

Relationship of the Use and Costs of Physician Office Visits and Prescription Drugs to Travel Distance and Increases in Member Cost Share

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ABSTRACT

BACKGROUND: The prescription drug benefit is commonly designed and managed as a stand-alone health insurance product without consideration of how the design of other medical benefits may impact its use.

OBJECTIVE: To determine the effects of member cost (copayment/coinsurance) increases on the relationship between the use of physician office visits and the type/tier of prescription medication purchased in a commercially insured population.

METHODS: Our research model utilized managed care organization member cost-share levels that were changed as part of the annual benefit renewal process to estimate the price–quantity–expenditure relationship between cost sharing and use of physician office visits/prescription drugs by benefit tier. The price–quantity–expenditure relationship was measured across a benefit copayment price change to determine the effect of a price increase on utilization/expenditures. We included the distance from the member's residence to the physician's office as a proxy for the time cost of an office visit. The study sample included 44,828 members who were fully insured for the full 12 months of 2002, continued coverage for the full 12 months of 2003, and whose benefit renewal occurred on January 1, 2003. We hypothesize that a relationship exists between office visit use and its expenditures and prescription drug use and its expenditures based on out-of-pocket cost. Hypotheses were tested using a least squares dummy variable regression model across claims records for years 2002 and 2003, containing consecutive yearly records for the same members. The unit of analysis was the member. Demand was estimated by benefit category and copayment tier to provide the study variables, price elasticity of demand, cross-price elasticity of demand, and distance elasticity. Expenditure is net health plan cost after subtraction of member cost share (including copayments, coinsurance, and deductibles). The expenditure categories in this study were pharmacy, medical office visits, and total health care costs.

RESULTS: Members with greater travel distance to a primary care physician (PCP) or specialty care physician (SCP) office experienced higher PCP and SCP visit utilization (distance elasticity = 0.164 and 0.202, respectively; $P < 0.01$). Greater travel distance to a PCP was also associated with higher tier-1 prescription use (0.048, $P < 0.01$) as well as higher total plan-paid (0.032, $P < 0.05$) and PCP expenditures (0.141, $P < 0.01$). Greater travel distance to an SCP was associated with higher use of drugs in all 3 pharmacy copayment tiers (0.085, 0.075, and 0.073 for tier 1, tier 2, and tier 3, respectively; $P < 0.01$ for each tier). The price effects of an increase in tier-1 copayments were fewer PCP office visits (-0.118, $P < 0.01$) but more SCP office visits (0.177, $P < 0.01$); SCP visits were also higher with increased tier-3 copayments (0.118, $P < 0.01$). Tier-2 prescription drug use decreased with higher office visit copayments (-0.105, $P < 0.05$). Increased tier-1 copayments were associated with lower expenditures for PCP office visits (-0.146, $P < 0.05$) but higher expenditures for SCP office visits (0.149, $P < 0.05$). While increases in tier-2 copayments were associated with lower PCP (and -0.322, $P < 0.01$) and SCP (-0.453, $P < 0.01$) expenditures, increases in tier-3 copayments were associated with higher PCP (0.495, $P < 0.01$) and SCP (0.197, $P < 0.05$) expenditures.

CONCLUSIONS: A relationship exists between physician office visits and prescription drug use based on member cost share and time factors. Increases in office visit copayments were associated with decreased use of drugs in the tier-2 pharmacy benefit category. Increases in tier-2 pharmacy benefit copayment levels were associated with lower PCP/SCP expenditures, but increases in tier-3 pharmacy benefit copayment levels were associated with higher PCP/SCP expenditures. The distance to a physician's office was directly proportional to the number of office visits. Separation of the management of pharmacy and medical

increases in prescription drug costs have been well documented, rising from 4.5% of national health expenditures in 1982 to 9.8% in 2002—the first year of claims data used in this study—and 10% as of 2004.¹ The proportion of gross domestic product (GDP) consumed by prescription drug spending has increased 260% since 1982, while the share of GDP consumed by total national health expenditures has increased by 70%. The fact that prescription drug costs have risen at a rate of 3.7 times total health care expenditures captures the attention of health care stakeholders.

The trend in pharmacy benefits management reflects an increase in the number of benefits that are “carved out,” causing pharmacy and medical benefits to be managed independently of one another.^{2,3} A Mercer/Foster Higgins national survey of employer-sponsored health plans showed that the percentage of employers who carved out pharmacy benefits ranged from 7% for employers with 500 to 999 employees to 37% for employers with 20,000 employees or more.⁴

Carving out specific benefits is thought to provide an enhanced opportunity to monitor and manage pharmacy expenditures. However, no study has determined that carved-out benefits for prescription drugs result in lower overall costs to either the employer or the health plan. Carving out the pharmacy benefit so that it is managed independently from medical benefits can be a barrier to the study, development, and

benefits may have significant cost implications for consumers, employers, and health plans. Therefore, optimal management of medical and pharmacy benefits may require a coordinated strategy and tactics.

KEYWORDS: Physician office visit, Copayment, Coinsurance, Benefit tier, Own-price elasticity, Cross-price elasticity, Expenditure

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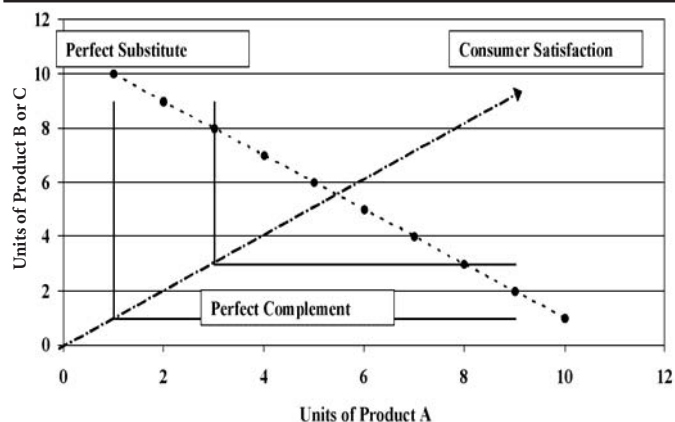
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FIGURE 1 Complements and Substitutes



Redrawn from Pindyck RS, Rubinfeld DL. *Microeconomics*. 6th ed. Upper Saddle River, NJ: Prentice Hall; 2005:73.

implementation of optimal strategies for managing total medical costs, including the pharmacy benefit. It is our contention that a relationship exists between the utilization of pharmacy benefits and medical benefits. As such, segregating pharmacy claims from medical claims and making them inaccessible to medical claims analysts limits the ability of insurers to optimize their health care management strategy.

Characterizations of consumer preferences for visiting certain physicians' offices or purchasing certain prescription drugs have traditionally been analyzed by looking at the specific benefit without considering the potential for substitution or complementarity across the 2 benefits. The price–quantity/price–expenditure relationship for a product or service can be evaluated by measuring the price elasticity—or flexibility—of demand, which compares the change in utilization or purchase of the product or service with the change in that product's price.⁵ Price elasticity is typically considered from 2 different perspectives: (1) own-price elasticity, in which the change in use of a product or service is related to its own price, and (2) cross-price elasticity, in which the change in use of a product or service is related to the price of a different product or service that could reasonably be a substitute or complement to the primary product.

Member cost share denotes the total amount of money paid by the patient for medical and pharmacy services and products at the point of service. Plan-paid expenditures are the payments by the health plan to providers. Coinsurance in the current market is a percentage of a negotiated fee schedule, whereas a copayment is a fixed dollar amount. The most common physician office visit copayment in our study was \$20, while the most common coinsurance was 20% of the contracted fee. The measurement of change in the use of or expenditure for a product or service due to price effects requires a change in price to separate

demand effects from supply effects. Price elasticity is defined as the percentage change in utilization or expenditures divided by the percentage change in price. Price elasticity values are typically expressed as “the change in the quantity demanded from a 1% increase in price.” For example, a distance elasticity value of 0.25 for physician office visits means that a 1% increase in distance results in a 0.25 % increase in the number of physician office visits; a price elasticity value of -0.25 for physician office visits means that a 1% increase in price results in a 0.25% decrease in the number of physician office visits.

When a product or service is considered to be price elastic, it means that as the price increases, utilization or total expenditure decreases. Price elasticity occurs because there are reasonable substitutes available for that product or service. When no substitutes are available, changes in price are not as likely to impact use or expenditure. The determination that a service is a substitute is based on the cross-price elasticity of demand, which measures the price relationship of service “x” to demand (utilization or expenditures) for service “y.” When the cross-price elasticity of demand is negative, the service is considered to be a complement; when positive, the service is considered to be a substitute.⁵

An example of a substitute product can be demonstrated by a consumer's choice in the purchase of beer. The consumer is indifferent to the brand of beer purchased as long as the price of each brand remains the same. When the price of beer “A” increases and the price of beer “B” is held constant, the consumer will preferentially purchase beer “B.” An example of a pharmaceutical substitute would be the purchase of omeprazole over the counter (OTC) in lieu of prescription esomeprazole. A complementary product or service would be one in which its use increases with the use of a primary product or service. An example of a complement would be the consumption of beer nuts when drinking beer. When the price of beer increases, the consumption of both beer nuts and beer decreases even though no change occurred in the price of beer nuts. An example of a pharmaceutical complement can be demonstrated by omeprazole OTC and naproxen—as naproxen use increases, the use of omeprazole OTC would also be expected to increase, particularly in persons at increased risk of gastrointestinal bleeding.

Figure 1 illustrates an indifference curve, so called because it identifies points where consumers are indifferent to the purchase of product A or product B because they both provide the same level of utility or satisfaction.⁵ A perfect substitute is shown by the negatively sloped dotted line. The solid L-shaped line plots the perfect complementary relationship between product C and product A. In addition to the price of the product or service, the time cost may also play an important role in the decision of which service or product to buy.⁶

The total member cost of a physician office visit includes the copayment amount, the time cost for the member to travel to the physician's office, and the wait time involved to see the physician. Because of the existence of this noncash form of cost,

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consideration of this additional price to visit the physician may provide insight into the relationship among the items in the products/services bundle. Given that higher cost or price is thought to have a negative effect on consumption, we contend that increased additional cost (of travel) results in decreased use of physician office visits.

Phelps and Newhouse studied the impact of coinsurance payments on physician office visits, physician expenditures, ancillary services, and expenditures for those services.⁷ However, they did not measure cross-price effects or consider medical and pharmacy services in any combination. They found that the introduction of a 25% coinsurance payment of total expenditures when there had been no previous coinsurance fee reduced physician office visit use by approximately 25%.

The RAND Health Insurance Experiment characterized consumer behavior as it related to the cost for acute care, chronic care, well care, outpatient care, hospital care, total medical and dental care, and prescription drugs.⁸ However, it did not report substitutions or complements for these products and services and apparently did not consider combinations of care. Price-related differences in utilization and price elasticities were reported on an aggregate level: (1) Higher cost sharing was associated with lower health care use. (2) No net effect on health was evident for the average patient; however, although counterintuitive, restricted activity days decreased with greater cost sharing. Poor patients showed improved blood pressure control with lower cost sharing as a result of greater compliance due to easier access to medication. (3) Overall expenditure levels did not vary by income group, but the types of services used did vary: poor patients experienced a greater reduction in the use of ambulatory services with increased cost sharing.

O'Brien, who studied National Health Service prescription drug use in the United Kingdom, reported a positive cross-price elasticity between OTC and prescription drugs, meaning that OTC drugs act as a substitute for prescription drugs.⁹ Manning et al. evaluated the cross-price elasticity for inpatient versus outpatient services and found that outpatient services were not a substitute for inpatient services, but suggested that outpatient services acted as a complement.¹⁰

Even though the behavior of the price–quantity relationship for medical services and prescription drugs logically suggests cross-price relationships, these health insurance benefits are commonly considered independently. There is a current trend toward designing and managing prescription drug and medical benefits separately, perhaps without adequate market information about consumer behavior when faced with a choice among types of health care services. These 2 factors—separation of the management of pharmacy and medical benefits and lack of adequate market information about consumer behavior—may have significant cost implications for consumers, employers, and health plans. To address this lack of information, we conducted an observational study of consumer preference for the combination of

health care services represented by physician office visits and prescription drugs in a commercially insured population. Consumer preference is the relationship between acquiring products or services and the satisfaction that this acquisition brings to the consumer, which is based on the assumption that consumers will seek the highest level of satisfaction that fits within their budget constraint. Our contention is that the benefit design for physician office visits helps to explain consumer preference for the number and type of prescription drugs used and that the benefit design for prescription drugs helps to explain consumer preference for the number and possibly the type (specialist or primary care) of physician office visits used.

Methods

The drug formulary for the pharmacy benefit for health plan members at BlueCross BlueShield of Tennessee in 2002 and 2003 was defined by a 3-tier copayment design (the drug formulary is no longer available on the Web site, but it may be obtained from the authors). The formulary contained some exclusions such as erectile dysfunction drugs, infertility drugs, antiobesity drugs, smoking deterrents, OTC drugs except insulin and glucose-monitoring products, and investigational drugs except where current Tennessee statute allows for coverage through medical exception (off-label use of drugs in Tennessee Code Title 56, Chapter 7, Part 23 [TCA 56-7-2352]).^{11,12} Copayment tier 1 included all generic drugs listed in the formulary as well as generic drugs that were not listed, with the exception of single-source generic drugs that are produced and priced by a single manufacturer at near-brand price. Copayment tier 2 included only selected brand-name formulary drugs that were considered by the plan to be more cost effective than similar drugs within a particular drug class (e.g., antidepressants, antihypertensives). Copayment tier 3 included brand-name products that were not selected for tier 2 plus all brand-name products that were not listed in the formulary. All brand-name drugs with a generic equivalent were also in tier 3. The copayments for prescription drugs varied by tier, with the lowest copayment in tier 1 and the highest copayment in tier 3.

The pharmacy benefit also included a preauthorization requirement for the following drugs: adapalene, anabolic steroids, fluconazole, itraconazole, palivizumab, thalidomide, tretinoin, antiobesity drugs (benzphetamine, diethylpropion, orlistat, phendimetrazine, phentermine, sibutramine), erectile dysfunction drugs, human growth hormone, and infertility drugs. The 3-tier copayment formulary structure did not change over the 2-year study period, although some drugs changed tiers. For example, Zoloft moved from tier 3 in 2002 to tier 2 in 2003, while Remeron moved from tier 2 to tier 3.

Estimates of price effects on demand (utilization or expenditures) require a price change to reduce the potential for misinterpreting the relationship between price and demand by inappropriately attributing a level of demand to, in this case, price. In our study,

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TABLE 1 Benefit Change Characteristics

Change Characteristic	Copayment/Distance Category					
	OV Copay	Tier-1 Copay	Tier-2 Copay	Tier-3 Copay	PCP Distance	SCP Distance
% change for study population	3.15	3.22	4.29	8.01	-3.82	-1.44
Price-change cohort (members*)	3,495	515	5,208	5,047	4,481	6,916
Control cohort (members*)	41,333	44,313	39,620	39,781	40,347	37,912
Average 2002 copay (\$) or distance (miles)	\$16.76	\$4.47	\$6.26	\$28.00	14.9	28.8
Average 2003 copay (\$) or distance (miles)	\$25.00	\$9.68	\$28.44	\$46.10	8.7	16.8
Average change in copay (\$) or distance (miles)	\$8.24	\$5.21	\$22.18	\$18.10	-6.2	-12.0
% change for copay/distance change cohort	49.2	116.6	354.3	64.6	-41.6	-41.7

* Price-change and control cohort sizes are different for each benefit category; e.g., 3,495 members experienced an office visit copay change January 1, 2003, while 41,333 members did not have a copay change for office visits.

OV=office visit; PCP=primary care physician; SCP=specialty care physician.

price change was measured by the change in point-of-service, out-of-pocket cost (copayment or coinsurance) from 2002 to 2003 for the study population. The price change is referred to as “exogenous” because our study models used price to estimate demand. Although the consumers did not have the ability to control price, they could control the number of units purchased and the total amount of their expenditures. The magnitude of the price change in our study was not modest, ranging from 49% to just over 350% of the 2002 copayment for the price change cohorts (Table 1).

Each year, approximately 30% of the plan membership renews or initiates their health insurance relationship with BlueCross BlueShield of Tennessee by enrolling with an effective date of January 1; the remaining 70% enroll or renew at other dates throughout the year. Annual renewal and enrollment is frequently accompanied by cost-sharing changes made to suit the objectives of the employer or individual or both based on their preference for how cost is paid, whether through a premium or a point-of-service copayment. Premiums are generally lower when point-of-service cost sharing (copayment or coinsurance) is higher and vice versa. Benefit plans may also fluctuate due to regulation changes from the state department of insurance, legislated mandates, product popularity and market trends, and the strategic and operational objectives of the health plan. At the January 2003 membership renewal, the total number of benefit plans in the study population increased from 48 to 57. Each plan represented a different combination of benefit levels for office visit (copayment and coinsurance) and prescription drug (copayment) cost sharing. While the average copayment change experienced by the entire study population was modest, Table 1 demonstrates that the average copayment of the cohort that experienced a benefit change increased by 49.2% for physician office visits from 2002 to 2003. The average tier-1 copayment increase was 116.6%, tier 2 increased 354.3%, and tier 3 increased 64.6%.

Data were extracted from an internal database that houses all member records and claims for health plan local business. Members from national accounts and the Federal Employees Program, those who were self-insured, those without both medical and prescription drug coverage, and those who were not covered for the entire 2 calendar years were not included in this study. Non-Tennessee residents were excluded.

The potential study population was 123,875 fully insured members from 2002. We included only those members whose benefit year coincided with the calendar year (January 1) for ease of analysis in reporting per-member-per-year (PMPY) expenditures and utilization. The benefit renewal date and any benefit copayment/coinsurance changes would therefore have the same change date, with claims records both 12 months before and after the benefit change being represented. Using these variables, our study population resulted in 44,828 members. The outcome of the extraction design is 2 distinct periods (2002 and 2003) of claims records for the same 44,828 fully insured members, producing a balanced panel. All 44,828 members were enrolled in a preferred provider organization during the study period. No other selection criteria were employed.

Claim records included all physician office visits and prescription drug purchases during the 2-year study period; claims for other services were not studied separately but were included in aggregate as total health care expenditures and total plan-paid costs. Total health care expenditures denotes the total amount of money paid per member for medical services and products. Total health care expenditures = member cost share + plan-paid expenditures. Member cost share = copayment, coinsurance, and deductibles. Plan-paid expenditures include any provider payments made by the health plan. The unit of analysis was the member record, comprising aggregated services and costs by member for either 2002 or 2003. Of the total 44,828 members, 13,114 (29.3%) had no physician office visit or prescription drug claims in 2002.

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TABLE 2 Descriptive Statistics

Variable	2002 Mean [SD]	2003 Mean [SD]	P Value†
Age	34.8 [17.8]	35.8 [17.8]	<0.001
Total sample	44,828	44,828	NA
Females (%)	22,018 (49.1%)	22,018 [49.1%]	NA
Actual DxCG score	1.17 [3.03]	1.33 [3.4]	<0.001
SCP distance in miles per visit	23.7 [38.1]	23.3 [36.5]	0.337
PCP distance in miles per visit	9.95 [15.2]	9.57 [12.9]	0.002
OV copayment (\$)	11.75 [21.31]	12.12 [22.50]	<0.001
Tier-1 copayment (\$)	7.14 [3.57]	7.37 [4.07]	<0.001
Tier-2 copayment (\$)	22.36 [23.70]	23.32 [27.02]	<0.001
Tier-3 copayment (\$)	24.59 [28.36]	26.56 [34.88]	<0.001
Per Member per Year Measures*			
SCP office visits‡	2.3 [4.9]	2.5 [5.3]	<0.001
PCP office visits‡	2.1 [3.2]	2.2 [3.2]	<0.001
Tier-1 pharmacy claims	3.7 [7.2]	4.4 [8.1]	<0.001
Tier-2 pharmacy claims	3.6 [7.2]	4.0 [7.7]	<0.001
Tier-3 pharmacy claims	2.7 [5.5]	2.8 [5.7]	0.001
Total pharmacy claims	11.07	12.14	<0.001
PCP office visit expenditures (\$)	133.69 [224.85]	142.17 [234.47]	<0.001
SCP office visit expenditures (\$)	252.83 [1,093.86]	309.17 [1,662.18]	<0.001
Total physician office visit expenditures (\$)	386.52	451.34	<0.001
Tier-1 pharmacy expenditures (\$)	41.51 [143.42]	52.97 [170.09]	<0.001
Tier-2 pharmacy expenditures (\$)	176.15 [614.57]	218.16 [720.14]	<0.001
Tier-3 pharmacy expenditures (\$)	146.78 [1,078.67]	176.86 [1,267.44]	<0.001
Total pharmacy expenditures (\$)	390.55	478.10	<0.001
Total plan-paid expenditures (\$)§	1,766.49 [5,676.13]	2,092.26 [6,828.78]	<0.001

* For the study sample of 44,828 members.

† PCP and SCP office visit expenditures include plan-paid expenditures for all services, including laboratory and radiology received by the patient in the course of the visit; however, it specifically excludes surgery; high-technology imaging such as MRI, PET, and CAT scans; invasive diagnostic procedures such as colonoscopy and bronchoscopy.

‡ Student t test.

§ Total plan-paid health care expenditures represent expenditures for all benefits paid by the health plan, including hospital inpatient and outpatient services, physician and other professional services, prescription drug and home infusion therapy, durable medical equipment, and home health and medical supplies. DxCG=diagnostic cost group; PCP=primary care physician; SCP=specialty care physician.

Demand was measured in 2 ways: (1) utilization, denoting the number of office visits and pharmacy claims PMPY and (2) expenditures, denoting health plan-paid costs PMPY by benefit category. Prescription drug expenditures by tier are depicted in Table 2 as benefit plan-paid costs PMPY. An office visit is defined as a member encounter with a unique physician on a specific date. A consequence of this definition is that more than 1 claim for the same patient from the same physician could be submitted for a specific date, but these claims would be counted as 1 office visit. Claims from a patient visiting 2 different physi-

cians on the same day would be counted as 2 office visits. Total plan expenditures include those for hospital inpatient and outpatient services, freestanding outpatient facilities such as ambulatory surgery centers, physician office and hospital visits, home health, durable medical equipment, home infusion therapy, and specialty and prescription drugs, in addition to other less frequently used products and services.

Our analytic strategy was to estimate demand by using least squares dummy variable (LSDV) regression. LSDV regression is a fixed-effects model specification, which is considered to be

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TABLE 3 The Empirical Model

The theoretical model for measuring price elasticity begins with the linear demand model¹³:

$$Q_d = a - bP$$

where Q_d = quantity demanded, P = price, a = the quantity demanded when price = 0 (the quantity axis intercept), and $b = P/Q$ or the slope of price-quantity, which is required by the law of demand to be negative. From this basic demand model, we take the derivative of quantity with respect to price (marginal function):

$$\frac{dQ_d}{dP} = -b$$

Next, the average function is calculated:

$$\frac{Q_d}{P} = \frac{a - bP}{P}$$

Finally, the ratio of the marginal function to the average function is taken:

$$\frac{-bP}{a - bP} = E_d$$

where E_d is the price elasticity of demand.

The calculation is simplified by using the natural log transformation:

$$E_d = \frac{d(\ln Q_d)}{d(\ln P)}$$

As is common with large data sets, this is accomplished by transforming the variables by taking the natural logarithm for all but dummy variables and then applying the ordinary least squares regression method to the transformed variables (log-log model). The functional form of the regression model for elasticities is specified by Gujarati¹⁴ below:

$$\ln Y_i = \ln \beta_1 + \beta_2 \ln X_i + u_i$$

An additional feature of the log-log model is that the log transform will also have the effect of transforming an exponential relationship to a linear one. Deaton and Muellbauer¹⁵ base the price elasticity of demand in the budget constraint by equating total expenditures to the sum of all prices for all purchases multiplied by the quantities for all purchases. Concerning health insurance benefits, in which total expenditures are likely to be related to the benefit design and the amount of the monthly premium, the traditional total expenditure constraint is not as important. The well-known economist, Milton Friedman,¹⁶ describes the reduced importance of the health care expenditure constraint: "Two simple observations are key to explaining both the high level of spending on medical care and the dissatisfaction with that spending. The first is that most payments to physicians or hospitals or other caregivers for medical care are made not by the patient but by a third party—an insurance company or employer or governmental body. The second is that nobody spends somebody else's money as wisely or as frugally as he spends his own." Such items as government-mandated benefits imposed by state legislatures,¹⁷⁻¹⁹ leverage,²⁰ monopoly pricing, information asymmetry,²¹ and health care capacity²² are more important determinants of total health care expenditures than the traditional budget constraint construct. Leverage is the effect of reducing the consumer point-of-service out-of-pocket exposure compared with the prices of health care products or services. Increasing leverage results in premium increases due to the effect of the relative exposure change on plan-paid costs.

The following equation presents the Deaton and Muellbauer³⁴ specification:

$$\log q_i = \alpha + e_i \log x + \sum e_{ik} \log p_k + u_i$$

where \log = natural log, α is the intercept term shown previously as β_1 , k represents products that are closely associated with the study product, x represents total expenditures, p = price, and e represents elasticity. An important assumption of this approach is that the only role of price and total expenditures is to determine the budget constraint; however, the authors caveat this by noting that if relative price is also used to judge quality, this constraint is not violated. Two additional principal constraints apply to their empirical specification: (1) the adding up constraint, which is based in the need for the sum of all budget shares not to exceed the budget, and (2) the homogeneity of the demand constraint. Deaton and Muellbauer further note that it is standard practice not to regard the adding up constraint in analyses of family budgets and that, in cross-sectional studies, homogeneity of demand plays no role since there are no price changes. We recognize that the role of the budget constraint in consumer choice of medical care is diminished in health insurance plans. We therefore used separate regressions for each benefit category, dropping the total expenditures term from the Deaton-Muellbauer specification to obtain the form specified above by Gujarati. We modified this specification further to include an accommodation of the dynamic nature of the price change from 2002 to 2003 by using the fixed-effects model.

more appropriate when the principal focus within the sample studied is in the effects themselves, as was the case in our analysis.²³ Fixed-effects models are useful when the samples are not randomly drawn, as in our study. They are also known as unobserved effects models because they are able to account for unobserved effects that are constant, and those vary over time.²⁴

Separate regression analysis was conducted to model utilization and expenditures by benefit category. The 5 utilization benefit

categories modeled were primary care physician (PCP) office visit PMPY, specialty care physician (SCP) office visit PMPY, tier-1 prescriptions PMPY, tier-2 prescriptions PMPY, and tier-3 prescriptions PMPY. The 5 expenditure benefit categories modeled were PCP \$PMPY, SCP \$PMPY, tier-1 prescription \$PMPY, tier-2 prescription \$PMPY, and tier-3 prescription \$PMPY. We selected these benefit categories because they represent, on average, the most typical components of the

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TABLE 4 Price (Copayment) and Distance Elasticities

Model	OV Copay	Tier-1 Rx Copay	Tier-2 Rx Copay	Tier-3 Rx Copay	Distance to PCP	Distance to SCP
PCP visits	0.038*	-0.118†§	-0.0275	-0.024	0.164‡	0.013
SCP visits	-0.067†*	0.177‡	-0.058	0.118‡	0.008	0.202‡
Tier-1 Rxs	0.043	0.138*	0.41‡	-0.527‡	0.048‡	0.085‡
Tier-2 Rxs	-0.105†§	0.0016	-0.033*	-0.0037	0.019	0.075‡
Tier-3 Rxs	-0.034	-0.0024	-0.229†§	-0.468†*	-0.03	0.073‡
Total plan-paid expenditures	-0.087‡	0.044	-0.343‡	0.084	0.032†	0.101‡
PCP expenditures	-0.081†*	-0.146†§	-0.322‡§	0.495‡	0.141‡	0.024
SCP expenditures	-0.076†*	0.149‡	-0.453‡§	0.197‡	0.011	0.175‡
Tier-1 expenditures	0.082	-0.294†*	0.053	-0.101	0.01	0.124‡
Tier-2 expenditures	-0.061	0.333‡	-1.075‡*	0.814‡	0.037	0.084‡
Tier-3 expenditures	0.0002	-0.099	-0.225	-0.747†*	-0.012	0.102‡

* Own-price elasticity; otherwise, all copayment elasticities are cross-price elasticities.

PCP and SCP office visit expenditures include plan-paid expenditures for all services, including laboratory and radiology received by the patient in the course of the visit; however, it specifically excludes surgery; high-technology imaging such as MRI, PET, and CAT scans; and invasive diagnostic procedures such as colonoscopy and bronchoscopy.

† $P < 0.05$.

‡ $P < 0.01$.

§ Complement.

|| Substitute.

OV=office visit; PCP=primary care physician; Rx=prescription; SCP=specialty care physician.

average medical care bundle of products. In our model, expenditures (health plan-paid costs) are those costs that the health plan is contracted to pay to the provider after subtracting the out-of-pocket costs paid at the point of service by the insured member.

The specification of the empirical model (Table 3) used in our analysis is the typical LSDV model:

$$\ln Y_i = \alpha_1 + \alpha_2 D + \alpha_g D_g + \beta_j \ln X_{ji} + \dots + \gamma_l (D_{ki} \ln X_{ki}) + \dots Z_i + u_i$$

where i indexes individuals, y is a continuous variable estimating either units or expenditures for each benefit category in separate regressions, α_1 is the intercept, and D is a dummy variable that represents the year (0 for 2002 before the benefits changed, 1 for 2003 after the benefits changed). The addition of D as an independent variable creates a differential intercept, representing the change in 2003 from the 2002 value of the intercept. The multiplication of the study variable slope terms by D creates differential slope terms that show the change from 2002 to 2003. β is used to represent the coefficient for the slope (X) terms and γ the coefficient for the differential slope terms. β values exist for each study and control variable, and γ values exist for each copayment and distance variable.

Study variables, represented by k , included office visit copayment (expressed in dollars) coinsurance payment (expressed in percentage of contractual amounts), tier-1 phar-

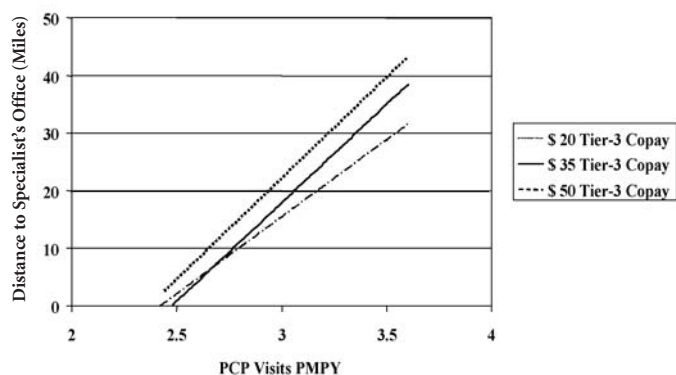
macy copayment, tier-2 pharmacy copayment, tier-3 pharmacy copayment, and distance in miles from the member's home address to PCP and SCP offices. Distance was measured using the Ingenix, GeoAccess GeoNetworks system. Distance, while perhaps the best measure available, is imperfect because of provider selection based on proximity to work or school rather than residence. Differential slopes are included for office visit copayment and coinsurance payment, as well as tier-1, tier-2, and tier-3 pharmacy copayments. Differential intercepts are also included for member cohorts whose copayment or travel distance changed from 2002 to 2003 by benefit category.

Z is an array of control variables that includes age, gender, the diagnostic cost group (DxCg) prospective relative risk score, and member geographical region of residence. The DxCg score represents the next year's expected total health care expenditures and is commonly used for risk adjustment and predictive modeling.²⁵ Copayment and coinsurance are measures of price representing the out-of-pocket expenditures incurred by the member for the purchase of the benefit product or service. Price effects are measured only by differential coefficients, denoted by D , because they reflect the change in utilization or expenditures associated with the price change as well as the member cohorts that experienced a price change, denoted by g .

We used this empirical model to test the hypothesis that the demand for physician office visits and prescription drugs is related by complementarity or substitutability, which are cross-

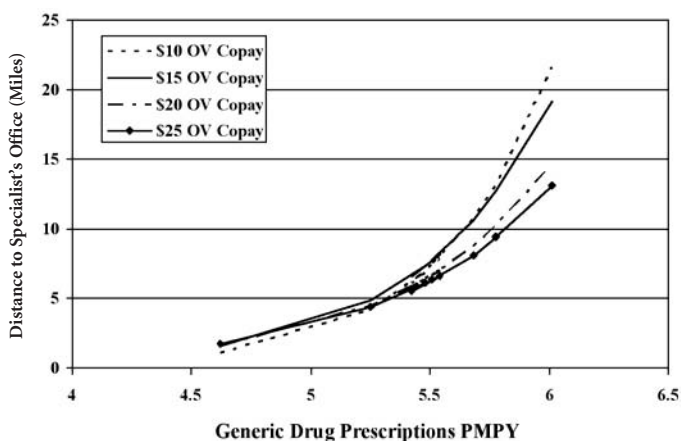
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FIGURE 2 Demand for PCP Visits as a Function of Tier-3 Copayment and Distance to a Specialist's Visit



PCP=primary care physician; PMPY=per member per year.

FIGURE 3 Demand for Generic Drug Prescriptions as a Function of Office Visit Copayment and Distance to a Specialist's Office



OV=office visit; PMPY=per member per year.

exists between benefit categories on the basis of price and time costs. Therefore, we were not concerned with a specific drug, drug class, or disease state, but with the benefit categories themselves as defined by price (copayment and coinsurance) and distance.

Results

Mas-Colell et al. graphically analyzed the demand for a product as a function of its price and the price of a related product.²⁶ Their simple illustration clearly shows the importance of understanding the role of cross-price information, although it does not address any of the technical methodological aspects of such an analysis. Similar simple illustrations are represented in Figures 2 and 3. Figure 2 shows the best-fit lines from a 2-variable linear regression between the distance traveled to the SCP's office—in this case, an opportunity cost—and the PCP's office visits PMPY. There is a separate regression line for each tier-3 prescription copayment level in the study sample. The Chow test demonstrates that the plotted regressions are different ($F = 7.574$, $F_{(2,25)} = 5.57$, $\beta = 0.01$). The adjusted R^2 (coefficient of determination) is 0.86 for the \$20.00 copayment, 0.98 for the \$35.00 copayment, 0.85 for the \$50.00 copayment, and 0.84 for the pooled regression. Figure 3 shows the best-fit lines from a 2-variable regression where x = tier-1 prescriptions PMPY and y = the distance to the specialist's office. Separate best-fit lines are plotted for each office visit copayment level. The Chow test also shows that the models are different ($F = 16.856$, $F_{(2,34)} = 5.26$, $\beta = 0.01$). The adjusted R^2 s are 0.91, 0.97, 0.88, and 0.79 for the \$10.00, \$15.00, \$20.00, and \$25.00 copayments, respectively, and 0.71 for the pooled regression. Figure 2 demonstrates prices or costs for 2 different products and their relationship to yet a third product, the PCP office visit. Figure 3 also depicts prices or costs for 2 different products and their relationship to a third product, tier-1 prescriptions.

The study sample included 44,828 commercially insured members from 2002 who were monitored for 12 months in calendar year 2003 after benefit categories were changed. Table 1 reports the sample size of the study population cohorts who had copayment or distance changes as well as the average amount of change for each affected benefit level. Of the 44,828 members, 11.3% (5,066) had coinsurance cost-sharing requirements: 10.4% had coinsurance alone, while 0.9% had both coinsurance and fixed copayments.

Descriptive statistics for the study population are shown in Table 2. All variables except the distance to a specialist's office and sample size were significantly different in 2003 compared with 2002. Control variables were used to account for observable differences in member characteristics. We controlled for differences between members associated with residence by geographical region of the state, age, gender, and expected health care costs via the DxCG score. Other differences between members were not observed including income, race, and educational level, among others.

price elasticities with opposite signs. Our hypothesis would be rejected if, for all models, no cross-price elasticities were significant (results for own-price and cross-price elasticities are shown in Table 4). Our a priori significance level was $P < 0.05$. Since a physician visit is not required to provide a new prescription drug to an established patient, physician visits did not need to be eliminated from the data set to accommodate the measure of cross-price elasticity. Rather, eliminating office visits under such a scenario would reduce the ability to identify complementarity between office visits and prescription drugs where it existed. The focus of our study was to determine whether a relationship

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The LSDV regression utilization model results are shown in Table 4. The differential study variables demonstrate the price–quantity/price–expenditure relationship within members both before and after a price change, thus measuring the effects of the price change that occurred on January 1, 2003, when the payment increase went into effect. Because office visit coinsurance was used in only 11.3% of the study population and did not show significant variation, it was dropped from all models. The OV benefit design was exactly the same for both PCPs and SCPs in both 2002 and 2003, which prevented using office visit copayment as a means of identifying the relationship between primary care visits and specialist visits, as no cross-price elasticity can be determined.

Distance Effects

We anticipated using distance as a proxy for the time cost of an office visit. Our a priori assumption was that distance would be inversely related to the number of visits. However, we found that distance was directly related to the number of office visits. Positive distance elasticities for office visits may represent the consumer's perception of value and perhaps quality—as the distance to a physician's office increases, the value of the physician's services is perceived to be greater. While not implying that we have tested this assumption, Table 5 presents the number of office visits by quintile of distance for both PCPs and SCPs and demonstrates that office visits generally increased with distance. When the distance to a PCP office visit was lower (i.e., perhaps the perceived value of a PCP office visit was less), an increased number of SCP office visits were used. When the distance to an SCP office was higher (the perceived value was greater), an increased number of SCP office visits were used. As shown in Table 4, all significant distance elasticities are positive, indicating that a greater travel distance is associated with an increase in office visit utilization/expenditures or pharmacy utilization/expenditures.

Price Effects

Table 4 illustrates the price elasticity results for all models. Price elasticity values are expressed as the change in the quantity demanded from a 1% increase in price. The PCP office-visit model displayed a significant negative cross-price elasticity for tier-1 prescriptions, indicating that tier-1 drugs are a complement to PCP visits. A 1% increase in the tier-1 copayment was associated with a 0.118% decrease in PCP office visits. Tier-1 and tier-3 prescription drugs showed significant positive cross-price elasticities for SPC office visits, indicating that these drugs are substitutes for SCP visits. A 1% increase in tier-1 copayments was associated with a 0.18% increase in SCP office visits, while a 1% increase in tier-3 copayments was associated with a 0.12% increase in SCP office visits. Tier-2 drugs are a substitute for tier-1 drugs, while tier-3 drugs are a complement to tier-1 drugs. A 1% increase in tier-2 copayments was associated with a 0.4% increase in tier-1 prescriptions, while a 1% increase in tier-3

TABLE 5 Relationship Between Average Frequency of Office Visits and Average Distance in Miles

Distance Quintile*	PCP Distance	PCP Visits PMPY	SCP Distance	SCP Visits PMPY
1	1.61	3.41	3.00	3.80
2	3.91	3.55	7.01	4.52
3	6.63	3.56	11.74	4.73
4	10.61	3.52	21.12	4.72
5	25.99	3.70	74.57	5.00

* $n=8,966$ in each quintile.

PCP=primary care physician; PMPY=per member per year;

SCP=specialty care physician.

copayments was associated with a 0.53% decrease in tier-1 use.

Office visits were shown to be a complement to tier-2 prescription drugs, with a 1% increase in office visit copayments associated with a 0.1% decrease in tier-2 prescription drug use. Tier-2 prescription drugs are a complement to tier-3 drugs; a 1% increase in tier-2 copayments was associated with a 0.23% decrease in tier-3 drug use. Higher tier-1 and tier 2 copayments were associated with lower PCP expenditures (complement), while higher tier-3 copayments were associated with higher PCP expenditures (substitute). Higher tier-1 and tier-3 copayments were associated with higher SCP expenditures (substitute), while higher tier-2 copayments were associated with lower SCP expenditures (complement). Higher tier-1 and tier-3 copayments were associated with higher tier-2 expenditures, suggesting that tier-2 drugs are a substitute for both tier-1 and tier-3 prescription drugs. Neither tier-1 nor tier-3 expenditures showed significant cross-price elasticities. Own-price elasticities were significant for all prescription drug expenditures and tier-3 prescription drug utilization. Increased office visit and tier-2 copayments were associated with lower total plan-paid expenditures.

Discussion

Our study adds to the current literature on pharmacy benefit design by determining that a significant relationship exists between physician office visit utilization and prescription drug purchases on the basis of cost sharing and that the distance to a physician's office is directly, not inversely, related to the number of office visits utilized. Our data reflect consumer preferences for particular aspects of the 5 most common products or services paid for by health insurance companies. These results compare with numerous previous studies that also found own-price elasticities for both physician services and prescription drug use based on cost sharing that fell within the same statistical ranges as those from our study. Acton²⁷ and Coffey²⁸ investigated distance and time elasticities, respectively, with respect to physician office visits, and their results also give credence to our conclusions (discussed below).

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When uncertain, price or cost can be a signal of quality to consumers.²⁹ Historically, there has been a lack of market information about the quality of health care providers, leading to consumer uncertainty regarding the purchase decision. When the price factor remains constant due to fixed office visit copayments, the distance to a physician's office may be a proxy for the perceived quality of services. Our results demonstrated that office visit and prescription drug benefits are related by copayment and distance elasticity. All prescription drug use was higher when the distance to a specialist was greater.

The price increase was related to behavioral changes in members. Tier-2 prescription utilization and total expenditures decreased when the office visit copayment amount increased; thus, tier-2 prescriptions are a complement to office visits. These price effects occurred following significant benefit price changes, suggesting that office visit copayments could be a significant factor in predicting prescription drug use. Based on the positive cross-price elasticities of PCP and SCP expenditures and SCP utilization, tier-3 prescriptions can be seen as a substitute for office visits. A prescription drug is frequently an output of a physician office visit. In our study, that output was likely to be a tier-1 or tier-2 prescription for PCP office visits or a tier-2 prescription for SCP office visits. A prescription drug is also frequently the output of a telephone call to the physician rather than the result of an office visit; in our study, that output was likely to be a tier-1 or tier-3 prescription. By reducing the need for an office visit, the phone call created the opportunity for a prescription drug to substitute for an office visit.

By studying nonmonetary factors in health care demand, Acton reported positive distance elasticities for physician office visits.²⁷ He imputed distance by travel mode, which was modeled using dummy variables. Concerning physician office visits, Acton concluded that those who walked to the physician's office (least distance) demanded the fewest visits and those who traveled by bus, subway, or taxi had similar demand levels. One reasonable interpretation of Acton's findings is that those who travel further for physician office visits demand relatively more visits, which is comparable with the findings in our study.

Coffey investigated the role of time elasticities in the initial demand for physician office visits and choice of provider, finding that a high expected time cost had a negative effect on both the choice of provider and initiation of the demand for provider office visits but did not influence the number of visits demanded once care had been established.²⁸ Coffey did not report distance elasticities; however, both Acton and Coffey justified their findings by proposing that, as out-of-pocket costs declined, factors other than price became more important in the purchase decision. Acton's analysis was published in 1975 and Coffey's in 1983, when the average out-of-pocket share of personal health care expenditures was 33% and 25%, respectively, and 75% and 60% for prescription drugs, respectively. In 2004, the average out-of-pocket share of personal health care expen-

ditures was 15.1%; it was 24.9% for prescription drugs.¹

Cost sharing in the health insurance benefit design has previously been reported to have an effect on physician service utilization. Rosett and Huang aggregated physician and hospital service together as medical care and reported the price elasticity for medical care as ranging from -0.35 to -1.5.³⁰ Fuchs and Kramer reported price elasticities for physician services of -0.1 to -0.36.³¹ Phelps and Newhouse⁷ reported an arc price elasticity of demand for physician visits of -0.137. Manning et al. reported price elasticities in the -0.1 to -0.2 range.¹⁰ Wedig reported elasticities of -.032 to -0.16, depending on whether the model was use/nonuse or conditional on use.³² Our study reported office visit own-price elasticities of -0.081 and -0.076 for expenditures and -0.067 for utilization, results that are slightly smaller but similar to the other estimates discussed above.

Important distinctions among these previous studies are the price measure, the level of utilization aggregation or expenditures, and the time periods studied. Wedig was not able to observe the prices in effect for those who did not utilize the service.³² Rosett and Huang did not use direct measures of price and use.³⁰ Fuchs and Kramer used the average and net prices of those who utilized the services; nonutilizers did not know the price, that is, their decision not to purchase was not based on the monetary price.³¹ In our study, price was observable for both the utilizing and nonutilizing population segments.

The nature of the price measures in the above-mentioned studies included coinsurance rates and out-of-pocket costs measured as a ratio of total care received, in addition to average rates based on aggregates or estimates. A copayment price measure is a more explicit price signal than coinsurance. Coinsurance in the current market is a percentage of a negotiated fee schedule. However, in some of the previous studies, coinsurance was applied to a usual and customary fee and, in at least one instance, to a discounted usual and customary fee. Because there is more explicit price information revealed in the copayment fee, it is possible that the cost signal to the consumer could result in a different price effect.

Contoyannis investigated the price elasticity for prescription drugs, reporting elasticities between -0.12 and -0.14.³³ The RAND Health Insurance Experiment found the elasticity for prescription drug expenditures to be -0.27.⁸ Coulson estimated the price elasticity of prescription drug use in low-income Pennsylvanians at -0.34.³⁴ Harris reported a price elasticity pertaining to all prescription drug use of -0.11 following copayment increases.³⁵ Hughes reported both long- (-0.37) and short-term (-0.32) elasticities of prescription drug use following a copayment change.³⁶ Johnson reported that the price elasticity of prescription drug use varied from -0.01 for copayments between \$1.00 and \$3.00 to -0.12 for copayments between \$3.00 and \$5.00 but stated that there were no differences in physician office visit utilization or hospitalizations.³⁷ Smith reported cross-sectional price elasticity for the number of size-

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adjusted prescriptions at -0.098 .³⁸ The previous studies did not separate prescription drugs by benefit tier. Meissner et al. studied the effect of rising copayment levels on the use of low-sedating antihistamines and nasal steroids and found that the arc price (own-price) elasticity of demand was 0.39 and -0.22 , respectively.³⁹ The Meissner results are different in sign (\pm) but similar in magnitude to the own-price elasticities reported in our study. Important methodological differences exist between our study and Meissner's that could account for the differences observed, including the bases of the price-elasticity estimate models, the inclusion of cross-prices, and distance information.

Limitations

A limitation of the fixed-effects model is that interpretation of the results is conditional. A lack of segregation in the copayment amount between PCP and SCP office visits limited our ability to identify the precise nature of the cross-price relationship, thereby resulting in an ambiguous result. It also seems unlikely that this consumer bundle of 5 products and services, the 5 most common products and services paid for by health insurance companies, fully represented the average medical care bundle; the presence of other products or services in the analysis, such as OTC drugs and emergency room visits, could yield a different interpretation of results or different results. Income, education, and race were not considered in this study. The role of Internet-mediated health information was not available nor considered in this study and may be a substitute for physician office visits for information seekers.^{40,41} We also used pharmacy claims rather than days supply as the measure of pharmacy utilization and did not investigate the possible effect of mail-service pharmacy in 2003 versus 2002.

Conclusions

The results of the present study support our hypothesis that a relationship exists between the use of physician office visits and the type/tier of prescription medication purchased based on expenditure and travel-time factors. A 1% increase in the office visit copayment was associated with a 0.105% reduction in the use of tier-2 drugs. A 1% increase in tier-1 pharmacy benefit copayments was associated with lower PCP office visits and expenditures and higher SCP office visits and expenditures. An increase in the tier-2 pharmacy benefit copayments was associated with lower PCP and SCP expenditures; an increase in the tier-3 copayment was associated with higher PCP and SCP expenditures as well as SCP office visit utilization. The principal health plan policy implications of our research are that medical benefits and pharmacy benefits are more likely to be optimally managed in concert rather than as 2 independent benefits. When pharmacy benefits are incorporated into the management of other medical services (office visits), it is then possible to consider and adapt to cross-price effects. Further investigations of complementarity and substitutability that contain a broader variance

in price changes for the bundle of products and services in our analysis could be clarifying for the health insurance industry.

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