
Physician Reaction to Price Changes: An Episode-of-Care Analysis

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Physicians may respond to fee reductions in a variety of ways. This episode-of-care analysis examines the impact of surgical fee reductions (mandated by the Omnibus Budget Reconciliation Acts [OBRA] of 1986-87) on the overall pattern and cost of health care services provided in association with the surgical procedure itself. The study focuses on six procedure groups: cataract extractions; total hip replacement; total knee replacement; coronary artery bypass graft (CABG) surgery; upper gastrointestinal (GI) endoscopy; and prostatectomy. Only two of these procedures give significant evidence for the existence of a service volume offset to the fee reductions.

INTRODUCTION

For nearly 25 years, Medicare has reimbursed physicians by using the customary, prevailing, and reasonable (CPR) methodology, which calculates payment rates from current and historical charge patterns in local geographic areas. As part of OBRA 1989, however, Congress fundamentally altered the method of physician payment under Medicare. A fee schedule is replacing the CPR methodology with a fixed fee per service, regardless of historical charges. The fees themselves, furthermore, are based on the resource-based relative value scale (RBRVS) developed by Hsiao and colleagues (1988) and refined by the Physician Payment Review Commission (PPRC) (1989) and HCFA.

The Medicare fee schedule (MFS) redresses a major perceived inequity in the current Medicare payment system—namely, that the CPR methodology “overpays” technical procedures like surgery and “underpays” other services such as office visits. By basing payments on relative work effort, the MFS increases most fees for visits and lowers fees for many surgeries and diagnostic tests. The implications of this change for physicians’ Medicare revenues are substantial. Simulations performed by HCFA have shown substantial declines for surgeons and radiologists, with corresponding increases for general and family practitioners (*Federal Register*, 1991). Little is known, however, about how physicians will respond to the new fee schedule. Of particular concern is how surgeons will respond to the payment reductions, which can be as high as 35 percent for some procedures. Will surgeons see fewer Medicare patients, or stop treating them altogether? Or will surgeons provide even more procedures in order to maintain target incomes? Or will beneficiaries themselves demand more procedures in response to the price cuts? The answers to these questions have important implications for both beneficiary access and program outlays.

Previous research suggests that fee freezes or outright fee reductions may lead to increased program costs. Gabel and Rice (1985) summarized the evidence from natural experiments involving such fee changes and concluded that physicians responded by increasing the quantity provided (including more surgery). In a

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recent reanalysis of data from one of the studies reviewed (Rice and McCall, 1982), the U.S. Congressional Budget Office (1989) concluded that physicians faced with fee reductions would “make up” at least one-half of the revenue loss through volume increases.

These natural experiments are limited in their ability to disentangle patient-induced demand from physician-induced demand as alternative responses to fee reductions. Nevertheless, the availability of supplemental coverage for most Medicare beneficiaries would seem to attenuate (if not eliminate) patient demand as an important factor. Econometric studies, furthermore, have found clear evidence of inducement in the case of surgery (Cromwell and Mitchell, 1986; Fuchs, 1978). Evidence for inducement in the case of office visits (McCarthy, 1985; Wilensky and Rossiter, 1981) is less clear.

In addition, previous research has generally examined physician responses either to fee freezes or to relatively small payment reductions. Under the MFS, reductions for many high-volume Medicare operations will be on the order of 20-30 percent. Knowing how physicians respond to cuts of this magnitude will help policymakers estimate future program outlays. The MFS itself will not be fully implemented for some time. Phase-in began in January 1992, but implementation will not be completed until January 1996. However, payment reductions for “overpriced” procedures that took effect in 1987 and 1988 provide a convenient opportunity to study physician reactions to fee reductions.

As part of OBRA 1986, prevailing charges for cataract surgery were reduced 10 percent, subject to a 75-percent floor (i.e., no charge could be reduced to less than 75 percent of the national average

prevailing charge). This “overvalued” procedure fee reduction went into effect on January 1, 1987. In OBRA 1987, Congress introduced a more sophisticated approach—reducing prevailing charges disproportionately more in high-fee areas—and applied it to a much larger group of procedures. Those procedures included total hip replacement, total knee replacement, knee arthroscopy, bronchoscopy, pacemaker insertion, CABG surgery, upper GI endoscopy, transurethral and suprapubic prostatectomy, dilation and curettage of uterus, carpal tunnel release, and (again) cataract surgery. Prevailing charges for these procedures did not receive the 1988 Medicare Economic Index update; instead, 1987 prevailing charges were reduced by 2 percent. A sliding scale formula was then applied that further reduced each charge, based on its relationship with the national average. The higher the area prevailing charge relative to the national prevailing charge, the greater the reduction made to the area prevailing charge (with a maximum possible reduction of 15 percent). In no case was an area prevailing charge allowed to fall below a floor that was set at 85 percent of the national average. These reductions went into effect on April 1, 1988.

The result of the OBRA 1987 formula was a potentially wide range in the size of the payment reductions across the country. The size of the reductions varied across geographic areas, specialties, the procedures themselves, and even individual physicians performing the same procedure in the same area. This last occurs to the extent that allowed charges are not all at the prevailing charge. Thus, the cross-sectional variation in fee reduction impacts can be used to evaluate physician responses from what would otherwise be a simple pre-post design.

ANALYTIC APPROACH

Physicians may respond to fee reductions in a variety of ways. The potential for an increase in procedure volume has received the greatest attention. Physicians, however, may also respond in other ways that similarly lead to increased outlays. Examples include the greater use of surgical assistance, more testing, provision of more "incidental" procedures, and fragmentation of billings. In order to investigate the importance of such "offsetting" effects, this episode-of-care analysis examines the impact of the surgical fee reductions on the overall pattern and cost of health care services provided in association with the surgical procedures themselves.

This article, nonetheless, is not intended to generate a "bottom line" offset estimate as appropriate for Medicare payment policy purposes.¹ Rather, we sought to answer a much narrower question—namely, whether physicians responded to the OBRA price reductions, at least in part, by providing more services as part of the surgical episode itself. We did not investigate the many other ways in which physicians might also have recouped Medicare fee reductions.

Our analytic approach is essentially cross-tabular or descriptive in nature. It basically implements the standard four-way quasi-experimental evaluation design, looking at the trend differences between "treatment" and "control" areas. Although analytically primitive, such methodology has nevertheless proved to be a reasonably dependable alternative for distinguishing "experimental" effects in other settings. While a serious econometric investigation is not conducted, the available data are also used to conduct a simple multivariate test,

one which clearly supports and substantially validates the findings obtained from tabular comparisons.

Due to the difficulty and expense of constructing episode-of-care records, the episode-of-care study was limited to six procedure groups judged to be broadly representative of the larger universe impacted by OBRA 1986 and 1987:

- Cataract extractions.
- Total hip replacement.
- Total knee replacement.
- CABG surgery.
- Upper GI endoscopy.
- Prostatectomy.

HCFA's 5-percent Part B Medicare Annual Data files were used to construct episode-of-care records for overvalued procedures in 4 years, 1986-89. The data for each "index" procedure (i.e., a procedure impacted by the fee reduction) were organized into three observational periods:

- Period I—the 30-day interval prior to surgery.
- Period II—the day of surgery (plus the hospital claim, if any).
- Period III—the 90-day interval subsequent to surgery.

In addition, a fourth observational interval (Period IV) was defined as being the entire study interval, accumulating experience for Periods I, II and III. In order to avoid undue complexity, anyone dying before the end of the observational period was excluded. Furthermore, in order to have a complete baseline and followup information, index procedures performed in the first 30 days and last 90 days of each year were excluded.

In order to distinguish potential "treatment effects," the 1986-89 changes in the content of the surgical "episodes" are analyzed in three groups. These groups are designed to reflect varying price impacts—

¹The PPRC (1993), however, has sought to do this. Using individual physician practice data, they estimate that surgeons offset more than one-half of the OBRA 1987 reductions.

Table 1
Procedure Group Sample Sizes, by Payment Reduction Impact Category

Procedure Group	Payment Reduction Impact Category					
	High		Medium		Low	
	1987 ¹	1989	1987 ¹	1989	1987 ¹	1989
Cataract Extraction	8,526	9,012	9,322	11,036	8,252	9,277
Total Hip Replacement	745	700	737	732	697	684
Total Knee Replacement	666	776	682	776	690	848
CABG Surgery	961	1,090	943	1,192	943	1,098
Upper GI Endoscopy	6,861	7,846	6,255	6,278	6,683	8,246
Prostatectomy	2,784	2,370	2,487	2,173	2,770	2,527

¹For cataract extraction, base year is 1986.

NOTES: CABG is coronary artery bypass graft. GI is gastrointestinal. The high payment-reduction group includes the one-third of carriers with the highest percentage price decreases (or the lowest percentage price increases). The low payment-reduction group includes the one-third of carriers with the lowest percentage price decreases (or the highest percentage price increases). The medium payment-reduction group includes the middle one-third of carriers.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-1989.

“low,” “medium,” and “high” price changes—and were defined from each carrier’s average change in the allowed charge for a given procedure.

For each procedure group except cataracts, we arrayed the carriers (including only those carriers with 10 or more procedures in each year) in order of the average percentage change in allowed charge between 1987 and late 1988, which is the average percentage “price” change associated with implementation of OBRA 1987. For cataracts, we used a longer interval, arraying carriers in order of the average percentage change in allowed charge between 1986 and late 1988. This longer interval reflects the cumulative “price” change associated with the dual implementation of OBRA 1986-87. For each procedure group, a high-impact group was defined to include those carriers with the highest percentage price decreases (or, equivalently, the lowest percentage price increases), accounting for approximately one-third of the procedures included in the study. For each procedure group, a low-impact group was analogously taken as being those carriers with the lowest percentage payment reduction (i.e., the highest percentage price increases), accounting for another one-third of study

procedures. Finally, those carriers accounting for the remaining one-third of the procedures were considered to constitute the medium-impact group. This design gave approximately equal numbers of procedures in each of three analytic groups, which helps to avoid mistaken inference due to disproportionate and small sample sizes. The sample sizes are indicated in Table 1, and the average percentage price changes are shown in Table 2.

The three analytic groups—high, medium, and low price reductions—basically reflect varying intensity of the treatment effects, but do so differently for each of the six procedure groups. For example, there is an 11-percentage-point difference in the price changes between the high- and low-payment-reduction groups for cataracts, but a difference of only 5 percentage points for prostatectomy.

With the exception of prostatectomy, the percentage magnitude of payment reductions in the high-impact category are surprisingly similar. The payment reduction for prostatectomy is only 3 percent, whereas payment reductions range from 7-8 percent for the others. The payment trends for the low-impact category are even more similar. For all six surgical procedures, the allowable reimbursement

Table 2
Average Percentage Price Changes, by Payment Reduction Impact Category: 1987-88¹

Procedure Group	Payment Reduction Impact Category			
	Entire Sample	High	Medium	Low
Cataract Extraction	-2.9	-8.2	-2.9	2.3
Total Hip Replacement	-1.8	-6.8	-1.8	3.3
Total Knee Replacement	-2.7	-6.7	-2.5	1.1
CABG Surgery	-2.5	-7.1	-3.2	2.8
Upper GI Endoscopy	-1.7	-6.5	-1.0	2.5
Prostatectomy	-0.5	-3.4	0.5	1.7

¹For cataract extraction, base year is 1986.

NOTES: CABG is coronary artery bypass graft. GI is gastrointestinal. The high payment-reduction group includes the one-third of carriers with the highest percentage price decreases (or the lowest percentage price increases). The low payment-reduction group includes the one-third of carriers with the lowest percentage price decreases (or the highest percentage price increases). The medium payment-reduction group includes the middle one-third of carriers.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-1989.

levels for lesser impacted carriers actually increased, although the increases were only 1-3 percent.

Whereas the payment reduction categories were defined from price changes for the 1987-88 and 1986-88 intervals (for non-cataract and cataract procedures, respectively), the observational intervals have been expanded to include 1989 for purposes of impact assessment. The estimated effects of the fee reduction are much greater and more dramatic when an additional year is allowed in distinguishing provider responses to the fee reductions. This implies that provider behavior does not adapt fully to reimbursement rate changes on a contemporaneous or same-year basis.

VARIABLE DEFINITIONS

For purposes of expositional efficiency, only a limited number of variables are defined and reported in this article. In conducting the episode-of-care study, however, we actually constructed and analyzed a much larger number of variables. On a selective basis, some of these additional findings will be noted in our discussion of study results.

For each of the six procedure groups included in the episode-of-care analysis, Tables 3-8 provide the following information by payment reduction category:

- (1) *Allowed Charges for the Index Procedure*—Percent change in charges allowed for the surgery itself.
- (2) *Volume of Index Procedures*—Percent change in the number of index surgeries performed.
- (3) *Surgical Assistance*—Percent change in the proportion of index surgeries involving surgical assistance.
- (4) *Additional Surgery*—Percent change in the proportion of index surgeries involving an additional surgical procedure, performed incidental to the index surgery by the same surgical provider.
- (5) *Period III Surgery*—Percent change in the proportion of index cases with another surgery by the index surgeon during the 90-day followup interval.
- (6) *Allowed Charges for Surgical Provider (Excluding Index Procedure)²*—Percent change in “all other” charges allowed for the index surgeon during the various observational intervals (i.e., Periods I, II, III, and IV). This represents changes in total episode payments to the surgical provider for services in addition to the index surgery itself.

²Unique Provider Identification Numbers (UPINs) were not available from our data. Thus, the “surgical provider,” as defined in this article, could either be a solo practice or a physician group. This inherent ambiguity was one reason for pursuing an episode-of-care analysis, inasmuch as the entire universe of services is monitored (independent of provider organization).

- (7) *Allowed Charges for All Other Physicians for the Entire Episode*—Percent change in charges allowed for physicians, except the index surgeon, during the entire 121-day observational interval (i.e., Periods I, II and III).
- (8) *Allowed Charges for All Part B Services for the Entire Episode (Excluding Index Procedure)*—Percent change in all physician charges allowed, for services other than the index procedure, during the entire 121-day observational interval.
- (9) *Relative Value Unit (RVU) Weights for Surgical Provider (Excluding Index Procedure)*—Same as variable (6), but service intensity is weighted by the RVU scale.
- (10) *RVU Weights for All Other Physicians for the Entire Episode*—Same as variable (7), but service intensity is weighted by the RVU scale.
- (11) *RVU Weights for All Part B Services for the Entire Episode (Excluding Index Procedure)*—Same as variable (8), but service intensity is weighted by the RVU scale.

Inasmuch as the same RVU price weights are used in all years, the changes indicated from variables (9), (10), and (11) reflect only changes in the “quantity” of services provided. The RVU-weighted comparisons essentially eliminate variation attributable to changing reimbursement rates for non-index procedures. Given the short time intervals involved in this investigation, one can reasonably assume that such price changes are exogenous to the intervention being evaluated.

PROCEDURE-SPECIFIC RESULTS

For each procedure group, we report and discuss the potential impact of fee reductions on the previously defined variables. In

reviewing these results, we emphasize the RVU-weighted results for variables (9), (10), and (11). We do so for the reason that, in 1987 (or 1986, in the case of cataracts), the average reimbursement rates paid for non-index procedures by carriers in the low-impact category were considerably lower than those paid by carriers in the high-impact category. Over the 2- or 3-year study interval (i.e., 1987-89 or 1986-89), the reimbursement rates for non-index procedures have tended to equilibrate across carriers. This pricing trend, which is believed to be substantially exogenous and independent, tends to obscure the impact of the overvalued procedure reductions on physician practice patterns. The RVU-weighted results avoid this difficulty and basically eliminate “noise” in the analytic comparisons. We consider now the results for each surgical procedure group included in this study, beginning with cataract extractions.

Cataract Extractions

As shown in Table 3, the average allowed charge for the high-impact group declined 7.3 percent over the 1986-89 interval, compared with a 2.4-percent increase for the low-impact group. Comparing these two extremes, Table 3 gives substantial evidence for the existence of a volume offset to the surgical fee reductions:

- The incidence of surgical assistance decreases proportionately less for the high-impact group.³
- The rate of increase in additional surgical procedures performed on the same date as the index procedure is greater for the high-impact group.

³The percentage-point decrease in surgical assistance was actually the same for the two groups. This occurred because the base-year incidence of surgical assistance was considerably greater in the high-impact group (18.0 percent) compared with the low-impact group (5.6 percent). Other findings reported are not similarly confounded by such dramatic disparities in the base-period levels.

Table 3
Episode-of-Care Summary for Cataract Extraction: 1986-89

Variable	Payment Reduction Impact Category		
	High	Medium	Low
		Percent Change	
(1) Allowed Charges for Index Procedure	-7.28	-1.35	2.41
(2) Volume of Index Procedures	5.7	18.4	12.4
(3) Surgical Assistance	-20.8	-45.0	-67.3
(4) Additional Surgery	29.4	6.4	2.7
(5) Period III Surgery	34.2	34.7	14.8
(6) Allowed Charges for Surgical Provider (Excluding Index Procedure):			
Period I	-5.5	8.6	-5.5
Period II	-11.6	-10.0	-22.7
Period III	31.3	33.6	5.4
Total Episode	9.5	17.3	-3.5
(7) Allowed Charges for All Other Physicians for the Entire Episode	3.6	31.2	22.8
(8) Allowed Charges for All Part B Services for the Entire Episode (Excluding Index Procedure)	15.0	31.4	16.0
(9) RVU Weights for Surgical Provider (Excluding Index Procedure):			
Period I	11.8	29.7	14.1
Period II	5.9	-7.0	-25.4
Period III	31.9	34.0	3.9
Total Episode	18.7	23.9	0.6
(10) RVU Weights for All Other Physicians for the Entire Episode	0.9	19.2	10.3
(11) RVU Weights for All Part B Services for the Entire Episode (Excluding Index Procedure)	13.9	25.0	9.9

NOTES: RVU is relative value unit. The high payment-reduction group includes the one-third of carriers with the highest percentage price decreases (or the lowest percentage price increases). The low payment-reduction group includes the one-third of carriers with the lowest percentage price decreases (or the highest percentage price increases). The medium payment-reduction group includes the middle one-third of carriers. Period I is the 30-day interval prior to surgery. Period II is the day of the surgery. Period III is the 90-day interval subsequent to surgery.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

- The rate of increase in procedures performed during the 90-day followup period is greater for the high-impact group.
- Total allowed charges for the surgical provider, for the entire episode, are 9.5 percent higher for the high-impact group, compared with a 3.5-percent decrease for the low-impact group.

The medium-impact group, although not experiencing the same degree of price reduction, nevertheless exhibits behavior similar to the high-impact group. In particular, total episode charges for surgical providers in the medium-impact group were increased by 17 percent, relative, again, to the 3.5-percent decrease for the low-impact group.

The total allowed charges for all physicians, tabulated in variable (8), give less

consistent evidence for an offset. Total allowed charges, excluding the index procedure, were increased by 15 percent for the high-impact group, 31 percent for the medium-impact group, and 16 percent for the low-impact group. While interesting, these results are less useful and potentially misleading for assessing the impact of the fee reduction. Although the allowed charges for other physicians in variable (8) have increased more for the low-impact group, it is difficult to posit a behavioral mechanism that would have produced substitution of that magnitude, and especially to observe such response so soon after the fee reductions. We believe that this pattern is largely attributable to a regression-to-the-mean phenomenon, with both reimbursement prices and service intensities in the low-impact group rising over time to

Table 4
Episode-of-Care Summary for Total Hip Replacement: 1987-89

Variable	Payment Reduction Impact Category		
	High	Medium	Low
		Percent Change	
(1) Allowed Charges for Index Procedure	-5.30	-1.38	4.89
(2) Volume of Index Procedures	-6.0	-0.7	-1.9
(3) Surgical Assistance	-3.7	9.8	-8.9
(4) Additional Surgery	28.3	15.8	-3.5
(5) Period III Surgery	-13.8	-5.3	34.5
(6) Allowed Charges for Surgical Provider (Excluding Index Procedure):			
Period I	-20.5	17.5	-3.5
Period II	20.9	-2.9	10.7
Period III	22.8	16.7	17.4
Total Episode	11.6	7.6	10.1
(7) Allowed Charges for All Other Physicians for the Entire Episode	0.2	16.3	11.6
(8) Allowed Charges for All Part B Services for the Entire Episode (Excluding Index Procedure)	6.9	10.5	15.8
(9) RVU Weights for Surgical Provider (Excluding Index Procedure):			
Period I	-25.2	4.1	-7.2
Period II	18.8	-5.7	4.0
Period III	16.7	20.8	15.0
Total Episode	8.8	5.4	5.7
(10) RVU Weights for All Other Physicians for the Entire Episode	-1.2	15.0	13.7
(11) RVU Weights for All Part B Services for the Entire Episode (Excluding Index Procedure)	8.5	12.9	16.0

NOTES: RVU is relative value unit. The high payment-reduction group includes the one-third of carriers with the highest percentage price decreases (or the lowest percentage price increases). The low payment-reduction group includes the one-third of carriers with the lowest percentage price decreases (or the highest percentage price increases). The medium payment-reduction group includes the middle one-third of carriers. Period I is the 30-day interval prior to surgery. Period II is the day of the surgery. Period III is the 90-day interval subsequent to surgery.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

the levels in the high-impact group. Our analysis of changes in practice behavior gives no indication that index providers in the high-impact group are merely substituting for other physicians. With regard to cataracts, for example, the additional procedures being performed by the index ophthalmologist are not ones that other, non-ophthalmologic physicians would provide.

The RVU-weighted variables—(9), (10), and (11)—indicate the same basic pattern, albeit even more dramatically. For the surgical providers, the total episode results in (9) indicate an 18-percentage-point differential between the rates of service intensity change in the high- and low-impact groups. Again, a somewhat larger differential is shown between the medium- and low-impact groups.

The rates of change in index procedure volume in (2) show a lower rate of increase in volume for the high-impact group, compared with the low-impact group (5.7 percent versus 12.4 percent). Much the same pattern was found for the other five procedure groups included in the episode-of-care study. However, because the assessment of volume effects was not the express interest of this study, such results are not emphasized.

While not shown in Table 3, additional results show that the average RVU weight for cataract procedures increased only 2-3 percent over the 1986-89 interval. Thus, we find little indication of procedure upcoding. The average RVU values for the other five procedure groups indicated even less meaningful changes.

Table 5
Episode-of-Care Summary for Total Knee Replacement: 1987-89

Variable	Payment Reduction Impact Category		
	High	Medium	Low
		Percent Change	
(1) Allowed Charges for Index Procedure	-4.41	-1.05	1.65
(2) Volume of Index Procedures	16.5	13.8	22.9
(3) Surgical Assistance	1.8	16.5	11.7
(4) Additional Surgery	-1.4	17.2	68.2
(5) Period III Surgery	-2.4	27.6	5.8
(6) Allowed Charges for Surgical Provider (Excluding Index Procedure):			
Period I	-3.9	31.3	-0.1
Period II	10.8	9.0	7.1
Period III	0.8	-3.9	-1.8
Total Episode	4.2	6.3	2.4
(7) Allowed Charges for All Other Physicians for the Entire Episode	0.3	23.6	23.6
(8) Allowed Charges for All Part B Services for the Entire Episode (Excluding Index Procedure)	4.4	17.3	18.6
(9) RVU Weights for Surgical Provider (Excluding Index Procedure):			
Period I	-8.6	15.6	0.0
Period II	2.6	11.9	5.9
Period III	3.5	-9.8	-1.2
Total Episode	0.8	2.8	2.0
(10) RVU Weights for All Other Physicians for the Entire Episode	0.0	14.1	17.5
(11) RVU Weights for All Part B Services for the Entire Episode (Excluding Index Procedure)	1.9	13.7	14.1

NOTES: RVU is relative value unit. The high payment-reduction group includes the one-third of carriers with the highest percentage price decreases (or the lowest percentage price increases). The low payment-reduction group includes the one-third of carriers with the lowest percentage price decreases (or the highest percentage price increases). The medium payment-reduction group includes the middle one-third of carriers. Period I is the 30-day interval prior to surgery. Period II is the day of the surgery. Period III is the 90-day interval subsequent to surgery.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

Other results (not reported here) show that the trends in second cataract surgery vary importantly by payment reduction category. During Period II (i.e., the day of surgery itself), the RVU-weighted intensity of second cataract procedures increased 62 percent in the high-impact group, but it decreased 66 percent in the low-impact group. Similarly, in Period III (i.e., the 90-day interval subsequent to surgery), the RVU-weighted intensity of second cataracts increased 37 percent and declined 4 percent, respectively, in the two groups. Further evidence is provided later on the differences in second cataract usage.

Total Hip Replacement

The results shown in Table 4 indicate that OBRA 1987 produced a 10-percent-

age-point payment differential between the high- and low-impact groups for this procedure group. During the 1987-89 interval, the average allowed charge for hip replacement decreased 5.3 percent in the high-impact group, but increased 4.9 percent in the low-impact group.

Unlike cataracts, the total episode results for this procedure give only weak evidence for the existence of an offset. Consistent with the offset hypothesis, total episode charges for the surgical provider increased at a modestly higher rate (11.6 percent) in the high-impact group, compared with an increase of 10.1 percent in the low-impact group. The RVU-weighted comparison indicates a somewhat larger differential, 8.8 and 5.7 percent, respectively. These differences, however, are not statistically significant.

Table 6
Episode-of-Care Summary for Coronary Artery Bypass Graft Surgery: 1987-89

Variable	Payment Reduction Impact Category		
	High	Medium	Low
		Percent Change	
(1) Allowed Charges for Index Procedure	-5.65	-1.89	3.05
(2) Volume of Index Procedures	13.4	26.4	16.4
(3) Surgical Assistance	0.2	20.8	3.6
(4) Additional Surgery	26.0	20.0	18.4
(5) Period III Surgery	8.9	21.1	12.7
(6) Allowed Charges for Surgical Provider (Excluding Index Procedure):			
Period I	-15.8	3.4	-12.6
Period II	5.0	10.6	-13.6
Period III	19.9	23.8	-18.5
Total Episode	4.5	11.4	-14.3
(7) Allowed Charges for All Other Physicians for the Entire Episode	5.9	9.2	6.9
(8) Allowed Charges for All Part B Services for the Entire Episode (Excluding Index Procedure)	6.2	6.8	4.9
(9) RVU Weights for Surgical Provider (Excluding Index Procedure):			
Period I	-14.8	4.0	-16.2
Period II	11.0	14.4	-8.2
Period III	8.0	24.4	-19.9
Total Episode	8.4	14.4	-11.0
(10) RVU Weights for All Other Physicians for the Entire Episode	1.9	6.6	4.3
(11) RVU Weights for All Part B Services for the Entire Episode (Excluding Index Procedure)	7.8	7.9	5.6

NOTES: RVU is relative value unit. The high payment-reduction group includes the one-third of carriers with the highest percentage price decreases (or the lowest percentage price increases). The low payment-reduction group includes the one-third of carriers with the lowest percentage price decreases (or the highest percentage price increases). The medium payment-reduction group includes the middle one-third of carriers. Period I is the 30-day interval prior to surgery. Period II is the day of the surgery. Period III is the 90-day interval subsequent to surgery.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

For the high-impact group compared with the low-impact group, Table 4 indicates a much larger rate of increase in additional surgery during the same day. However, we also see a much lower rate of increase in surgery during the 90-day followup interval. The rate of surgical assistance declines less rapidly in the high-impact group.

Total Knee Replacement

This procedure group gives no indication of an offset. Comparing the high- and low-impact groups (Table 5), we find the following:

- The incidence of surgical assistance increased more in the low-impact group.
- The incidence of additional surgery performed during the same time as the

index surgery increased dramatically more in the low-impact group.

- The rate of surgery during the 90-day followup period increased somewhat more for the high-impact group.
- Total episode charges for the surgical provider increased only 2 percentage points more for the high-impact group.
- The RVU-weighted "quantity" of all index provider services increased 1 percentage point less for the high-impact group.

The evident lack of impact may be attributed, in part, to having a less robust "treatment" or intervention. Compared with payment differentials of approximately 10 percentage points for cataracts and hip replacements, the price impact on knee replacement is only 6 percentage points. During the 1987-89 interval, average charges for

Table 7
Episode-of-Care Summary for Upper Gastrointestinal Endoscopy: 1987-89

Variable	Payment Reduction Impact Category		
	High	Medium	Low
		Percent Change	
(1) Allowed Charges for Index Procedure	-6.35	0.30	2.82
(2) Volume of Index Procedures	14.4	0.4	23.4
(3) Surgical Assistance	36.3	-18.8	-16.7
(4) Additional Surgery	11.1	4.0	25.2
(5) Period III Surgery	9.0	0.8	-5.6
(6) Allowed Charges for Surgical Provider (Excluding Index Procedure):			
Period I	3.6	10.5	2.7
Period II	14.6	7.6	35.6
Period III	9.5	4.2	1.9
Total Episode	8.9	6.6	9.4
(7) Allowed Charges for All Other Physicians for the Entire Episode	2.7	8.9	17.8
(8) Allowed Charges for All Part B Services for the Entire Episode (Excluding Index Procedure)	7.1	11.7	21.0
(9) RVU Weights for Surgical Provider (Excluding Index Procedure):			
Period I	1.9	7.6	-1.8
Period II	10.9	3.7	31.1
Period III	10.6	2.1	-2.1
Total Episode	8.3	3.9	5.8
(10) RVU Weights for All Other Physicians for the Entire Episode	-0.4	4.0	13.8
(11) RVU Weights for All Part B Services for the Entire Episode (Excluding Index Procedure)	4.3	6.6	16.2

NOTES: RVU is relative value unit. The high payment-reduction group includes the one-third of carriers with the highest percentage price decreases (or the lowest percentage price increases). The low payment-reduction group includes the one-third of carriers with the lowest percentage price decreases (or the highest percentage price increases). The medium payment-reduction group includes the middle one-third of carriers. Period I is the 30-day interval prior to surgery. Period II is the day of the surgery. Period III is the 90-day interval subsequent to surgery.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

the index procedure decreased 4.4 percent in the high-impact group and increased 1.6 percent in the low-impact group.

CABG Surgery

Like cataracts, this procedure group exhibits a substantial and significant offset effect. As shown in Table 6, during the 1987-89 interval, the average allowed charge for this procedure decreased 5.6 percent in the high-impact group and increased 3.0 percent in the low-impact group. Thus, the surgical fee reductions produced roughly a 9-percentage-point price differential in this procedure group.

The apparent effects on surgical assistance and Period III surgery are neither dramatic nor significant, although some additional same-day surgery is indicated.

Nevertheless, total episode charges for the surgical provider increased 4.5 percent in the high-impact group, but decreased 14.3 percent in the low-impact group. The total RVU-weighted service intensities increased 8.4 percent and decreased 11.0 percent, respectively. The latter suggests that a combined 19-percentage-point differential in the quantity of non-index care provided to index patients may be attributed to the surgical fee reductions. Total allowed charges for other cardiac procedures, performed on the same day, increased 23 percent in the high-impact group and decreased 17 percent in the low-impact group.

Upper GI Endoscopy

This procedure group (Table 7) gives only modest evidence for an offset effect.

Table 8
Episode-of-Care Summary for Prostatectomy: 1987-89

Variable	Payment Reduction Impact Category		
	High	Medium	Low
		Percent Change	
(1) Allowed Charges for Index Procedure	-4.55	0.97	1.58
(2) Volume of Index Procedures	-14.9	-12.6	-8.8
(3) Surgical Assistance	-18.0	14.4	-23.1
(4) Additional Surgery	9.3	-1.9	12.6
(5) Period III Surgery	-5.4	12.0	-0.7
(6) Allowed Charges for Surgical Provider (Excluding Index Procedure):			
Period I	9.0	28.8	21.6
Period II	8.9	12.9	26.2
Period III	10.5	16.7	17.5
Total Episode	9.4	22.6	21.4
(7) Allowed Charges for All Other Physicians for the Entire Episode	13.4	14.6	18.5
(8) Allowed Charges for All Part B Services for the Entire Episode (Excluding Index Procedure)	13.9	15.5	20.8
(9) RVU Weights for Surgical Provider (Excluding Index Procedure):			
Period I	5.2	12.8	11.0
Period II	11.4	2.9	17.3
Period III	6.8	1.5	10.4
Total Episode	7.0	7.6	12.3
(10) RVU Weights for All Other Physicians for the Entire Episode	13.3	9.7	16.1
(11) RVU Weights for All Part B Services for the Entire Episode (Excluding Index Procedure)	13.0	10.8	17.8

NOTES: RVU is relative value unit. The high payment-reduction group includes the one-third of carriers with the highest percentage price decreases (or the lowest percentage price increases). The low payment-reduction group includes the one-third of carriers with the lowest percentage price decreases (or the highest percentage price increases). The medium payment-reduction group includes the middle one-third of carriers. Period I is the 30-day interval prior to surgery. Period II is the day of the surgery. Period III is the 90-day interval subsequent to surgery.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

Focusing on the index provider's RVU-weighted service intensity for the entire episode, we find that the rate of change is only 2.5 percentage points higher in the high-impact group, compared with the low-impact group. This difference is not statistically significant. On the other hand, if one looks at the RVU-weighted service intensity in Period III, we find a pattern which is consistent with the offset hypothesis—namely, that Period III services increase 10.6 percent for the high-impact group and decrease 2.1 percent for the low-impact group. In particular, the relative incidence of Period III surgery is considerably increased in the high-impact group. This differential, however, is largely mitigated by the extraordinary 31.1-percent increase in service intensity seen for the low-impact group in Period II. Thus, on balance, we

must conclude that no meaningful evidence for an offset is shown for endoscopy.

Prostatectomy

This procedure group also gives no evidence of an offset to the surgical fee reduction. Quite the contrary, as shown in Table 8, allowed charges and RVU-weighted service volumes increased at a higher rate for the low-impact group. Total episode service volume for the surgical provider increased only 7.0 percent for the high-impact group, compared with a 12.3-percent increase for the low-impact group. This difference is not statistically significant. Nevertheless, additional same-day surgery and Period III surgery also show the same pattern.

Prostatectomy is a comparatively less expensive procedure, and it unquestionably

accounts for a smaller proportion of surgeon income than cataract and CABG procedures. Also, the treatment effect for prostatectomy is less robust, with only a 6-percentage-point price differential indicated from the high- versus low-impact group comparisons. Consequently, it was anticipated that this procedure group would be less likely to elicit a provider response to the fee reduction. Indeed, the pattern shown in Table 8 may indicate what might have been expected for other procedures in the absence of the fee reduction intervention.

For example, in the absence of the fee reductions, one tends to assume that the service volume or intensity would have increased at the same rate in all three price reduction groups. However, that may not be the appropriate assumption about what otherwise would have pertained. For all six procedure groups, the 1987 (or 1986) service levels in the low-impact group were lower than those in the high-impact group. Thus, our finding for prostatectomy—namely, that the non-index service intensity per episode is rising faster in the low-impact group—may reflect a regression-to-the-mean phenomenon. The service intensity for the low-impact group appears to be gravitating or rising to the same absolute level as the high-impact group. In the absence of the fee reductions, it is possible that we would have seen similar patterns for cataracts, total hip replacement, total knee replacement, and CABG surgery. If so, the program impacts may be substantially understated from our approach to measuring offsets.

It is not easy, however, to establish the appropriate assumption about what otherwise would have happened. Indeed, it probably can not be done without also looking at the experience for surgical procedures not impacted by the fee reductions.

ESTIMATION OF THE OFFSET EFFECTS

Only two of the six procedure groups included in this study—cataract extractions and CABG surgery—give significant evidence for the existence of a service volume offset to the fee reductions. Our findings with respect to the four other surgical procedures included in this study are not statistically significant. We now ask the question, how important are the offsets indicated from our findings? In an effort to answer that question, we perform the following calculations which focus on the service intensity differences between the high- and low-impact groups in measuring the importance of the offsets, if any.

For each procedure group, we shall initially assume that the fee reductions are responsible for the entire price trend differential between the high- and low-impact groups. For example, as shown in Table 3, there is a 9.7-percentage-point differential between rates of change in the average allowed for cataracts (i.e., the percentage-point differential between -7.28 percent for the high-impact group and 2.41 percent for the low-impact group). This differential implies a \$169 reduction in the allowed amount per episode for the group most affected by the payment reductions—calculated as 9.7 percent of the 1986 average allowed charge for cataracts in the high-impact group.

We also assume that, for the surgical provider, the total episode differences in RVU-weighted service intensity trends between the high- and low-impact groups can be attributed to the fee reductions. Table 3 indicates an 18.1-percentage-point differential between the trends in total episode service intensity for the surgeon (i.e., the percentage-point differential between 18.7 percent for the high-impact

Table 9
Comparison of High- Versus Low-Impact Groups: 1987-89¹

Procedure Group	Estimated Fee Impact		Estimated "Offset"		Percentage "Offset"
	Percent	Amount	Percent	Amount	
Cataract Extractions	*-9.7	*\$-169	*18.1	*\$64	*37.9
Total Hip Replacement	*-10.2	*-293	3.1	9	3.1
Total Knee Replacement	*-6.1	*-160	-1.2	-3	-2.1
CABG Surgery	*-8.7	*-405	*19.4	*122	*30.2
Upper GI Endoscopy	*-9.2	*-34	2.5	7	21.1
Prostatectomy	*-6.1	*-78	-5.3	-12	-15.0

*Statistically significant.

¹For cataract extraction, base year is 1986.

NOTES: CABG is coronary artery bypass graft. GI is gastrointestinal.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

group and 0.6 percent for the low-impact group). This differential suggests that—after controlling for the arguably exogenous changes in actual reimbursement rates—cataract surgeons in the high-impact group billed an additional \$64 for services—calculated as 18.1 percent of the 1986 average allowed for the entire episode, excluding the index procedure, in the high-impact group. Thus, our results indicate that surgeons made up \$64, or 38 percent, of the \$169 fee reduction for cataracts through other billings to the same patients.

The above estimates and similar results for the five other procedure groups are summarized in Table 9. As can be seen, all of the fee impact estimates are significantly different from zero. However, the offset estimates are significant only for the cataract and CABG procedure groups. The percentage offsets estimated for these two groups are 38 percent and 30 percent, respectively. The average of these two offset estimates is 34 percent. The simple average for all six procedures is 12.5 percent. However, if you weight the procedure-specific values by procedure volume and the average allowable reimbursement for each, the average is 24.7 percent. This latter estimate represents the average per

episode offset involved on a program-wide basis, in terms of total Medicare reimbursement for all six procedures.

This estimation, however, begs a number of important questions. One of these concerns the behavioral adjustment process involved. In our data, insufficient time may have elapsed for the surgical providers to complete their adaptation to the surgical fee reductions. Also, as discussed above, some narrowing of the fee differentials may have taken place anyway in the absence of the fee reduction legislation. If so, the fee impacts are overstated in Table 9, and the offset percentages are understated. This question about what otherwise would have happened, as well as our question about the longer run adaptation, could not be answered from this study.

CHANGES IN PRACTICE BEHAVIOR

For the two procedure groups indicating significant offset effects, cataracts and CABGs, we seek in Tables 10 and 11, respectively, to distinguish the procedures responsible for the offsets. In these tables, we identify the procedures and procedure categories which account for at least a one-unit difference, in absolute value, between the high- and low-impact groups in their service intensity

Table 10
Changes in the Surgical Provider's Billing of Selected Non-Index Procedures for
Cataract Extraction: 1986-89

Procedure	RVU-Weighted Change, by Payment Reduction Impact Category		Difference ¹
	High	Low	
Total	38.81	-21.12	59.93
Second Cataract	25.42	-11.38	36.80
Keratoplasty	7.40	-0.76	8.16
Fistulization of Sclera for Glaucoma With Trabeculectomy	6.04	0.60	5.44
Discission or Removal of Secondary Membranous Cataract	16.26	10.84	5.42
Posterior Segment—Vitreous	-0.79	-5.37	4.58
Iridotomy by Photocoagulation	2.86	0.24	2.62
Anesthesia for Lens Surgery	2.34	0.31	2.03
Trabeculotomy	0.88	-0.72	1.60
Plastic Repair of Canaliculi	1.09	0.00	1.09
Ophthalmic Ultrasound	8.42	10.67	-2.25
Intraocular Lens Purchase	-30.87	-28.60	-2.27
Comprehensive Visit	-0.24	3.05	-3.29

¹This category is calculated by subtracting low payment-reduction group RVU-weighted changes from high payment-reduction group RVU-weighted changes.

NOTE: RVU is relative value unit.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

trends. Consider, for example, the second cataract procedure in Table 10. The RVU-weighted volume of such procedures—equivalent to 1987 reimbursement dollars—in the high-impact group increased by 25.4 units over the 1986-89 interval, compared with a volume decrease of 11.4 units in the low-impact group. Thus, the 1986-89 trend difference between the two groups is 36.8 units. This suggests that the second cataract procedure has contributed approximately \$37 to the \$64 offset estimated for cataract extractions in Table 9. Other results for the two procedure groups are discussed separately later.

Cataract Extractions

In the aggregate, the procedures included in Table 10 account for approximately \$60, or 94 percent, of the \$64 offset estimated for cataracts. If one also includes discission or removal of secondary membranous cataract, additional cataract procedures actually contribute about \$42 (\$37 plus \$5) to the \$64 offset. That does not mean, however, that additional cataracts were responsible for that

proportion of the offset. Because some of the “differences” in Table 10 are negative, it takes more than \$64 worth of positive differences to yield a \$64 net difference.

In general, the procedures responsible for the cataract offset, and most especially the additional cataract procedures themselves, are often discretionary and subject to substantial practice variation. Keratoplasty (reconstruction or transplantation of the cornea) and fistulization of sclera for glaucoma (cutting a hole in the sclera to relieve pressure inside the eye) are generally unrelated to cataract surgery but also involve considerable discretion on the part of the ophthalmologist.

CABG Surgery

In the aggregate, the procedures included in Table 11 account for approximately \$102, or 84 percent, of the \$122 offset estimated for CABG surgery in Table 9. A much larger number of procedures are included in this table, and the interpretation is accordingly more difficult. In

Table 11
Changes in the Surgical Provider's Billing of Selected Non-Index Procedures for
Coronary Artery Bypass Graft (CABG): 1987-89

Procedure	RVU-Weighted Change, by Payment Reduction Category		Difference ¹
	High	Low	
Total	29.07	-73.40	102.47
Valve Procedures	22.77	-15.01	37.78
Thoracic Aortic Aneurysm	18.74	2.49	16.25
Cardiac Catheterization	4.18	-10.83	15.01
CABG, Surgical Assistance	0.11	-11.53	11.64
Second CABG	1.85	-9.64	11.49
Lung and Pleura—Excision	3.40	-3.54	6.94
Hospital Care	2.92	-3.89	6.81
Postinfarction Myocardial Procedures	-16.04	-22.19	6.15
Septal Defect	3.59	-2.12	5.71
Exploration	2.02	-3.46	5.48
Patent Ductus Arteriosus; Ligation	3.10	0.00	3.10
Sternum Procedures	5.29	2.39	2.90
Assembly/Operation of Pump With Oxygenator	-2.86	-5.31	2.45
Excision of Intracardiac Tumor	0.00	-2.22	2.22
Pericardium Procedures	0.68	-1.32	2.00
Electrocardiogram Interpretation	-0.13	-2.06	1.93
Endoscopy With Therapeutic Aspiration of Tracheobronchial Tree	1.59	-0.30	1.89
Mediastinum	-0.03	-1.56	1.53
Wounds of the Heart and Great Vessels	0.35	-1.15	1.50
Pulmonary Artery Embolectomy	-1.90	0.00	-1.90
Angiocardiography	0.00	2.01	-2.01
Aneurysm Repair	2.93	5.35	-2.42
Blood Vessel Repair	-1.95	0.76	-2.71
Anesthesia	-4.93	-0.76	-4.17
Consultations	-1.67	2.73	-4.40
Unrelated Surgery	-5.32	-0.71	-4.61
Vascular Injection Procedures	-3.53	2.69	-6.22
Miscellaneous Cardiac Procedures	-6.09	5.78	-11.87

¹This category is calculated by subtracting low payment-reduction group RVU-weighted changes from high payment-reduction group RVU-weighted changes.

NOTE: RVU is relative value unit.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

particular, we have some concern that the differences indicated could reflect changes in billing rather than practice behavior. It is possible that some index providers are now billing related procedures that were not formerly billed separately (fragmentation of billing). Also, there may be some shifting between the billing codes; for example, procedures formerly billed as miscellaneous cardiac procedures may have been more recently billed as valve procedures or something else.

Our results further reflect the impact of technical change on practice behavior. We see, for example, that postinfarction myocardial procedures have declined in

both the high- and low-impact groups, albeit to a somewhat lesser extent in the high-impact group. This undoubtedly reflects the findings from recent clinical trials which have not supported the advantages of such early treatment.

Some of the procedures accounting for the CABG offset—e.g., valve procedures, second CABG, and thoracic aortic aneurysm—involve very substantial additional risk to the patients. Others, such as cardiac catheterization, are substantially discretionary. Based on this study, however, we can not evaluate whether the high- or low-impact practice trends are more appropriate.

A SUPPLEMENTAL "OFFSET" RESULTS TEST

A large-scale econometric study examining the experience for surgical procedures not impacted by the surgical fee reductions may be helpful in answering unresolved questions and should yield more precise estimates of the pure offset effects.⁴ While a serious econometric investigation was not conducted as part of this project, we used the available data to conduct a simple multivariate test and thereby seek additional, corroborating evidence for the offset effects estimated above.

For each procedure group included in the episode-of-care analysis, we estimated the following linear model:⁵

$$\Delta Q = \beta_0 + \beta_1 \times \Delta P + \beta_2 \times Q^{87}$$

where

$$\Delta Q = (Q^{89} - Q^{87}) / Q^{87}$$
$$\Delta P = (P^{89} - P^{87}) / P^{87}$$

P^{87} and P^{89} = the average allowed surgical charges in 1987 and 1989, respectively, and

⁴Several different econometric strategies are possible. The preferred alternative, however, would be to conduct a pooled cross-section time-series analysis, pooling observations for both OBRA and non-OBRA surgical procedures by geographic area over multiple time periods. If this were done, a fixed effects specification—wherein dummy variables were included for each geographic area and type of surgery—could be used to control for unobserved differences (e.g., income, urbanicity, provider supply, and HMO market share), and thereby minimize bias with respect to coefficient estimation for the included variables. Also, UPINs should be used in distinguishing the surgical provider.

⁵Our first-difference model specification is expressly intended to mitigate omitted variables problems. Indeed, for short time series, first-difference analysis is frequently preferred to fixed effects estimation. The lagged quantity variable is not endogenous; the right-hand-side variable is not quantity but percentage change in quantity. Nevertheless, the specification introduces a potential econometric problem. In particular, if the quantity variable is measured with error (as it almost certainly is), the left-hand-side and right-hand-side errors are inversely correlated; and the coefficient estimated for the quantity variable most probably has a negative bias. Even if this errors-in-variables problem were severe, the inclusion of the quantity variable should (theoretically) improve the efficiency of estimation for the price variable. De facto, the quantity variable, in part, corrects for errors in measuring the dependent variable.

Q^{87} and Q^{89} = the RVU-weighted values of other services provided, on a total episode basis, by the index provider in 1987 and 1989, respectively.

The offset hypothesis suggests that ΔQ will vary inversely with ΔP . In other words, those surgical providers subject to the largest price reductions, or lowest price increases, are predicted to exhibit the greatest increases in billing of non-index procedures. The second independent variable, Q^{87} , is included to control for a potential regression-to-the-mean phenomenon—namely, the possibility, as suggested above, that the non-index service intensity in the lower impact groups is rising faster and gravitating to the same level as the high-impact group. This would imply a negative coefficient for the Q^{87} variable; that is, if the base level is low, the increase will be greater. For the cataract procedure, of course, the base year is 1986.

The results for all six procedure groups are reported in Table 12. Although the percentage of variation explained by these rudimentary models is never more than 26 percent, all six of the models yield significant F values. Also, the base-year Q variables are highly significant (.05 level or better) in all six models; and the coefficients estimated for this variable are uniformly negative as predicted by the regression to the mean hypothesis.⁶

The ΔP variable—our proxy for the fee reduction intervention—is significant in only two models. It is significant at the .05 level or better for both cataract extraction

⁶We also pooled the six surgical procedures included in our study and estimated a first-difference model incorporating fixed effects for procedure and carrier. The price and quantity variables in this model were both highly significant, with the predicted negative signs. Indeed, the results indicated an even larger offset.

Table 12
 ΔQ -Regression Models: 1987-89¹

Independent Variable	Regression Coefficients, by Procedure Group ²					
	Cataract Extraction	Total Hip Replacement	Total Knee Replacement	CABG Surgery	Upper GI Endoscopy	Prostatectomy
Constant	54.0 (11.3)	53.4 (19.1)	44.3 (14.0)	23.5 (11.3)	39.0 (8.36)	36.5 (12.5)
ΔP	*-1.06 (0.46)	0.844 (0.995)	-1.03 (0.84)	*-1.88 (0.75)	0.036 (0.369)	-0.177 (0.595)
Q	**-.0996 (0.0273)	*-.118 (0.0485)	**-.114 (0.035)	*-.0293 (0.0130)	**-.101 (0.0251)	**-.0963 (0.0461)
Summary Statistics						
R-Square	.24	.14	.23	.23	.26	.08
Adjusted R-Square	.21	.10	.20	.19	.23	.05
F Value	7.44	3.34	6.26	5.73	8.47	2.18

*Significant at .05 level or better.

**Significant at .01 level or better.

¹For cataract extraction, base year is 1986.

²Standard errors in parentheses.

NOTES: CABG is coronary artery bypass graft. GI is gastrointestinal.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data files, 1986-89.

and CABG surgery; and the coefficient estimates are negative as implied by the offset hypothesis. The ΔP coefficient estimates for the four other procedure groups are highly insignificant, with only one procedure having a coefficient estimate even as large as its standard error.

The multivariate test supports and substantially validates the offset findings obtained above from our comparison of the high- and low-impact groups. The same two procedure groups, cataracts and CABGs, indicate significant offsets.

In Table 13, we have calculated the offset percentages implied by the multivariate results and compare those estimates to the estimates obtained from the comparisons reported in Table 9. The multivariate estimate of the offset percentage for cataract extraction is somewhat lower than the comparison-based estimate; and that obtained for CABG surgery is somewhat higher. Nevertheless, the magnitudes are broadly similar, and the two-procedure averages for the two estimation approaches are nearly the same (32 percent and 34 percent,

respectively). The offset percentages estimated from the multivariate model for other procedure groups bear no discernible relationship to estimates from the comparisons. This further attests to the insignificance and essentially random nature of those results.

Finally, one may ask why cataracts and CABGs, but not the four other procedure groups, would show an offset. We can not give a definitive answer to that question, but we offer the following hypothesis. The cataract and CABG procedures may have elicited stronger and quicker practice responses because those procedures are relatively more important as a percentage of income to the providers involved. As reported by Escarce (1993), cataract surgery accounts for 49 percent of Medicare revenues to ophthalmologists, and CABG surgery accounts for 43 percent of Medicare revenues to cardiothoracic surgeons. By comparison, the four other procedures included in this study account for an average of only 19 percent of Medicare revenues to the principal specialty

Table 13
Two Alternate Estimates of the
"Offset" Percentages

Procedure Group	Estimated "Offset" Percentage	
	Heuristic Comparisons	Multivariate Model
Cataract Extraction	*37.9	*27.3
Total Hip Replacement	3.1	-12.4
Total Knee Replacement	-2.1	15.9
CABG Surgery	*30.2	*35.9
Upper GI Endoscopy	21.1	-3.7
Prostatectomy	-15.0	4.2

*Statistically significant.

NOTES: CABG is coronary artery bypass graft. GI is gastrointestinal.

SOURCE: Center for Health Economics Research analysis of Health Care Financing Administration Part B Medicare Annual Data file, 1986-89.

associated with each. Thus, our results are consistent with the hypothesis that an intervention impacting a greater proportion of provider revenues is likely to elicit a larger and more immediate offset response.

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