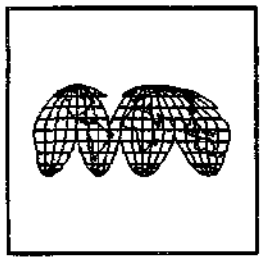
Workshop in Political Theory and Policy Analysis

513 N. Park | Indiana University | 812-855-0441

Colloquium Presentation
February 15, 1993



Learning, sharing, and working with diverse languages in communicating and using knowledge.

The Workshop in Political Theory and Policy Analysis combines teaching, research, and related activities where faculty, visiting scholars, and students have opportunities to participate in productive scholarship. The term "workshop" is used to emphasize a conviction that research skills are best acquired where students and faculty, working as apprentices and journeymen, participate in the organization and conduct of research.

Professor Steven C. Hackett, Department of Economics and Workshop in Political Theory and Policy Analysis, Indiana University, will be the speaker for the Workshop Colloquium on Monday, February 15, 1993. His presentation is entitled "Heterogeneity and Share Contracting in Medical Group Practices." An abstract of his paper is provided below.

This paper offers an empirical analysis of the relationship between income sharing rules and heterogeneity in medical group practices. The economies to group formation associated with risk-sharing, mutual monitoring, and internal referral are served by sharing at least a portion of group income equally. Sharing group income equally is problematic, however, when group members differ in their contribution to joint income, hereafter termed "productivity." Member physicians may differ in productivity because of differences in ability, effort, or specialty field. The analysis below is addressed to the question of how income sharing rules in physician groups are affected by variation in member productivity. The analysis finds considerable evidence supporting the argument that productive heterogeneity limits the use of equal income sharing. For example, less group income is shared equally in multispecialty groups relative to single specialty groups because the former include physicians from fields with widely different income-generating potential. The same holds for specialty groups where physician services can be characterized as differentiated reputation goods, and in relatively large groups where it becomes increasingly difficult to form around homogeneous physician attributes. No such group size effect is found in multispecialty groups, which suggests that most of the quantitative effects of heterogeneity are concentrated in relatively small multispecialty groups, which by their very nature can be expected to be heterogeneous because of productivity differences across specialty fields.

A copy of his paper is available by calling the above telephone number. Colloquium sessions begin at 12 noon and adjourn promptly at 1:30 p.m. You are welcome to bring your lunch. Coffee is provided free of charge, and soft drinks are available. We hope you will be able to join us!

Heterogeneity and Share Contracting in Medical Group Practices*

Steven C. Hackett
Department of Economics
and
Workshop in Political Theory and Policy Analysis
Indiana University
Bloomington, IN 47405
(812) 855-1021 INTERNET: SHACKETT@UCS.INDIANA.EDU

January 22, 1993

* I would like to thank Keith Crocker, Martin Gaynor, Joe Kerkvliet, Dean Lueck, Lin Ostrom, Philip Russell, Suzanne Scotchmer, and Jimmy Walker for their helpful comments. Special thanks to Tom Lyon for the valuable insights, ideas, and encouragement he has offered at various stages of this project. George Auld generously shared his data and his expertise on medical group practices with me, thus making this project possible.

Abstract

This paper offers an empirical analysis of the relationship between income sharing rules and heterogeneity in medical group practices. The economies to group formation associated with risk-sharing, mutual monitoring, and internal referral are served by sharing at least a portion of group income equally. Sharing group income equally is problematic, however, when group members differ in their contribution to joint income, hereafter termed "productivity." Member physicians may differ in productivity because of differences in ability, effort, or specialty field. The analysis below is addressed to the question of how income sharing rules in physician groups are affected by variation in member productivity. The analysis finds considerable evidence supporting the argument that productive heterogeneity limits the use of equal income sharing. For example, less group income is shared equally in multispecialty groups relative to single specialty groups because the former include physicians from fields with widely different income-generating potential. The same holds for specialty groups where physician services can be characterized as differentiated reputation goods, and in relatively large groups where it becomes increasingly difficult to form around homogeneous physician attributes. No such group size effect is found in multispecialty groups, which suggests that most of the quantitative effects of heterogeneity are concentrated in relatively small multispecialty groups, which by their very nature can be expected to be heterogeneous because of productivity differences across specialty fields.

JEL classification D23, L14, L84

I. INTRODUCTION

This paper studies the effects of heterogeneity on sharing rules used to allocate joint income in medical group practices.[1] Medical groups may form around a particular specialty, such as pediatrics or cardiology, or include physicians from a number of different specialty fields. Groups may form to exploit scale economies [Farrell and Scotchmen 1988], to share risk [Cheung 1969], to mutually monitor [Carr and Mathewson 1990], or to internalize lucrative referrals by primary care physicians (family practitioners, internists, and pediatricians) to surgeons and specialists. While costs can presumably be shared by a group of solo practitioners sharing office or other expenses, a key element of the American Medical Association's (AMA's) definition of a medical group practice specifies that "[i]ncome from medical services provided by the group are treated as receipts of the group and distributed according to some prearranged plan" [AMA 1992, p. 1]. The economies to group formation associated with risk-sharing, mutual monitoring, and internal referral are served by sharing at least a portion of group income equally. Sharing group income equally is problematic, however, when group members differ in their contribution to joint income, hereafter termed "productivity."

While there have been a good number of important theoretical and case-study analyses of share contracting in professional groups [Kwon 1978; Leibowitz and Tollison 1980; Gilson and Mnookin 1985; Radner 1986; Farrell and Scotchmer 1988; Carr and Mathewson 1990; Kandel and Lazear 1992], the empirical literature is comparatively sparse. Gaynor (1989) and Gaynor and Pauly (1990) analyze 1978 group medical practice data sampled from five medical group practice specialties. A key element of their analyses of pricing and productive efficiency is a compensation scale measuring

[1] Many of the early group medical practices were formed by employers such as the Northern Pacific Railroad in the late 19th century to provide medical care to employees working in remote locations. The Mayo Clinic was the first successful nonindustrial group practice. As Phelps (1992) reports, the clinic was named after a bad batch of chicken salad eaten at a summer picnic that caused widespread stomach illness in Rochester, Minnesota. Successful treatment of the stomach malady lead to the formation of the "Mayo" clinic.

the extent to which a surveyed physician "regarded his compensation as completely unrelated to productivity" [Gaynor and Pauly (1990) p. 556]. A strong positive relationship is found between the compensation scale and (i) the degree of nonprice competition among group members, and (ii) output as measured by number of office visits per week. Gaynor and Gertler (1992) view medical groups as using income sharing rules and group size as instruments to motivate effort and to share risk. They find that risk-aversion (measured by the desire of physician-members for income regularity) leads to higher compensation scale values in order to share risk, and smaller group sizes to promote effort. I am not aware of any empirical studies focused on estimating the effects of heterogeneity on group income sharing rules.

The present study begins in section II by deriving a number of predictions based on the hypothesis that equal income sharing decreases as productivity differences increase among group members. The data considered below provide group-level observations on group specialty and group size. The predictions are based on arguments that these variables provide information on group heterogeneity, and so can be used to assess the hypothesis regarding heterogeneity and income-sharing rules. These predictions are then tested in section III using data from a 1986 survey of group income sharing rules conducted in association with the American College of Medical Group Administrators.

The first prediction is addressed to productivity differences across specialty fields. Multispecialty groups tend to include a mixture of primary care physicians with relatively low-priced services on the one hand, and surgeons and specialists with relatively high priced services on the other. Equal income sharing is predicted to occur with lower frequency in multispecialty groups than in single specialty groups. This prediction is strongly supported by the analysis. For example, the analysis finds that while 36 percent (270/758) of all single-specialty groups studied here share all group income equally, such sharing rules are used in only 4 percent (20/506) of all multispecialty groups.

The second prediction is based on differences in the degree that physician services can be

considered as reputation goods. Pauly and Satterthwaite (1981) provide evidence that the services provided by primary care physicians qualify as a reputation good, since individual physicians provide differentiated services, and consumers choose individual primary care physicians based on recommendations from relatives, friends, and associates they trust. In order to provide an incentive for a physician to make the effort investment in developing a reputation, a physician's income must be linked to his productivity. Ancillary physician services (anesthesia, pathology, and radiology) likely offer the strongest contrast to primary care groups in that they are least likely to qualify as a reputation good. This is because they provide relatively homogeneous services, and are usually unknown to the patients they serve. Ancillary groups tend to have exclusive service arrangements with hospitals, and so patients are generally referred to the group rather than to a particular ancillary physician, and receive service from whichever physician happens to be working that shift. Thus the second prediction is that equal income sharing will occur with lower frequency in single specialty, primary care groups relative to other types of single specialty groups, and in particular ancillary care groups. This prediction is also strongly supported. To illustrate, while 19 percent of all primary care groups divide all group income equally, 93 percent of all ancillary groups equally share all group income.

The third prediction follows from theoretical research on partnerships by Farrell and Scotchmer (1988). They assume that groups form because of scale economies, and that individuals differ in ability. When groups form from a limited population, then the range from high to low productivity in the group necessarily increases as group size rises. As a consequence equal income sharing will decline as group size rises, since as groups grow and productivity differences widen, the most productive members become increasingly unwilling to share income equally with the least productive members. The analysis below finds that the percentage of group income shared equally declines as the size of single specialty groups rises, which is consistent with the prediction that large groups

contain a wider range of ability types than smaller groups. In contrast, no such relationship is found between equal sharing and group size in multispecialty groups. This latter result suggests that the quantitative effects of heterogeneity in multispecialty groups largely follow from productivity differences that by their very nature are realized in very small groups: multispecialty groups include physicians from specialty fields with different income-generating potential, and this diverse membership cannot generally be accommodated by rules that pool income and allocate equal shares.

II. MEDICAL GROUP PRACTICES: DISCUSSION AND PREDICTIONS

This section of the paper begins with a discussion of the nature of medical group practice. This discussion of medical group practice then provides a background for the presentation of the key predictions, which are then evaluated against the evidence presented in section HE.

The Economics of Group Practice

Why do some physicians (or professionals in general) join together into groups rather than operate independently? Farrell and Scotchmer (1988) argue that partnerships arise because of scale economies. In the context of medical groups, scale economies to medical groups may arise from work load smoothing when business arrives in lumps, from office administration (scheduling, collections, and insurance reporting), or from capital equipment. There is some evidence for scale economies to group practice. For example, in their 1975 survey of medical group practices, the AMA report that the highest percentage of physician group members as a percentage of all physicians in private practice was in the radiology field (57.2 percent), a specialty that uses relatively expensive capital equipment [AMA 1976]. In contrast, the lowest incidence of group formation (of the group categories listed in the data appendix below) was in the psychiatry field (10.2 percent), a specialty

that uses minimal capital equipment. Similar findings are reported in an earlier study by Newhouse (1973).

Fama and Jensen (1983), Carr and Mathewson (1990), and Kandel and Lazear (1992) argue for a mutual-monitoring advantage to professional groups. The equilibrium model of Carr and Mathewson perhaps best illustrates the issues. Carr and Mathewson's model is motivated by case-study information from Gilson and Mnookin (1985), which suggests that many legal group practices set seniority-indexed equal group income shares, rather than indexing group income shares to productivity. Carr and Mathewson then develop a model in which law firms are distinguished by group-specific (brand-name) capital, and it is more costly for consumers of legal services to assess quality than it is for fellow group members. In this setting, Carr and Mathewson argue that mutual monitoring is a way of protecting group-specific reputational capital, since "fraudulent behavior places both joint and specific capital investment at risk" (p. 314). Seniority-indexed equal group income sharing provides an added incentive for mutual monitoring, where the individuals doing the most monitoring are experienced senior personnel most closely tied to the group's reputation.

Lee (1991) finds substantial evidence for mutual monitoring in medical group practices. Of the groups he studied, 49 percent routinely monitored whether staff physicians perform routine preventative procedures. In addition, 66 percent had a screening protocol for colorectal cancer, 30 percent distribute algorithms defining appropriate tests for particular medical problems, 50 percent had programs to identify problem physicians and modify their behavior, 75 percent had quality-of-care protocols, and 65 percent monitored direct physician costs.

Another motive for group formation derives from Cheung's (1969) pioneering work on diversification in (agricultural) share contracts.[2] In agriculture, a cash rent contract (fixed wage contract) places all crop yield risk on the tenant (land owner), and if the tenant is risk-averse, such an

[2] Also see Stiglitz (1974).

arrangement is non-optimal. The alternative is to use a contract in which parties are compensated with realized crop shares. In the context of professional groups, risk-averse professionals operating independently, or in groups that divide income based on individual productivity, have asset holdings that are highly concentrated in their specialized human capital. When stochastic income shocks are less than perfectly correlated across individuals, then they have an incentive to join together in a sharing contract that divides at least some group income equally in order to diversify their individual asset holdings. Gilson and Mnookin (1985) have more recently applied this notion to law firms using seniority-based allocation rules, and show that such a scheme gives lawyers an incentive to further specialize. Gaynor and Pauly (1990) point out that making a portion of a physician's income independent of productivity, as when a portion of group income is divided equally, may be preferred by risk-averse physicians when individual productivity has a stochastic component.

Given that there is a motive for professionals to form groups, the next question is why both single and multispecialty group practices exist contemporaneously. Again there is a tradeoff between the benefits and the costs of single specialty groups. A clear benefit of single specialty groups is that professionals within a given specialty are best able to mutually monitor one another. Kandel and Lazear (1992) state that "partnerships tend to be formed among individuals who perform similar tasks because mutual monitoring is more effective" (p. 816), while Carr and Mathewson (1990) argue that "lower costs from both monitoring and remedial action push partnerships toward organizations of similar legal specialists" (p. 314).

In contrast, the risk-sharing motive for sharing contracts provides an incentive for diversified groups when physicians are confronted with field-specific shocks such as technological innovation on the supply side, or changes in the incentive structure of health insurance contracts on the demand side. Thus the risk sharing motive promotes group diversity and so works against the mutual monitoring incentive for group homogeneity.

A second advantage of multispecialty groups arises from incentives for primary care physicians to refer patients internally. Share contracts among primary care physicians on the one hand and surgeons and specialists on the other may give primary care physicians an incentive to internally refer patients. Internal referral can be lucrative. Mitchell and Sunshine (1992) and Swedlow et al. (1992) offer considerable evidence that physicians use joint venture affiliations to "skim the cream" from the pool of patients by self-referring those patients with the most generous insurance, and then ordering costly procedures at a rate that exceeds the national average. In fact, internal referral is deemed to be sufficiently lucrative that joint venture affiliations are thought to place physicians in ethical jeopardy.[3] Thus multispecialty groups that promote internal referral (e.g., by sharing part of group income equally) may have a profitability advantage because they internalize the lucrative affiliation between primary and more specialized care physicians.[4]

There is thus a tradeoff that is consistent with the contemporaneous mixture of single specialty and multispecialty group practices observed in the data. Single specialty groups arise in circumstances in which mutual monitoring is highly valuable and the task is highly specialized, and in communities sufficiently large to support a single specialty group. Multispecialty groups arise in circumstances where there are large gains to internal referral, where risk-averse physicians are concerned about

[3] The U.S. Department of Health and Human Services issued safe-harbor regulations limiting the use of self-referral to outside facilities in September 1991, while the Internal Revenue Service has taken the policy that not-for-profit hospitals may lose their tax-exempt status if they enter into self-referral joint ventures with physicians. In December 1991 the AMA approved ethical guidelines that advised physicians to avoid self-referral involving outside facilities where the physician has an ownership interest. Similar statements have been made by the American College of Physicians, the American College of Surgeons, and the American College of Radiology.

[4] Other advantages of multispecialty groups may arise because of small community size and the nature of team production. First, following the work of Bresnahan and Reiss (1991), multispecialty groups may arise in smaller and isolated communities that cannot support single specialty groups sufficiently large to fully exploit scale economies. Second, some medical services may best be produced using a team of physicians from diverse specialty fields. For example, patients may benefit from the close coordination of multispecialty care offered by a multispecialty group.

specialty-specific shocks, or in smaller communities where scale economies can only be exploited in a multispecialty practice.

Sharing rules determining physician income axe of central importance to medical groups. For example, Beck (1972) and Azevedo (1990) argue that disputes over surplus division cause more medical groups to break up than all other factors combined. The comments of Ross, Williams, and Schafer (1984) illustrate:

> "[T]he surgeon [has] an income advantage when worth is measured in terms of fees paid. The specialist in internal medicine may labor just as long, but... [the] skillful diagnostic talents [of the internist] are worth less ~ again, measured in terms of fees paid. Thus throughout the physician's professional life, compensation relationships may be affected. Disparity in income among specialties creates friction within groups....Probably the most common factor leading to the complete dissolution of [medical] groups is the inability of the individuals in the group to agree on an acceptable method of compensation" (p 202, 209).

As Ross et al. point out above, primary care physicians who diagnose patients generally have much lower productivities, as measured by income, than the surgeons and specialists to whom they refer patients. This differential represents a premium to the added training necessary for physicians to be certified by "specialty boards." Phelps (1992) reports that the internal return on specialized human capital substantially exceeds competitive returns, particularly for surgical and hospital-related specialties relative to primary care.[5] This extra-competitive internal rate of return has been a source of concern for policy makers. For example, McKay (1990) points out that the Health Professions Educational Assistance Act of 1976 instituted a quota scheme to encourage the offering of first-year residencies in primary care fields.[6] Using American Medical Association (AMA) data, McKay has computed mean annual physician net income (before taxes) and mean annual hours worked for eight medical specialties. Using her most recent data (1987), one can get a rough estimate of productive

[5] For example, Phelps (1992) reports 1987 internal rates of return of 22 percent associated with specialization in general surgery and 26 percent for OB/GYN.

[6] While this quota scheme expired in 1980, McKay points out that the issues surrounding policies designed to encourage more residents to enter primary care fields resurface with regularity.

differences across these eight physician fields by dividing average annual net income by average annual hours worked:

Pediatrics	$85,300/2541	=	$33.57
Family Practice	$91,500/2561	=	$35.73
Internal Medicine	$121,800/2654	=	$45.89
Psychiatry	$102,700/2076	=	$49.47
Ob/Gyn	$163,200/2685	=	$60.78
Anesthesiology	$163,100/2446	=	$66.68
Surgery	$187,900/2491	=	$75.43
Radiology	$180,700/2323	=	$77.79

Thus the largest hourly net income (radiology) is more than twice as large as the smallest, and the three primary care fields are all below the other surgical and specialist fields, which is strong evidence for productive heterogeneity across physician specialty fields.[7] Thus despite the inevitable heterogeneity across physicians within a given field, multispecialty medical groups are confronted with an additional productive heterogeneity based on differences in income (and so on differences in the internal return on specialized training) across specialty fields.

Predictions

The central hypothesis is that as the productive heterogeneity of a group increases, equal income sharing will decline. As Akerlof (1970) and many others have pointed out, pooling arrangements are more likely to fail when the relevant parties are heterogeneous. Pooling physicians of widely different productivities and opportunity costs under an income sharing arrangement that allocates equal shares fails when the most productive physicians leave for more lucrative outside opportunities. The data examined in this study contains group-level observations on group specialty and group size, and the predictions below follow from the contention that these variables provide information on group heterogeneity, and so can be used to assess the hypothesis regarding heterogeneity and income-

[7] The ratio of high to low average net income per hour has actually risen over time from 1.49:1 in 1970 to 1.78:1 in 1980 to 2.32:1 in 1987.

sharing rules.

The discussion above has illustrated that productive differences across specialty fields can be substantial. While productive heterogeneity in multispecialty groups may arise because of underlying differences in physician ability, effort supply, or choice of specialty field, only the first two are present in single specialty groups. The first prediction follows from the idea that groups which contain physicians from different specialty fields will feature greater productive heterogeneity than groups organized around a single specialty field:

Prediction: Equal income sharing will occur with lower frequency in multispecialty groups relative to single specialty groups

A second prediction is derived from the idea that certain physician specialty fields are more condusive to reputation formation and vertical product differentiation than others. Pauly and Satterthwaite (1981) isolate primary care fields as best qualifying as a reputation good. They provide evidence that individual primary care physicians provide differentiated services, and consumers choose their primary care physician based on recommendations from relatives, friends, and associates they trust. Presumably these recommendations correlate with the effort and the skill that a physician is known to apply to a patient's case. Following the logic of the reputation model developed by Klein and Leffler (1981), a quasi rent flow is required to provide suppliers with an incentive to build a reputation for product quality. In order for a group to provide member physicians with an incentive to take the added effort to build a reputation for quality service, a physician's compensation should be closely linked to his individual reputation. When physician services are a reputation good, optimal incentives are created by linking income shares to a physician's productive contribution to group income. When physicians are heterogeneous, this group income allocation will deviate from equal sharing. This argument leads to the following prediction:

Prediction: Equal income sharing will occur with lower frequency in primary care groups relative to other single specialty groups

The second prediction is restricted to single specialty groups to eliminate sources of group heterogeneity associated with multispecialty groups. Discussions with group practice administrators who are expert in this area suggest that the strongest contrast to primary care fields is to be found with ancillary care fields (anesthesia, pathology, and radiology).[8] Ancillary physician services are the least likely to qualify as a reputation good among health consumers, since the services that these physicians provide are not directly observable to the patients that they serve, and so are difficult to differentiate. Moreover, unlike primary care physicians, health consumers are not referred to particular ancillary care physicians based on the experiences (e.g., bedside manner and quality of diagnosis) of other health consumers that they know and trust. Ancillary groups generally enter into exclusive service contracts with hospitals, and then rotate the member physicians equally through desirable and undesirable shifts. Thus patients usually receive service from whichever physician happens to be working that shift. These common business practices suggest that ancillary specialist services are least like reputation goods.

A final prediction relates sharing rules to group size. Work by Farrell and Scotchmer (1988) predicts that productive heterogeneity will inefficiently limit group size when group income is equally divided. In particular, when there are scale economies to group production, and individuals have heterogeneous abilities, then share contracts specifying equal sharing are "inefficient because people cannot exploit economies of scale except by sharing with less able people" (p. 281). In Farrell and Scotchmer's model the core allocation is arrived at in a decentralized manner by first allowing the group with the highest joint return (and thus individual return) to form. The next group then forms

[8] I thank George Auld of the Virginia Mason Clinic and Philip Russell of Southern Indiana Radiology Associates for providing me with the following characteristics of ancillary group practice.

from among the remaining individuals in a manner designed to again yield the highest joint return, and so on. One of their central findings is that these equal sharing groups do not fully exploit available scale economies, and thus are inefficiently small, because of productive heterogeneity.

To illustrate their result, consider the following stylized example of an isolated town with three physicians. To keep the exposition simple, set direct costs equal to zero. Let $A_1 = 20$, $A_2 = 15$, and $A_3 = 10$ be the normalized income levels the three physicians could earn in independent practice. Let 6 be a multiplicative parameter that reflects Farrell and Scotchmer's generic scale economy-based premium to group practice. $\delta = 1.00$ when group size is one (solo practice), 1.35 for a two-physician group, and 1.43 for a three-physician group. Assume that the joint return is shared equally.

The total income-maximizing group size is three, yielding total income of 1.43*(20+15+10) = 64.35. The equilibrium is inefficient, however, and features a two-physician group that includes physicians 1 and 2, and excludes physician 3, and yields total income of 57.25. Physicians 1 and 2 each receive 23.63 in this equilibrium group, and physician 3 gets income of 10 operating independently. This two-physician group cannot be blocked, since neither physician 1 nor physician 2 has an incentive to regroup or operate independently.[9] Suppose that now a group can index at least part of their sharing rule to an individual's productivity, as measured by their share of total outside option income associated with solo practice. In particular, consider a sharing rule that divides 1/3 of group income equally, and 2/3 in proportion to an individual's productivity. Under this indexing scheme the equilibrium features a group that includes all three physicians. In this three-physician group the first physician receives income of 26.22, the second receives 21.49, while the third receives

[9] If physicians 1 and 3 form a group, the per-capita return in the group is 20.25, and physician 2 gets 15. If physicians 2 and 3 form a group, the per-capita return in the group is 16.88, and physician 1 gets 20. If physicians 1, 2, and 3 all form a group, the per-capita return is 21.45. If no group forms, physician l's payoff is 20, physician 2's payoff is 15, and physician 3's payoff is 10. Thus physician 1 and physician 2 are best off joining together in a group yielding a per-capita return of 23.63.

16.68. The next best alternative is for physicians 1 and 2 to form a group that excludes physician 3, in which case physician 1 receives income of 25.86, and physician 2 receives 21.39, and physician 3 receives 10.

This example illustrates that in the presence of productive heterogeneity and a limited population, equal sharing groups will be inefficiently small, and that a productivity-indexed sharing rule can allow for full exploitation of scale economies.[10]

Prediction: The percentage of group income shared equally will decline as group size rises

If heterogeneity is the primary factor limiting equal income sharing in large groups, then the group size effect can be expected to be weaker in multispecialty groups than in single specialty groups. Small single specialty groups can be formed around physicians of very similar productive attributes (similar work habits and skills), as suggested by Farrell and Scotchmer. In contrast, by their very nature small multispecialty groups can be expected to be heterogeneous because of productivity differences across specialty fields. This is illustrated in a 1991 AMA survey of group medical practices [AMA 1992], which found that 68 percent of all multispecialty groups included an internist, 54 percent included a family practitioner, 46 percent included a general surgeon, 33 percent included a pediatrician, 31 percent included an OB/GYN, and 26 percent included a radiologist. Thus even a relatively small multispecialty group with 3 or 4 members can be expected to include physicians from relatively low-paying primary care fields on the one hand, and relatively high-paying specialty and surgery fields on the other. As a consequence, while heterogeneity is predicted to increase with group size regardless of group type, the effect of group size on sharing rules should be

[10] Farrell and Scotchmer point out that if the population of individuals is sufficiently large, then equal sharing groups will be able to form around a homogeneous productivity type and fully exploit scale economies. In this case group heterogeneity will not increase with group size.

quantitatively stronger in single specialty groups.

Gaynor and Gertler (1992) offer an alternative explanation for equal income sharing to decline with group size, based on the argument that efficiency is enhanced by providing an incentive-motivating linkage between physician output and compensation. Specifically, the larger the group the smaller is the marginal influence of an individual physician's effort on pooled group income, and thus the weaker are the incentives associated with compensation derived form equal income sharing. Kandel and Lazear (1992) are less sanguine regarding the importance of incentive compensation, and offer evidence that group culture and mutual monitoring are used by groups to overcome the poor incentive properties of equal sharing in large groups. If the group size effect on income sharing rules was solely driven by incentives, then the quantitative effects should be the same in single specialty and multispecialty groups. These issues will be analyzed along with the other predictions in the section below.

III. ANALYSIS

Description of the Data

The data are from a 1986 survey of medical group practices in the United States conducted by George Auld of the American College of Medical Group Administrators, and are described in greater detail in the data appendix below. Respondent physician groups generally meet the definition of the American Medical Association, which defines medical group practice as "[t]he provision of health care services by three or more physicians who are formally organized as a legal entity in which business and clinical facilities, records, and personnel are shared. Income from medical services provided by the group are treated as receipts of the group and distributed according to some prearranged plan" [AMA 1992, p. 1]. The data depart from this definition in that a few 2-physician

groups are included in the sample. The great majority of medical group practices are horizontally-structured partnerships or professional corporations. For example, in their 1991 survey the AMA found that 75.6 percent of all groups are organized as professional corporations, while 15 percent are organized as partnerships. These groups may have contractual or other relationships with hospitals or health maintenance organizations (HMOs).

The data are cross-sectional in nature, and include group-level observations on type of group practice (see the data appendix below for specialty categories), number of physicians, the percentage of group income shared equally, the percentage of group income shared based on individual productivity, and the way in which the group defines productivity. A total of 758 observations are on various types of single specialty groups, while 506 are on multispecialty groups. It is interesting to point out that the vast majority of medical group practices compensate physicians using a linear sharing formula that weights an equal shares component and a component tied to productivity. In fact, on average only 3 percent of joint surplus was divided based on a weighted factor other than equal shares or a productivity measure.[11] Holmstrom and Milgrom (1987) argue that linear sharing rules are "strikingly robust" theoretically, and are consistent with optimal compensation schemes in much richer field environments.

The analysis below is divided into two parts. The first two predictions are tested using simple two-sample, nonparametric testing techniques, since they are by nature making a two-sample comparison. This non-parametric analysis provides a broad comparison of groups that share all income equally with groups that share at least a portion of income based on individual productivity. The second part of the analysis uses econometric techniques to evaluate the group size prediction, and offers additional insight into the first two predictions.

[11] The "other" category may reflect activities such as administration or research, or simply a seniority premium.

Nonparametric Analysis

The first prediction is that equal income sharing will occur with lower frequency in multispecialty groups compared to single specialty groups. This prediction is strongly supported by the available evidence. To see this, first consider Figure 1, which is constructed by first determining the percentage of group income that groups share equally, and then plotting the observed frequency of each equal-share percentage. Note that while only 4 percent of all multispecialty groups pool all of their income for equal sharing, in contrast 36 percent of all single specialty groups share all group income equally. More formally, the question is whether this difference in the distribution of sharing rule forms is significant. This hypothesis is tested using standard nonparametric techniques. Two techniques commonly used in this context are the Wilcoxon and the Kolmogorov-Smirnov tests. In the Wilcoxon test procedure both samples are combined into a single ordered sample, and then ranks are assigned to the sample values from the smallest to the largest. The ranks are then summed for each of the two samples, and the difference is then taken between these sums. The null hypothesis is rejected if in absolute value the difference is sufficiently large. The Kolmogorov-Smirnov test computes the sample cumulative distribution functions, and computes the maximum of the absolute value of the difference between the distribution functions. If this difference is sufficiently large in absolute value, the null hypothesis can be rejected.

The nonparametric test results strongly reject the null hypothesis of no difference in the underlying distribution of sharing rule form (as measured by the percentage of group income shared equally) across single specialty and multispecialty groups. The Wilcoxon Z value is -11.53, and the associated significance level is .00001. Similarly the Kolmogorov-Smirnov procedure generated a maximum absolute difference D = .378, with an associated significance level of .00001. These results are not sensitive to the choice of test procedure.

The second prediction is that equal income sharing will occur with lower frequency in single

specialty, primary care groups compared to other single specialty groups, and in particular in comparison to ancillary care groups. This prediction is tested by first constructing two samples with observations on the percentage of group income to be divided equally. One sample consists of sharing rule observations from single specialty, primary care groups, while the other sample consists of sharing rule observations from all other single specialty group practices. The question is whether one can reject the null hypothesis that both samples are consistent with the same underlying distribution. The Wilcoxon procedure strongly rejects the null hypothesis of no difference in underlying distribution [Z = -6.404; significance level = .0001]. Similar results are found using the Kolmogorov-Smirnov procedure.

Groups sharing all income equally constitute 19 percent of the sample of single specialty primary care groups, while in contrast 43 percent of the other single specialty groups share all income equally. An even stronger contrast is given by comparing income sharing rules used in primary care groups to those used in ancillary care groups. Again the two samples are significantly different [Z = 12.73; significance level = .0001]. The striking difference between sharing rules in single specialty primary care groups and single specialty ancillary care groups is illustrated in figure 2. Note that 93 percent of the ancillary groups share all income equally.

These statistical tests provide powerful evidence in support of the first two predictions. The third prediction is addressed in the multiple regression analysis below.

Regression Analysis

Ordinary least squares multiple regression analysis is used to evaluate the third prediction that the percentage of overall group income shared equally will decline as group size increases, and to gain further insight into the fixed effects of group specialty form on equal income sharing. The dependent variable is the percentage of overall group income shared equally among group members

(EQSHARE). The variable GROUPSIZE represents the number of physicians in a particular group. It is possible that the sensitivity of EQSHARE to GROUPSIZE depends on whether the group is single or multispecialty, as mentioned in section II above. To take this into account, the variable MULSPCSIZE is included. MULSPCSIZE is zero unless the group is multispecialty, in which case it measures the number of physicians in the group. Dummy variables are also included to estimate the fixed effects of group specialty type on EQSHARE. The dummy variable MULTSPEC takes on the value of 1 for multispecialty group practices, and zero otherwise. Similarly the dummy variable PRIMCARE takes on the value of 1 for single specialty, primary care groups, and is zero otherwise, and the dummy variable ANCILLARY takes on the value of 1 only for single specialty, ancillary groups, and is zero otherwise.

The multiple regression results are given in Table 1. The reported standard errors are adjusted to be heteroskedastic-consistent following procedures suggested by White (1980). The adjusted R^2 is 27.44 percent, and the F-statistic for the regression is 96.53, which is significant at below the one percent level. While all of the point estimates are significant at the 5 percent level, those for the intercept, MULTSPEC, and ANCILLARY are significant at below the 1 percent level.

The regression analysis strongly supports the prediction that equal income sharing will decline as single specialty group size rises, and reinforces the support provided by the nonparametric analysis for the predicted effects of group specialty type on income sharing rules. To see this, first consider the results for multispecialty groups. The sum of the estimated coefficients for the intercept of the regression and MULTSPEC is 18.13, which gives the average percentage of multispecialty group income shared equally for the hypothetical case of zero group size. The results for single specialty groups suggest a much different story. First, the net intercept terms are estimated to be 40.51 for single specialty primary care groups, 101.17 for single specialty ancillary groups (not different than 100 at the one percent significance level), and 49.22 for all other single specialty groups. As with

multispecialty groups, these sums give the average percentage of group income shared equally for the hypothetical case of zero group size. All of these estimates are significantly greater than the 18.13 percent estimated for multispecialty groups, which suggests that very small multispecialty groups are substantially more heterogeneous than very small single specialty groups.

Single specialty groups also differ from multispecialty groups in the sensitivity of equal income sharing to group size. The sum of the estimated coefficients for SIZE and MULSPCSIZE is 0.01, which gives the estimated total effect of group size on EQSHARE in multispecialty groups. Note that SIZE and MULSPCSIZE effectively offset each other; the total effect of multispecialty group size on equal income sharing is not different from zero at the one percent significance level. Thus on average only about 18 percent of group income is shared equally in multispecialty groups, and this relatively low percentage of group income shared equally is fully realized at small group sizes. In contrast, the coefficient on the variable GROUPSIZE gives the total effect of group size on the percentage of group income shared equally in single specialty groups. While adding physicians to multispecialty groups is estimated to have no significant effect on the percentage of group income shared equally, each physician added to a single specialty group is estimated to reduce the percentage of group income shared equally by .58 percent. For example, if a 10 physician primary care group (e.g., pediatrics) expands to include a total of 20 physicians, the percentage of group income shared equally is predicted to decline from 34.7 percent to 28.9 percent. The regression analysis provides evidence supporting heterogeneity as a primary explanation for the effects of group size on the percentage of group income shared equally. The efficiency effects of incentive compensation do not appear to be the only motive limiting equal income sharing.

The regression analysis also estimates that as single specialty groups get large, the percentage of group income shared equally will decline to levels comparable to multispecialty groups, which suggests that large single specialty groups feature considerable productive heterogeneity. Moreover,

the threshold group size at which this occurs differs across the categories of single specialty group practice considered above. Using the regression estimation, the threshold size for single specialty primary care groups is 39 physicians. In contrast ancillary groups would have to include about 141 physicians. The threshold size for single specialty groups outside of these categories is 53. It is interesting to point out that only 3 of the 758 single specialty groups surveyed here exceed the estimated threshold size, which seems to imply that the single specialty groups in the data are less heterogeneous than the sampled multispecialty groups.

As a final point, note that nearly 45 percent of all multispecialty groups divide all group income based on productivity;, as shown in Figure 1. This result is unanticipated. Such a sharing rule prevents physicians from exploiting many of the benefits of groups identified in the theoretical literature. In particular, both the risk sharing and the internal referral motives for multispecialty groups are predicated on sharing rules having a weighted equal shares component. The absence of an equal shares component in nearly 45 percent of multispecialty groups suggests that in many cases these motives are not too strong. Yet if scale economies are the central motive explaining the existence of multispecialty groups that allocate all group income based on productivity, the question is why these scale economies are exploited in multispecialty groups?

One plausible explanation is that these multispecialty groups primarily arise in smaller communities that cannot support enough physicians in most specialty fields to form a single specialty group. While the survey data do not include community size, this notion is supported by 1975 survey data collected by the AMA [AMA 1976]. In that survey of medical group practices, family practice and multispecialty groups were found to constitute 84.2 percent of all medical group practices in nonmetropolitan areas, but only 61.6 percent of all medical groups in metropolitan areas. The point is that even if physicans prefer single specialty groups, they cannot exploit scale economies in small communities.

IV. CONCLUDING COMMENTS

This study offers considerable evidence in support of the hypothesis that equal income sharing in medical group practices will decline as group heterogeneity increases. First, equal income sharing is used with reduced frequency in multispecialty groups relative to single specialty groups, which is consistent with the notion combining physicians from multiple specialty fields increases the productive heterogeneity of the group. Second, the analysis finds that equal sharing rules are used with lower frequency in primary care group practices relative to other types of single specialty groups, and in particular ancillary groups. This evidence supports the argument that there will be more effort-based productivity differences in single specialty groups representing fields where physician services can be considered a reputation good, and so income sharing rules in these groups motivate the production of reputation goods by linking compensation with individual productivity.

The analysis also found evidence supporting the notion that the added heterogeneity implied by increased group size reduces the percentage of group income shared equally, and so supports the arguments given in Farrell and Scotchmer (1988). In contrast, no such relationship between group size and equal income sharing was found for multispecialty groups. The lack of an estimated relationship between group size and equal income sharing is consistent with the argument that substantial heterogeneity in small multispecialty groups weakens the quantitative implications of the group size effect. It is likely that both heterogeneity and efficiency effects are important in medical group practices. Multispecialty groups on average only share about 18 percent of group income equally, which we have seen is not sensitive to group size. Since a substantial percentage of multispecialty group income is allocated based on productivity, increased group size will have very little effect on the incentive structure of physician compensation, which is consistent with the regression analysis.

The overall result that equal income sharing declines with the productive heterogeneity of group members is broadly consistent with studies of quota schemes devised by common-pool resource (CPR) user groups.[12] Collective action is costly, and is usually motivated by earlier periods of damaging noncooperative resource use. When resource users are heterogeneous in terms of then" harvest productivity, the pattern of historic resource use will also be heterogeneous, which can create problems for those wishing to impose uniform quotas. For example, Johnson and Libecap (1982) studied rules devised to conserve Gulf of Mexico shrimp, and found that conservation rules generally allocated use in a manner consistent with individual productivity. Wiggins and Libecap (1985) show that oil lease owners' attempts at contracting for unitized production tend to fail because lease productivities are heterogeneous, and productive information is asymmetrical; lease owners are unable to agree to a rule for sharing the oil resulting from unitized production. McKean (1992) finds that quota schemes devised by heterogenous CPR user groups are usually indexed to measures of individual productivity, and that equal sharing rules are rare. Thus schemes designed to equalize harvests will tend to redistribute surplus relative to past noncooperative distributions, and so will be difficult to successfully implement.

[12] There has also been some illuminating empirical studies of share contracting in agriculture, which are somewhat different than professional groups in that there are usually only two parties — the land owner and the tenant. Allen and Lueck (1992) argue that cash rent contracts lead to the tenant overworking the land, while crop sharing contracts lead to shirking on labor inputs.

DATA APPENDIX

The data used in this study were collected from a 1986 cross-sectional survey of medical group practices by George Auld of the Virginia Mason Clinic in Seattle and the American College of Medical Group Administrators. Auld mailed out survey instruments to 3000 medical group practices throughout the United States, making up approximately one-half of the membership of the Medical Group Management Association (MGMA), or about 19 percent of the 15,485 medical group practices identified in a nearly contemporaneous AMA study of group practices [AMA 1985].[13] Completed responses were received from 1264 medical group practices, which together included 18,608 physicians. Single specialty groups surveyed here are categorized as follows: anesthesia, cardiology, cardiovascular/thoracic/vascular surgery, family practice, general surgery, internal medicine, miscellaneous surgery, OB/GYN, ophthalmology, orthopedics, otolaryngology, pathology, pediatrics, psychiatry, radiology, and urology.

The survey first asked medical groups to give the percentage of total physician income from (1) productivity, (2) equal sharing, and (3) an "other" category that the respondent could fill in. The second part of the survey asked the medical group whether their productivity measure (i) is based on gross charges or by actual collections, (ii) is net of direct physician expenses, (iii) gives credit for lab or radiology tests ordered, and (iv) changes when the physician has performed services for a health maintenance organization. The third part of the survey asked (a) whether the respondent is a multispecialty group or single specialty group, and if the latter, to give the specialty field, and (b) the respondent to list their official MGMA region of the US — either east, south, midwest, or west. The fourth part of the survey allowed the respondent groups to make any clarifying comments.

To access this data, contact George Auld, Director of Finance, Virginia Mason Clinic, 1100 Ninth Avenue, P.O. Box 900, Seattle, WA 98111.

[13] Membership in the MGMA is open to all groups with at least three physicians.

REFERENCES

Akerlof, G., "The market for 'lemons': Qualitative Uncertainty and the Market Mechanism," Quarterly Journal of Economics, August 1970, 84, 488-500.

AMA, Medical Groups in the U.S., Chicago: American Medical Association, 1992.

___, Group Medical Practice in the U.S., Chicago: American Medical Association, 1976.

Allen, D., And D. Lueck, "Contract Choice in Modern Agriculture: Cash Rent vs. Cropshare," Journal of Law and Economics, October 1982, 35, 397-426.

Azevedo, D., "Can You Make Your Income-Division Formula Work Better?" Medical Economics, August 20 1990,67.

Beck, L., "Dividing Group Practice Income," Pennsylvania Medicine, November 1972, 75, 35-7.

Bresnahan, T., and P. Reiss, "Entry and Competition in Concentrated Markets," Journal of Political Economy, 1991, 99, 977-1009.

Carr, J., and F. Mathewson, "The Economics of Law Firms: A Study in the Legal Organization of the Firm," Journal of Law and Economics, October 1990, 33, 307-30.

Fama, E., and M. Jensen, "Agency Problems and Residual Claims," Journal of Law and Economics, June 1983, 26, 327-49.

Farrell, J., and S. Scotchmer, "Partnerships," Quarterly Journal of Economics, May 1988, 103, 279-97.

Gaynor, M., "Competition Within the Firm: Theory Plus Some Evidence from Medical Group Practice," Rand Journal of Economics, Spring 1989, 20, 59-76.

_____, and M. Pauly, "Competition and Productive Efficiency in Partnerships: Evidence from Medical Group Practice," Journal of Political Economy, June 1990, 98, 544-73.

_____, and P. Gertler, "Moral Hazard in Partnerships," photocopy, Johns Hopkins University, July 1992.

Gilson, R., and R. Mnookin, "Sharing Among the Human Capitalists: An Economic Inquiry into the Corporate Law Firm and How Partners Split Profits," Stanford Law Review, January 1985, 313-92.

Holmstrom, B., and P. Milgrom, "Aggregation and Linearity in the Provision of Intertemporal Incentives," Econometrica, March 1987, 55, 303-28.

Johnson, R., and G. Libecap, "Contracting Problems and Regulation: The Case of the Fishery," American Economic Review, December 1982, 72, 1005-22.

Kandel, E. and E. *Lazear,* "Peer Pressure in Partnerships," Journal of Political Economy, August 1992, 100, 801-17.

Klein, B., and K. Leffler, "The Role of Market Forces in Assuring Contractual Performance," Journal of Political Economy, August 1981, 89, 615-41.

Kwon, J., "A Model of the Law Firm," Southern Economic Journal, 1978, 45, 63-74.

Lee, R., "Monitoring Physicians: A Bargaining Model of Medical Group Practice," Journal of Health Economics, 1991, 9(4), 463-81.

Leibowitz, A., and R. Tollison, "Free Riding, Shirking, and Team Production in Legal Partnerships," Economic Inquiry, 1980, 18, 380-94.

McKay, N., "The Economic Determinants of Specialty Choice by Medical Residents," Journal of Health Economics, 1990, 9, 335-57.

McKean, M., "Success on the Commons: A Comparative Examination of Institutions for Common Property Resource Management," Journal of Theoretical Politics, July 1992, 4, 247-82.

Mitchell, J., and J. Sunshine, "Consequences of Physicians' Ownership of Health Care Facilities — Joint Ventures in Radiation Therapy," New England Journal of Medicine, November 19, 1992, 327, 1497-1501.

Pauly, M., and M. Satterthwaite, "The Pricing of Primary Care Physicians' Services: A Test of the Role of Consumer Information," Bell Journal of Economics, Autumn 1981, 12, 488-507.

Phelps, C, Health Economics, New York: HarperCollins, 1992.

Radner, Roy, "Repeated Partnership Games with Imperfect Monitoring and No Discounting," Review of Economic Studies, January 1986, 53, 43-57.

Ross, A., S. Williams and E. Schafer, Ambulatory Care Organization and Management, New York: John Wiley and Sons, 1984.

Stiglitz, J., "Incentives and Risk Sharing in Sharecropping," Review of Economic Studies, April 1974, 41, 219-55.

Swedlow, A., G. Johnson, N. Smithline, and A. Milstein, "Increased Cost and Rates of Use in the California Workers' Compensation System as a Result of Self-Referral by Physicians," New England Journal of Medicine, November 19, 1992, 327, 1502-1506.

White, H., "A Heteroskedasticity-Consistent Covariance Matrix and a Direct Test for Heteroskedasticity," Econometrica, 1980, 48, 721-46.

Wiggins, S., "The Comparative Advantage of Long-Term Contracts and Firms," Journal of Law, Economics, and Organization, Spring 1990, 4, 155-70.

Wiggins, S., and G. Libecap, "Oil Field Unitization: Contractual Failure in the Presence of Imperfect Information," American Economic Review, June 1985, 75, 368-85.

Williamson, O. Markets and Hierarchies, New York: Free Press, 1975.

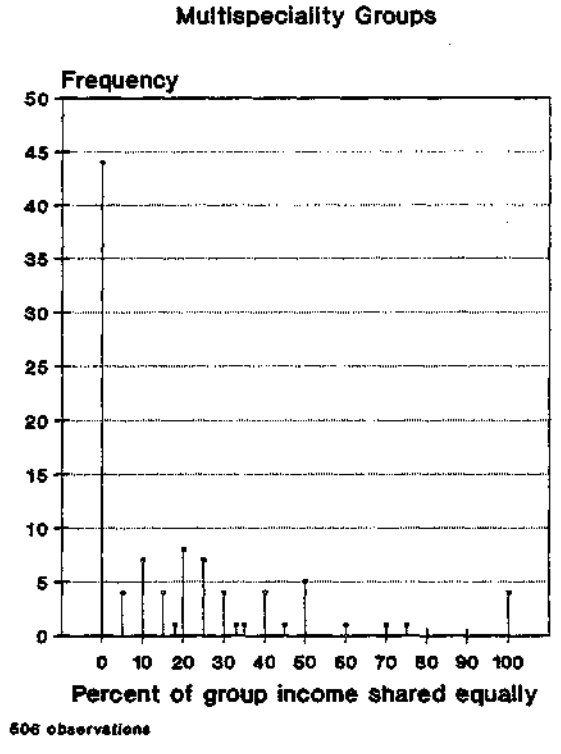
Table 1

OLS Regression Results

Dependent Variable: Percentage of Group Income Shared Equally (EQSHARE)

Independent Variable	Estimated Coefficient	Heteroskedastic Consistent Standard Error	Significant at 5 Percent Level?
Intercept	49.22	2.49	yes
MULTSPEC	-31.09	2.94	yes
PRIMCARE	-8.71	3.24	yes
ANCILLARY	51.95	3.03	yes
GROUPSIZE	-.58	.24	yes
MULSPCSIZE	.59	.24	yes

Figure 1: Portion of Group Income Shared Equally



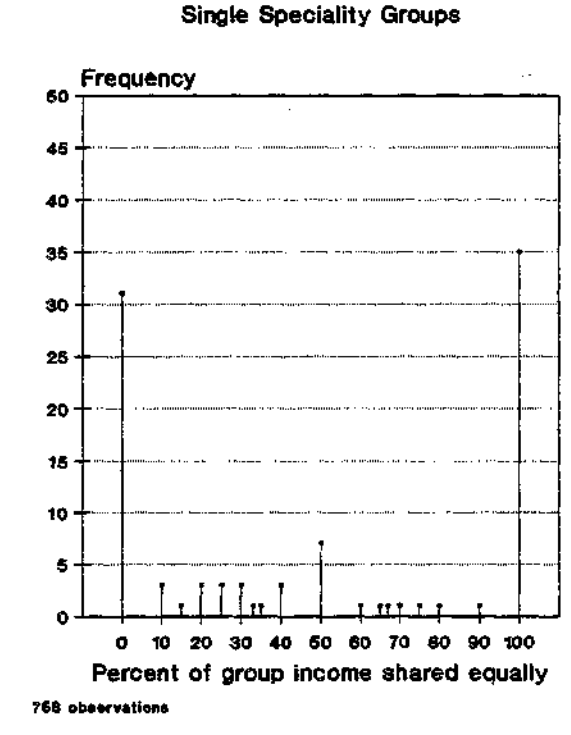


Figure 2: Portion of Group Income Shared Equally