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A CASE STUDY OF ORTHOPEDICS IN UTAH

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ABSTRACT

This paper attempts to evaluate the underlying the economic incentives for different health care pricing schemes currently utilized in U.S. and Canadian health care. The paper motivates the idea that medical providers have strong economic incentives to introduce new technology and undertake invasive surgical procedures as often as possible, as opposed to treating patients conservatively.

The specific case of orthopedics in the state of Utah is studied. A supply side model of physician behavior is used to study the evolution of reimbursement levels from payers per surgical procedure. The results suggest that physicians have acted strategically by presenting more procedures to payers as the reimbursement level per procedure have dropped over time.

Also, traditional health insurance has been unsuccessful in limiting the growth in health care costs while capitation may lead to the undertreatment of patients who may require invasive surgical care. The authors advance the idea that invasive surgical care. The authors advance the idea that invasive surgical care can be more efficiently organized into episodes of care by controlling health care expenditure levels while providing adequate surgical care.

Key words: episodes of care, capitation, usual and customary, protocol

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HEALTH CARE PRICING STRATEGIES:

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I. Introduction

This paper attempts to study a theory of pricing health care services. Traditionally, health care services have been priced on a cost-plus basis or fee-for-service. Cost, on the whole, has been defined to be the usual and customary charges levied by health care providers (hospitals, surgeons, equipment manufacturers, etc.) for a particular geographic region. The final price providers extend to payers (insurers, employers, and the patients themselves) and is a function of payer size or market presence and the variance in the reimbursement level. The determination of the final price or fee by the physician exhibits price discriminating behavior due to the inelastic demand for orthopedics and the asymmetry of information between providers and patients [1].

Economic theory suggests that the more successful the physician becomes in price discriminating amongst patients the greater the loss of consumer surplus with the rents accruing to the physician. Payers, as agents for patients, have responded by implementing cost containment measures which are intended to change the pricing strategy of orthopedics.

A pure economic assessment of orthopedic surgical fees indicates that costs are sensitive to new technology and health status measurement.[1] The cost containment measures that payers have been implementing raises philosophical, ethical, and political issues with society but is beyond the scope of this study [2].

The cost containment measures vary depending on the type of payer. The most common method used in the 1980s has been freezing or severely limiting the increases in fee levels reimbursed to providers over the years. There is evidence that, in the case of Medicare, physician revenue declined under the Medicare Fee Schedule (MFS), but, due to increased service volume and complexity, about one-half of the lost revenue was recovered [3].

In the case of the state of Utah, these results also hold. Figure 1 shows the average monthly reimbursement levels from insurers and other payers per procedure, including Medicare, for 40 different physician practices from January 1990 through October 1993 for multiple specialties (orthopedics, radiology, internal medicine, etc.). The data are not trended over time, indicating that the nominal reimbursement levels per procedure in dollars (PRICE) have increased only moderately

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[1]This refers to the development of clinical protocols to establish a methodology to handle each surgical procedure.

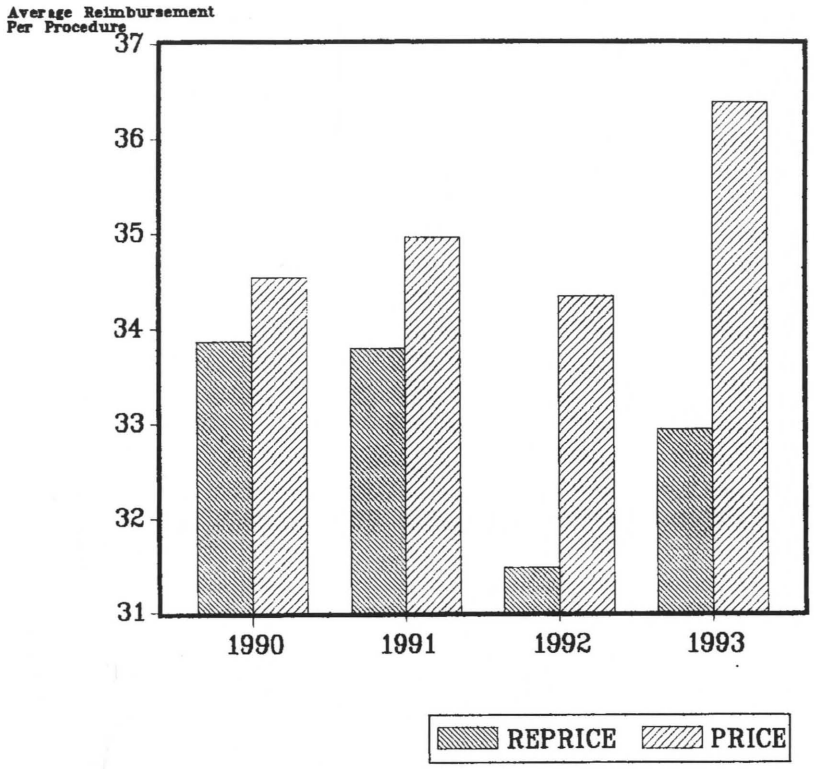

Figure 1. Average monthly reimbursement levels from insurers and other payers per procedure.

in almost 4 years not only for Medicare but across the board for all payers. In real terms, the physician's income has dropped per procedure (REPRICE).

The response by physicians to lower reimbursement levels has been to increase the level of billable procedures submitted to payers. Figure 2 shows the evolution of procedures for the same physician group over the same period of time.

The negative income effect caused by a drop in real reimbursement levels is offset by a substitution effect through an increased number of procedures. The overall price effect is positive, suggesting that physician revenue continues to increase.

The response by physicians has been, in some cases, to create demand for certain procedures that have very flexible clinical protocols and have financial incentives [4].[2] The pricing behavior by physicians have both an income and

[2]Financial incentives refer to how surgeons will "create demand" when faced with increased competition for patients or changes in fee schedules by recommending and providing a different mix of services to their patients than if they acted solely in the patient's best interests.

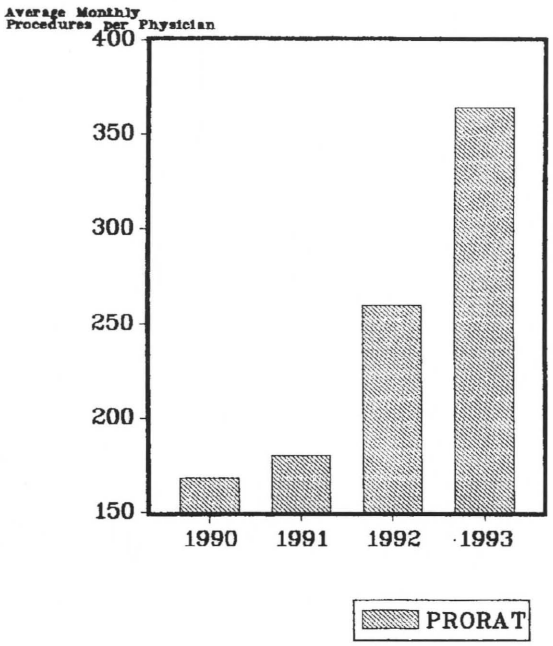

Figure 2. Evolution of procedures for the same physician group over same period of time.

substitution effect. The key effect. The key parameters that effect physician pricing behavior have been asserted to be size of payer, size of market, margins, and time costs.

The size of the market and the payer are important in determining the magnitude of the income effect of a fee change relative to a substitution effect. The relative margins and time costs to physicians outline the profitability inducements. For example, a strong inducement could be laboratory tests, where the marginal cost is low in relation to the fee, and the physician's time cost is very small [5].

The analysis of pricing behavior in orthopedics by both health care providers and payers will provide a useful format to study the policy and economics of health care reform. The American Association of Orthopedic Surgeons (AAOS) recently cited that, over time, orthopedic practices will become increasingly more competitive amongst themselves, the income of orthopedic surgeons will drop by 25%, and the demand for orthopedic surgeons will decrease [6].

The continued price pressure on orthopedics hinges on the budgetary constraints that payers undergo versus the expansion of technology. This paper also attempts to evaluate the question of whether the value is worth the incremental cost increase to patients and payers or does it simply force payers to permit excessively flexible clinical protocols for certain orthopedic surgical procedures allowing physicians to extract higher fees [7].

In the state of Utah, the demographics for health care differ from nationwide averages and become a major consideration in the pricing of health care. Table 1 shows a series of health care measures comparing Utah with the United States. Differences indicate that Utah has a lower number of medical providers per 100,000 inhabitants but also has a healthier population reflected by a low infant mortality rate and a higher life expectancy resulting in one of the lowest per capita health care payment levels nationwide.[3] This contrasts with the level of utilization of knee and hip arthoplasty procedures, which is by far the highest nationwide for Medicare recipients. The .883 and .977 age-adjusted rates, for hip and knee, respectively, for Utah is closely followed by neighboring states such as Idaho (.661 and .892), Montana (.652 and .698), Colorado (.642 and .705), and Arizona (.606 and .799). The only exception in the Intermountain West is Wyoming (.194 and .232). This can be partially explained by the fact that no major medical facilities exist in Wyoming, where residents, in many instances, go to Denver or Salt Lake City for major surgeries [10].[4]

Table 1. Selected Health Care Measures

Category	Utah	United States
Per capita health care payments, 1991	$1,969	$2,868
% of avg. family income spent on health care	10.2	11.7
% of population not covered	11.5	14.2
Hospital beds per 100,000, 1990	324	488
Physicians per 100,000, 1990	183	217
Infant mortality rate, 1990	6.3	8.9
Knee arthoplasty, 1991	.977	NA
Hip arthoplasty, 1991	.883	NA
Life expectancy, 1993	78.0 years	75.8 years

Note: Both of the categories for knee and hip arthoplasty represent age-adjusted rates calculated by state in (Peterson et al. 1992). First the rate of arthoplasty for each age strata in each state was multiplied by the number of Medicare beneficiaries nationally in that age strata. Second, the sum of each of these figures (the rate of arthoplasty for each age strata multiplied by the number of Medicare beneficiaries in that age strata) was calculated for each state. Third, this number was divided by the total number of medicare beneficiaries nationally.

Sources: [8, 9, & 10].

[3]Utah ranks fourth nationwide for per capita health care expenditures and infant mortality rate and first for life expectancy.

[4]Another reason cited by Peterson et al. [10] is that perhaps the western lifestyles may be more physical and active.

These results are consistent with the demographic data where Utah has the nation's lowest levels of smoking, heart disease, and amongst the lowest for cancer and other major illnesses.

Understanding the demographic differences between the Intermountain West and the rest of the United States allows us to study different pricing strategies in the provision of health care benefits.

The first example is a model of mandated benefits. The impact of a mandate has had a history of success in Hawaii, with only 6.8% of the population left not covered. The rate of coverage for workers of all classes is higher in Hawaii, but employer-provided policies are less likely to include coverage for spouses while children enjoy a higher rate of coverage. The effect of the mandate has caused a substantial shifting of the cost in the form of lower wages. However, relative to the entire United States, the mandate has had positive wage effects [11].[5] This is similar to findings that wages actually increased with the implementation of Canada's National Health Insurance (NHI) [12].[6]

The level of per capita health care expenditure for Hawaii was the 16th highest nationwide in 1991, compared to being amongst the lowest prior to the enactment of the Hawaii mandate in 1974. The state of Hawaii focused on improving the level of participation and access by laborers across all income classes rather than on the containment of cost. The medical providers were permitted to submit their charges on a U&C basis.[7]

The second model is the utilization of episodes of care in the treatment of health care. Most insurance plans have coinsurance and a cap on out-of-pocket spending and leave some items uncovered. These uncovered items are left to the patient to negotiate or most likely pay to the medical providers directly. The more severe or limited the insurance plan the greater the impact on reducing expenditures. In the Rand Health Insurance Experiment (HIE), it was estimated that the least generous insurance plan of the HIE reduced expenditures by 31% relative to a free care plan (zero out-of-pocket price). The intent of the episode of care is to acquire the specific services for each clinical procedures, primarily for specific illnesses,

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[5]Positive wage effects refers to when real wages increase despite the additonal cost of the mandate imposed on the unit cost of labor to employers.

[6]A straight comparison between the U.S. and Canada, according to some economists, may be misleading because, between 1967 and 1987, Canadian GDP grew by nearly twice the rate of the United States. Therefore, any comparison of health spending should be adjusted to compensate for the differing rates of economic growth. Other relevant factors cited include population growth, general inflation, currency exchange rates, the larger U.S. elderly population, higher rates of violence and crime, and investment in research and development [13].

[7]U&C refers to the level of reimbursement that patients (laborers) receive based on the submitted charges by medical providers. U&C itself refers to "Usual and Customary" or what appears to be a reasonable charge given what other medical providers charge for a similar procedure in a similar geographic region.

chronic conditions, or well-care procedures, at a predetermined price. The pricing of the episode of care by the employer or insurance company establishes a prenegotiated price with the principal medical providers prior to the patient visiting the doctor. This also averts the problem of medical providers submitting bills to patients in excess of the amount paid by the employer or insurance company typically seen in U&C health insurance plans [14].

The final and third strategy is capitation, a reimbursement strategy proposed for health maintenance organization (HMO) style health care providers.[8] Capitation is designed to leave providers at risk of providing incentives for them to increase the efficiency of their organization because they are paid a fixed amount per covered individual per month, regardless of the level of care. In most cases, there is no underwriting factors concerning the medical status of the individuals covered, forcing the medical providers to accept the risk.

If a covered group is healthly or has a low level of utilization, then the medical provider is profitable. However, if the group has a history of ill health, then medical providers will be unprofitable. The latter has led to adverse selection by corporations when seeking medical coverage for its employees. If a company has had good claim experiences for its employee group, it will elect not to undertake a capitation strategy. However, if a company's medical insurance plan had a poor claim history, then, given the fact that generally no underwriting factors are considered, a capitation strategy is generally adopted to transfer the risk to medical providers [15].

The economics of the 3 pricing models are also influenced by the strategic behavior exhibited by physicians and hospitals, given that they are profit-maximizing entities while the employers and insurance carriers are cost-minimizers. The following 3 sections highlight the differences and comparative advantages of each pricing strategy.

Given the different incentives of each group (patients, doctors, hospitals, insurers, and employers), a definitive pricing structure that considers the self-interests[9] or improvements of each group's overall economic welfare is not apparent.

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[8]Many capitation payers in the state of Utah are not organized as HMOs. Rather, they contract with physician groups by specialty and hospitals at preset prices for specific services rendered and are referred to as PPOs (preffered provider organization).

[9]Refers to the economic self-interest of the physician, which is the revenue-maximizer, as compared to the economic self-interest of patients, which is the cost-minimizer.

II. Pricing Strategies

1—Traditional Insurance Reform and Mandates

The legislative mandate attempts to address the problem of the uninsured portion of the U.S. population, which currently approaches 35 million individuals. The economic issue of a mandate is the impact upon labor markets in general.

Economic theory suggests that consumers must be prepared to pay more for products; or, more likely in a competitive economy, employers will be faced with a dilemma to reduce payroll costs to offset these new and increased costs of health benefits. Payroll reductions may take several forms. One is a reduction in cash compensation, which in practice is unlikely. More probable is a reduction in the number of employees, either through layoffs or by postponing the hiring of new workers. In either case, the level of unemployment will theoretically increase among low-skilled workers for whom mandated health benefits constitutes a relatively large increase in employee compensation [16].

The empirical results of studies conducted by Hawaii [11] and Canada [12] refute the idea that mandates for health insurance are directly related to the level of unemployment. The increased levels of coverage in both Hawaii and Canada indicate that not only did wages ***not*** decrease but actually increased over time. The state of Hawaii provides a good test case, with almost a 20-year track record under a mandated system with a multiple-payer environment, in providing a better understanding of the potential impacts to labor markets. In the case of Canada, the NHI program essentially nationalized health care under a one-payer scheme and is currently not considered a viable option in the U.S.

In Hawaii, employers were essentially required to pay the vast majority of the health insurance premiums because employees were limited to paying 50% of the gross premiums up to 1.5% of gross earnings.[10] All insurance plans had to contain certain benefits, such as inpatient hospital coverage, emergency room care, maternity, and medical or surgical services. In the event the employer does not establish a medical plan for its employees, the state of Hawaii could require that the employees medical expenses be paid by the employer or prevent an employer from doing business in the state [11].

Mandated benefits may have the incidence implications and deadweight losses similar to taxes, although mandates may be preferable to taxes, given that employees may have a positive value for the mandated benefit, there is an

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[10]For example, assuming that an average premium was $1,800, an employer must pay $900 for each worker. However, due to the 1.5% employee cap, a worker making $20,000 a year could only be asked to pay $300, leaving the employer responsible for at least $1,500 per worker.

accompanying outward shift in the supply curve. If the valuation is exactly at cost, the entire cost of the insurance will be shifted to workers in the form of lower wages, regardless of the elasticities of supply and demand.

If the valuation by workers is less than cost, depending on the elasticities of the labor supply and demand curves, the cost will be split between the worker and the employer [17]. Using the conventional model, assumed elasticies of labor supply and demand of .1 and .25, respectively, result in a predicted cost shifting of 71% to the employees in the form of lower wages [18]. Summers continues by suggesting that if workers value the benefit more than the cost, then a market failure exists, allowing the mandate to actually enhance efficiency. The actual results of increased wages, reduced unemployment, and increased coverage levels for employees in Hawaii provides encouragement to policyholders. However, not unlike the comments made earlier about comparing the Canadian experience with the U.S., one must take into account the high level of economic growth, demographic differences, lifestyles, and other qualitative variables to fully explain these results.

A second major result of the Hawaiian mandate has been the growth of health care expenditures, which has been below the average annual rate for Utah though slightly higher than the national average from 1980-1991. Table 2 presents the differences by category of expenditures.

Both hospital care and physician services represent about two-thirds of the total national health care expenditures. Prescription drugs represent a much smaller share—5% to 6%.

In Utah, an estimated 215,000 people have no health insurance. The Utah legislature created the Health Care Policy Options Commission and encharged it to present options that would broaden access, expand coverage, and hold down

Table 2. Health Care Expenditures: Average Annual Percentage Change, 1980-1991

Category	Utah	Hawaii	U.S.	Difference: Utah/Hawaii	Difference: Utah/U.S.
Hospital care	11.6	12.3	9.9	-.7	+1.7
Physician services	11.6	10.0	11.6	+1.6	0
Prescription drugs	13.0	10.9	10.6	+2.1	+2.4
Total	11.7	11.4	10.5	+.3	+1.2

Note: Expenditure for retail prescription drugs.

Source: [18].

costs. Governor Leavitt appointed 13 members to the Commision in May 1993. The Commission reported its findings to the governor on November 29th that same year. The report outlined 3 options for consideration to the 1994 legislative session which still remain pending.

Option 1.—This option appears to be the least controversial of the 3 and essentially would leave the current system intact. It emphasizes changes in insurance laws to prohibit insurance from excluding small companies or individuals with high-risk factors or "preexisting conditions."

It would also increase health insurance coverage by phasing in an expanded and leaner state-operated Medicaid program and would define a "standard benefit package" to simplify price comparisons. Prices to consumers would vary slightly, depending on a "community rating," age, and incentives for living a healthy lifestyle.

Under this option, consumers could carry their insurance from job to job. This option provides universal ***access*** but not universal ***coverage***. A major weakness is the lack of effective cost-containment features. This option is heavily supported by insurance companies and unopposed by medical providers.

Option 2.—Option 2 includes the same features as option 1 and adds phased-in employer or individual mandates and sets up a purchasing cooperative. Employers would be required to contribute at least 50% of the cost of health insurance for their employees.

Individuals and small businesses would obtain insurance through the purchasing cooperative. This option also allows universal access to insurance but still falls short of universal coverage. Doctors, hospitals, and HMOs generally support this option, while insurance companies oppose it because the purchasing cooperatives are perceived as a threat to the way they do business [19]. This is because the medical provider structure is left intact. However, the role of insurance companies is diminished because a network of purchasing cooperatives would challenge the control of insurers over the purchase of health care by consumers like small employers and individuals. Traditionally, these groups have been unable to negotiate prices with medical providers due to a lack of economic influence that could otherwise be provided by a purchasing cooperative.

Option 3.—Under this option, employment and health insurance would no longer be linked, thus providing coverage for the unemployed as well as the employed. This option would offer universal coverage and would be financed through broad-based taxes (cigarettes, alcohol, income, etc.). This is the most dramatic of all the health care options and is opposed by both medical providers and insurance companies [20].

This option would approach a national health insurance scheme which, in the opinion of some, imposes a heavy regulatory burden upon the medical providers and insurance companies. This option has been perceived by these groups as a way to reduce their income over time.

The economic cost of the uncovered portion of the population is passed on through cost-shifting at the hospital level and then on to the covered portion of population by way of premiums. In the event that all health insurance was required on a guaranteed-issue basis, where no one is denied coverage, studies indicate that premiums would increase by 25% to 35% [19].[11]

Table 3 summarizes the key elements of each option studied by the commission. The lack of cost controls in health care prices is a serious concern contemplated in insurance reform or mandates. Physician services in recent years have been reimbursed by payers at an increasing lower percentage of submitted charges. Figure 3 shows that there is an evolution of difference between submitted charges and reimbursed payments paid by payers (DCHPY).[12] This graph shows that the gap has grown from 5% to 7% in 1990 to about 12% to 16% in 1993 in actual write-offs by physicians.

Table 3. Utah Health Care Reform Options

Category/Option	#1	#2	#3
Universal access (insurance reform)	✓	✓	✓
Standard benefit package	✓	✓	✓
Health care purchasing cooperative		✓	
Employer mandates		✓	
New broad-based taxes			✓
Universal coverage			✓

Note: The goal of insurance reform is to reduce the cost of insurance or make it avaliable to a wider group of individuals. Among some of the most common suggestions are guaranteed renewability and continuity or portability of health insurance policies. There would also be premiums limits and guaranteed-issue prohibiting the denial of coverage to new applicants.

Source: [20].

[11]In a guaranteed-issue environment, insurers are required to accept all applicants for health insurance irrespective of any current illnesses and preexisting conditions.

[12]Refers to individual patients who pay coinsurance and deductibles up to a certain level.

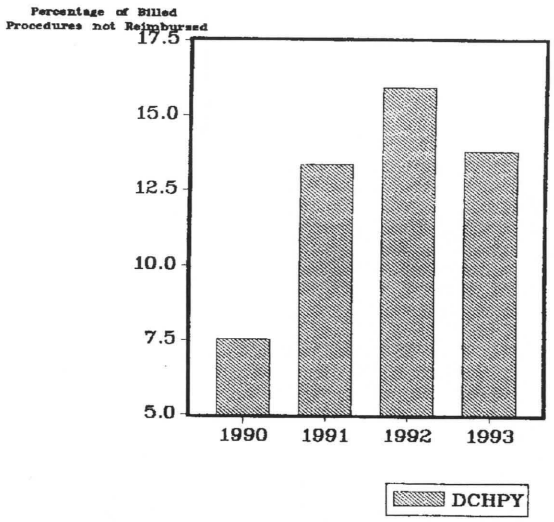

Figure 3. Submitted charges and reimbursed payments paid by payers (DCHPY).

This suggests that insurance payers have become far more demanding concerning the relationship of price and services rendered. This has been true for office visits, lab tests, and X-rays.

The negative impact of decreasing levels of reimbursements has initiated a negative income effect which has caused physicians to respond with more procedures and added technological complexity.

Figure 4 shows, for the same group of physicians between January 1990 to October 1993, the monthly variance of physician billing (VOLATILE).[13]

The other element that has limited the success of cost controls is the rapid developing nature of medical technology. As new surgical techniques become available, payers have not been able to accumulate sufficient data about prices and the nuances of different surgical procedures to challenge and adjudicate a submitted surgical charge [21].

Another problem has been the increased levels of health insurance in the U.S. Individual patient out-of-pocket percentages of total health care expenditures has fallen from about 55% to about 25%. The difference has accrued at the expense of the government (Medicare, Medicaid, and Workers Compensation) and private health insurance [22].

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[13]The decrease is even worse if calculated in real terms. This verifies, to a certain extent, Escarce's (1993a or b?) comments that physicians may be induced to generate more billable procedures as a substitution effect to offset a negative income effect.

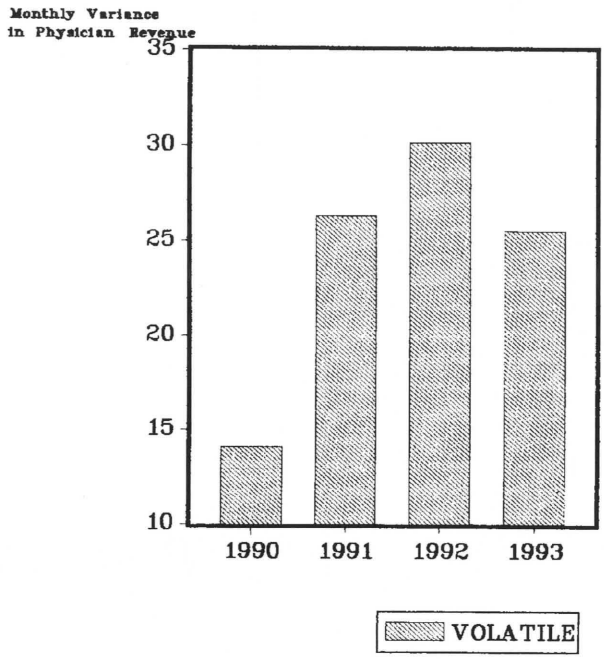

Figure 4. Monthly variance of physician billing (VOLATILE).

These reasons suggest that insurance reform and mandates would increase the percentage of covered population without severe impacts on labor but would fall short in reversing the upward cost spiral of health care expenditures.

2—Episodes of Care

The second pricing strategy is referred to as episodes of care. An episode of care attempts to break down a surgical procedure into separate components. Each component is then priced to come up with an overall aggregate price.

The episode of care process attempts to establish a negotiated price between payers and medical providers based on a level of services required given the diagnosis. Priced episodes of care distribute financial risk in a polycentric spread over those entities within the health care system who are best able to manage their appropriate share. Everyone participates in the risk management, from facility to payer to physician to patient. Furthermore, all participants know up front what the costs and risks are going to be, with the consequence that it is administratively simple [23].

Figure 5 shows an example of an orthopedic clinical algorithm for a knee injury. The algorithm prescribes the negotiated course of diagnosis with preestablished prices. The episode of care is the natural unit for analyzing the effects

of price. It has been argued that using models in analyzing social experiments that are grounded in behavior gives substantial payoffs in prediction [24].

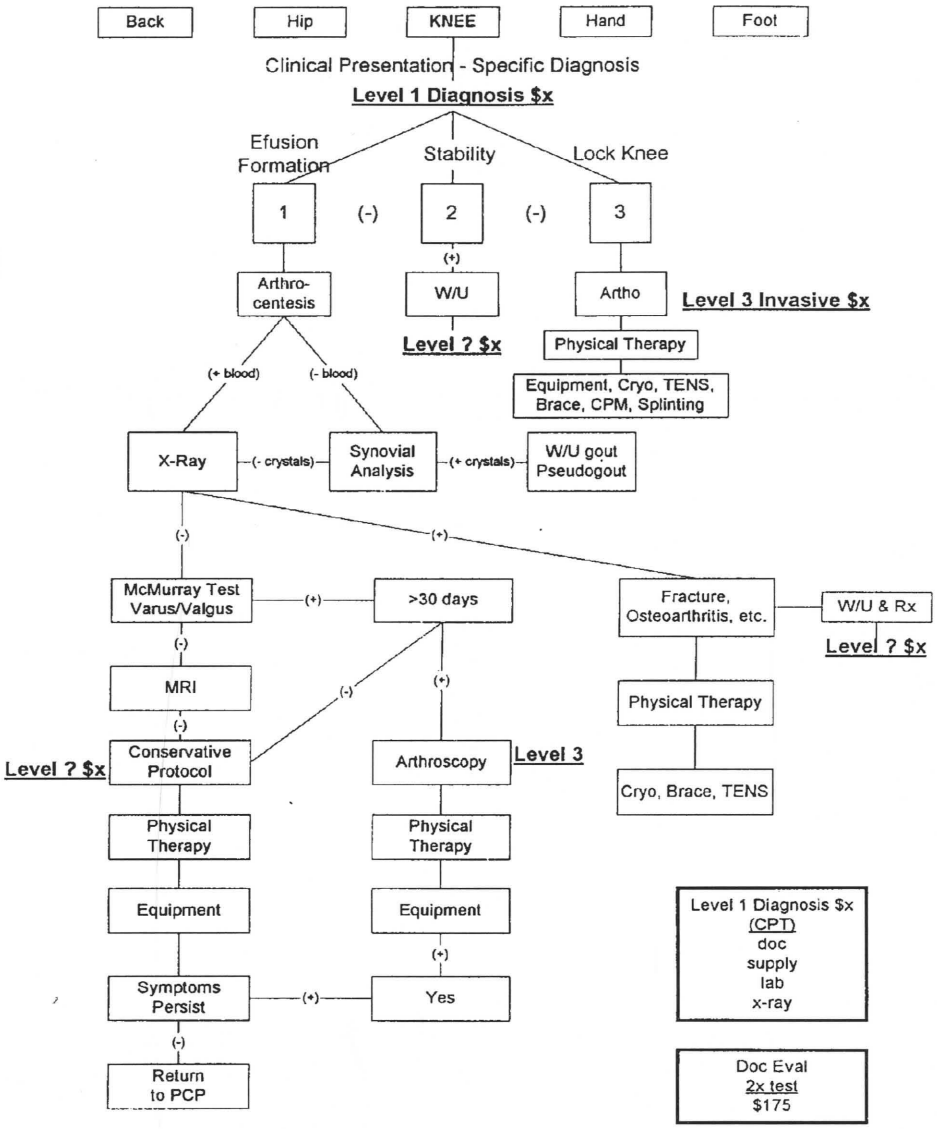

Figure 5. Sample clinical algorithm.

The cost-containment emphasis of the episode of care tries to combine the economic incentives of the economic agents/medical providers, patients, and employers.[14] The medical providers are guaranteed a price for services rendered. There is no adjudication process, so submitted charges equal payments. It avoids any type of discriminatory pricing behavior based on a patient's insurance or wealth by providers.

The patient is better off because a clinical outcome is guaranteed by the negotiation process. The price and services provided are known a priori. This becomes a particularly important point, since, currently, patients do not know the various components involved in a surgical procedure: hospital, assistant surgeon, surgeon, durable medical equipment, physical therapy, implants, etc. Each of these elements is organized and headed by CPT codes mapped out into a pricing matrix. Table 4 provides a nonexhaustive exhibit of the 10 most commonly utilized surgical procedures amongst six of Salt Lake City's orthopedic surgeons.

The patient's only relevant price is the out-of-pocket price (deductible plus coinsurance), whereas the providers acting for themselves get more revenue and satisfaction from providing higher quality (more expensive) care and only are

Table 4. Episode-of-Care Pricing Matrix

CPT Codes	EOC Price	Surgeon Fee	Asst. Surgeon	Anes.	Pain Mgmt.	Facility	DME	Physical Therapy	Implant Costs	In Pt. Out Pt.
27130	$17,440	$2,880	$720	$500	$175	$5,000	$600	$700	$3,000	IP
29823	4,800	1,400	NA	203	NA	2,000	NA	300	NA	OP
29881	3,285	1,200	NA	220	NA	1,200	NA	175	NA	OP
29848	2,000	600	NA	200	NA	900	NA	NA	NA	OP
29888	9,000	2,482	1,000	324	NA	2,000	100	NA	800	OP
23120	3,100	740	NA	250	NA	1,200	NA	NA	NA	OP
64721	1,925	600	NA	150	NA	700	NA	NA	NA	OP
29877	3,285	1,200	300	280	NA	1,200	100	150	NA	OP
29876	3,600	1,200	NA	232	NA	1,200	NA	NA	NA	OP
20680	1,768	300	NA	238	NA	990	NA	NA	NA	OP

Note: NA refers to the fact that no services are included in the episode of care for a particular provider or component.

Source: [25].

[14]Note that insurance companies and health care organizations are excluded because they are considered to be agents that act on behalf of employers and individuals in either adjudicating health care expenditures or medical services.

affected by the out-of- pocket price in their role as agents for the patient. Patients are mainly responsible for the initial contact in an episode, but providers are responsible for decisions on care thereafter.

It is the pricing of the episode of care between medical providers and insurers, as agents for employers, which acts as a brake to contain the prescribing of more expensive and unnecessary care.

For employers, the precontracting of surgical procedures allows permits for budget certainty and effectively allows for the establishment of a ***market*** for medical services not unlike any other commodity. The employer is then able to track the productivity of certain medical providers and the pricing of individual components of surgical procedures.

Second, the availability of full disclosure to purchasers of health care, both employers and patients, should enable them to optimize their consumption of health care subject to the quality of services and their own budget constraint. Also, episodes of care pricing would be particularly informative in studying short-run transitory changes in demand, such as "catch-up" demand in response to new and fuller (permanent) coverage and "sales" behavior in response to temporarily better coverage.

Finally, an episode analysis allows one to estimate the separate effects of the component parts of insurance plans and thus generate estimates for insurance plans other than those studied [14].

Table 5 presents a relative comparison from the same sample of 156 orthopedic episodes of care in the state of Utah. The figures in the table represent the difference of the negotiated price for an episode of care and the U&C charge that the large payers were reimbursed in 1994 for the same orthopedic surgical procedure. The 10 listed procedures represent about 70% of all the orthopedic surgeries undertaken by the group of surgeons surveyed.

The differences between the episode of care and U&C is consistent with the economic literature. The largest local payers[15] in the state all pay above the episode-of-care price but substantially below the nonlocal or out-of-state payers because of their negotiating power with providers. The bigger the payer, the more patients it can direct towards providers and move down the demand curve and pay lower prices and not substantially affect the level of service to customers. The out-of-state payers,[16] who may be big nationally, have little local information or leverage concerning the price of orthopedic

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[15]These include companies like Blue Cross & Blue Shield of Utah, Worker's Compensation, PEHP, Premier Medical, and First Health.

[16]The out-of-state or nonlocal payers are companies like Aetna, CIGNA, John Hancock, Principal Financial, Mutual of Omaha, etc.

Table 5. Selected Comparison Between Prices of Episodes of Care and U&C

CPT Code & EOC Price/Payer Type	Local Large Payers	Nonlocal Payers
27130—$17,440	DNA	$24,438
29823—4,800	$5,381	DNA
28881—3,285	4,395	6,939
29848—2,000	2,362	3,299
29888—9,000	14,000	14,912
23120—3,100	3,440	3,894
64721—1,925	2,152	2,470
29877—3,285	3,792	4,163
29876—3,600	4,769	5,790
20680—1,768	2,507	3,712

Notes: The figures in Table 5 were obtained from actual encounter data for six orthopedic surgeons and two large hospitals in the Salt Lake City area in 1994.
DNA = Data not available.

Source: [25].

surgical procedures in the Salt Lake City area. These types of payers tend not to challenge the providers and, as a result, pay higher fees due to their lack of market power.

Also, in the more highly priced procedures (i.e., 27130 for $17,440), the variance among payers is very large because of the many other component parts that are included in the procedure other than hospital and physician services (see Table 4) and the complexity of the procedure itself.

In the state of Utah there are about 3,000 hip arthoplasties conducted per year of which 1,000-1,500 are concentrated among 5 insurance companies or managed care organizations.[17] The lack of information for the smaller payers have contributed to their consistently overpaying as compared to the larger local payers.

3—Capitation Payment System

A major concern to corporations has been the perception that health care costs are out of control. In 1990, Allied-Signal, with 110,000 employees and another 50,000 retirees, projected that its medical costs were going to increase by 20% over 3 years. It finally determined that its fee-for-service, or U&C plan, could no longer continue because insurance

[17]Managed care organizations is a broad definition for HMOs, PPOs, and IPOs.

plans have shown no ability to control the costs that are shifted on them by government plans, other high-risk employers, and from certain managed care plans.[18]

Allied-Signal contracted with 22 networks nationwide where it paid a fee per employee and their eligible dependents to gain access to comprehensive health care. This allows the employer to control the economic risk. Allied-Signal limited its out-of-pocket expenditures to the fee paid to the network. This method, in essence, has "capitated" the maximum amount the employer must pay. The risk is borne by the medical provider as to the level of utilization [26].

The incentives for the efficient use of resources are created by financial risk. If the medical provider cannot use resources efficiently, costs may exceed payments, and the organization will suffer financial loss.

The financial risk of a provider results from both random and systematic variation in the cost of treating patients. The financial risk due to random variation in costs is handled best by various stop-loss, risk pooling, and reinsurance options for small providers who will be most sensitive to loss from random factors. Large providers will have a big enough experience base to self-insure against extreme random variations in cost. Controlling for systematic variation in costs, however, requires adjustments in reimbursements to reflect systematic real differences in cost that are not controllable by the health care provider. Four sources of systematic variation in costs are:

1. Beneficiaries (i.e., age, sex, income, welfare status, health status, etc.)
2. Treatments (i.e., differences in treatment provided to similar individuals with similar diseases or conditions)
3. Providers (i.e., differences in the cost of providing a similar treatment for specialist physician, teaching hospital, public clinic, for-profit ambulatory surgical center, etc.)
4. Location (i.e., local wage levels, degree of local competition for medical patients, city size, etc.)

The calculation of the capitation payments rests heavily on the beneficiary characteristics outlined in source 1 by 3 dimensions.[19] These dimensions can be assigned a price by using ordinary least-squares regression. From these prices, a blended rate for each individual can be computed. The outcome indicates that the more specific the beneficiary data are, the better the explained variance in the regression estimates. In the case of the state of South Carolina, this methodolgy was

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[18]Other reasons cited by Allied-Signal was that companies that take decisive action on health care costs will be ahead of the competition and that health care must be managed like a business.

[19]The reference to "dimensions," according to [15], is the best way to explain how the data are segmented into different social and economic stratas. The first dimension is characterized by individuals who have little hospital use and limited physician use. The second dimension is characterized by those individuals who have several physician visits for such illnesses as heart, lung, abdominal, renal, and arthritis but little hospital use. The third and final dimension consists of the chronically ill who use both hospital and physician services intensively.

used and resulted in a model where 64.5% of the variance in the fixed capitation payment was explained by beneficiary characteristics.

Efficiency is defined for medical providers under a capitation payment system which includes both purchasing inputs at minimum cost and combining these inputs to produce the output (needed health care) at minimum cost. Any fixed-price payment system (i.e., a system based on any unity, including individual services) provides incentives for the first kind of efficiency. Incentives for the other kinds of efficiency are created by choosing payment units that encompass several related kinds of services. Incentives to combine services efficiently within the unit determined by the payment system will be created by placing the provider at risk for the total cost of the combination.

These incentives for efficient behavior for providers may be motivated to enroll only healthy people selectively or to disenroll high-service users (i.e., those who become chronically ill), and to undertreat enrollees. Such behavior has been observed among some HMOs in California.

Consistent with economic theory under a capitation payment system, medical providers have incentives to minimize risk inherent in reimbursement systems by adjusting the capitation rates for health status and other relevant beneficiary characteristics. This forces employers who use capitation to attempt to extract productivity guarantees for clinical outcomes. The HMO or PPO may also try to spread its risk by acquiring stop-loss insurance or by subcontracting with other providers to mitigate its exposure for some of the more riskier surgical procedures and illnesses.

An example in the state of Utah is the case of a large PPO organization which covers 80,000 people in Salt Lake, Weber, Utah, and Tooele Counties. They recently put out a bid to all the major physician groups on its Orthopedic and Podiatry Physician service commitment.[20] Table 6 presents a comparison of the price estimated by medical providers to subcontract themselves to the PPO and the episode-of-care physician price for the same orthopedic surgical procedures. No beneficiary characteristics were provided to estimate the level of utilization by the group or its current health status. The physician's incentive in the event of excess demand by the PPO's enrollees will be to undertreat and perhaps not renew the arrangement with the PPO.

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[20]Physician services include both surgical services and office visits.

Table 6 shows the large differences between the capitation price and both episodes of care and the U&C price. These cost savings accrue to the benefit of employers and the managed care organization that utilizes capitation payment systems.

Though capitation shifts the financial risk to providers in principle, the medical providers act strategically in the event of excess patient demand. If medical providers see excess demand, they may simply withhold services by undertreating patients, since there is no required provider guarantees concerning clinical outcomes.

The assumption of financial risk imposes a negative income effect where medical providers lose income from the lower fees imposed by the capitation payer which the provider cannot refuse due to the market power the payer exhibits (i.e., Blue Cross & Blue Shield of Utah).

The utilization of health care services has been measured to evaluate how increased levels of health coverage (i.e., Champus, Medicare, etc.), health insurance, and HMO particpation influenced the demand for physician office visits and hospital care. In the case of physician office visits, only health insurance shows a statistical significance at the 10% level

Table 6. Relative Price Comparison Between Capitation, Episodes of Care, and U&C for Orthopedic Physician Services in Utah

CPT	Episode of Care Capitation Price	Price	Variance U&C	Variance Capitation-EOC	Capitation-U&C
27130	$2,049.59	$2,880	$3,727.5	$830.41	$1,677.91
29823	949.56	1,400	1,575	450.44	175
29772	812.21	1,200	NA	387.79	NA
29848	352.60	600	NA	247.40	NA
29888	1,442.38	2,482	$3,255	1,039.62	1,812.62
23120	497.33	740	840	242.67	342.67
64721	402.62	600	882	197.38	497.38
29788	489.25	1,200	NA	410.75	NA
29876	845.01	1,200	1,680	354.99	834.99
20680	294.38	300	420	5.62	125.62

Note: The capitation price is based on the capitation payment from the PPO to the medical providers divided by the weighted RBRVS unit value times the number of estimated surgical procedures for the covered population.

Source: [25].

in an Almost Ideal Demand System (AIDS) [27].[21] This suggests that, as the level of one's health insurance increases, the number of physician office visits will also increase.

Concerning the influence upon hospital care, all health coverages and health insurance are statistically significant at the 10% level. HMO participation, a capitation payment system, was statistically insignificant for both physician office visits and hospital care [7].

III. Empirical Analysis of Physician Behavior

1—Billable Procedures and Price Behavior

The economic incentives of physicians indicate that, when confronted with a constraint that causes a negative income effect, they will behave strategically. The response by physicians has been to submit more billable procedures creating a substitution effect. The total price effect is evaluated by the sum of the negative income effect plus the substitution effect of the increased submission of medical procedures by physicians.

To test this economic phenomena, an ordinary least-squares regression analysis was conducted. The data are the Prime Source physician billings from January 1990 through October 1993. The historical structure of the self-employed physician practices has shown that a large portion of the total billable dollars are allocated to many nonmedical costs.[22] So any reduction in income at the margin to a physician's practice, in most cases, reduces the physician's direct take-home pay. The strategic direction of the physician's practice has been limited due to increasing levels of expenses and limited overall revenue growth [28]. The change in the level of procedures billed and its relationship to structural variables are measured below. The seasonality of billed procedures is also measured.

The dependent variable for the regressions is the total billed procedures (PROCEDUR) for all physicians' practices. The state or explanatory variables are the following:

STRUCT —a binary variable that attempts to assess if the large jump in billed procedures is attributable to some structural change in the industry
QTIME —a quadratic time variable
DCHPY —the difference between the level of total charges billed and the reimbursed payments collected from payers

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[21]The Almost Ideal Demand System (AIDS) minimizes the cost or expenditure, $C(u,p)$, necessary to achieve a given level of utility, (u), given an exogenous set of prices, (p).

[22]Nonmedical expenses include administrative staff, rent, malpractice insurance, etc.

VOLATILE —monthly variation in physician revenue or collected payments
$D_2 \ldots D_{12}$ —11 dummy variables to test for seasonality
PRICE —average reimbursement per procedure for all physicians
REPRICE —average real reimbursement per procedure for all physicians

The results in Table 7 indicate that all regressions are aurocorrelated and are unreliable to use for forecasting but allows us to establish a statistical relationship between the dependent variable and the state variable(s). In the case of Regression #1, there is a weak relationship between the level of billed procedures and the average real reimbursement per procedure (REPRICE). In Figure 1, it was shown that the average reimbursement remained relatively unchanged while the real level of reimbursement showed a slight decrease over time.

In regressions #2 and #3, the explanatory variables represent related measures of uncertainty amongst physicians. The DCHPY variable, the difference between submitted billed charges and collected payments, and the VOLATILE, the monthly variation in collected payments, appear to have signalled to the physician practices to increase the level of billed procedures over time. Both are significant at the 5% level.

Table 7. Relationship Between Billed Procedures and Price Constraints

State Variables/ Regressions	#1	#2	#3	#4	#5
CONSTANT	7,690.11	6,299.66	6,125.95	6,008.13	13,099.63
	(2.076)	(4.4167)	(4.632)	(11.584)	(1.995)
REPRICE	-9997.17				-185.80
	(-0.911)				(-1.267)
VOLATILE		104.01			60.518
		(1.9644)			(0.2517)
DCHPY			224.45		-206.52
			(2.285)		(0.5283)
STRUCT				5,645.49	-358.07
				(7.782)	(-0.3853)
$D_2 \ldots D_{12}$					All statistically insignificant
QTIME					6.6056
					(8.0139)
R^2	0.0025	0.0823	0.1083	0.5848	0.8917
F-statistic	0.1081	3.8590	5.223	60.559	14.408
Durbin-Watson	0.1219	0.3362	0.393	0.383	1.096

*t-statistics are in parentheses.

In regression #4, there is evidence of a structural change in the level of billable procedures submitted by physicians to payers in the early part of 1992. This has been attributed to the heightened political awareness of health care reform in the presidential elections and increased adjudication efforts by payers. The STRUCT variable is statistically significant at the 1% level.

Finally, in regression #5, a mutlivariate analysis was conducted. The model appears to be a good one with an R^2 of .89 and an F-statistic of 14.408, making the model significant at the 1% level. A low Durbin-Watson statistic of 1.096 suggests that there is evidence of negative autocorrelation. There also exists some multicollinearity between DCHPY and VOLATILE due to the strong linear relationship between the two variables making any forecast unreliable.

The previous set of regressions indicate that physicians, when confronted by increased variability in collected payments and flat nominal average reimbursements per procedure, have responded through increased levels of procedures. Under a traditional insurance U&C format, the increased level of procedures can be manifested through additional blood tests, X-rays, etc. While under capitation, the economic incentive by physicians is to possibly undertreat patients since the reimbursement level is contractually fixed [29].

2—Evolution of Physician Revenue

In order to measure the change in physician revenue over time given the constraints by payers, a Box-Jenkins model was developed to forecast the monthly levels of physician revenue. The model includes: 11 dummy variables to test for seasonality, a first-order autoregressive variable (AR), and a first-order moving average variable (MA). A summary of the residuals is seen in Appendix 3. The autocorrelations pattern spikes beginning at lag 1 and decreases thereafter. Also, a slight sine wave pattern exists. The partial autocorrelations spike at lag 1 is significant and zero elsewhere. The model indicates evidence of some seasonality because one of the 11 dummy variables had a t-statistic which is statistically significant (see Appendix 4). The analysis of the residuals (Appendix 3) indicates that a moving average process may exist because the autocorrelation pattern starts at lag 1 and is zero thereafter. The partial autocorrelation pattern spikes decreasingly at lag 1. The appearance of some seasonality in our results defines our final model as follows:

$$\begin{array}{l} Payments = -378{,}830 - .691(E_{t-1}) + 1.0134(Payments_{t-1}) + \ldots -91{,}167(D_{12}) \\ \quad t_{calc} \quad (-.075) \quad (-3.51) \quad (11.01) \qquad\qquad (-2.77) \\ \qquad R^2 = .888 \qquad\qquad n = 44 \\ \qquad DW = 2.12 \qquad\qquad F = 17.79 \end{array}$$

where E represents the error term, and *Payments* is the monthly collected physician revenue.

The model is a good one, since 89% of the variance in actual physician services revenue is accounted for by the model. The AR, MA, and D_{12} parameters are significant at a level of error of less than 1%. In Appendix 5, the pattern of the autocorrelation and partial autrocorrelations reflect that no AR and MA process remains. The plotting of the residuals in Appendix 5 indicates that the error terms are random and independent of each other. The model includes a constant, 11 dummy variables, a first-order autoregressive variable, and a first-order moving average variable.

The AR and MA parameters have no probability of error. The dummy variables all have very different probablities of error except for D_{12}. The model is statistically significant at the 1% level of significance [30].

The previous regressions in sections II.1 and II.2 indicate that billable procedures by physicians are highly correlated with volatility in collected payments, structural changes in the health care industry, and time. The revenue or *Payments* variable for physicians is trended and indicates some seasonality, because the D_{12} dummy variable is significant at the 1% level of significance [30].

IV. Conclusions

The 3 pricing strategies are attempts to improve cost controls and incentives to both medical providers and patients. All of these strategies have not significantly altered the growth of the health care expenditures. While all 3 strategies have proported to mitigate or eliminate the relative growth of physician fees for office and surgical procedures, causing a negative income effect, medical providers have been able to introduce the use of more procedures in billing payers because of improved technology and increased patient demand for health care services.

A pricing strategy under health Care reform must attempt to understand the strategic behavior that medical providers undertake in the face of price pressures from the purchasers of health care—insurance companies, managed care organizations, and employers.

Managed care organizations in the Intermountain West in 1988 only accounted for 29% of the health insurance enrollees who were in a managed care plan, in most cases, either an HMO or PPO. By 1993, this figure had increased to 51%.

The real spending on health care in the Intermountain West grew more slowly over the 1980-1991 period than in any other region in the U.S. (3.4% per year versus a national average of more than 4.5%).

Another concern that is nonprice-related is the guarantees of productivity from medical providers. The episode of care encompasses the double facet of being cost control conscious but also assuring that the quality of health care delivery is the same throughout the surgical or recovery experience. The management of a diagnosis all the way through until the last provider component has serviced the patient increases the efficiency of the medical providers and employers because employees return to work sooner following a satisfactory surgical experience [31]. Such an approach should enable the U.S. to reduce its infant mortality rate and increase life expectancy.

Ultimately, meaningful reform of the nation's health care system will do more than just unburden public sector budgets and provide health security. It will improve living standards. For years, the rising cost of health care has forced a shift in the composition of the typical compensation package away from take-home wages and salaries and toward fringe benefits, especially health insurance. Between 1966 and 1994, the share of health benefits in total labor compensation increased from 2.0% to 7.2%, while cash compensation correspondingly fell. In short, working men and women, for the most part, paid for escalating health costs by taking home lower pay than they would have otherwise [32].

So reform must be able to: (1) mitigate the overall growth of health care expenditures, and, (2) guarantee a certain level of quality along with improving the accessibility and portability of health care coverage. This suggests that meaningful reform will show up in the form of reduced health care costs causing higher take-home pay for Americans.

In Table 8, one can see how an evaluation of the strategic elements of health care reform relate individually to each pricing strategy. The table is a subjective evaluation of the strong and weak points of each strategy to achieve a policy goal of higher take home wages but improved overall health care.

The rating system goes from 0 to 3, where 0 signifies that a particular pricing strategy has a low emphasis in a specific area; whereas 2 and 3 suggest a medium and strong emphasis, respectively.

Table 8. Pricing Strategy Comparison

Item/Category	Capitation	Episodes of Care	U & C
Effective cost controls	3	2	1
Monitored clinical outcomes	1	3	0
Total	4	5	1

In the case of U&C, there has been significant empirical evidence that traditional health insurance has had little success in controlling health care expenditures with no interest in monitoring a patient's health care experience. The overall scores of 4 and 5 for capitation and episodes of care reflect a strong and a medium interest in containing the growth of health care costs. However, with respect to the concern for the clinical outcome, the two strategies part company. The episode of care recognizes that lower fees to medical providers alone do not reform the health care system but simply teaches providers the techniques to raise revenue or "induce demand" in other ways.

The episode of care strategy would also eliminate the "December effect" observed in the empirical analysis in part III of this paper for physician-collected billings or payments. Under the current system, once patients have satisfied their annual deductible and/or out-of-pocket limit at the beginning or middle of the year, additional discretionary medical expenditures are often incurred by individuals in November and December, since the marginal cost is zero.

The episode of care, on the other hand, states upfront the payer and patient portion clearly irrespective of what time of the year the expenditure is incurred. The marginal cost to patients is constant at all times.

The effective pricing of health care must insure cost controls that establish a certain standard of quality. The effective pricing of episodes of care across all specialties, not just orthopedics, would provide better disclosure to all economic agents as information asymmetries are reduced and would translate health care into understandable units of measure while helping to achieve the policy goals of higher take home wages.

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Appendix 1

Description of Orthopedic Procedures

CPT Code	Description
27130	Total hip replacement
29823	Arthoscopy shoulder debridem
29772	Lateral retincular release
29848	Arthoscopy wrist/carpal ligament
29888	ACL reconstruction
29881	Arthoscopy knee/meniscectomy
64721	Carpal tunnel
29788	Arthoscopy knee/debridement
29876	Artoscopy synorectomy
20680	Removal of hardware

Appendix 2

LS // Dependent Variable is PROCEDUR
Date: 6-28-1995 / Time: 22:29
SMPL range: 1990.01 – 1993.09
Number of observations: 45

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	12286.775	3764.6282	3.2637419	0.0022
REPRICE	-9997.1692	10969.658	-0.9113474	0.3672

R-squared	0.018949	Mean of dependent var	8893.711
Adjusted R-squared	-0.003866	S.D. of dependent var	3732.200
S.E. of regression	3739.407	Sum of squared resid	6.01E+08
Log likelihood	-433.0300	F-statistic	0.830554
Durbin-Watson stat	0.151533	Prob (F-statistic)	0.367193

LS // Dependent Variable is PROCEDUR
Date: 6-28-1995 / Time: 22:06
SMPL range: 1990.01 – 1993.09
Number of observations: 45

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT	2-TAIL SIG.
C	6299.6605	1426.3193	4.4167252	0.0001
VOLATILE	104.00953	52.946182	1.9644388	0.0560

R-squared	0.082354	Mean of dependent var	8893.711
Adjusted R-squared	0.061013	S.D. of dependent var	3732.200
S.E. of regression	3616.551	Sum of squared resid	5.62E+08
Log lilkelihood	-431.5268	F-statistic	3.859020
Durbin-Watson stat	0.336289	Prob (F-statistic)	0.055963

LS // Dependent Variable is PROCEDUR
Date: 6-28-1995 / Time: 22:16
SMPL range: 1990.01 – 1993.09
Number of observations: 45

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	6125.9449	1322.5230	4.6320140	0.0000
DCHPY	224.45146	98.209626	2.2854324	0.0273

R-squared	0.108313	Mean of dependent var	8893.711
Adjusted R-squared	0.087576	S.D. of dependent var	3732.200
S.E. of regression	3565.030	Sum of squared resid	5.47E+08
Log likelihood	-430.8811	F-statistic	5.223201
Durbin-Watson stat	0.393058	Prob (F-statistic)	0.027279

LS // Dependent Variable is PROCEDUR
Date: 6-28-1995 / Time: 22:17
SMPL range: 1990.01 – 1993.09
Number of observations: 45

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT	2-TAIL SIG.
C	6008.1364	518.66490	11.583850	0.0000
STRUCT	5645.6896	725.48626	7.7819387	0.0000

R-squared	0.584776	Mean of dependent var	8893.711
Adjusted R-squared	0.575120	S.D. of dependent var	3732.200
S.E. of regression	2432.754	Sum of squared resid	2.54E+08
Log lilkelihood	-411.6844	F-statistic	60.55857
Durbin-Watson stat	0.382942	Prob (F-statistic)	0.000000

LS // Dependent Variable is PROCEDUR
Date: 6-28-1995 / Time: 22:32
SMPL range: 1990.01 – 1993.09
Number of observations: 45

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	14864.462	7050.9379	2.1081538	0.0441
REPRICE	-23131.211	16162.300	-1.4311832	0.1634
VOLATILE	16.696201	245.05649	0.0681320	0.9462
DCHPY	-148.38502	391.58393	-0.3789354	0.7076
STRUCT	-480.56390	935.58643	-0.5136499	0.6115
D2	-960.60356	1084.2654	-0.8859487	0.3832
D3	405.13957	1088.9130	0.3720587	0.7127
D4	-354.94472	1104.6240	-0.3213263	0.7503
D5	-163.52778	1094.0528	-0.1494697	0.8823
D6	-782.36147	1177.6654	-0.6643325	0.5119
D7	-1893.0278	1145.5754	-1.6524689	0.1096
D8	-1287.2948	1123.4710	-1.145819	0.2616
D9	-2059.4456	1166.1297	-1.7660520	0.0883
D10	-519.30911	1195.6241	-0.4343415	0.6674
D11	-1287.1529	1194.3954	-1.0776606	0.2904
D12	-2163.8856	1191.3292	-1.8163625	0.0800
QTIME	6.3561480	0.7708269	8.2458823	0.0000

R-squared	0.893289	Mean of dependent var	8893.711
Adjusted R-squared	0.832311	S.D. of dependent var	3732.200
S.E. of regression	1528.331	Sum of squared resid	65402244
Log likelihood	-383.1138	F-statistic	14.64940
Durbin-Watson stat	1.098455	Prob (F-statistic)	0.000000

Appendix 3

IDENT PAYMENTS
Date: 6-28-1995 / Time: 22:36
SMPL range: 1990.01 – 1993.09
Number of observations: 45

Autocorrelations	Partial Autocorrelations	ac	pac
. |**********	. |**********	1	0.840	0.840
. |*********	. |****	2	0.798	0.312
. |*********	. |** .	3	0.764	0.153
. |********	. |*** .	4	0.654	-0.223
. |********	. |* .	5	0.626	0.074
. |*******	. |*** .	6	0.507	-0.265
. |*****	. |* .	7	0.416	-0.086
. |*****	. |.	8	0.355	-0.037
. |*** .	. |* .	9	0.269	0.046
. |*** .	. |** .	10	0.241	0.120
. |*** .	. |** .	11	0.205	0.120
. |* .	. |*** .	12	0.113	-0.209
. |* .	. |** .	13	0.063	-0.156
. |.	. |.	14	0.029	-0.004
. |.	. |.	15	-0.013	0.018
. |.	. |.	16	-0.036	0.019
. |* .	. |* .	17	-0.095	-0.046
. |* .	. |* .	18	-0.110	0.096
. |** .	. |.	19	-0.117	0.034
. |** .	. |* .	20	-0.157	-0.102

Box-Pierce	Q-Stat	159.86	Prob	0.0000	S.E. of correlations	0.149
Ljung-Box	Q-Stat	184.63	Prob	0.0000		

Appendix 4

LS // Dependent Variable is PAYMENTS
Date: 6-28-1995 / Time: 22:39
SMPL range: 1990.02 – 1993.09
Number of observations: 44
Convergence not achieved after 20 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-378830.93	5064213.1	-0.0748055	0.9409
D2	-48550.660	29022.854	-0-1.6728424	0.1048
D3	1200.9363	39453.017	0.0304397	0.9759
D4	-2750.5158	46168.788	-0.0595752	0.9529
D5	14610.216	50609.722	0.2886840	0.7748
D6	-33101.223	53356.949	-0.6203732	0.5397
D7	-51863.756	54751.155	-0.9472632	0.3511
D8	-44983.870	55057.354	-0.8170365	0.4203
D9	-75869.893	54532.450	-1.3912797	0.1744
D10	4076.1675	50537.730	0.0806559	0.9363
D11	-70927.228	43955.315	-1.6136212	0.1171
D12	-91167.575	32922.480	-2.7691588	0.0095
MA(1)	-0.6912510	0.1970953	-3.5071925	0.0014
AR(1)	1.0134076	0.0920451	11.009900	0.0000

R-squared	0.885214	Mean of dependent var	326812.8
Adjusted R-squared	0.835473	S.D. of dependent var	148931.7
S.E. of regression	60409.47	Sum of squared resid	1.09E+11
Log likelihood	-538.3991	F-statistic	17.79662
Durbin-Watson stat	2.128159	Prob (F-statistic)	0.000000

Appendix 5

IDENT RESID
Date: 6-28-1995 / Time: 22:40
SMPL range: 1990.01 – 1993.09
Number of observations: 45

Autocorrelations	Partial Autocorrelations		ac	pac
. .	. .	1	0.005	0.005
. .	. .	2	-0.037	-0.037
. * .	. * .	3	0.075	0.076
. * .	. * .	4	-0.094	-0.097
. .	. .	5	0.015	0.024
. .	. * .	6	-0.028	-0.043
. * .	. .	7	-0.040	-0.023
. * .	. * .	8	0.075	0.062
. ** .	. ** .	9	-0.134	-0.133
. .	. * .	10	0.034	0.046
. .	. .	11	0.028	-0.001
. ** .	. * .	12	-0.138	-0.107
. * .	. * .	13	-0.083	-0.113
. .	. .	14	0.000	0.005
. .	. .	15	-0.022	-0.016
. * .	. * .	16	-0.059	-0.085
. * .	. * .	17	0.108	0.124
. .	. * .	18	-0.002	-0.043
. .	. .	19	-0.006	0.005
. .	. * .	20	-0.034	-0.055

Box-Pierce	Q-Stat	3.89	Prob	1.0000	S.E. of correlations	0.149
Ljung-Box	Q-Stat	5.38	Prob	0.9995		

Appendix 6

obs	PAYMENTS	PROCEDUR	REPRICE	DCHPY	VOLATILE	QTIME
1990.01	193858.0	4951.000	39.15532	7.260754	15.64276	1.000000
1990.02	169257.0	4267.000	39.48783	3.865479	8.879629	4.000000
1990.03	190005.0	5254.000	35.93623	10.35307	22.25655	9.000000
1990.04	212209.0	5319.000	39.53859	-0.616844	-1.570397	16.00000
1990.05	208907.0	5499.000	37.51470	6.367886	14.35570	25.00000
1990.06	173549.0	4825.000	35.26657	5.251816	12.74077	36.00000
1990.07	146845.0	5481.000	26.22211	13.37822	33.30411	49.00000
1990.08	179645.0	5736.000	30.49105	12.02301	27.73994	64.00000
1990.09	208271.0	5565.000	36.18092	2.492905	6.245049	81.00000
1990.10	175442.0	6389.000	26.43145	13.04492	32.20576	100.0000
1990.11	204299.0	6238.000	31.49656	7.228920	18.08150	121.0000
1990.12	181646.0	6082.000	28.69749	9.741201	24.59443	144.0000
1990.01	222831.0	7554.000	28.24588	12.19116	29.24270	169.0000
1991.02	168445.0	6240.000	25.73667	21.71747	44.58353	196.0000
1991.03	255447.0	6985.000	34.71712	13.17552	26.48542	225.0000
1991.04	246447.0	6985.000	33.40785	14.46400	29.07551	256.0000
1991.05	246619.0	7383.000	31.54787	14.20669	29.83952	289.0000
1991.06	323084.0	7360.000	41.38780	18.88261	30.07748	324.0000
1991.07	258530.0	5585.000	43.53236	6.327484	12.02543	361.0000
1991.08	268169.0	5968.000	42.14991	7.511227	14.32191	400.0000
1991.09	209449.0	6046.000	32.44072	20.84634	37.56848	441.0000
1991.10	268690.0	6467.000	38.80844	0.863461	2.035920	484.0000
1991.11	240062.0	7244.000	30.87611	17.23909	34.21914	529.0000
1991.12	252142.0	6764.000	34.67268	13.37374	26.40381	576.0000
1992.01	254541.0	6846.000	34.52520	17.88899	32.48410	625.0000
1992.02	289941.0	7460.000	35.99918	7.617828	16.38810	676.0000
1992.03	304657.0	8669.000	32.38808	14.83597	29.68426	729.0000
1992.04	293939.0	9097.000	29.70413	13.56920	29.57487	784.0000
1992.05	436317.0	10498.000	38.14445	7.471901	15.23826	841.0000
1992.06	287956.0	8879.000	29.69047	19.90191	38.02934	900.0000
1992.07	340910.0	9639.000	32.32539	17.76574	33.43604	961.0000
1992.08	370689.0	10847.000	31.20879	20.48124	37.47329	1024.0000
1992.09	369217.0	12846.000	26.22599	13.64565	32.19267	1089.0000
1992.10	568889.0	14578.000	35.52002	11.78564	23.19576	1156.0000
1992.11	369986.0	12668.000	26.51850	19.30723	39.79758	1225.0000
1992.12	346551.0	12350.000	25.43658	14.95053	34.75950	1296.0000
1993.01	603702.0	16746.000	32.59087	7.294758	16.82942	1369.0000
1993.02	501621.0	16041.000	28.19407	15.18247	32.68305	1444.0000
1993.03	616272.0	17896.000	30.71195	14.96318	30.29015	1521.0000
1993.04	636089.0	15967.000	35.58665	12.27576	23.55581	1600.0000
1993.05	604108.0	14262.000	37.77680	12.87197	23.30618	1681.0000
1993.06	558528.0	12271.000	40.75793	17.08973	27.29734	1764.0000
1993.07	560198.0	10882.000	45.87472	10.90140	17.47559	1849.0000
1993.08	554256.0	13322.000	37.06009	16.93192	28.92541	1936.0000
1993.09	501406.0	12266.000	36.39796	16.98296	29.35148	2025.0000