$Q^d = f^d(X_d, Q^s),$$
$$Q^s = Q^d,$$

suffers from a major problem with identification. This is true since methods which estimate simultaneous equations are, by nature, instrumental variables. Therefore, the demand function estimated is

$$Q^d = f^d(X_d, \hat{Q}^s) = f^d(X_d, X_s),$$

and the system is not identified. However, the current work uses firm level data and avoids this problem. The supply variable is not the number of physicians in an area, or even the number of visits in an area, but rather the units of service for the individual firm. Since firm-level data on service units is used, inclusion of the area-wide physician density in the demand function tests SID without resulting in the type of problem discussed by Auster and Oaxaca.

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physician density are less easily dismissed. Increases in physician density, by increasing the potential supply of services, would quite naturally lead to increases in the quantity of services supplied in the market. However, this should be accompanied by decreases in fees, the price of medical services. This issue is addressed by the introduction of quality and tests run below.

Therefore, instrumental variables remains a valid procedure for estimating the model developed later in this chapter. Given this, and the conceptual problem discussed above, firm level data appears to be superior to aggregated data for testing induced demand by the physician firm.

The use of firm level data, though important for acquiring accurate results, is not completely new to the literature. However, the introduction of quality, one of the primary goals of this chapter, is new. Given the nature of the market being considered, this is a factor of primary importance which must be considered before reasonable inferences can be drawn.

Consider the following scenario. The market for physicians' services is in equilibrium in a given area. Suppose the numbers of physicians per capita increases. As a result, one observes the total number of visits increase, and/or the average fee goes up. What could be an explanation for this unexpected phenomena? Many have argued that it is due to SID. The nature of this increase in demand is rarely discussed, but presumably it is in the form of increased testing, increases in some elective procedures, or increased frequency of visits. As a result of this activity, which is undertaken for profit rather than medical reasons, the demand for medical care increases, and the observed behavior results.

However, a second hypothesis is also possible. Decades of work in economics has demonstrated that quality is a very significant aspect of production. Physicians' services are no exception. As demonstrated in the first chapter of this dissertation, quality is a

major component of the service offered by physicians. Therefore, one can easily imagine that one response to increased pressure from competing physicians would be for physicians to increase the quality of their services. Increased quality will necessarily lead to increases in the demand for services if patients value quality in any way. This increase in the demand curve for the representative physician could result in higher fees, despite the increased competition (which works to depress fees). Additionally, if every physician offers higher quality service, then this increase in quality on average in the market will lead to increases in the demand for medical care in the market. Note, that physician density does not, in and of itself, lead to a change in the market demand curve. If fees, quality, and physician behavior are not affected by increased physician density, then the market demand curve will be similarly unaffected. Each physician will simply service a smaller share of the market. However, if increases in competition stimulates increases in quality, then market demand will increase, *independent of any inducement*. This will produce an increase, not only in fees, but in the market clearing quantity as well.

Recognition of the impact quality may have on a market changes the interpretation of past work on induced demand. If one ignores quality, both theoretically and empirically (as is uniformly true in past tests of this hypothesis), then two potential explanations for a positive relationship between physician density and medical utilization and fees are observationally equivalent. That is, there would be no way to determine if the positive correlations are the

result of SID, or of increased quality. However, if quality is included, and there still remains a positive correlation between the demand curve faced by the representative physician and physician density, one may infer that demand inducement remains a viable hypothesis. However, if quality is included, and there is no correlation remaining between the variables of interest, then one must seriously question the validity of SID. As discussed below, when quality is considered, no evidence for SID appears, and in fact the evidence *against* inducement appears.

III,b. Testing the Hypothesis:

This chapter proposes two tests of induced demand in the market for physicians' services. The first is an indirect test which utilizes results from Chapter 1, while the second is a direct test of supplier induced demand. In both cases, the underlying theoretical model is of a physician firm which simultaneously maximizes both utility and income. Most work which has explored induced demand theoretically has modeled physicians as utility maximizers, so in this sense the current work is consistent. However, profit maximizing behavior is also attributed to physicians[6]. One potential test for demand inducement is to

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6 For a complete exploration of the model under discussion, including comparative static results and complete discussion of assumptions and conclusions, see Chapter 1.

ascertain whether or not physicians behave, empirically, in a manner consistent with both utility maximization and demand inducement.

To investigate this question, the theoretical model from Chapter 1 is modified slightly. The utility framework outlined in Equation (6) of Chapter 1 is maintained, while the profit objective function is altered to incorporate induced demand. This can be easily accomplished once it is recognized that the ability to induce demand at will implies that the demand function is no longer relevant. Unlike traditional market models, physicians able to induce are not confined to movement along a demand curve since the curve itself can be "placed" according to the desires of the physician. In other words, any point in H-P space is then a potential equilibrium solution. Assuming, therefore, that the total hours decision can be represented as a function of price, H=H(P), then the physician firm's profit objective function can be written as:

$$(1) \qquad \bar{\pi} = P \cdot v \cdot h - C(v,h) + \lambda[\ H(P) - v \cdot h\ ].$$

Structurally, the only difference between this profit function and the one presented in Chapter 1 is the fact that H is now represented as a function. Technically, this implies that the physician will maximize profits across four, rather than just three, control variables: v, h, λ, and P (which due to the physician's control over patient demand, is a physician choice variable). This results in four first order conditions for profit maximization.

$$(2) \quad \bar{\pi}_v = P \cdot h - C_v(\cdot) - \lambda \cdot h = 0,$$

(3) $\bar{\pi}_h = P \cdot v - C_h(\cdot) - \lambda \cdot v = 0,$

(4) $\bar{\pi}_\lambda = H(P) - v \cdot h = 0,$

(5) $\bar{\pi}_P = v \cdot h + \lambda \cdot H_P = 0.$

where H_P is the first partial of H(P) with respect to P.

Manipulation of (4) leads to:

$$v \cdot h + \lambda \cdot H_P = 0 \quad \Rightarrow \quad H + \lambda \cdot H_P = 0.$$

Therefore, dividing by H and multiplying by P leads to,

(6) $P + \lambda \cdot e_s = 0 \quad \Rightarrow \quad P = -\lambda \cdot e_s,$

where e_s is the elasticity of supply of hours per week. With this result and rewriting (3) such that only price and the lagrange constraint remain on the left hand side, it is easy to see that:

(7) $-\lambda(1 + e_s) = C_h(\cdot)/v > 0.$

Since the $\lambda = U_L/U_I > 0$, it must therefore be true that $e_s < -1$. In other words, a profit/utility maximizing physician who is capable of inducing demand will *always* choose to operate on the negatively sloped portion of supply, and within the elastic region. A physician who is maximizing utility across income and leisure will therefore never choose to set the equilibrium point on any point along the inelastic portion of the supply curve. This provides one possible test of inducement. If we find equilibrium points occurring on inelastic portions of the negatively sloped region of the supply of service curve, then that finding would not be consistent with the model of utility maximizing physician who have

the capacity to induce demand[7].

To carry out this test, the empirical model specified in Chapter 1 is utilized. Briefly, it is:

$$(8)\quad \ln H = \alpha_1 + \alpha_2 P + \alpha_3 P^2 + \alpha_4 EX + \alpha_5 WNP + \alpha_6 URB + \alpha_7 BRD + \alpha_8 CLR + \alpha_9 LAB + \alpha_{10} XRAY + \alpha_{11} IMM + \alpha_{12} PCP + \alpha_{13} PHV + \alpha_{14} POS + \alpha_{15} MTR + \alpha_{16} MALPP + \alpha_{17} AUTO + \alpha_{18} NUR + \sum_{i=19}^{32} \alpha_i SP_{i-18} + e_1,$$

$$(9)\quad \ln h = \beta_1 + \beta_2 P + \beta_3 P^2 + \beta_4 EX + \beta_5 WNP + \beta_6 LAB + \beta_7 XRAY + \beta_8 IMM + \beta_9 PCP + \beta_{10} PHV + \beta_{11} MTR + \beta_{12} MALPP + \beta_{13} AUTO + \beta_{14} NUR + \sum_{i=15}^{29} \alpha_i SP_{i-14} + e_2,$$

$$(10)\quad \ln P = \gamma_1 + \gamma_2 H + \gamma_3 MIN + \gamma_4 AGE + \gamma_5 WNP + \gamma_6 URB + \gamma_7 BRD + \gamma_8 PUBI + \gamma_9 PRII + \gamma_{10} NAM + \gamma_{11} FRD + \gamma_{12} NE + \gamma_{13} NC + \gamma_{14} SO + \sum_{i=15}^{29} \alpha_i SP_{i-14} + e_3.$$

Variable definitions and the data used are discussed in Chapter 1.

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[7] Note that this is a pure theory of inducement. That is, there are no *a priori* assertions about "psychic costs" of inducement or need to impose restrictions based upon poorly defined ethical considerations. The model assumes that physicians who have the ability to induce will do so.

Results from this NL3SLS estimation are presented in Table 2. The model performs well, and is consistent with the theoretical modeling of physicians as utility maximizers across income and leisure in a competitive market. However, for the issue of SID, Table 4, which contains a comparison of estimated supply elasticities (total hours of service per week, at the means) and demand elasticities (also total hours of service per week at the mean) is more informative.

A second, and perhaps more intuitive, way to interpret the test devised above is to consider the total revenue function of a physician firm in this model:

(12) $R = P \cdot H(P).$

Differentiating revenue with respect to price results in:

$$\frac{\partial R}{\partial P} = H + \frac{\partial H}{\partial P} \cdot P$$

$$= H \cdot \left(1 + \frac{\partial H}{\partial P} \cdot \frac{P}{H} \right).$$

So

(13) $$\frac{\partial R}{\partial P} = H \cdot \left(1 + e_s \right) \gtreqless 0 \text{ as } e_s \gtreqless -1.$$

Therefore, if physicians are operating on the negatively sloped portion of their individual supply functions, and if the elasticity of supply is greater that -1 (i.e., inelastic supply), then it is easy to understand *why* the result obtained in (7) follows. Figure 4 illustrates the logic. Notice that if demand were to increase from D to D', thereby causing price to go up, and the physician is still

operating in the inelastic portion of the supply function, then by (13), revenue must increase. It is also true that since total time, H, is falling, cost must be decreasing. This decrease in work hours leads to increases in utility, if leisure is a normal good. Therefore we see that movement of the demand curve from D to D' unambiguously increases the physician's utility since income and leisure are both rising. For this reason, again, any utility maximizing physician capable of inducing demand would never choose to operate in the inelastic portion of the supply function.

Table 4 demonstrates that for most specialties, the elasticity of supply at the mean (and so the average equilibrium supply elasticity) is negative and greater than -1 (that is, inelastic[8]). This implies that there are unexploited returns from inducement in the existing market place. This leads one to conclude that physicians are either not pure utility maximizers, or they are

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[8] Four specialties, dermatology, ophthalmology, orthopedic surgery, and otolaryngology, do operate on the elastic portion of the supply curve, implying that there may be no unexploited gains from inducement. Two, cardiology and general practice, have positive elasticities of supply, which also is not consistent with inducement since (13) clearly demonstrates that not only does inducement imply elastic points, but also it implies a negative elasticity. Positive elasticities are just as inconsistent with inducement as are inelastic results.

not able to effectively induce demand. The first conclusion flies in the face of most assumptions about individual behavior in economics and most work which supports SID. If one is to rely upon professional ethics to explain why unexploited utility should exist in a market, it becomes necessary to also explain a mechanism capable of setting the level of this ethical barrier and mechanisms for allowing these constraints to weaken in the face of competition. Such a theory has yet to be developed. For this reason, the second interpretation seems the most likely. If SID is a force in the market, the onus of explanation lies upon the shoulders of advocates of this hypothesis to provide some rigorous explanation as to why physicians will ignore the most basic of economic motivations, the potential for increased utility[9].

The arguments presented above cast some doubt upon the

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9 The elasticities presented in Table 4 were also calculated on 95% confidence intervals of the estimates. The results, with one exception, are completely consistent with those in Table 4. Three of the four specialties with elastic point estimates remain elastic even on the upper and lower bounds of the parameter estimates (orthopedic surgery has a lower bound point elasticity of -.95). Of the specialties which have elastic point estimates, only one, allergy, has an upper bound which is elastic (in this case the upper bound is -1.04, while the lower bound is -.79). All other specialties are inelastic throughout the 95% confidence interval.

existence of induced demand in the market for physicians' services. It remains to directly test the supplier induced demand hypothesis and determine if some explanation for past empirical confirmations is possible. Before this direct test can proceed, geographical information is required. To identify states of origin for the observations, marginal income tax rates by states were matched to the MTR variable in the sample (which was divided into regions, to reduce duplication of tax rates and allow greater numbers of states to be identified). This process is valid since the MTR variable is not a survey response, but rather was added to the data at a later date using Facts and Figures from Government Finance, 1977. The same source is used currently to identify the state of origin of the physician. However, due to duplication of tax rates between some states in the same census region, some observations were lost. This method identified 20 states. The resulting sample contains 725 observations[10].

Once states have been identified, two additional variables are added to the estimating model, permitting a direct test of SID. The

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10 The model specified in Chapter 1 was run on this sub-set of the original sample. The results were consistent with the results presented in Table 2, which was produced using the entire sample. Consequently, biases do not appear to have been introduced by this sub-sampling technique.

first is physician density[11] (PDEN) by state. This variable is included in all three equations. Past work has included PDEN only in the demand curve. However, if one is to argue that increased competition from additional physicians encourages physicians to change their behavior (i.e. to change the quality of their service), then PDEN must be included in the supply side of the model as well. Exogenous changes in the physician density in an area is equivalent to a structural change in the market place. This structural change is expected to affect supply behavior[12], and so, PDEN is included in the supply side. A test of the validity of this is performed below. Physician density by state is a very broadly defined variable Unfortunately, it is the finest geographical distinction the data will support. It may capture state-wide effects other than competitive pressure from physicians. One such effect is the extent of urbanization. States with a greater proportion of their population urbanized may possess greater demand for medical

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[11] In this case, PDEN is the number of active MDs in a state per 100,000 population, taken from the Statistical Abstract of the United States, 1978.

[12] As one extreme example, if a market were to suddenly shift from perfect competition to monopoly, due to an exogenous change in supplier density, then the "supply" behavior of the remaining firm will change.

services, as well as a broader base of "interesting" cases and larger amounts of capital equipment. Additional state-wide effects which may be reflected in PDEN are educational differences, income effects and differences in culture, again introducing distortions into the information contained in PDEN. Therefore, the percent urbanized population of a state (PURB) is included along with PDEN to help filter out some of the potential noise introduced by the density variable.

The model estimated to test for induced demand is similar to (1)-(3) in all but two regards. First, as mentioned above, PDEN and PURB are included in all three equations to test for SID. Secondly, the quality proxy, h (time per visit), is included in the demand curve. The new specification is of the form:

(7) $$\ln H = \alpha_1 + \alpha_2 P + \alpha_3 P^2 + \alpha_4 EX + \alpha_5 WNP + \alpha_6 URB + \alpha_7 BRD + \alpha_8 CLR + \alpha_9 LAB + \alpha_{10} XRAY + \alpha_{11} IMM + \alpha_{12} PCP + \alpha_{13} PHV + \alpha_{14} POS + \alpha_{15} MTR + \alpha_{16} MALPP + \alpha_{17} AUTO + \alpha_{18} NUR + \alpha_{19} PDEN + \alpha_{20} PURB + \sum_{i=21}^{33} \alpha_i SP_{i-20} + e_1,$$

(8) $$\ln h = \beta_1 + \beta_2 P + \beta_3 P^2 + \beta_4 EX + \beta_5 WNP + \beta_6 LAB + \beta_7 XRAY + \beta_8 IMM + \beta_9 PCP + \beta_{10} PHV + \beta_{11} MTR + \beta_{12} MALPP + \beta_{13} AUTO + \beta_{14} NUR + + \beta_{15} PDEN + \alpha_{16} PURB + \sum_{i=17}^{26} \alpha_i SP_{i-16} + e_2,$$

$$(9) \quad \ln P = \gamma_1 + \gamma_2 H + \gamma_3 h + \gamma_4 MIN + \gamma_5 AGE + \gamma_6 WNP + \gamma_7 URB + \gamma_8 BRD + \gamma_9 PUBI + \gamma_{10} PRII + \gamma_{11} NAM + \gamma_{12} FRD + \gamma_{13} NE + \gamma_{14} NC + \gamma_{15} SO + \gamma_{16} PDEN + \gamma_{17} PURB + \sum_{i=18}^{31} \alpha_i SP_{i-17} + e_3 .$$

As before, this is a semi-log specification estimated using NL3SLS. The results are presented in Table 11[13].

Though the results are generally consistent with those

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[13] In order to gauge the consistency of this model with those estimated in Chapter II and III, Tables 12 and 13 are presented. These display the estimated 95% confidence intervals for the backward bending points of total hours per week, H^c, and time per visit, h^c. The estimates for H^c are quite close to those presented in Table 8, though the precision is somewhat reduced (as indicated by the wider confidence interval). Likewise the estimates for h^c are close to those in Table 5, again, with a wider confidence interval. The results in all three models of this dissertation concerning the backward bending points of the supply functions are reasonable consistent. Some distinctions do exist between the three equation model Chapter II and the four equation model of Chapter III, as discussed in Chapter III. However, even though the introduction of PDEN and PURB decreased the precision of the system, the estimates appear to be consistent with those in past chapters.

presented in Table 2, the performance of many variables is not as satisfying (though the principal variables, P and P^2, remain consistent in sign and significance). The reason for this may be due to the introduction of PDEN. As mentioned above, this measure of physician density at the state level may not be without some element of noise. However, several results on the quality equation and demand equation are quite revealing.

To gain direct evidence of the effects of competition in the market for an individual physician's service, the performance of PDEN is of crucial importance. One primary result is that PDEN is insignificant in the demand equation when quality is taken into consideration. As discussed above, a true test of the existence of supplier induced demand is whether physician density has an effect on the demand curve faced by the physician, and not on the market demand curve. The sign and significance of the parameter on PDEN is such a test. A positive and significant sign on PDEN in the estimated demand supports SID, while an insignificant, or negative and significant, effect of PDEN on demand is evidence against SID. In this model of demand faced by a representative physician, PDEN has no significant affect on demand (neither does it appear to affect the supply of hours from the equation of H). The t-statistic on PDEN in the demand equation is .52. As such, these results can be interpreted as failing to find any evidence to support the hypothesis that physicians induce demand for their services in response to increased competitive pressure.

In order to gain some knowledge about the robustness of this

result, the model specified in equations (7)-(9) was estimated in several different forms. The model was run with PDEN and PURB removed from the supply side, and also run without h in the demand equation. This was done to give SID the "best chance." However, in all specifications, PDEN remained uniformly insignificant with very low t-statistics. Additionally, a likelihood ratio test was performed to test the null hypothesis that PDEN and PURB should not appear in the supply side of the system. The chi-squared test statistic for this test was 24.35, rejecting the hypotheses.

However, the current results go further than simply failing to find support for SID. In the equation for average quality, h, one finds a significant and positive effect associated with PDEN. That is, the parameter on PDEN in the h equation demonstrates that as the density of physicians increases, the average physician responds to this competition by increasing the quality of their service. This effect is significant at greater than the .01 level. If an increase in PDEN leads the average physician to increase the quality of their service, can this explain past observations on positive correlations between physician density and utilization and price? The answer, according to the estimate of the demand function, is "yes." The parameter on quality, h, in the demand function is positive and significant. This says that as quality increases, *ceteris paribus* (including PDEN in this *ceteris paribus* bundle), patients will demand greater amounts of service from the individual physician, and fees rise commensurately.

These results show that one could expect to find positive

correlations between physician density and fees.In fact, in the data used for this study, PDEN and P (price of service) do display positive correlation of .13 (significant at the .01 level). This is only a simple correlation, though it might be taken as evidence of SID if more sophisticated explorations are not undertaken. However, given the results in Table 11, one should be slow to blame this positive correlation on supplier induced demand. Rather, the results indicate that physicians respond to increased competition by increasing the quality (i.e. the time spent per patient visit) of their service. PDEN has a positive effect on quality, with a t-statistic of 2.19. In addition, though PDEN is insignificant in demand, quality is not. Quality has a positive effect on the estimated inverse demand equation (with a t-statistic of 2.01) indicating that increases in quality lead to increases in fees.

Therefore, one interpretation of these results is that increased physician density encourages physicians to offer higher quality service, and this higher quality stimulates patients to increase their demand for service, resulting in higher fees. This implies that the positive correlation between fees and physician density often observed (and observed in the data used for this study) can not be categorically associated with SID. Any model which empirically ignores the quality dimension of the market for medical care, will ignore a major influence in that market, and therefore produce uninterpretable results. Since all past empirical work has not taken quality into account when testing for the presence of SID, all past work must be questioned in light of these

new results.

One other piece of evidence against SID is the insignificant signs in the regional dummies, NE, NC, and SO, in Table 11. One empirical observation presented in support of SID is a regional heterogeneity in the use of medical services. This is one of the principal arguments in Cromwell and Mitchell (1986). However, results from estimates in this chapter do not find evidence of significant regional differences in the demand for medical services. Additionally, these results are generally borne out in earlier chapters.

Other results in terms of sign and significance are generally consistent with those presented in Table 2. One of the two new variables, PURB, is significant in both supply equations, H and h (in 3SLS). This implies that physicians in more urbanized states tend to work not only more hours per week, but spend greater time per visit with their patients as well. One interpretation might be that more urbanized states provide a larger patient base from which to draw interesting or challenging cases, which encourages this increase in quality and total supply of service by the individual physician. Additionally, more urbanized states may have higher income levels, greater educational levels, more desirable living conditions, and many other factors which could affect the behavior of physicians. A unique interpretation of this result is not possible. PURB may also pick up some effects from competition. Highly urbanized areas tend to have greater concentrations of physicians. In the data used for this chapter, the simple

correlation between PDEN and PURB is .49 (significant at the .01 level). If PURB is picking up some of this effect then it implies that in more urbanized, competitive situations, physicians supply greater quality and more total hours of service (though it is interesting to note that the effect on total hours does not stand up as well to changes in the estimating procedure, since PURB is insignificant in the 2SLS estimate of the H equation). In the demand curve, it is interesting to note that PURB is significant and positive, but the proxy for income, WNP, loses its significance. This may indicate that PURB is picking up inter-state differences such as differences in income levels.

IV. Other Issues

Before concluding this discussion of SID, several additional issues need to be addressed. First, one question which deserves attention (and more than can be given within the confines of this dissertation) is what market structure exists in actuality in the market for physician's services. This may seem, with some reason, to be a question which should be answered at the beginning of the current work; however, this chapter, and the chapters preceding do not support direct tests of market structure, and inferences must be drawn indirectly after other evidence has been collected. Secondly, in light of the evidence presented against SID, one may wish to consider whether this evidence could support other conclusions

besides the ones espoused above.

The question of market structure is in many ways basic to the entire debate surrounding SID. The SID hypothesis itself, in fact, reduces to a question of market structure. Is the market for physician's services competitive in nature, or do physician's have monopoly power, which allows them to exercise some control over their patient's demand? Additionally, a market structure in which price is removed from both the physician and patient as a choice variable, and set exogenously by governmental forces (though Medicaid and Medicare) and major insurance companies (Blue Cross, for instance), is also reasonable. From a behavioral standpoint, a market characterized by perfect competition and a market in which price is exogenously set by regulating agencies would be observationally equivalent. However, it is possible to devise a test between these two alternatives and a market structure in which physicians face a downward sloping demand curve for their services in the price-visits dimension.

This test can be drawn from the model estimated from equations (7)-(9), specifically, from the demand curve presented in (9). The demand equation is modeled with price as a function of hours per week, H, and time per visit, h (the proxy for quality). As expected, price is a decreasing function of H and an increasing function of h. However, since H is a function of both h *and* visits, v, it is possible to test whether there is any significant effect from visits on the demand curve. This will therefore provide a rough test of market structure. The null hypothesis is that visits

have no effect on price (that is, either a perfectly competitive market, or a market characterized by exogenous price in the visits dimension).

To proceed with this test, note that:

$$(14) \qquad \frac{\partial P}{\partial v} = \left(\frac{\partial v}{\partial P}\right)^{-1} = \left(\frac{\partial \frac{H}{h}}{\partial P}\right)^{-1} = g(\hat{\beta}).$$

Therefore, the effect of visits on price can be expressed as a non-linear function of the estimated parameters on H and h. From this relationship, the standard error of $g(\hat{\beta})$ can be calculated and a simple t-test on the significance of $g(\hat{\beta})$ performed. The t-statistic from this test is -762, which strongly rejects the hypothesis that visits have no effect on price[14]. This implies that

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[14] One additional insight at this point concerns the elasticity of visits with respect to price. Using the procedure outlined above, the elasticity of visits is calculated to be -0.03. This is small relative to prior elasticity measures. Fuchs and Kramer (1972) estimate the elasticity of demand for visits to be -0.36. McCarthy's (1985) estimate for the elasticity of demand ranged from -3.07 to -3.32., while Cromwell and Mitchell (1986) estimate the elasticity for surgeries to be between -0.14 and -0.17. One significant difference is that these authors are estimating *market* demand curves, while the estimates in this dissertation are for firm level demand curves. What is intriguing about the comparison is that the market demand seems more elastic than the firm-level demand, which is counter to expectations.

the market for physician services contains some monopolistic elements. To what degree monopoly power resides with physicians is a question reserved for future research.

Additionally, it is shown in Chapter III that the market for physician's services cannot be characterized as purely competitive. On page 110, a likelihood ratio test is run which tests the significance of regulation (through Medicaid) in the market. The test indicates that a model which included Medicaid influences is superior to one which does not, implying that regulation has important effects in the market. Future work on the structure of the market for physicians' services must also consider these effects, in addition to potential monopoly power on the part of physicians.

The second issue concerns how one interprets results. Evidence against SID presented in this chapter is hopefully persuasive, though not necessarily conclusive. Results have been presented with the view that they do not support SID; however, one should, for objectivity, ask if it is possible that some readers could interpret these results as providing *support* for SID. The answer to this question may be "yes." Despite the fact that we can demonstrate that there are unexploited opportunities to increase physician utility by engaging in SID, some might argue that this is simply evidence of physician ethical restraint. Physicians can be viewed as utility maximizers who suffer a "psychic cost" when they

engage in inducement. If true, unexploited opportunities to increase income and decrease labor can be explained. Additionally, others might argue with the interpretation of time per visit as a measure of quality, and argue that the results in Table 11 only show that physicians "induce demand" by spending more billable time with each patient. Answering these criticisms is not easy. In the final analysis, one can rely upon a "maximum likelihood" approach. Which possible world seems most likely to produce the system we observe? Are physicians traditional utility maximizers who operate in a market which permits no SID, and respond to increased pressure by differentiating their product through increases in quality? Or contrarily, are physicians, engaged in a struggle between strict utility maximization and professional ethics, able to increase demand for their services by increasing, for non-medical reasons, the time they spend with each patient (an increase which has positive perceived value to the patients)? The answer to this conundrum must, in part, depend upon one's priors. Given the weight of evidence presented, and the lack of solid theoretical foundation for SID, the current chapter favors the former view of the world, and sees little support for the hypothesis of SID.

V. Conclusions

For many years researchers in the field of health economics have debated the validity of the hypothesis that physicians, in

response to competitive pressure from entry, induce demand for their services. The supplier induced demand hypothesis gained acceptance in some quarters based upon prior biases, and the empirical observations that physician densities are positively correlated to both physician fees and utilization. Supplier induced demand seemed the only possible explanation for these observations. Research into this question suffered from a lack of consistency in rigor, assumptions, and procedure. Studies based upon aggregated data typically find support for the hypothesis; while those based upon micro data often fail to find support. Throughout the debate, the existence or absence of the correlations between physician density and fees and utilization remain the accepted test.

The current work demonstrates that another major shortcoming of past explorations into the SID issue is the total empirical neglect of quality choice as an important aspect of the market for physician's services. Physician responses to competition by changing the quality of their service are one potential explanation for the empirical evidence supporting SID to date. Estimates from a model of the physician firm find that there are significant unexploited opportunities for physicians to increase utility by inducing demand. This finding implies that physicians are either not able to induce demand, or they are not pure utility maximizers.

In addition to this evidence, a model of the physician firm including both quality and physician density in the demand equation finds no evidence to support the inducement hypothesis. However, this model does clearly demonstrate that physicians will respond to

increased competition by increasing the quality of their service. This higher quality is translated into higher fees by patient's positive valuation of increasing quality of service. The implication is that past studies, by neglecting quality, have found positive correlations between physician density and fees resulting not from induced demand, as they argue, but rather resulting from biases associated with omitted variables.

For policy purposes this chapter indicates, yet again, that one must take care when placing all the blame for the current "crisis" in health care at the feet of the individual physician. Often the tendency is to cite physician behavior as nefarious and at the root of rapidly rising costs and decreasing availability. Supplier induced demand would be one mechanism resulting in these costs. However, the results presented in this chapter place the validity of suppler induced demand in health care in jeopardy. Increased competition may result in higher fees, but this could be primarily due to the demand-side valuation of increased quality, not supply-side inducement. Therefore, policies aimed at maintaining restrictions on entry into the medical market, purporting to avoid demand inducement, are misguided. Freer access to the medical profession is one policy implication of the current work.

CHAPTER V

CONCLUSIONS

The three essays in this dissertation contained in Chapters II through IV attempt to shed light on the nature of the interaction between physician firms and their patients. As such it is an exercise with a defined goal in mind, specifically to gather evidence which will aid in the process of devising effective policy. Each chapter contains a discussion of the policy implications from the results presented in that chapter. However, it is helpful to consider the implications of all three essays taken as an integrated whole. In addition, it would be wise at this point to consciously step away from the more descriptive methodology, which is the tone of previous chapters, and temper the policy discussion with an explicit recognition that, in the real world, adjustments are neither instantaneous nor perfect.

One central issue surrounding the decision whether to regulate an industry or not is the competitiveness of that industry. If an industry "endowed with public trust" is competitive in nature, then many economists and policy makers feel that government intervention cannot improve upon the structure and performance established by market forces. However, if suppliers in this industry possess significant market power, such that they are able to drive fees

above marginal costs and output below that which maximizes social welfare, then many argue that there is a role for government regulation. It remains, then, to discover whether the industry which provides primary health care is competitive or not.

The results presented in Chapter II and Chapter IV indicate that physicians appear to behave as if they are competitive agents. This implication, primarily from Chapter II, arises when one recognizes the importance of quality in the provision of medical services. By including quality, empirical findings conform well to theoretical expectations discussed in the context of a competitive firm. Not only do the results in Chapter II demonstrate that physicians empirically conform to a model based upon competition, but Chapter IV finds evidence against one often-cited source for physician market power. The hypothesis is that physicians, when faced with increasing pressure from new competitors, can and do induce their patients to increase demand for medical services. This "supplier induced demand" means that physicians face no effective demand constraint and so can induce demand for their services for profit, rather than medical, reasons. If this is true, a strong case for government intervention can be made. However, Chapter IV presents evidence that this is in fact not true. Rather this chapter finds that physicians respond to increased competition by increasing quality, which itself increases demand in the price-quantity dimension.

In addition to this evidence on the competitive nature of physicians in the current market, Chapter III explores certain

issues surrounding the implementation of Medicaid. This program which is intended as a safety net for the poor (though it is effectively a safety net for poor women and children only) is shown to have several unintended negative side effects. Specifically both theoretical and empirical evidence indicates that Medicaid produces a two-tiered system of health care in the United States. That is, individuals who are covered by Medicaid are relegated to a system which not only provides fewer numbers of visits, but also supplies a lower level of quality for those visits. To compound the problem, evidence indicates that this quality level is the minimum possible. The reason such unexpected consequences arise is due to the complete circumvention of the Medicaid patient's demand mechanism. By allowing no balance billing or copayment physicians receive no marginal benefit or penalty for adjusting the quality of service they provide to Medicaid patients. Therefore utility maximizing physicians choose the lowest acceptable quality.

These results might seem to imply that there is little role for the government in the market for physician services; however, this would be a rash conclusion to draw. In many respects the medical market place is dissimilar from markets for other goods. For instance, in the arena of technical advances, medicine stands out. If a sudden breakthrough were to occur in the automotive industry which made cars self-cleaning, it would likely be very expensive initially to implement this innovation. In this case the market allocates most resources to wealthier individuals, while those with lower incomes go without self-cleaning cars. Few would protest this

system. However, when the innovation is a CAT scanner which is capable of providing information to save lives, the market approach appears less satisfactory. In this case, the market dictates that wealthier individuals receive the resources, while those with lower income, and apparently less valuable lives, do not. While a person might be willing to forego the consumption of a new car due to the dictates of the market, few people would be willing to passively forego the consumption of their life, or the lives of their children, simply because they possess too few dollars. The consequences to society of allocating all health resources to those individuals with the most resources is, in all likelihood, too great. While this example is extreme in its presentation, it serves to reinforce the lesson that health care cannot be treated in the same casual manner as a car, or other simple commodity. In this case, economists cannot divorce themselves from normative considerations.

What conclusions can then be drawn from the evidence presented in this dissertation? First, given that a role for government has been clearly chosen by society in the allocation of health care, comfort can be taken in the evidence which demonstrates that physicians appear to behave competitively. Therefore a more "minimal" approach to regulation may be safely taken. This minimal set already contains the concept of a safety net under the poor. The results from Chapter III do not discount the *notion* of a safety net, rather they simply demonstrate the shortcomings of the current system. Medicaid as a concept has great merit. However, the extant structure, by circumventing patient's demand for quality, negatively

affects the level of care Medicaid patients receive. The solution is not to scrap Medicaid, but to implement a copayment of some type. This copayment (necessarily small in magnitude due to the low incomes of those covered) will allow some marginal incentive to physicians for providing higher quality care. Additionally, if society should choose to devote more resources to this program, increasing the reimbursement level will lead to increases in availability. A second possibility would be to return in part to pre-1965 methods of giving poor families lump-sum grants based upon expected need, and *then* provide a catastrophic coverage for situations which cannot be foreseen (such as serious illness and accident). These recommendations would maintain the essence of Medicaid while simultaneously ameliorating several of the negative effects of the program.

As for recent calls for more stringent direct regulation of physicians in the arena of fee restrictions, entry restrictions, and treatment standards, the implications of this dissertation are equally clear. The desire for such increasingly constrictive restraints of physician behavior has at its root the belief that physicians possess undue market power and do not properly act as agents for their patients. Chapter IV finds that one such supposed basis for physician market power, induced demand, does not appear to be a factor in the market. In fact, increases in the numbers of physicians leads to increases in the average quality of care, a move for which patients are willing to pay. Additionally, Chapter II indicates that restrictions on fees will only exacerbate excess

demand problems and lead to lower levels of service by each physician (a short-run phenomena which may extend into the long-run if entry restrictions are sufficiently severe). The recommendation which follows from these results for the policy options mentioned above is to avoid their implementation. Fee controls, entry restrictions, and treatment standards cannot be shown to have positive effects, and can be shown to possess significant negative effects. Therefore, in this instance, such policies cannot be advocated. Other solutions to shortfalls in availability must be devised.

In the final analysis, this dissertation is presented in the hope that it increases our knowledge concerning the behavior of physicians in the current market. The knowledge gained indicates that physicians behave competitively and that some of the shortfalls perceived in the allocation of medical services have their roots in poorly implemented governmental policy. This does not imply that there is no role for regulation, but rather that *some* past approaches have serious flaws. These flaws are not insurmountable, and programs such as Medicaid can be made to operate more efficiently. However, it does serve as a warning to those who see a role for regulation in every aspect of the medical market place. At least at the level of the individual physician, the market appears to work effectively, and it is not necessarily true that the governmental bureaucratic process can improve upon it.

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APPENDIX A: TABLES

TABLE 1

Physician Specialties

Dummy Variable	Specialty
S1	Allergy
S2	Cardiovascular Disease
S3	Dermatology
S4	Gastroenterology
S5	General Practice
S6	General Surgery
S7	Internal Medicine
S8	Neurological Surgery
S9	Obstetrics/Gynecology
S10	Opthalmology
S11	Orthopedic Surgery
S12	Otolaryngology
S13	Pediatrics
S14	Psychiatry
S15	Urology

TABLE 2

Estimated Physician Firm Supply and Demand Functions

Supply				Demand	
	H		h		P
INT	2.59**	INT	-1.26**	INT	4.46**
	(6.46)		(2.91)		(147.84)
P	0.09**	P	0.05**	H	-0.01**
	(3.86)		(2.13)		(35.41)
P^2	-0.001**	P^2	-0.0005*	MIN	0.01
	(4.43)		(1.67)		(0.91)
EX	0.0001	EX	0.002**	AGE	-0.003**
	(0.08)		(1.93)		(11.90)
WNP	0.003	WNP	-0.004	WNP	0.003**
	(0.47)		(0.63)		(2.01)
URB	0.02			URB	0.06**
	(0.70)				(8.41)
BRD	0.03			BRD	0.08**
	(1.17)				(15.01)
CLR	0.04**				
	(4.10)				
LAB	0.07	LAB	0.23	PUBI	0.01
	(1.40)		(3.99)		(1.07)
XRAY	-0.28**	XRAY	-0.11	PRII	-0.002
	(3.16)		(0.99)		(0.25)
IMM	0.06	IMM	-0.38**		
	(0.98)		(5.07)		
PCP	-0.08	PCP	-0.75**		
	(0.81)		(6.68)		
PHV	0.19**	PHV	-0.46**	NAM	0.006
	(2.56)		(5.21)		(0.89)
POS	-0.02			FRD	-0.007
	(1.47)				(1.10)
MTR	0.25	MTR	0.86**	NE	0.001
	(0.88)		(2.89)		(0.22)
MALPP	0.00003	MALPP	-0.00003	NC	-0.01
	(0.58)		(0.05)		(1.51)

(Table 2, con't.)

AUTO	0.00002**	AUTO	0.000003	SO	-0.02**
	(2.49)		(0.29)		(2.93)
NUR	0.02	NUR	-0.04*		
	(1.30)		(1.76)		
SP1	-0.09	SP1	-0.12*	SP1	-0.02
	(1.34)		(1.70)		(1.26)
SP2	0.10	SP2	0.32**	SP2	-0.06**
	(1.02)		(3.17)		(3.13)
SP3	-0.08	SP3	-0.58**	SP3	-0.02
	(0.94)		(6.75)		(1.18)
SP4	0.01	SP4	0.35**	SP4	-0.02
	(0.10)		(3.04)		(0.89)
SP5	0.07	SP5	-0.29**	SP5	-0.007**
	(0.99)		(3.87)		(4.99)
SP6	0.10	SP6	0.21**	SP6	0.002
	(1.48)		(2.77)		(0.13)
SP7	0.06	SP7	0.06	SP7	-0.08**
	(0.84)		(0.82)		(5.37)
SP8	-0.01	SP8	0.46**	SP8	-0.02
	(0.12)		(5.00)		(1.40)
SP9	0.13*	SP9	-0.004	SP9	-0.001
	(1.89)		(0.06)		(0.09)
SP10	0.03	SP10	-0.26**	SP10	-0.01
	(0.32)		(2.97)		(0.77)
SP11	0.20**	SP11	0.11	SP11	-0.01
	(1.94)		(1.00)		(0.74)
SP12	0.02	SP12	-0.21**	SP12	-0.005
	(0.22)		(2.42)		(0.32)
SP13	-0.03	SP13	-0.21**	SP13	0.07**
	(0.38)		(2.81)		(4.66)
SP14	0.01	SP14	0.73*	SP14	-0.05**
	(0.17)		(9.31)		(3.47)

* Indicates significance at the .1 level.
** Indicates significance at the .05 level.
t-statistics in parentheses.

TABLE 3

Estimated Critical Values and Observed Means of Total Hours per Week Suppled

Specialty	Lower Bound	Estimated Value (H^c)	Upper Bound	Observed Mean Hours Worked
1	53	59	65	54
2	63	69	76	66
3	51	56	61	47
4	56	61	67	58
5	59	65	71	62
6	62	68	74	64
7	59	65	71	64
8	56	62	68	62
9	64	70	77	60
10	55	61	66	51
11	62	68	75	57
12	55	60	66	54
13	54	59	65	59
14	55	60	66	54
15	57	62	68	59

TABLE 4

Calculated Elasticities of Supply and Demand

Specialty	Supply Elasticity	Demand Elasticity
1	-0.83	-1.44
2	0.001	-1.16
3	-1.48	-1.64
4	-0.67	-1.34
5	0.04	-1.24
6	-0.39	-1.21
7	-0.009	-1.20
8	-0.45	-1.26
9	-0.75	-1.18
10	-1.32	-1.51
11	-1.00	-1.36
12	-1.06	-1.43
13	-0.31	-1.32
14	-0.73	-1.42
15	-.072	-1.32

Elasticities are calculated at the means.

TABLE 5

Estimated Critical Values and Observed Means of Minutes per Visit Supplied

Specialty	Lower Bound	Critical Value (h^c)	Upper Bound	Observed Mean
1	24	28	32	31
2	39	45	52	43
3	19	21	24	22
4	41	48	55	47
5	22	25	28	22
6	32	37	41	35
7	30	35	40	32
8	40	46	53	52
9	31	35	40	33
10	24	28	32	26
11	30	35	40	34
12	24	28	32	27
13	22	26	29	25
14	62	71	81	71
15	29	34	39	35

TABLE 6

Estimated Elasticities of Time per Visit Supplied

Specialty	Elasticity
1	0.88
2	0.85
3	0.78
4	0.61
5	1.64
6	0.91
7	0.99
8	0.59
9	0.89
10	0.78
11	0.74
12	0.88
13	1.33
14	0.40
15	0.79

Elasticities calculated at the means.

TABLE 7

Estimated Supply and Demand Functions for Physician Firms with Medicaid

	Supply					Demand	
	H		h		PMA		P
INT	2.60** (5.15)	INT	-1.50** (1.97)	INT	-2.40 (1.37)	INT	4.43** (120.81)
P	0.09** (3.89)	P	0.07** (1.94)	P	-0.05 (1.28)	H	-0.01** (36.99)
P^2	-0.001** (5.19)	P^2	-0.001** (2.46)			PMA	0.03 (0.24)
IRMA	-0.03 (0.52)	IRMA	-0.13 (1.08)	IRMA	0.68 (0.78)	h	0.04 (2.68)
PMA	-0.25** (2.78)	PMA	-0.86** (5.19)			MIN	-0.02 (0.46)
EX	-0.0001 (0.30)	EX	0.001 (0.84)	EX	-0.01* (1.63)	AGE	-0.003** (11.35)
WNP	0.003 (0.86)	WNP	0.003 (0.39)			WNP	0.003** (2.33)
URB	0.01 (0.73)			URB	-1.05** (3.91)	URB	0.05** (5.57)
BRD	0.02 (1.23)			BRD	0.25 (1.03)	BRD	0.09** (14.10)
CLR	0.03** (5.26)			CLR	0.19* (1.84)		
LAB	0.05 (1.83)	LAB	0.24** (3.85)	LAB	-0.77* (1.65)		
XRAY	-0.22** (3.63)	XRAY	-0.13 (1.10)	XRAY	0.43 (0.55)		
IMM	-0.05 (1.26)	IMM	-0.53** (6.18)	IMM	-1.01* (1.70)		
PNCP	0.25** (3.48)	PNCP	0.97** (7.39)	PADM	2.86** (2.20)		
PHV	0.06 (1.11)	PHV	-0.69** (7.20)	PHV	1.46** (1.94)	NAM	0.05** (3.03)
POS	-0.02** (2.45)					FRD	-0.01 (1.33)

(Table 7, con't.)

MTR	0.45** (2.30)	MTR	1.31** (3.85)	MTR	5.04** (2.15)	NE	0.01* (1.58)
MALPP	-0.00001 (0.38)	MALPP	-0.00004 (0.57)			NC	-0.004 (0.53)
AUTO	0.00002** (2.94)	AUTO	0.00001 (0.92)			SO	-0.001 (0.13)
NUR	0.004 (0.37)	NUR	-0.08** (3.40)	NUR	-0.07 (0.39)		
COMC	0.03 (0.35)	COMC	-0.25 (1.33)			COMC	-0.02 (0.57)
COBS	0.08 (0.92)	COBS	0.28* (1.82)			COBS	0.05* (1.83)
COPI	0.13 (1.33)	COPI	-0.003 (0.02)			COPI	-0.04 (1.11)
OPS	0.002 (1.09)	OPS	-0.01** (2.27)				
SP1	-0.04 (1.08)	SP1	-0.13* (1.63)	SP1	0.13 (0.22)	SP1	-0.02 (1.29)
SP2	0.08 (1.07)	SP2	0.11 (0.86)	SP2	-2.49** (2.95)	SP2	-0.08** (3.75)
SP3	-0.09 (1.62)	SP3	-0.61** (6.11)	SP3	-0.66 (0.93)	SP3	-0.02 (0.89)
SP4	-0.01 (0.20)	SP4	0.24* (1.81)	SP4	-0.78 (0.82)	SP4	-0.03 (1.26)
SP5	0.05 (0.90)	SP5	-0.45** (4.61)	SP5	-0.26 (0.41)	SP5	-0.07** (4.56)
SP6	0.09** (1.94)	SP6	0.24** (2.82)	SP6	-0.14 (0.24)	SP6	0.0002 (0.01)
SP7	0.05 (0.82)	SP7	-0.15 (1.50)	SP7	-0.59 (0.94)	SP7	-0.08** (5.07)
SP8	-0.01 (0.11)	SP8	0.45** (4.41)	SP8	0.13 (0.17)	SP8	-0.03* (1.78)
SP9	0.09** (1.91)	SP9	0.03 (0.31)	SP9	-0.75 (1.26)	SP9	-0.003 (0.22)
SP10	0.03 (0.53)	SP10	-0.24** (2.47)	SP10	0.34 (0.48)	SP10	-0.01 (0.55)
SP11	0.15** (2.21)	SP11	0.14 (1.14)	SP11	-1.46* (1.71)	SP11	-0.02 (1.02)

(Table 7, con't.)

SP12	0.0003 (0.01)	SP12	-0.17* (1.83)	SP12	-0.14 (0.20)	SP12	-0.003 (0.18)
SP13	-0.01 (0.27)	SP13	-0.33** (3.44)	SP13	-0.22 (0.34)	SP13	-0.07** (4.38)
SP14	-0.05 (1.01)	SP14	0.59** (5.70)	SP14	-1.07 (1.65)	SP14	-0.08** (4.04)

* Indicates significance at the .1 level.
** Indicates significance at the .05 level.
t-statistics in parentheses.

TABLE 8

Estimated Critical Values for Total Hours Supplied per Week in a Model of Physician Firms with Medicaid

Specialty	Lower Bound	Critical Value (H^c)	Upper Bound
1	62	69	70
2	73	81	89
3	62	68	75
4	68	75	83
5	71	78	86
6	76	84	92
7	70	78	86
8	69	76	84
9	79	87	97
10	70	78	86
11	75	83	92
12	69	76	84
13	65	72	79
14	65	72	80
15	71	78	86

TABLE 9

Estimated Critical Values of Minutes per Visit in a Model of Physician Firms with Medicaid

Specialty	Lower Bound	Critical Value (h^c)	Upper Bound
1	3o	42	48
2	57	66	77
3	33	39	45
4	73	85	100
5	33	39	45
6	55	64	75
7	46	54	63
8	64	75	88
9	58	68	80
10	49	57	66
11	55	64	75
12	45	53	62
13	36	42	49
14	104	121	141
15	53	62	72

TABLE 10

Esimated Elasticities of Demand, Supply of Total Hours and Supply of Quality in a Model of Physician Firms with Medicaid

Specialty	Total Hours Demanded	Total Hours Supplied	Quality Supplied
1	-1.44	-0.93	-1.60
2	-1.16	0.01	0.08
3	-1.65	-1.72	-3.83
4	-1.34	-0.77	-0.67
5	-1.25	0.06	0.23
6	-1.22	-0.45	-0.47
7	-1.21	0.002	0.09
8	-1.26	-0.52	-0.46
9	-1.19	-0.87	-0.98
10	-1.52	-1.58	-2.43
11	-1.36	-1.15	-1.42
12	-1.44	-1.24	-1.90
13	-1.33	-0.35	-0.53
14	-1.43	-0.83	-0.52
15	-1.32	-0.85	-0.97

Elasticities calculated at the means.

TABLE 11

Estimated Supply and Demand Functions in a Model of Physician Firms, Testing for Supplier Induced Demand

Supply				Demand	
H		h		P	
INT	3.06** (9.69)	INT	-1.42** (2.67)	INT	4.40** (86.11)
P	0.07** (4.18)	P	0.06** (2.22)	H	-0.01** (24.61)
P^2	-0.001** (5.34)	P^2	-0.001** (2.14)	h	0.04* (2.01)
				MIN	0.02 (1.49)
EX	-0.0003 (0.46)	EX	0.002** (2.24)	AGE	-0.003** (9.00)
WNP	0.01 (1.21)	WNP	-0.009 (0.87)	WNP	0.001 (0.63)
URB	0.01 (0.40)			URB	0.05** (4.78)
BRD	0.03 (1.06)			BRD	0.08** (10.92)
CLR	0.02** (2.72)				
LAB	0.03 (0.76)	LAB	0.19** (2.34)	PUBI	-0.01 (0.47)
XRAY	-0.08 (1.04)	XRAY	-0.08 (0.52)	PRII	0.01 (1.28)
IMM	0.03 (0.56)	IMM	-0.40** (3.80)		
PCP	-0.11 (1.42)	PCP	-0.85** (6.08)		
PHV	0.11 (1.70)	PHV	-0.49** (4.18)	NAM	-0.002 (0.27)

(Table 11, con't.)

POS	-0.02			FRD	-0.004
	(1.10)				(0.57)
MTR	0.17	MTR	0.40	NE	0.01
	(0.57)		(0.87)		(0.69)
MALPP	0.00004	MALPP	-0.0001	NC	0.0001
	(0.96)		(1.35)		(0.01)
AUTO	0.00001	AUTO	-0.00002	SO	-0.003
	(1.41)		(1.59)		(0.18)
NUR	0.01	NUR	-0.02		
	(0.77)		(0.75)		
PDEN	.00004	PDEN	0.001**	PDEN	-0.00004
	(0.18)		(2.19)		(0.52)
PURB	0.16*	PURB	0.28**	PURB	0.03
	(1.97)		(2.46)		(1.26)
SP1	-0.04	SP1	-0.06	SP1	-0.04*
	(0.42)		(0.38)		(1.77)
SP2	0.11	SP2	0.24	SP2	-0.07**
	(1.16)		(1.52)		(2.49)
SP3	-0.02	SP3	-0.59**	SP3	-0.01
	(0.18)		(3.95)		(0.52)
SP4	0.05	SP4	0.44**	SP4	-0.04
	(0.47)		(2.74)		(1.15)
SP5	0.03	SP5	-0.25*	SP5	-0.09**
	(0.35)		(1.92)		(4.07)
SP6	0.11	SP6	0.20	SP6	-0.02
	(1.42)		(1.56)		(0.89)
SP7	0.04	SP7	0.02	SP7	-0.09**
	(0.48)		(0.13)		(3.84)
SP8	-0.02	SP8	0.45**	SP8	-0.05*
	(0.25)		(2.99)		(1.79)
SP9	0.20**	SP9	-0.06	SP9	-0.007
	(2.36)		(0.42)		(0.31)
SP10	0.01	SP10	-0.22	SP10	-0.03
	(0.11)		(1.50)		(0.99)
SP11	0.08	SP11	0.003	SP11	-0.01
	(0.68)		(0.02)		(0.44)

(Table 11, con't)

SP12	0.05 (0.56)	SP12	-0.12 (0.80)	SP12	-0.01 (0.44)
SP13	-0.001 (0.01)	SP13	-0.21 (1.53)	SP13	0.08** (3.28)
SP14	0.003 (0.05)	SP14	0.78** (5.85)	SP14	-0.09** (3.23)

* Indicates significance at the .1 level.
** Indicates significance at the .05 level.
t-statistics in parentheses.

TABLE 12

Estimated Critical Values for Total Hours Supplied per Week in a Model of Physician Firms, Testing SID

Specialty	Lower Bound	Critical Value (H^c)	Upper Bound
1	59	69	81
2	68	80	93
3	58	68	79
4	62	73	85
5	60	70	82
6	66	77	90
7	62	73	85
8	60	70	82
9	72	84	99
10	58	67	78
11	62	72	84
12	61	71	83
13	58	68	79
14	59	68	80
15	60	70	82

TABLE 13

Estimated Critical Values of Minutes per Visit in a Model of Physician Firms, Testing SID

Specialty	Lower Bound	Critical Value (h^c)	Upper Bound
1	25	29	34
2	38	44	51
3	19	21	25
4	48	55	63
5	21	24	27
6	30	34	39
7	28	33	37
8	39	45	51
9	30	35	40
10	24	27	31
11	27	31	35
12	26	29	34
13	22	25	28
14	62	71	81
15	27	31	36

APPENDIX B: FIGURES

FIGURE 1

Utility and Profit Maximizing Decision in a Model of Physician Firms

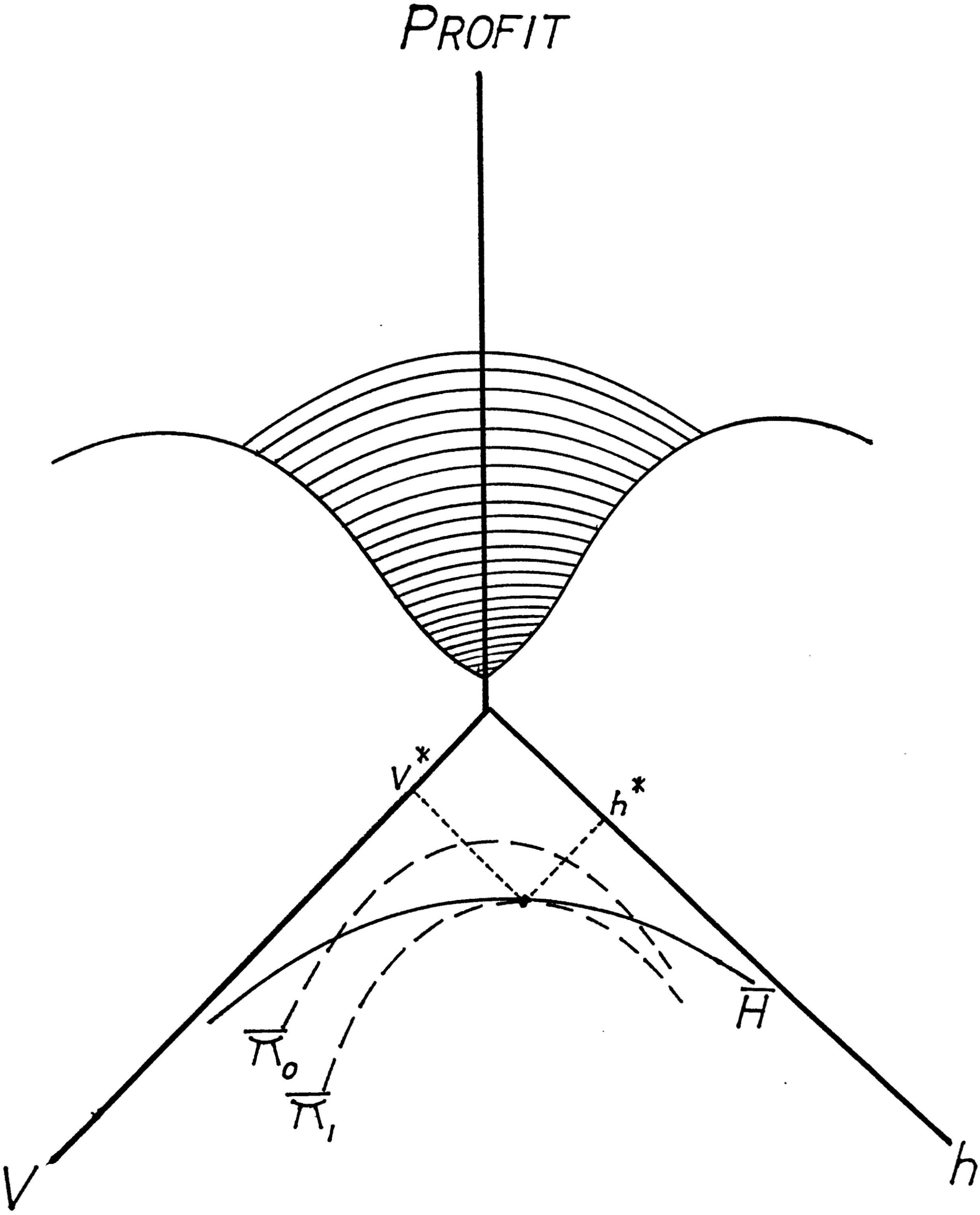


FIGURE 2

Implications of Using a Single Equation Approach
in Estimating Market Supply

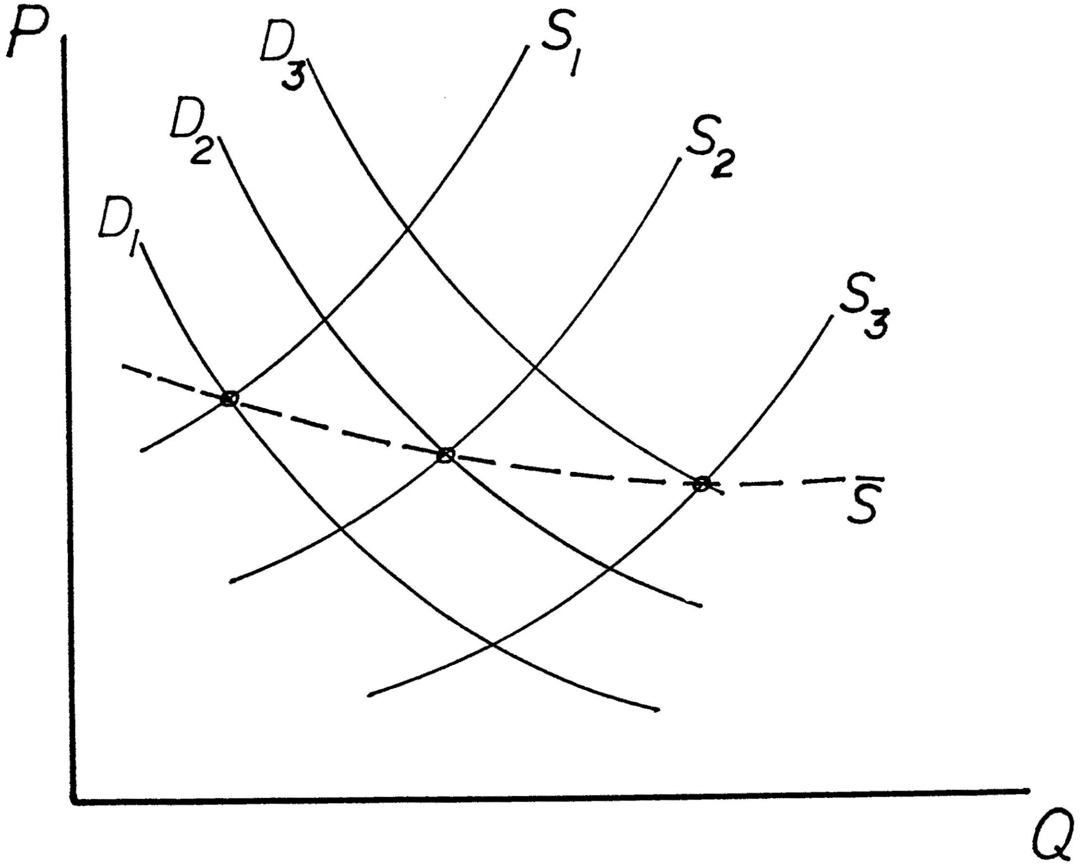


FIGURE 3

Estimated Supply and Demand Curves in a Model of Physician Firms
(Urology)

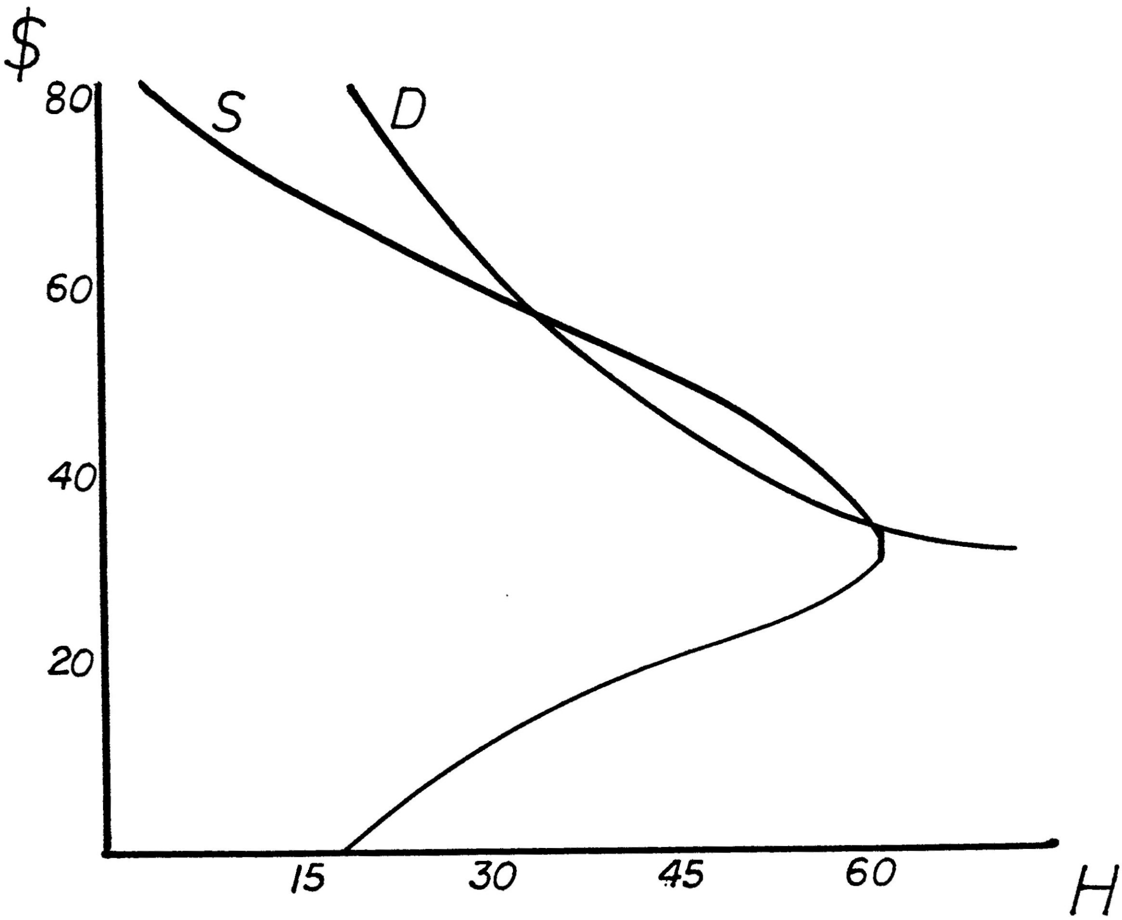
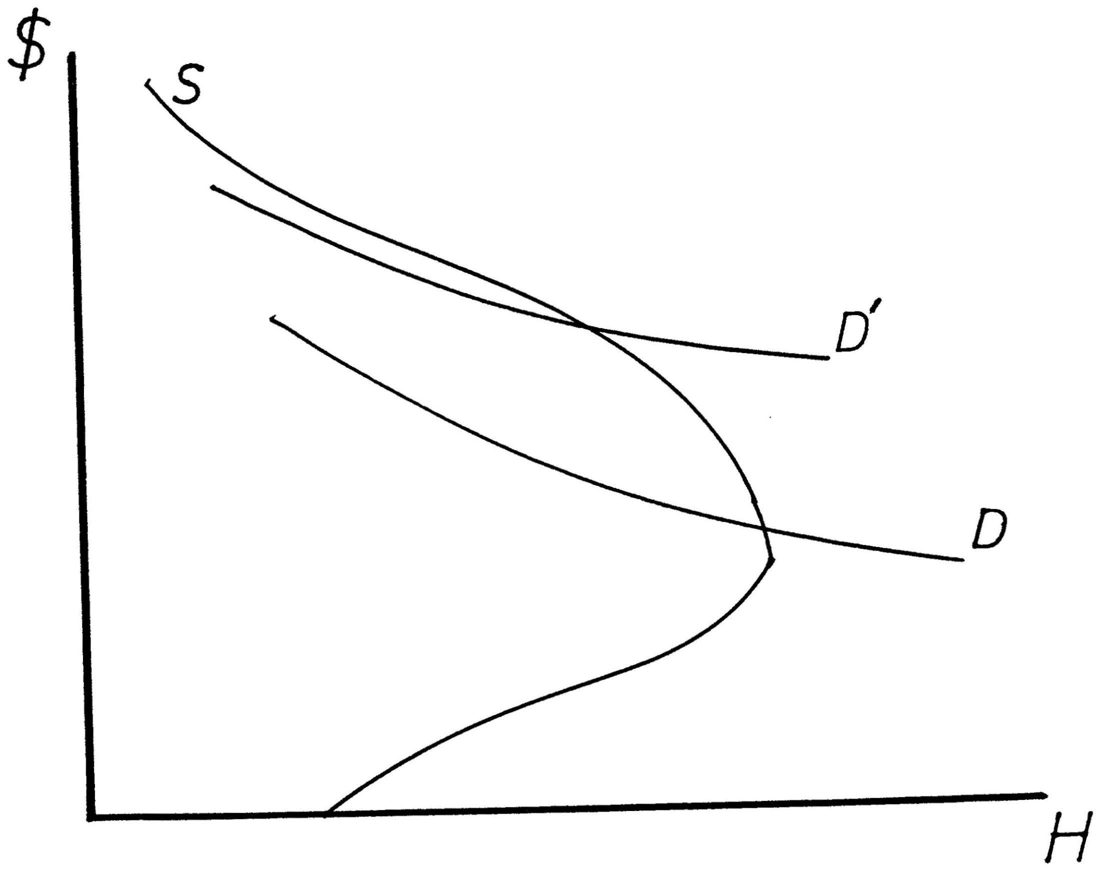


FIGURE 4

Implications of Results from an Estimated Model of Physician Firms for Supplier Induced Demand



VITAE

William David Bradford

24B Nute Road
Madbury, NH 03820
(603) 749-9357

Whittemore School of Business
and Economics
McConnell Hall
University of New Hampshire
Durham, NH 03824
(603) 862-3379

EDUCATION

Ph.D., Economics, Louisiana State University, 1991
M.S., Economics, Louisiana State University, 1989
B.S., Foreign Languages, Mississippi State University, 1987

DISSERTATION

Three Essays in the Economics of the Physician Firm

RESEARCH INTERESTS

Health Economics
Industrial Organization

TEACHING INTERESTS

Health Economics
Industrial Organization
Econometrics
Economic History

AWARDS

Excellence in Teaching Award, College of Business, Louisiana State University, 1990.
Excellence in Teaching Award, Department of Economics, Louisiana State University, 1990.
Excellence in Teaching Award, Department of Economics, Louisiana State University, 1989.

PUBLICATIONS

"The Price of Beer: Some Evidence from Interstate Comparisons" (with W.P. Culbertson), forthcoming, International Journal of Industrial Organization.

"Preliminary Report on a Cost Benefit Study of Mandated Ethanol-Gasoline Blends" (with C. Dahl), Proceedings of the Eleventh Annual North American Conference for the International Association of Energy Economists, (October, 1989), pp. 226-236.

REPORTS

"Chemical Waste in Louisiana, 1987: A Summary of Hazardous Waste and Toxic Chemicals" (with S. Farber and D. Wascom), Report to the Louisiana Department of Environmental Quality, 1989.

CURRENT RESEARCH

"Quantity and Quality Choice in the Physician Firm" (with R.E. Martin), under review.

"Physician Firm Quality and the Choice Between Medicaid and Private Patients" (with R.E. Martin).

"Medical Service Quality: Effects on Evidence Surrounding Supplier Induced Demand" (with R.E. Martin).

PAPERS PRESENTED

"A Structural Comparison of the Soft Drink and Malt Beverage Industries," Western Economic Association Meetings, 1990.

"A Cost Benefit Study of Mandated Ethanol-Gasoline Blends" (with C. Dahl), Allied Social Sciences Annual Meetings, 1989.

"Preliminary Report on the Effectiveness of a Mandatory Gasohol Program on Automotive Exhaust Emmissions to the Year 2000" (with C. Dahl), Southern Economic Association Meetings, 1989.

PROFESSIONAL EXPERIENCE

Assistant Professor, Department of Economics, University of New Hampshire, 1991 to present.
Graduate Teaching Assistant, Department of Economics, Louisiana State University, 1988-1991.
Graduate Research Assistant, Department of Economics, Louisiana State University, 1987-1988.

PROFESSIONAL ORGANIZATIONS

American Economic Association.
Omicron Delta Epsilon.
Southern Economic Association.
Western Economic Association, International.

PERSONAL

Birthdate: January 27, 1965.
Marital Status: Married.
Citizenship: U.S.A.

REFERENCES

Dr. Stephen C. Farber
Department of Economics
Louisiana State University
Baton Rouge, LA 70803
(504) 388-3791

Dr. R. Carter Hill
Department of Economics
Louisiana State University
Baton Rouge, LA 70803
(504) 388-1490

Dr. Robert E. Martin
Department of Economics
Louisiana State University
Baton Rouge, LA 70803
(504) 388-3793

Dr. Paul F. Paskoff
Department of History
Louisiana State University
Baton Rouge, LA 70803
(504) 388-4454

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: William David Bradford, III

Major Field: Economics

Title of Dissertation: Three Essays in the Economics of the Physician Firm

Approved:

[signature]
Major Professor and Chairman

[signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

Paul F. Parker
William J. Moore
[signature]
John [signature]
Daryl McKee

Date of Examination: