Does Seeing the Doctor More Often Keep You Out of the Hospital?

Robert Kaestner
National Bureau of Economic Research
Institute of Government and Public Affairs
University of Illinois
Department of Economics
University of Illinois at Chicago
815 West Van Buren Street, Suite 525
Chicago, IL 60607
kaestner@uic.edu

Anthony T. Lo Sasso
Institute of Government and Public Affairs
University of Illinois
Division of Health Administration and Policy
School of Public Health
University of Illinois at Chicago
1603 W. Taylor St., Chicago, IL 60612
losasso@uic.edu

Abstract: By exploiting a unique health insurance benefit design, we provide novel evidence on the causal association between outpatient and inpatient care. Our results indicate that greater outpatient spending was associated with more hospital admissions: a $100 increase in outpatient spending was associated with a 2.7% increase in the probability of having an inpatient event and a 4.6% increase in inpatient spending among enrollees in our sample. Moreover, we present evidence that the increase in hospital admissions associated with greater outpatient spending was for conditions in which it is plausible to argue that the physician and patient could exercise discretion.

1. Introduction

There are plausible scenarios in which a trip to the doctor's office leads to the detection and successful treatment of a condition that, if left untreated, would result in illness and hospitalization. For example, hyperlipidemia, if untreated, is significantly associated with coronary artery disease, but appropriate diagnosis and treatment with statins substantially reduces future illness and hospitalization. However, there are equally plausible scenarios in which a visit to the doctor leads to a referral to a specialist for additional evaluation and potential invasive treatment for a condition that, if left untreated, would resolve itself in time (or is best left untreated). For example, a PSA (prostate-specific antigen) exam for prostate cancer that is abnormally high may lead to a referral to a urologist, a biopsy and surgery.

These two treatments for common illnesses are illustrative examples of primary care, one effective and cost reducing and the other ineffective and cost increasing, that are central to the current health care reform debate. The Patient Protection and Affordable Care Act (ACA) includes several provisions that bolster the supply of primary care physicians and subsidize receipt of primary care. Underlying this policy is the belief that primary care is preventive and cost reducing (see, for example, Starfield et al. 2005; Rittenhouse and Shortell 2009). In addition, the expansion of health insurance coverage, which is also a prominent part of the ACA, is often justified with references to the cost-effectiveness of primary care, which is known to increase among newly insured persons. On the other hand, almost everyone agrees that there is significant waste in the US health care system. Important evidence supporting the waste argument comes from the Dartmouth Atlas of Health Care (e.g., Wennberg et al. 2005; Fisher et al. 2009). The Dartmouth view is that much spending on medical care is due to "supply-sensitive" care, which is care that is intensive (e.g., many visits to specialist), expensive (e.g., invasive procedures), and driven by provider preferences (e.g., no clearly defined evidence-based guidelines). Much of this "supply sensitive" care has little proven health benefits. If the Dartmouth view is correct, then greater insurance coverage and greater use of primary care will result in more hospitalizations because visits to the doctor often result in aggressive treatment that involves hospitalization and arguably little health benefit (Fisher et al. 2003).

Empirical evidence on the association between primary (outpatient) care and inpatient care is sparse, particularly evidence that may be interpreted as causal, despite the importance of this relationship to health economics and health policy. Research that comes closest to providing such evidence are studies that examine the association between health insurance status and hospitalizations because of the known increase in primary care that comes with insurance coverage. However, health insurance changes the price of both inpatient and outpatient care and studies of the association between health insurance and hospitalization do not directly provide evidence on the association between primary care and hospitalization.

Three recent studies provide mixed evidence as to the relationship between health insurance coverage and hospitalization using quasi-experimental methods. Using a regression discontinuity design, Anderson et al. (2012) found that young adults who lost family health insurance coverage had significantly lower rates of emergency department use and hospital admissions than those who did not lose family health insurance coverage. Kolstad and Kowalski (2010) examined the Massachusetts health care reform and found that gaining insurance was associated with a decrease in hospital admissions through emergency department, an increase in hospital admissions through other channels, and no change in total hospitalizations. Miller (2011), who also studied the Massachusetts reform, found that reform was associated with a decrease in outpatient emergency room visits, particularly those that are preventable with primary care.

Experimental findings from the Rand Health Insurance Experiment (HIE) showed that health insurance coverage (i.e., more generous coverage) was associated with an increase in use of emergency room services and hospitalization (Newhouse 1993). Specifically, emergency department use was 30% to 35% lower for those with the least generous insurance (95% coinsurance) than for those with the insurance plan that paid all costs (i.e., free plan), and any use of inpatient services was 25% lower for those with the least generous insurance (95% coinsurance) than for those with the insurance plan that paid all costs; the findings led the researchers to conclude that inpatient and outpatient services were complements. Similarly, evidence from the Oregon Medicaid experiment also shows that obtaining health insurance, in this case, Medicaid, is positively associated with hospitalization (Finkelstein et al. 2011).

Another line of research related to the question of whether outpatient and inpatient care are substitutes or complements are studies examining the association between changes in prescription drug use (or prices), which is a distinct type of outpatient care, and use of inpatient services. There have been several studies and the evidence from these studies is mixed.[1] For example, Chandra et al. (2010) reported that increases in copayments for prescription drugs among employees in the California Public Employees Retirement System were associated with a decrease in the use of prescription drugs and an increase in the probability of hospitalization. However, Kaestner and Khan (2012) found that gaining prescription drug insurance through Medicare Part D was associated with a 28% increase in prescription drug use, a 45% increase in spending on prescription drugs, and no change in inpatient spending among a sample of

[1] Studies in this area include: Soumerai et al. (1991); Johnson et al. (1997); Breischer et al. (2005); Hsu et al. (2006); Chandra et al. (2010); Afendulis et al. (2011); McWilliams et al. (2011); and Kaestner and Khan (2012).

Medicare recipients drawn from the Medicare Current Beneficiary Survey. Results from other studies offer similarly mixed evidence. More importantly, the evidence from these studies is limited by the focus on prescription drugs, which is an important, but small part of outpatient care.

In sum, there is virtually no recent evidence, particularly evidence that can be interpreted as causal, as to whether outpatient and inpatient care are substitutes or complements. This is an important gap in knowledge because of the importance of this question to understanding how the health care market operates. Evidence as to whether outpatient and inpatient care are substitutes or complements is central to both health economics and health policy.

In this paper, we obtain estimates of the relationship between outpatient and inpatient care. To our knowledge, ours is the first study to assess directly whether outpatient and inpatient care are substitutes or complements. Importantly, the research design underlying our empirical analysis supports the case for interpreting our estimates as causal. Our research takes advantage of changes in insurance plan features that affect only outpatient care with the most important feature being a unique benefit design in which funds contained in a savings account (technically a health reimbursement arrangement or HRA) can be used only to pay for outpatient and pharmacy services, and *not* inpatient care and outpatient surgery services.[2] The inability to use HRA dollars for inpatient care, in contrast to the better known Health Savings Account (HSA) products, is the key to our research design because it provides an exogenous change in the price of outpatient care without affecting the price of inpatient care. Capitalizing on the exogenous change in insurance plan design specific to outpatient services contrasts to other studies that, for example, focus on the association between health insurance or changes in health insurance

[2] We also exploit variation in outpatient care due to changes in prescription drug copayments and outpatient deductible.

benefits and inpatient care, because the changes typically alter the price of both outpatient and inpatient care. The design was a feature marketed by the insurer intended to prevent a costly hospitalization from depleting the account balance. The insurance product was designed and sold by a health insurer offering exclusively high-deductible health plans on a full replacement basis in the small group market.

Results of our analysis indicate that a $100 (4%) increase in outpatient spending resulted in an $89 (4.6%) increase in inpatient spending among employees in the employer-sponsored insurance plans in our sample. Moreover, the increase in hospital admissions associated with greater outpatient spending was concentrated among conditions in which there is significant geographical variation in admission rates and for which physicians exercise considerable discretion—care consistent with "supply sensitive" treatment that has been shown to be without clinical evidence of its effectiveness. In contrast, there was no relationship between outpatient spending and admissions for low-discretion (variation) procedures such as major cardiovascular care or for births.

2. Setting and Data

Data for the empirical analysis are drawn from the universe of claims for a small Midwestern health insurance company that was an early entrant in the "consumer-driven" health plan market. The data include claims and enrollment information for employees and their dependents within firms offering a high-deductible health plan sponsored by the health insurance company from 2000 through mid-2006. We have information on all paid claims for inpatient, outpatient, and pharmaceutical services throughout the policy year. We use only observations that included full policy years. In addition, we have information on health plan characteristics including HRA "deposits" at the beginning of each policy year, roll-over account balances from the prior year, deductible amount, coinsurance rates for both in- and out-of-network care (the claims data contain an indicator for network status of the provider), out-of-pocket maximum levels, and copayments for pharmaceuticals. Employers are able to change plan characteristics annually.

The HRA plan design used notional (non-transferable) accounts for first-dollar coverage of pre-specified health care purchases. Employers and employees could fund their accounts on a tax-free basis and unspent dollars roll over into subsequent years. As noted earlier, a key feature of the insurance plan design was that HRA dollars could not be used to pay for expenditures associated with inpatient care or outpatient surgery; a separate hospital and surgery deductible is specified in the benefit design to impose cost-sharing on that type of utilization. Note that this plan feature is distinct from HSA designs, which allow account dollars to be used for inpatient and outpatient health care expenditures.[3] Another advantageous feature of the HRA plans in our study is that the insurer sold the insurance policies exclusively on a total replacement basis; employers do not offer competing plans from this or other insurers and almost all firms offer just one insurance plan to employees.[4] Therefore, employees do not choose among insurance plans and we do not have to address the selection issue that comes from employee plan choice. We limit our sample to firms that had five or more enrollees because of the possibility that changes in health and use of services for specific enrollees will determine insurance plan features. In larger firms, insurance plan features are plausibly exogenous with respect to individual enrollee

[3] The insurer began offering HSAs after they were created in the 2004 Medicare Modernization Act, but given the timing of our data very few firms offered them to employees. A small number of enrollees (<1%) were dropped because they were enrolled in HSAs.

[4] A small number, 3%, of employers offered more than one plan design to employees in the study period. Most commonly, employees could select a higher or lower deductible option. However, results reported below did not change appreciably when these few employers were excluded from the sample. It is very common among small firms that offer health insurance to only offer one plan: the 2012 Kaiser/HRET Employer Health Benefit Survey reveals that 83% of small firms (3-199) who offer health insurance offer only one plan (Kaiser Family Foundation 2012).

behavior. Results (available from authors) are virtually unchanged from those we report below if we limit the sample to firms with 10 employees, suggesting that results are not being driven by employer-responses to employee health care spending.

Table 1 presents descriptive statistics for individual enrollees by policy year. Our data include 2,380 company-years representing 959 unique firms. Note that the period represents the start-up period for the insurer's operation, which began operation in 2000, and thus there are few employers in the early years. We limit the analysis to firms with information for full policy years. Therefore, because our data only include completed policy years ending by 7/31/06 the number of firms (observations) in the sample is reduced substantially in 2005. The average firm size is approximately 25 employees. The average age of the employee is about 40 years.[5] In just over half of cases the employee is a single enrollee. Not surprisingly, and consistent with national trends, spending in all categories increased over time. Outpatient spending increased from $2350 in 2001 to $2872 in 2005 and average pharmaceutical spending more than doubled over the period. The fraction of enrollees using inpatient services stayed relatively constant at 15% over the period, though average spending on inpatient care increased.

3. Research Design and Econometric Methods

Our objective is to obtain estimates of the association between outpatient care (spending) and inpatient care (spending). This empirical objective is motivated by two hypotheses grounded in theory as to the causes of an association between outpatient care (spending) and inpatient care (spending). The first hypothesis is that outpatient care consists of treatments that repair health subsequent to illness and/or prevent illness. This hypothesis is consistent with the human capital model of the demand for health and health care (Grossman 1972). In this case, outpatient care is health improving and, all else equal, will decrease inpatient care, which is an indicator of serious

[5] For family units the characteristics represent the employee.

illness. The all else equal assumption is particularly important because the association between the quantity of outpatient and inpatient care is almost surely positive if health shocks are not well measured because such shocks will cause an increase in both outcomes. The second hypothesis is that outpatient care consists of treatments that have little value in terms of repairing health or preventing illness. This hypothesis is consistent with theories of physician agency and supplier induced demand (e.g., McGuire 2000), and the geographical variation in treatments documented by the Dartmouth Atlas of Health Care (Fisher et al. 2003). In this case, more outpatient care results in greater inpatient care, as physicians exercise discretion and treat marginal illnesses "aggressively" using intensive, inpatient care. The two hypotheses are not mutually exclusive and it is likely that outpatient care has characteristics consistent with both hypotheses. Here, we estimate the average association between outpatient and inpatient care.

Ideally, our estimates are interpretable as causal estimates. To obtain such estimates, we estimate the following regression model:

$$(1)\ IPUSE_{ijt} = \alpha_j + \delta_t + \beta_1\ OUTSPEND_{ijt} + \beta_2\ COIN_{jt} + \beta_3\ COOUT_{jt} + \beta_4 HOSPDEDUCT_{jt} + \beta_5 OOPMAX_{jt} + \gamma X_{ijt} + \varepsilon_{ijt}.$$

In equation (1), inpatient utilization (i.e., any use) of employee/family *i* in firm *j* in year *t* depends on a firm-specific fixed effect, α_j; year fixed effects, δ_t; coinsurance for in-network care (*COIN*); coinsurance for out-of-network care (*COOUT*); the hospital-specific deductible (*HOSPDEDUCT*), which represents an out-of-pocket payment requirement associated with each inpatient or outpatient surgery event; the out-of-pocket maximum (*OOPMAX*), which is the maximum amount that can be paid out-of-pocket by the enrollee during the policy year; and personal characteristics (*X*) of the employee/family (e.g., age, gender, number of dependents, year of tenure in the plan). Note that all insurance plan features vary only by firm, year and type of insurance unit (family vs. individual). Our interest is in the effect of outpatient spending (*OUTSPEND*) on inpatient use. Also note that equation (1) only contains insurance plan features that are related to inpatient spending, and plan characteristics specific to outpatient spending such as the outpatient deductible and the employee HRA are omitted.

The main challenge in estimating equation (1) is that outpatient spending may be influenced by unmeasured characteristics that also affect inpatient spending, most notably health status. To address the potential endogeneity concern we use an instrumental variables approach. The instruments for outpatient spending are the employer's contribution to the spending account (HRA), the outpatient deductible, and pharmacy copayment levels. These benefit design features are determined prior to the start of the year and affect only the cost of outpatient use. For example, a change in the amount of employer's contribution to the HRA, which by design is only relevant to outpatient spending, will affect outpatient use, but not inpatient use beyond how outpatient use affects inpatient use.[6]

The identifying assumption of the instrumental variables approach is that employers make decisions regarding HRA contributions and other benefit design features independently of employee health and preferences for health care. Plausible explanations for employer changes in benefit design include the rising costs of health care, changes in firm profitability or the firm's competitive position that affect decisions about compensation (including health care benefits), and potential adjustments to a new benefit plan for which the firm had no prior experience. It is important to note that equation (1) includes firm-specific fixed effects that control for time

[6] It is possible that an employer's contribution to the account could have an income effect on the household and thus indirectly change inpatient spending, but given the relatively small magnitudes involved the size of such an effect would be exceedingly small.

invariant employer-specific factors that might be associated with both health care spending and health plan characteristics. Below, we present evidence that supports the identification assumption underlying the instrumental variables approach.

In Table 2, we present data on benefit plan characteristics that are the source of variation used to instrument for outpatient spending. The figures in Table 2 have been adjusted for the changing composition of firms in order to provide a description of how plan features have changed over time within firm, which is the key source of variation that we use to obtain estimates of the association between inpatient and outpatient spending. The values in Table 2 indicate that employers tend to decrease plan generosity systematically over time: employer account contributions fall over time within firm by approximately $100 per year and the outpatient deductible increases by approximately $50 per year.[7] The observed changes represent compelling and substantial sources of within-firm variation in outpatient benefit generosity that are expected to affect outpatient spending decisions by enrollees. Importantly, the changes pertain only to outpatient spending and therefore provide a source of plausibly exogenous variation to identify the association between inpatient and outpatient spending.

The specification of the first stage model used to predict outpatient spending is:

$$(2)\ OUTSPEND_{ijt} = \theta_j + \tau_t + \pi_1\, EMPCONTRIB_{jt} + \pi_2\, OUTDEDUCT_{jt} + \pi_3 COPAY_{jt} + \pi_4 COIN_{jt} + \pi_5 COOUT_{jt} + \pi_6 OOPMAX_{jt} + \pi_7 HOSPDEDUCT_{jt} + \rho X_{ijt} + \eta_{ijt}.$$

[7] We do not directly observe the employer contributions to the HRA in our data because the insurer only recorded the total contribution to the account balance at the beginning of the year. Nevertheless, we are able to proxy for the employer's contribution by determining the *minimum* observed account balance measured at the beginning of the policy year among employees in firm *j* and year *t*. The minimum account balance is specific to employees in each coverage option: single, employee plus one dependent, employee plus two or more dependents. Hence to the extent that at least one employee in each coverage option-firm-year cell chooses not to contribute to their account (the calculation excludes rollover dollars), our approach will identify the true contribution of the firm to the account. If all employees contribute some amount to the HRA, the minimum observed amount is a reasonable proxy to the generosity of the employer contribution. See Lo Sasso et al. (2010) for additional details.

In equation (2), outpatient spending depends on the following excluded instruments that by design can only affect outpatient spending: employer contribution to the account (*EMPCONTRIB*), the outpatient deductible (*OUTDEDUCT*), and the pharmacy copayment level (*COPAY*). In addition, the other plan features that may affect inpatient care and personal characteristics described in equation (1) are included in the model.

Instrumental variables estimates obtained from equations (1) and (2) represent local average treatment effects (LATE). As illustrated in Table 2 the primary sources of variation driving changes in outpatient care are changes in employer contributions to the HRA and changes in the outpatient deductible. Thus the employees who are induced to alter their consumption of outpatient care are a relatively healthy group of employees and unlikely to be chronically ill who predictably exceed the deductible.

To this point we have ignored dynamic aspects of the problem. However, outpatient care this year may affect inpatient care in the subsequent year. That is, being treated on an outpatient basis for a condition *last* year may avoid a hospitalization *this* year. Alternatively, if spending involves largely “supply sensitive” care then previous outpatient spending has little effect on current health (perhaps even a negative effect) and will have little influence on current inpatient care. In fact, outpatient spending last year that is largely “supply sensitive” may increase inpatient spending this year because of the persistence of such physician-induced care. Still further, if some outpatient care is necessary as a follow-up to inpatient care we might be concerned about the timing of events in the contemporaneous model above. In this manner, lagged outpatient care must clearly precede current inpatient care. In order to assess the influence of lagged outpatient spending on current inpatient care, we reformulate our model as:

$$(3)\ IPUSE_{ijt} = \alpha_j + \delta_t + \beta_1\, OUTSPEND_{ij(t-1)} + \beta_2\, COIN_{jt} + \beta_3\, COOUT_{jt} + \beta_4 HOSPDEDUCT_{jt} + \beta_5 OOPMAX_{jt} + \gamma X_{ijt} + \varepsilon_{ijt}$$

where inpatient use in time *t* is function of lagged outpatient use. We are able to instrument for lagged outpatient spending with same (lagged) instrument set described earlier.

The specification of equation (3) yields estimates of the total effect of lagged outpatient spending on inpatient care that includes the direct association and the indirect associations that operate through current outpatient spending and lagged inpatient spending. If outpatient spending is truly preventive, and the relationship is dynamic, we expect the estimate of the association between lagged outpatient spending and inpatient care to be negative. One necessary compromise in the lagged specification is that it requires three, not two, years of consecutive enrollment by firms, thus reducing our sample size considerably.[8]

We also estimate an alternative specification in which we include current outpatient spending in the model:

$$(4)\ IPUSE_{ijt} = \alpha_j + \delta_t + \beta_1\, OUTSPEND_{ijt} + \beta_2\, OUTSPEND_{ijt-1} + \beta_3 COIN_{jt} + \beta_4\, COOUT_{jt} + \beta_5 HOSPDEDUCT_{jt} + \beta_6 OOPMAX_{jt} + \gamma X_{ijt} + \varepsilon_{ijt}.$$

The only difference between equations (3) and (4) is the inclusion of contemporaneous outpatient spending. Including current outpatient spending eliminates the indirect association

[8] We have assumed a dynamic model in which lagged inpatient care does not affect current inpatient care. Not doing so would require data on four years for each firm. We do not have sufficient data to estimate such a model.

between lagged outpatient spending and inpatient care that operates through current outpatient spending.

4. Results

4.a. First Stage—Associations between Plan Characteristics and Outpatient Spending

Table 3 displays estimates of the effect of a hypothetical $100 increase in the employer contribution to the HRA on outpatient spending. The employer contribution is only one of three excluded instruments in our model, but it provides a representative example of how the change in outpatient care is manifested. A full set of estimates can be found in Appendix Table 1. The estimate indicates that an additional $100 contribution to the HRA account yields a $32 increase in outpatient spending. The estimate is statistically significant suggesting a strong first stage relationship between the employer's contribution to the HRA and outpatient spending.[9]

In order to understand what components of outpatient care change when the employer contribution changes, we estimated similar first-stage regression models for three major components of outpatient spending plus a residual category, which we refer to as "other". The first category includes spending on outpatient specialty services (services provided by otorhinolaryngology, pulmonologist, allergist, neurologist, dermatology, and rehabilitation, among others). The second category includes spending on office visits defined as office-based evaluation and management for new or established patients ranging from 10 minutes to 1 hour. The third category includes spending on prescription drugs. All other outpatient spending is aggregated into the "other" category. Estimates indicate that a $100 increase in employer contribution to the HRA is associated with a $11 increase in spending on outpatient specialty services; an $8 increase in spending associated with office visits; a $6 increase in spending on prescription drugs; and a $7 increase in "other" outpatient spending. The results in Table 3

[9] The F-statistic associated with the excluded instruments is 23. Standard errors calculated with a bootstrap.

suggest that a more generous employer contribution to the account leads patients to visit the doctor's office more frequently (25% of the total effect), which in turn leads to referrals to outpatient specialty care (one-third of the total effect) and some change in pharmaceutical use (20% of the total effect). In the next section we consider whether the observed increases in outpatient care are associated with changes in inpatient utilization.

4.b. Relationship between Inpatient and Outpatient Spending

Table 4 reports OLS and instrumental variables estimates of the relationship between inpatient spending and outpatient spending. Two dependent variables are used: a binary variable representing the presence of any inpatient spending and the amount of inpatient spending (including zero spending). For each dependent-independent variable combination, we estimate two model specifications that differ according to whether we include age by gender interaction terms. We provide the alternative specifications to assess whether changes in employee characteristics over time that are known to affect health and spending on medical care affect estimates. If the age-gender interaction terms have little effect on our main coefficient of interest, it is evidence in support of the research design. We present estimates of equation (1) for both dependent variables obtained using linear regression methods.[10]

OLS estimates in the left hand side of Table 4 indicate that a $100 increase in outpatient spending is associated with a 0.2 percentage point increase in the probability of having any inpatient spending. IV estimates indicate that a $100 increase in outpatient spending is associated with a 0.4 percentage point (2.7% of mean) increase in the probability of having any inpatient spending. Not surprisingly, given the results in Table 3, the F-statistics for the joint significance of the excluded instruments are between 23 and 25 depending on the model. Also, we fail to

[10] We have also estimated logit models for binary outcomes and, for analyses of inpatient spending, generalized linear models using a gamma distribution with log link. Estimates from the alternative models were very similar to the linear models and are available upon request of the authors.

reject the null hypothesis in the over-identification test, which is important evidence supporting the validity of the research design.

To put the IV estimate of the effect of outpatient spending in context, consider that the employer contribution to the HRA account declined by approximately $500 on average between 2000 and 2005. Using the estimate from Table 3, this decline in the employer contribution is associated with a $160 decrease in annual outpatient spending. Based on the estimate of the association between outpatient spending and the probability of any inpatient care, this $160 decrease in outpatient spending decreased the probability of having any inpatient care by 4.4%.[11] This is a clinically and economically significant effect of the observed change in the employer contribution to the HRA account. Also note that the addition of age-by-gender interaction terms to the model has virtually no effect, which suggest that changes in employee composition are not affecting estimates. In fact, Appendix Table 3 displays estimates from a model that includes individual fixed effects. Estimates are very similar to the results shown in Table 4, but the precision of estimates is substantially reduced because of a smaller sample.

The right hand panel of Table 4 presents estimates of relationship between outpatient spending and inpatient spending. The OLS estimate of the association between outpatient spending and inpatient spending indicates that a $100 increase in outpatient spending is associated with a $77 (4 percent) increase in inpatient spending. The 2SLS estimate of same relationship indicates a slightly larger effect size of $89 (4.6%). Consider the effect of the $160 decrease in outpatient spending as a result of the change in average employer contributions between 2000 and 2005 on inpatient spending. Such a decrease in outpatient spending decreased inpatient spending by $144.

[11] Appendix Table 2 contains full regression results.

As we have noted, IV estimates tend to be larger (in absolute value) than OLS estimates. While this circumstance may appear to be surprising given that a likely source of bias of OLS estimates is unmeasured health that would tend to make OLS estimates larger (more positive) than IV estimates, it is important to recognize the LATE nature of the IV estimate. Only in the case of no treatment heterogeneity is it reasonable to compare IV and OLS estimates for the purpose of discussion of possible causes of bias. Absent this special case, IV (LATE) and OLS procedures are estimating different parameters, and there is no expectation that one should be larger or smaller than the other. In this case, changes in outpatient spending that we use are most likely affecting relatively healthy people (as compared to chronically ill) with some ailments and they are likely to differ from the average patient.

Table 5 presents estimates from the simple, dynamic model described earlier. Here, we allow for a lagged effect of outpatient spending. The use of lagged spending addresses concerns about the temporal order of outpatient and inpatient spending as well as concerns that effects of outpatient spending on inpatient care are delayed. We focus our discussion on the instrumental variables estimates. The estimate of the association between lagged outpatient spending and any inpatient care is 0.0026 and statistically significant. The IV estimate of the association between lagged outpatient spending and inpatient spending is positive, small and not statistically significant. Combined, estimates suggest that lagged outpatient care increases the proportion of sample with some inpatient care, but reduces inpatient spending amount for some portion of those with inpatient spending. However, all estimates are positive, which is inconsistent with the argument that outpatient care is largely preventive and more consistent with the argument that outpatient care is largely of the “supply sensitive” type.

Estimates presented in the third and fourth columns of Table 5 are obtained from a model that includes both lagged and current outpatient spending. IV estimates of associations between lagged outpatient spending and inpatient spending are small and not statistically significant. Standard errors are noticeably larger in the models that include both lagged and contemporaneous outpatient spending. Overall, estimates in Table 5 suggest that lagged outpatient spending has little direct effect on current inpatient care, which is evidence inconsistent with the argument that the association between outpatient spending and inpatient care is largely preventive. In contrast, IV estimates of effects of current outpatient spending on inpatient care in Table 5 remain positive, statistically significant and roughly the same magnitude as estimates obtained from models that omit lagged outpatient spending. Thus, again, we find evidence consistent with the argument that, on average, outpatient care increases the quantity of and spending on downstream care (i.e., inpatient care).

In order to assess what types of inpatient conditions are affected by changes in outpatient care, we examined the effects of outpatient spending on inpatient admissions grouped by the amount of geographical variation in admission rates. Geographical variation in inpatient admissions is often used as a marker for physician discretion—decisions for which there is uncertainty over whether an admission is necessary and/or clinically beneficial (Sirovitch et al. 2008). Changes in outpatient care should plausibly have larger effects on high-variation hospital admissions for which there is a great deal of physician discretion than for low-variation hospital admissions for which there is little physician discretion. For example, we might expect to observe some enrollees induced into back and neck surgical procedures and other care that is subject to greater physician discretion when people are exogenously exposed to greater amounts of outpatient care.

We grouped hospital admissions into categories using diagnosis related group (DRG) codes and the classification system employed by Silber et al. (2010) that was developed to distinguish between inpatient events with low variation across providers (example: major cardiovascular procedures), middle variation across providers (example: laparoscopic cholecystectomy), and high variation across providers (example: spinal fusion surgery). The full list of procedures and DRG codes is available in Appendix Table 4.

Table 6 presents estimates of associations between outpatient spending and hospital admission rates classified by the extent of potential provider discretion. Estimates are generally consistent with expectations. Changes in outpatient spending have minimal effect for low variation procedures, and the effect size increases in absolute value with the degree of variation in care. High variation inpatient care, including back and shoulder procedures increase significantly when individuals use more outpatient health care services. A $100 (4%) increase in outpatient spending is associated with a 0.1 percentage point (5% of mean) increase in the probability of admission for a high-variation condition.

We also assessed whether outpatient spending had an association with hospital admissions for ambulatory-care sensitive (ACS) conditions. ACS conditions are widely thought to be preventable when access to primary care is unimpeded and have been defined by the Agency for Healthcare Research and Quality (AHRQ) as Prevention Quality Indicators (PQIs) and include admissions for diabetes complications, hypertension, asthma, and bacterial pneumonia (AHRQ 2012). Previous work has examined ambulatory care sensitive conditions as an outcome in different populations that could be affected by insurance coverage (e.g., Bindman et al. 1995; Pappas et al. 1997; Shi et al. 1999; Kaestner et al. 2001; Dafny and Gruber 2005). If outpatient spending is largely prevention, then the association between outpatient spending and

ACS admissions is expected to be negative. However, the Dartmouth Atlas of Health Care has examined ambulatory care sensitive conditions and documented that admission rates for these conditions are highly variable across geography, at least in the Medicare population. The high degree of geographic variation implies that the ambulatory care sensitive conditions identified by AHRQ and others may be more discretionary than the developers of these measures believe. Specifically, the Dartmouth authors write: "When science-based guidelines are weak, physicians must be guided by their subjective opinions about the effectiveness of admitting such patients to hospitals, rather than providing treatment in another setting. Hospitalization rates for these – and for most medical conditions – are also highly correlated with the local supply of hospital beds" (Dartmouth Atlas 2012).

The fourth column of Table 6 presents the instrumental variables estimate of the association between outpatient spending and admission for an ambulatory-care sensitive condition. Consistent with Dartmouth Atlas view, we find that increases in outpatient spending results in a statistically significant increase in hospitalizations for ambulatory care sensitive conditions. The effect size, 0.07 percentage points, is close to the estimate associated with high-variation admissions.

Finally, we examined whether outpatient spending was associated with births. Births represent a falsification test related to the measurement of key variables in our specification. While there is little reason to expect increases in the employer contribution to the HRA to have a causal effect on births, if savings account contributions were improperly measured or if employer contributions were altered based on potential health care need an effect might manifest when examining births. Thus it is reassuring that the effect of outpatient spending on births is very close to zero and statistically insignificant.

5. Conclusion

An important issue in assessing recent health care reform is the likely costs and benefits of expanded access to primary care. Proponents of expanded use of primary care often argue that in addition to improving health, expanded primary care use may reduce the costs of health care because increased contact with primary care providers will allow for greater detection of previously unknown and untreated conditions, hence leading to reduced hospitalizations. In this article, we take advantage of a unique health insurance benefit design to assess the causal relationship between outpatient services and hospitalization.

Using proprietary data from an insurer, we employ an instrumental variables strategy to investigate whether variation in the use of outpatient services were associated with changes in hospitalizations. To our knowledge, ours if the first paper to provide such estimates, at least estimates that are plausibly interpretable as causal. Estimates indicated that greater outpatient spending was associated with more hospital admissions and greater inpatient spending. For example, a $100 (4%) increase in outpatient spending was associated with a 2.7% increase in the probability of having an inpatient event and a 4.6% increase in inpatient spending among employees in the employer-sponsored insurance plans in our sample. Moreover, we presented evidence that the increase in hospital admissions associated with greater outpatient spending was for conditions in which it is plausible to argue that the physician could exercise more discretion—treat “aggressively”. In contrast, there was no association between outpatient spending and admissions for births or low-variation procedures such as major cardiovascular care.

The nearly dollar for dollar positive association between changes in outpatient spending and changes in inpatient spending has significant implications for both theory and policy. In terms of theory, our results suggest that outpatient spending and inpatient spending are complements, at least at the margin for which our LATE estimates apply. More importantly, the positive association between outpatient and inpatient spending that we find is not, as is often the case, because unmeasured health confounds the association. Tests of the validity of the instrumental variables research design we employed support its validity, which implies that changes in outpatient spending that result from changes in insurance plan benefit designs are plausibly exogenous. Thus, the positive association between outpatient spending and inpatient spending we find is consistent with the Dartmouth view that much health care spending, in this case outpatient spending, is “supply sensitive” and largely without substantial health benefit. This result persisted even when we estimated a dynamic model that allowed lagged outpatient spending to influence current inpatient care.

It is interesting to note that the context of our results was a high-deductible, “consumer driven” insurance plan with a focus on demand side cost sharing. Our results suggest that consumers appear to respond significantly to changes in cost sharing, and that even though the initial change in consumer health care use in response to changes in cost sharing is for relatively low cost, outpatient care, there is also a decrease in subsequent use of more expensive inpatient care. For example, the $500 average decrease in the employer contribution to the HRA that occurred between 2000 and 2005 was associated with a $160 decrease in outpatient spending and a $144 decrease in inpatient spending. Thus, total spending decreased by $304, or approximately 5%. Our results suggest that high deductible insurance plans targeted at reducing outpatient use of services may be effective at reducing the discretionary use of inpatient services that other researchers have suggested have marginal health benefit. The consumer-directed approach is a contrast to administrative and supply-side approaches to reduce the same supposed unnecessary use of services such as the establishment of the U.S. Preventive Services Task Force that identifies cost-effective prevention services that merit no cost sharing; the establishment of the Patient-Centered Outcomes Research Institute; and payment reforms linking payments to clinical outcomes and how the delivery of care is organized (e.g., accountable care organizations).

Overall, the findings from our study are consistent with the argument made in Sirovich et al. (2008) and others associated with the Dartmouth Atlas of Health Care. In this view, using more primary care services leads to more hospitalizations as a result of physicians' discretionary decisions regarding aggressive and intensive treatment. Cleary not all physicians need to practice medicine in an "aggressive" treatment style for such findings to obtain; when individuals are exogenously induced to use more outpatient care through a more generous insurance plan design, enrollees merely need to have a positive probability of seeing a physician with an aggressive treatment style. In addition, health insurance has a direct effect on hospitalization because it lowers the price of inpatient care. The implication of these findings is that expanding health insurance, as recent federal reform (Patient Protection and Affordable Care Act) proposes, will be cost increasing. While the greater costs associated with increased use of primary care may come with improvements in health, a hypothesis in need of more credible evidence, costs will increase nevertheless. Claims that costs will decrease do not appear to be well founded.

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Table 1 - Descriptive Statistics of Enrollee and Plan Characteristics of Private, Employer-Sponsored Plans

Policy Year Beginning:	2000	2001	2002	2003	2004	2005†
Age	41.82	38.44	40.33	40.01	40.96	41.62
Female	0.51	0.36	0.38	0.37	0.40	0.41
Single	0.67	0.54	0.53	0.55	0.55	0.54
Employee +1	0.13	0.16	0.18	0.16	0.17	0.17
Employee +2	0.21	0.30	0.29	0.28	0.28	0.28
Number of dependents	0.80	1.11	1.07	1.03	1.03	1.02
Total outpatient spending	1349	2350	2471	2445	2501	2872
Any IP/OP surgery spending	0.130	0.165	0.148	0.142	0.144	0.151
Total IP/OP surgery spending	701	1634	1900	1644	1857	2226
Total Drug Spending	281	386	442	466	500	602
Number of Enrollees	184	2,082	8,227	14,501	24,523	22,500
Number of Firms	7	74	339	594	1,013	887

Notes: family coverage is treated as one insurance unit includes only employers whose policy years began no later than 8/1/2005.
† Employer-years starting in 2005 are only a subset of the full set of firms beginning their policy-year in 2005 as claims data were not available after 7/31/06.

Table 2: Within Firm-Adjusted Plan Characteristics

Policy Year Beginning:	2000	2001	2002	2003	2004	2005
Employer Contribution	1,051	811	675	694	631	544
Outpatient Deductible	2,089	1,759	1,719	1,893	1,969	2,043
OOP Max	6720	5869	6743	7275	7850	7980
In-Network Coinsurance	91	92	92	91	91	91
Out-of-network Coinsurance	68	69	69	67	67	66
Hospital/Surgery Deductible	199	91	271	545	640	691
Pharmacy Copay – 10/20/45	1.09	1.07	1.03	0.26	0.00	-0.02
Pharmacy Copay – 10/25/45	-0.10	-0.08	-0.04	0.73	0.97	0.92
Pharmacy Copay – 15/35/60	0.00	0.00	0.01	0.00	0.01	0.10
Pharmacy Copay – 10/20/35 & 5/15/30	0.01	0.01	0.01	0.01	0.02	0.01
Number of Enrollees	184	2,082	8,227	14,501	24,523	22,500

Notes: estimates are time dummies in a regression of employer contribution and deductible on time dummies and employer-by-coverage-type fixed effects.

Table 3 – Estimates of the Effect of Increasing Employer HRA Contribution by $100 (First Stage Model)

Total Outpatient Spending	32.43**
	(9.67)
Outpatient Specialty Services	10.94
	(6.37)
Office visits	7.91**
	(2.03)
Drugs	6.41*
	(2.99)
Other	7.17**
	(1.75)

Notes: N = 72,017. Insurance plan features included in model are: employer contribution to HRA, pharmacy copayment regime indicator variables (10/20/45, 10/25/45, 15/35/60, 10/20/35), outpatient deductible, in-network coinsurance, out-of- network coinsurance, hospital/surgery specific deductible, and stop-loss. Other covariates are: plan characteristics (in-network coinsurance, out-of-network coinsurance, hospital/surgery specific deductible, and stop-loss); enrollee characteristics (age, employee only, employee plus one, employee plus dependents, number of dependents, and indicators years enrolled in plan; year indicators (2000-2005); and firm fixed effects. Age is specified as a linear spline in employee age (less than 25, 25-35, 35-45, 45-55, 65+). Age spline dummies are interacted with gender. "Other" category includes the following: Emergency Room, Preventive, Consultations, Critical Care, Nursing Facility Services, Domiciliary/Rest Home Services, Home Services, Care Plan Oversight Services, Diagnostic Imaging, Diagnostic Ultrasound, Other Radiology (mainly oncology and therapy), Radiation Oncology, Clinical Treatment Planning, Radiation Treatment, Proton Beam Treatment, Hyperthermia, Clinical Brachytherapy, Nuclear Medicine, Musculoskeletal System, Cardiovascular System, and Pathology. Full estimates available in Appendix Table 1.
Standard errors clustered at the firm in parentheses.
** = statistically significant at 1% level; * = statistically significant at 5% level

Table 4: Firm Fixed Effect Estimates of the Effect of Outpatient Spending on Inpatient Care

	Any Inpatient Spending (mean = 0.147; σ = 0.354)			Total Inpatient Spending (mean = 1,925; σ = 12,457)		
	OLS	IV	IV	OLS	IV	IV
Total Outpatient Spending ($100s)	0.0020**	0.0041**	0.0041**	77.43**	89.35**	89.34**
	(0.0003)	(0.0005)	(0.0005)	(9.23)	(15.81)	(15.80)
F-statistic of Excluded Instruments		22.94	22.54		22.94	22.54
P-value of Hansen J-Statistic (Over ID-test)		0.1084	0.1071		0.3420	0.3412
Age-by-Sex Interactions	No	No	Yes	No	No	Yes

Notes: Sample size = 72,017. Standard errors in parentheses are clustered on firm. Mean of Total Outpatient Spending (scaled by 100) = 25.95. Each observation represents a family-unit-year observation. The model includes year effects, firm fixed effects, plan characteristics (in-network coinsurance, out-of-network coinsurance, hospital/surgery specific deductible, and stop-loss) and enrollee characteristics ((age, employee only, employee plus one, employee plus dependents, number of dependents, and indicators years enrolled in plan).Employee age is specified as a linear spline in employee age (less than 25, 25-35, 35-45, 45-55, 65+). IV model is the identified by inclusion of employer contribution to HRA, pharmacy copayment regime indicator variables (10/20/45, 10/25/45, 15/35/60, 10/20/35), and outpatient deductible.

** = statistically significant at 1% level; * = statistically significant at 5% level

Table 5: Firm Fixed-Effect Estimates of the Association Between Lagged and Current Outpatient Spending and Inpatient Care

	OLS	IV †	OLS	IV †
	Panel A: Any Inpatient Spending			
Outpatient Spending ($100s)	-	-	0.0019**	0.0036**
			(0.0005)	(0.0009)
Lagged Outpatient Spending ($100s)	0.0009**	0.0026**	0.0002	0.0019*
	(0.0002)	(0.0005)	(0.0002)	(0.0009)
	Panel B: Total Inpatient Spending			
Outpatient Spending ($100s)	-	-	81.43**	112.11**
			(12.85)	(35.48)
Lagged Outpatient Spending ($100s)	33.21**	0.21	1.95	-19.85
	(6.33)	(23.71)	(8.09)	(30.24)

Notes: Sample size = 28,150. The number of firms is 865. All other standard errors are clustered on firm unless otherwise noted.
Mean of dependent variable = 1466; mean of Outpatient Spending ($100s) = 25.95; mean of Lagged Outpatient Spending ($100s) = 29.67. Standard errors in parentheses are clustered on firm. Each observation represents a family-unit-year observation. The model includes year fixed effects, firm fixed effects, plan characteristics (in-network coinsurance, out-of-network coinsurance, hospital/surgery specific deductible, and stop-loss) and enrollee characteristics (age, employee only, employee plus one, employee plus dependents, number of dependents, and indicators years enrolled in plan).Employee age is specified as a linear spline in employee age (less than 25, 25-35, 35-45, 45-55, 65+). Age spline dummies are interacted with gender. IV model is the identified by inclusion of the following variables and/or their lags: employer contribution to HRA, pharmacy copayment regime indicator variables (10/20/45, 10/25/45, 15/35/60, 10/20/35), and outpatient deductible.
† Bootstrapped standard errors use 500 replications.
** = statistically significant at 1% level; * = statistically significant at 5% level

Table 6: 2SLS Estimates of the Association Between Outpatient Spending and Inpatient Care for Particular Inpatient Diagnoses

	(1) Low Variation Inpatient Visit	(2) Middle Variation Inpatient Visit	(3) High Variation Inpatient Visit	(4) Ambulatory Care Sensitive	(5) Birth
Outpatient Spending ($100)	0.00023	0.00037**	0.00109**	0.00067**	0.00008
	(0.00023)	(0.00014)	(0.00026)	(0.00015)	(0.00017)
Mean of Dependent Variable	0.0237	0.0044	0.0209	0.0131	0.0158

Notes: N = 72,017. All regressions are 2SLS with firm fixed effects. Standard errors in parentheses are clustered on firm. All models have age*female interactions. Ambulatory care sensitive conditions are defined by the Agency for Healthcare Research and Quality as Prevention Quality Indicators (PQIs) and are described at (http://www.qualityindicators.ahrq.gov/modules/pqi_resources.aspx). Definition of “low”, “middle” and “high” are available in the appendix. The mean of outpatient spending is 25.95. The F-Statistic of excluded instruments is 8.860. The model includes year fixed effects, firm fixed effects, plan characteristics (in-network coinsurance, out-of-network coinsurance, hospital/surgery specific deductible, and stop-loss) and enrollee characteristics (age, employee only, employee plus one, employee plus dependents, number of dependents, and indicators years enrolled in plan).Employee age is specified as a linear spline in employee age (less than 25, 25-35, 35-45, 45-55, 65+). Age spline dummies are interacted with gender. IV model is the identified by inclusion of employer contribution to HRA, pharmacy copayment regime indicator variables (10/20/45, 10/25/45, 15/35/60, 10/20/35), and outpatient deductible.
** = statistically significant at 1% level; * = statistically significant at 5% level

Appendix Table 1: First-stage Estimates of Effects on Outpatient Spending

First Stage: *Outpatient Spending ($100s)*		
Employer HRA Contribution	0.0032***	(0.001)
Outpatient Deductible	-0.0025***	(0.0004)
Copayment: 10/25/45 [10/20/45 omitted]	-8.793***	(1.783)
Copayment: 15/35/60 [10/20/45 omitted]	0.574	(2.384)
Copayment: 10/20/35 [10/20/45 omitted]	-4.179	(4.511)
In-network Coinsurance	0.433***	(0.105)
Out-of-network coinsurance	0.208*	(0.119)
Hospital Deductible	-0.002**	(0.001)
Stop-loss	0.0001	(0.0002)
Household, 1 dependent	12.967***	(1.206)
Household, 2+ dependents	13.911***	(2.576)
Number of dependents	5.770***	(0.639)
Year 2 enrolled	5.883***	(0.781)
Year 3 enrolled	7.781***	(1.248)
Year 4 enrolled	10.871***	(1.902)
Year 2001	17.207***	(5.174)
Year 2002	19.316***	(5.852)
Year 2003	26.088***	(6.196)
Year 2004	24.552***	(6.436)
Year 2005	23.130***	(6.544)
Age 25-34	-1.697	(1.124)
Age 35-44	2.823**	(1.300)
Age 45-54	11.026***	(1.407)
Age 55-64	20.673***	(1.440)
Age 65+	30.827***	(2.762)
Female	1.407***	(0.588)

Notes: Regression includes firm fixed effects. Standard errors clustered on firm are in parentheses. The instruments excluded from the inpatient equation include employer HRA contribution, outpatient deductible, and pharmacy copayment regime indicator variables (10/20/45, 10/25/45, 15/35/60, 10/20/35). The F-statistic for the excluded instruments is 22.94. The sample size is 72,017 which includes 1,506 firms.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix Table 2: OLS and 2SLS Estimates of the Effect of Outpatient Spending on Inpatient Care

	Any Inpatient Spending			Inpatient Spending		
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
Outpatient Spending	0.002***	0.004***	0.004***	77.430***	89.349***	89.337***
	(0.000)	(0.001)	(0.001)	(9.225)	(15.809)	(15.798)
In-network coinsurance	0.002***	0.001	0.001	7.734	1.735	1.708
	(0.001)	(0.001)	(0.001)	(24.885)	(25.548)	(25.562)
Out-of-network Coinsurance	-0.001	-0.001*	-0.001*	-23.382	-26.224	-26.214
	(0.001)	(0.001)	(0.001)	(15.807)	(16.474)	(16.469)
Hospital Deductible	0.000	0.000	0.000	0.079	0.102	0.102
	(0.000)	(0.000)	(0.000)	(0.079)	(0.108)	(0.108)
Stop-loss	0.000	0.000	0.000	-0.021	-0.021	-0.021
	(0.000)	(0.000)	(0.000)	(0.036)	(0.037)	(0.037)
Household, 1 Dependent	0.042***	0.018*	0.018**	8.422	-128.672	-134.295
	(0.006)	(0.007)	(0.007)	(207.394)	(234.913)	(232.021)
Household, 2+ Dependent	0.061***	0.039***	0.040***	113.995	-15	-20.13
	(0.009)	(0.011)	(0.011)	(337.337)	(377.832)	(378.625)
Number Dependent	0.019***	0.008	0.007	-97.528	-167.079	-166.444
	(0.003)	(0.005)	(0.005)	(112.904)	(130.426)	(132.627)
Year 2 enrolled	0.022***	0.010*	0.010*	323.691**	253.874	254.143
	(0.004)	(0.005)	(0.005)	(118.071)	(147.565)	(147.615)
Year 3 enrolled	0.027***	0.011	0.011	370.728	280.739	281.181
	(0.006)	(0.007)	(0.007)	(237.377)	(256.043)	(256.271)
Year 4 enrolled	0.040***	0.018	0.018	309.895	182.902	184.022
	(0.010)	(0.012)	(0.012)	(339.017)	(382.101)	(382.731)
Year 2001	-0.002	-0.037	-0.036	367.146	165.274	165.556
	(0.026)	(0.030)	(0.030)	(895.857)	(954.845)	(958.519)
Year 2002	-0.031	-0.068*	-0.068*	165.372	-54.19	-55.007
	(0.026)	(0.030)	(0.030)	(881.656)	(943.276)	(946.387)
Year 2003	-0.047	-0.084**	-0.083**	-328.274	-544.655	-545.224
	(0.027)	(0.031)	(0.031)	(895.548)	(959.062)	(962.280)
Year 2004	-0.065*	-0.094**	-0.094**	-244.307	-413.474	-414.695
	(0.028)	(0.031)	(0.031)	(886.576)	(942.807)	(946.001)
Year 2005	-0.085**	-0.111***	-0.111***	-231.164	-385.25	-386.454
	(0.029)	(0.031)	(0.031)	(892.563)	(942.692)	(945.574)
Age 25-34	0.007	0.011*	0.009	-90.807	-70.850	-104.829
	(0.004)	(0.005)	(0.005)	(125.079)	(126.877)	(159.496)
Age 35-44	0.002	-0.004	-0.002	-311.167*	-346.384*	-374.810*
	(0.005)	(0.007)	(0.006)	(140.927)	(149.464)	(182.794)

Age 45-54	0.005	-0.018	-0.019	-89.371	-222.532	-214.568
	(0.006)	(0.009)	(0.010)	(192.815)	(256.208)	(319.820)
Age 55-64	0.037***	-0.005	-0.006	582.689*	333.514	336.19
	(0.009)	(0.014)	(0.016)	(286.862)	(428.157)	(548.316)
Age 65+	0.073***	0.01	0.015	536.386	164.313	177.058
	(0.015)	(0.022)	(0.026)	(545.666)	(719.435)	(866.187)
Female	0.013***	0.010**	0.009	24.758	7.359	-29.679
	(0.003)	(0.003)	(0.010)	(108.326)	(104.465)	(234.855)
(Age 25-34)*Female			0.005			82.861
			(0.011)			(242.012)
(Age 35-44)*Female			-0.006			74.183
			(0.011)			(275.761)
(Age 45-54)*Female			0.003			-21.829
			(0.011)			(335.289)
(Age 55-64)*Female			0.003			-3.925
			(0.013)			(504.390)
(Age 65+)*Female			-0.014			-33.16
			(0.025)			(1003.582)
Constant	-0.063			1044.327		
	(0.062)			(2373.315)		
Adjusted R-Square	0.151	0.033	0.033	0.122	0.101	0.101
N	72,017	72,017	72,017	72,017	72,017	72,017

Notes: Standard errors in parentheses are clustered on firm

* p < 0.10, ** p < 0.05, *** p < 0.01

Appendix Table 3: Member and Firm Fixed Effect Estimates

	Any Inpatient Spending (mean = 0.159; σ = 0.366)		Total Inpatient Spending (mean = 2,064; σ = 12,665)	
	OLS	IV	OLS	IV
	Panel A: Member Fixed Effect (# of members = 19,383)			
Total Outpatient Spending ($100s)	0.0017***	0.0033**	74.08***	144.38**
	(0.0004)	(0.0017)	(12.07)	(55.66)
F-statistic of Excluded Instruments		2.09		2.09
P-value of Hansen J-Statistic (Over ID-test)		0.736		0.424
	Panel B: Firm Fixed Effect (# of firms = 866)			
Total Outpatient Spending ($100s)	0.0019***	0.0033***	74.82***	92.20***
	(0.0003)	(0.0007)	(10.80)	(19.85)
F-statistic of Excluded Instruments		12.78		12.78
P-value of Hansen J-Statistic (Over ID-test)		0.611		0.602

Notes: Sample size = 47,537. Standard errors in parentheses are clustered on firm. The member fixed effect model drops 24,480 singleton observations. To maintain a consistent sample, these same observations are excluded from all regressions in table. See notes from Table 4 for description of covariates.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix Table 4: **Definitions of Low, Middle and High Variation Surgical DRGs**

Low Variation:
491: Major Joint and Limb Reattachment Procedures of Upper Extremity
191: Pancreas Liver and Shunt Procedures
209: Major Joint and Limb Reattachment Procedures of Lower Extremity
159: Hernia Procedures except Inguinal and Femoral on patients older than 17 with complications and comorbidities
160: Hernia Procedures except Inguinal and Femoral on patients older than 17 without complications and comorbidities
110: Major Cardiovascular Procedures with complications and comorbidities
111: Major Cardiovascular Procedures without complications and comorbidities
170: Other Digestive System Operating Room Procedures with complications and comorbidities
171: Other Digestive System Operating Room Procedures without complications and comorbidities
154: Stomach Esophageal and Duodenal Procedures on patients older than 17 with complications and comorbidities
155: Stomach Esophageal and Duodenal Procedures on patients older than 17 without complications and comorbidities
218: Lower Extremity and Humerus Procedures except on the Hip, Foot, and Femur on patients older than 17 with complications and comorbidities
219: Lower Extremity and Humerus Procedures except on the Hip, Foot, and Femur on patients older than 17 without complications and comorbidities
210: Hip and Femur Procedures except on Major Joints in patients older than 17 with complications and comorbidities
211: Hip and Femur Procedures except on Major Joints in patients older than 17 without complications and comorbidities
148: Major Small and Large Bowel Procedures with complications and comorbidities
149: Major Small and Large Bowel Procedures without complications and comorbidities
150: Peritoneal Adhesiolysis with complications and comorbidities
151: Peritoneal Adhesiolysis without complications and comorbidities

Middle Variation:
493: Laparoscopic Cholecystectomy without Common Duct Exploration with complications and comorbidities
494: Laparoscopic Cholecystectomy without Common Duct Exploration complications and comorbidities
217: Wound Debridement and Skin Graft except Hand for Musculoskeletal and Connective Tissue Disorders
114: Upper Limb and Toe Amputation for Circulatory System Disorders
197: Cholecystectomy except by Laparoscope without Common Duct Exploration with complications and comorbidities
198: Cholecystectomy except by Laparoscope without Common Duct Exploration without complications and comorbidities
292: Other Endocrine Nutrition and Metabolic Operating Room Procedures with complications and comorbidities

293: Other Endocrine Nutrition and Metabolic Operating Room Procedures without complications and comorbidities
216: Biopsies of Musculokeletal System and Connective Tissue
257: Total Mastectomy for Malignancy with complications and comorbidities
258: Total Mastectomy for Malignancy without complications and comorbidities
146: Rectal Resection with complications and comorbidities
147: Rectal Resection without complications and comorbidities
157: Anal and Stomal Procedures with complications and comorbidities
158: Anal and Stomal Procedures without complications and comorbidities
226: Tissue Procedures

High Variation:
287: Skin Graft and Wound Debridement for Endocrine, Nutrition and Metabolic Disorders
497: Spinal Fusion except Cervical with complications and comorbidities
498: Spinal Fusion except Cervical without complications and comorbidities
233: Other Musculoskeletal System and Connective Tissue Operative Room Procedures with complications and comorbidities
234: Other Musculoskeletal System and Connective Tissue Operative Room Procedures without complications and comorbidities
263: Skin Graft and/or Debridement for Skin Ulcer Cellulitis with complications and comorbidities
264: Skin Graft and/or Debridement for Skin Ulcer Cellulitis without complications and comorbidities
120: Other Circulatory System Operation Room Procedures
161: Inguinal and Femoral Hernia Procedures on patients older than 17 with complications and comorbidities
162: Inguinal and Femoral Hernia Procedures on patients older than 17 without complications and comorbidities
223: Major Shoulder/Elbow Procedures or other Upper Extremity Procedures with complications and comorbidities
224: Major Shoulder/Elbow Procedures or other Upper Extremity Procedures without complications and comorbidities
113: Amputation for Circulatory System Disorders except Upper Limb and Toe
499: Back and Neck Procedures except Spinal Fusion with complications and comorbidities
500: Back and Neck Procedures except Spinal Fusion without complications and comorbidities
193: Billary Tract Procedures except only total Cholecystectomy with or without Common Duct Exploration with complications and comorbidities
194: Billary Tract Procedures except only total Cholecystectomy with or without Common Duct Exploration without complications and comorbidities