Do Physicians' Financial Incentives Affect Medical Treatment and Patient Health? Online Appendix

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A. Brief History of Medicare Physician Payments

1. *Medicare Fee Schedule for Physician Services*

Our estimate of how price shocks influence health care provision relies on a number of institutional details about provider payments in the Medicare health insurance system. We therefore include an overview of the Medicare payment system here to strengthen our assumption about the exogeneity of certain price shocks, as argued briefly in section I.[1]

When Medicare was created by the Social Security Act of 1965, physicians were largely skeptical of federal interference in the practice of medicine, raising concern that they might not participate in the program (Newhouse 2003). To encourage their participation, Medicare gave doctors freedom to set their own prices, subject to the constraint that the charges were comparable with the "customary, prevailing and reasonable" rates in the physician's practice area (eventually known as a Fee Schedule Area [FSA] or Medicare Payment Locality [MPL]). Tying reimbursement rates to a physician's practice area would ensure that physicians in high-cost urban areas could obtain reimbursements commensurate with their expenses, while allowing lower reimbursements to be paid to physicians in lower-cost rural areas.

The Health Care Financing Administration (HCFA; now the Center for Medicare and Medicaid Services, or CMS) oversaw Medicare's implementation by hiring contractors (or "carriers") to administer the program in each state. The contractors, who generally had responsibility for one state each, determined which geographic areas would constitute a unique health care market. This decentralized process led to dramatic differences in the distribution of regions across states, as illustrated in the top panel of Figure 1.[2] Wisconsin had eight regions, for example,

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[1]Newhouse (2003, ch. 1) presents a detailed history of these payments, including many facets that are omitted here.

[2]In the instances when a county was split into different Payment Localities, we assign it to the "more urban one", as specified in 61 *FR* 34631 (1996) on the assumption that most medical services in the pre-consolidation era probably took place in the urban and better-reimbursed part of the county.

while neighboring Minnesota (a state of similar population) had only one; Texas had 32 while more populous California had 21. Areas shown in darker shades on the map have higher relative reimbursement rates, while lighter-colored areas have lower prices. As the map makes clear, reimbursement rates are correlated with population or density, as urban areas tend to have higher reimbursements than lower-cost rural areas.

The Payment Localities shown in the top panel of Figure 1 served as the basis for geographic reimbursement differentials from 1965 through the early years of the Resource Based Relative Value Scale (RBRVS) fee schedule.[3] Through the RBRVS fee schedule, HCFA established a quantity measure for each of 8,677 unique services (a number that had expanded to 13,223 by 2005)[4] and a per-unit price index specific to the Locality in which a service was provided. RBRVS was legislated through the Omnibus Budget and Reconciliation Act of 1989,[5] was implemented beginning in 1992[6], and remains in place today. The units of quantity are called Relative Value Units (RVUs) and are intended to measure the real resource intensity associated with providing a given service (Hsiao et al., 1988). The price measure is called the Geographic Adjustment Factor (GAF), which varied across space to account for differences in input costs across the Payment Localities.[7] Within each Locality, the GAF is computed on the basis of average input costs across the counties in the locality.

These input costs are organized into three categories, both for the purpose of determining resource intensity (the RVUs for a service) and for calculating area-specific input prices (the GAF). These categories are known as physician work, practice expense (PE), and malpractice expense (MP). The physician work RVUs are intended to capture "the financial value of physicians' time, skill, and effort that are associated with providing the service" (GAO, 2005, p. 5). CMS computes a Geographic Practice Cost Index (GPCI) associated with physician work in order to account for the different value of physician labor across areas. The work GPCI is computed based on wages of other professionals in the area, and the differences across payment localities are then scaled down by three-quarters (GAO, 2005, p. 7).[8]

The other two types of RVUs are intended to capture the costs of other inputs

[3]Some minor changes occurred, but the 1965 Payment Localities were left largely intact through 1996, which is the year of the localities shown on the map (61 *Federal Register* 59494 [1996]).

[4]The list of services and associated Relative Value Units is provided by CMS at `http://www.cms.gov/PhysicianFeeSched/01_overview.asp` (accessed October 16, 2011).

[5]Pub. L. 101-239 (1989).

[6]56 *FR* 59502 (1991)

[7]The presence of such an adjustment may not be theoretically optimal, but it seems to be politically necessary because of concerns about beneficiaries' access to care in whichever geographic region they choose.

[8]The scaling of work GPCI results from the tension between adjusting prices to accurately compensate for local input costs—hence the existence of GPCIs—and the desire to equalize urban/rural payment differentials. Congress occasionally changes the rules regarding GPCI adjustments, such as arbitrarily imposing a floor on the work GPCI from 2004 through 2006 and on all GPCIs in Alaska in 2005 and 2005 (GAO, 2007, p. 7).

that a physician purchases to perform various services. The practice expense RVUs represent the office rent, staff time, and supplies and equipment needed to perform a service. It includes both fixed costs, such as office rent and capital equipment, and some variable costs such as staff time and disposable supplies. The PE GPCI attempts to adjust for the costs of these inputs across regions, and CMS computes it based on estimates of wages among occupations that supply physicians with inputs (nurses, health technicians, and administrative staff) and area rents. Finally, the malpractice expense RVUs capture a particular service's contribution to the physician's annual malpractice insurance premium. Malpractice insurance premiums are generally fixed annual costs per physician, regardless of the number of services performed. As with part of the PE RVUs, reimbursement for malpractice insurance constitutes an attempt to pay physicians their average costs rather than marginal costs. Malpractice premiums are generally relatively constant within a state, so the MP GPCI varies mostly at the state level rather than within states.

Because reimbursement for a particular service is based on three types of RVUs, each with an associated GPCI, equation (1) was a slight simplification. It is more accurate to model reimbursements for a given service j in area i at time t as:

(A1)

$$\text{Reimbursement}_{i,j,t} = \text{Conversion Factor}_t \times \sum_{type \in \{\text{Work, PE, MP}\}} \text{Relative Value Units}_{type,j} \times \text{Geographic Practice Cost Index}_{type,i}.$$

To escape the endogeneity of both the level of the GAF and the changes due to its regularly scheduled updates, we exploit a substantial one-time change in Medicare's system of geographic adjustments, which took place in 1997 and is described in section I.

2. Contemporaneous Changes in Medicare Payments

The payment area consolidation that supports our identification of supply responses to reimbursement rates took place during an era of many changes in the health care industry. Medicare itself changed many payment policies during the 1990s, largely as a result of Congressional action, and Newhouse (2002, 2003) provides extensive histories of these changes. Cutler and Gruber (2002) discuss other changes to federal payment policies during the 1990s that could affect the Medicare market by changing patients' or providers' behavior. We discuss the most relevant of these changes here to show that they do not threaten our identification strategy.

The introduction of the Resource-Based Relative Value Scale (RBRVS) to determine Medicare Fee Schedule payments starting in 1992 led to dramatic changes in health care supply. The long-term rapid growth in Medicare spending on physician services briefly paused for three years (Newhouse 2002, Figure 13.1), while health spending overall grew less rapidly than before or after that period (Cutler and Gruber 2002, Figure 12.3). This change is an important part of the long-term history of Medicare spending and the RBRVS, but was a national shock that should not differentially affect supply trends within states based on their consolidation status.

Since the RBRVS was introduced, Congress has frequently tinkered with the Conversion Factor that scales RVUs into dollars (Newhouse 2003, ch. 1). Surgeons had a separate (higher) Conversion Factor for a period, and it is eminently plausible that this could differentially affect supply in areas with different proportions of services. The Balanced Budget Act of 1997 (BBA)[9] introduced a new permanent rule for updates to the Conversion Factor. This rule, known as the Sustainable Growth Rate (SGR), replaced the prior Volume Performance Standard and was intended to link Medicare spending to GDP growth. But as soon as the Balanced Budget Reconciliation Act of 1999 (BBRA),[10] Congress began adjusting payments off of the trend set by the SGR formula. Both systematic and idiosyncratic changes to the Conversion Factor influence payment rates for the services we study, but our empirical strategy accounts for such effects and our central identifying assumption is robust to Conversion Factor changes. First, time fixed effects account for the nationwide changes imposed by the adoption of SGR and its subsequent updates. Second, control states that experienced no consolidation, but have counties with similar characteristics to states that experienced consolidations, account for time-varying effects that might result from temporarily paying surgeons more than non-surgeons. Third, the timing of our estimated supply responses coincides with the shock induced by the payment area consolidation.

BBA and BBRA also changed Medicare payment policies for hospitals, post-acute care facilities, home health care providers, and Health Management Organizations serving Medicare beneficiaries. Newhouse (2002) argues that these payment changes had significant impacts on use of services that may be complements or substitutes with physician care. The impacts of Medicare payment rates on total spending depend on these potential interactions, but our geographically-based estimates do not. As long as these payment rates have similar effects on counties with similar observable characteristics, our controls for time-varying effects of county population and our matching estimator will account for effects of these changes independent of the payment area consolidation shocks.

The Medicare Modernization Act of 2003 (MMA)[11] was enacted towards the end of our sample period and introduced Medicare Part D to cover outpatient prescription drugs. Part D was not implemented until 2006, after our sample ends, so changes in substitution patterns between office visits and drug purchases will not influence our estimates. The MMA also changed the GAF for certain

[9]Pub. L. 105-33 (1997)
[10]Pub. L. 106-113 (1999)
[11]Pub. L. 108-173 (2003)

payment areas in 2004 through 2006. Alaska was granted idiosyncratic increases in each GPCI to 1.67 in 2004 and 2005. The MMA also imposed a minimum work GPCI of 1, so payment variation was reduced in the lowest-cost rural areas. This largely affected statewide payment areas in low-cost states that had previously experienced payment locality consolidations, although some sub-state areas were also affected.

National and state-level changes to Medicaid payments and eligibility can spill over into private and Medicare markets (Glied and Graff Zivin 2002), and our period of analysis included numerous such changes (Clemens 2012b). But the state-based nature of the Medicaid program means that such spillovers should affect positively and negatively price-shocked areas identically. Medicaid payment rates are set by individual states, and eligibility is determined by a combination of state and federal policy. Thus our state-by-year fixed effects should effectively account for these changes.

3. Additional Details on Payment Area Consolidation

In general, the payment region consolidation merged together previously distinct fee schedule areas, but there are a few small exceptions to this pattern. Before the consolidation, Massachusetts had an "urban" payment region including the Boston and Worcester areas, and after the consolidation Worcester was split apart from Boston and merged with rural Massachusetts. Similarly, Pennsylvania had grouped Philadelphia and Pittsburgh together prior to the consolidation, and they were split apart afterwards, with Pittsburgh joining the "Rest of Pennsylvania" (excluding Philadelphia) region.

The Medicare fee schedule had 210 payment areas up through 1996. Los Angeles County had eight distinct fee schedule regions, all of which had the same payment rates, so we treat them as one. We drop Puerto Rico and the U.S. Virgin Islands, and we also exclude Alaska from our dataset because of changes in the definitions of some county-equivalent geographic units during this sample period, leaving us with 200 pre-consolidation payment areas in our data.

4. Previous Payment Area Consolidation

In one of the first studies of health care supply with a credible identification strategy, Rice (1983) studies the effects of reimbursement rates on the supply of physician services using a similar geographically-determined shock to the calculation of Medicare "prevailing charges" in the state of Colorado in 1976. Our empirical context is national in scope and hence has several advantages over that utilized by Rice. First, the consolidation generated shocks to prices in 145 of the 210 initial payment localities. This allows us to conduct our analysis at an aggregate geographic level and hence incorporate extensive margins, such as physician participation in Medicare, that previous work at the physician level cannot capture. Also due to the number and variability of our shocks, we obtain reasonable statistical power even while allowing conservatively for correlated errors at the level of the old payment localities.

Second, Rice's consolidation and our consolidations all increased reimbursement rates in a manner negatively correlated with urban density. We use the experience of states that were unaffected by the consolidation to control for differential trends across urban and rural areas. Such controls involving unaffected states were not available to Rice due to data limitations. We are able to study the evolution of care over an extended time period, allowing us to control directly for pre-existing trends that were correlated with the changes in the reimbursement rates. We are also able to follow the dynamics of care provision for close to ten years following the shock to prices. Third, the federal imposition of the consolidation may mitigate concerns that the policy change occurred in response to the experience of a particular health care market.

Finally, Medicare's reimbursement policy was more flexible during the 1970s, when Rice's Colorado consolidation took place. At that time, providers were not obligated to accept Medicare's determination of reimbursement rates, and physicians' willingness to accept Medicare's preferred payment rates is one of the margins that responded to prices in general (Mitchell and Cromwell 1982) and to the 1976 Colorado price shock in particular (Rice and McCall 1982). We have the advantage of studying an era when prices were strictly determined by the Medicare fee schedule, so providers' price behavior was constrained and all adjustments take place on the quantity margin.

B. Empirical Appendix

1. *Payment Area Level Analysis*

As described in section IB, we run our analysis at the payment area level while adjusting our supply and price change measures for county-level controls. To do so, we adopt the following procedure. We first partial the county-level controls out of both our supply and price change measures. We next aggregate the residualized variables to the payment area level. We finally estimate the effect of price changes on care provision in a payment area-level regression.

Step 1: Partial Out Controls

The first step in this procedure is to run a regression identical to equation (2) but with the price change interactions $\Delta RR_i \times I_p$ eliminated as independent variables. We run a version of this regression with the supply measure, and with each year's reimbursement rate interaction, as an outcome:

$$\ln(\text{RVUs}_{i,t}) = \gamma_i + \delta_t + \eta_{s(i),t} + \zeta'\mathbf{X}_{i,t} + \rho_{i,t}. \tag{B1}$$

$$\forall p \quad \Delta RR_i \times I_p = \gamma_i + \delta_t + \eta_{s(i),t} + \zeta'\mathbf{X}_{i,t} + \sigma^p_{i,t}. \tag{B2}$$

Step 2: Aggregate to Payment Area Level

The residuals from these regressions represent an adjusted health care supply measure, $\widehat{\rho_{i,t}}$ and adjusted price change measures, $\widehat{\sigma^p_{i,t}}$ respectively. We aggregate these adjusted measures to the level of pre-consolidation payment areas-by-year by taking a simple average, where $\#a$ denotes the number of counties in payment area a:

$$\widetilde{\rho_{a,t}} = \frac{1}{\#a} \sum_{i \in a} \widehat{\rho_{i,t}} \tag{B3}$$

$$\forall p \quad \widetilde{\sigma^p_{a,t}} = \frac{1}{\#a} \sum_{i \in a} \widehat{\sigma^p_{i,t}} \tag{B4}$$

Step 3: Run Supply Regression at Payment Area Level

Finally, we use these average adjusted residuals in a regression at the level of payment areas by year. We are thus able to conduct inference at the appropriate level, payment area-by-year, while making use of meaningful controls at the county level:

$$\widetilde{\rho_{a,t}} = \sum_{p \neq 0} \theta_p \cdot \widetilde{\sigma^p_{a,t}} + u_{a,t} \tag{B5}$$

In this regression, θ_p represents our estimated supply response in period p, while $u_{a,t}$ is the error term. We estimate standard errors using a nonparametric bootstrap as follows.

Bootstrap Procedure

We compute standard errors using a bootstrap procedure that accounts for:

- Sampling variation in partialing out the controls, in equations (B1) and (B2);
- Sampling variation in the final estimation in equation (B5); and
- Potential correlation between errors over time and within a payment locality.

To do so, we randomly draw 500 samples of pre-consolidation payment areas, with replacement. By sampling payment areas, rather than counties, we allow for clustering in the standard errors at that level. Using each such sample, we estimate equations (B1)-(B5). Our estimated standard error for each coefficient θ_p is the standard deviation of the coefficients $\hat{\theta}_p$ estimated across all 500 replications.

2. *Medicare Claims Data*

In our baseline specification we take several measures to reduce the potential impact of outlier observations. Outliers can have profound effects in studies of health care due to the long right tail of the health spending distribution. Although we have aggregated observations at the county level, outliers remain a concern because the aggregates for many small counties are estimated using a small number of observations. To limit the effect such outliers we take three steps. First, we weight each county-by-year observation by the number of unique patients receiving care in that county in that year, thus limiting the influence of small-sample observations. This makes our results interpretable as estimates of changes in the average quantity of care across patients rather than across counties. Second, we use diagnosis information to construct a standard set of variables indicating the comorbidities affecting each Medicare beneficiary (Elixhauser et al., 1998).[12] In the county-level regressions we account for these health status indicators by controlling for the share of each county's sample population that has two, three, four, and six or more of these comorbidities. We also control for a set of sample-specific demographic variables—the share of beneficiaries in that county belonging to the age groups 65–69, 70–74, 75–80, 80–84, and 85 or more years old, the share female, the shares black and Hispanic, and and the fraction of the beneficiary population eligible for Medicare due to end-stage renal disease—and for the fraction of a county's sample of Medicare beneficiaries that receives coverage through a Medicare Advantage HMO. As a final step, we winsorize the sample at the 1st and 99th percentiles.

Summary statistics computed from these data are presented in Table 1. We split counties into the 333 with a negative price shock from the consolidation, the 1,359 with a positive shock, and the 1,224 counties not involved in a consolidation. Table 1 confirms that the average price increase is larger than the average decline, and areas experiencing negative price shocks tend to be larger, denser, and more frequently in a metropolitan area.[13] As a result, they tend to treat more patients annually, provide substantially more care, and receive substantially more Medicare charges. Aggregating the three groups together, the claims data include nearly 51 million claims annually, representing 74 million RVUs, which together are worth $2.7 billion. These claims represent care from an average of 1,021 patients per county, but the data come from only 1.6 million unique patients since the average patient is treated by providers in two counties each year. There are no noticeable differences in average patient health (measured by number of Elixhauser comorbidities) or demographics across the three groups of counties.

3. Definition of Elective Procedures

We define elective procedures to include minor procedures, ambulatory procedures, eye procedures, orthopedic procedures, and imaging procedures, in partic-

[12]The number of diagnoses could certainly be endogenous with respect to the GAF, but we find no evidence for a response of diagnoses to the consolidation-induced shock physician reimbursement rates.

[13]Metropolitan area counties are defined using the Office of Management and Budget's 1999 definitions, with all counties in a Metropolitan Statistical Area or New England Consolidated Metropolitan Area considered to be metropolitan.

ular the following Betos codes:

- P2A: Major procedure, cardiovascular—CABG
- P2C: Major Procedure, cardiovascular—Thromboendarterectomy
- P2D: Major procedure, cardiovascular—Coronary angioplasty (PTCA)
- P3B: Major procedure, orthopedic—Hip replacement
- P3C: Major procedure, orthopedic—Knee replacement
- P4B: Eye procedure—cataract removal/lens insertion
- P5A: Ambulatory procedures—skin
- P5B: Ambulatory procedures—musculoskeletal
- P6A: Minor procedures—skin
- P6B: Minor procedures—musculoskeletal
- P8A: Endoscopy—arthroscopy
- P8B: Endoscopy—upper gastrointestinal
- P8C: Endoscopy—sigmoidoscopy
- P8D: Endoscopy—colonoscopy
- P8E: Endoscopy—cystoscopy
- P8F: Endoscopy—bronchoscopy
- P8G: Endoscopy—laparoscopic cholecystectomy
- P8H: Endoscopy—laryngoscopy
- I4A: Imaging/procedure—heart including cardiac catheter

Other procedures are defined to include the following Betos categories:

- P1A: Major procedure—breast
- P1B: Major procedure—colectomy
- P1C: Major procedure—cholecystectomy
- P1D: Major procedure—turp
- P1E: Major procedure—hysterctomy
- P1F: Major procedure—explor/decompr/excis disc
- P1G: Major procedure—Other
- P2B: Major procedure, cardiovascular-Aneurysm repair
- P3A: Major procedure, orthopedic—Hip fracture repair
- P4A: Eye procedure—corneal transplant
- P4C: Eye procedure—retinal detachment
- P5C: Ambulatory procedures—groin hernia repair
- P7A: Oncology—radiation therapy
- P7B: Oncology—other
- P9A: Dialysis services

4. Identifying Physician-Owned MRIs

We identify physician-owned MRIs as outlined in section VB. We define MRIs of the head/neck and other regions using Betos categories I2C and I2D, respectively.

Medicare uses the same *CPT* code to represent performing the MRI ("technical component") and reading the image ("professional component"). We require that the claim either indicates the technical component of the service, or alternatively is a "global" bill (encompassing both the technical and professional components).

Specialty codes are listed at `http://www.resdac.org/ddvib/Files/HCFA_PRVDR_SPCLTY_TB.htm` (accessed October 16, 2011). Because we use only a 5 percent sample of claims, while Baker (2010) uses a larger 20 percent file, we depart from his methodology in not requiring a certain number of claims before considering a physician to be an MRI machine owner.

C. Solution to Model of Physician Practice Style

Equations (4) give the physician's utility levels conditional on adopting the standard practice style and the intense style, respectively:

$$
\begin{aligned}
U_S(q;\gamma_i) &= (r-\bar{c})q - e\left(\frac{q}{\gamma_i}\right) + \alpha b(Q)q \\
U_I(q;\gamma_i) &= (r-\underline{c})q - e\left(\frac{q}{\gamma_i}\right) + \alpha b(Q)q - k
\end{aligned} \tag{C1}
$$

Conditional on the physician's discrete investment decision, physician labor and variable inputs are adjusted continuously to optimize the production level. Holding the practice style given, the physician therefore chooses the quantity to supply according to the following first-order conditions:

$$0 = (r-\underline{c}) - \frac{1}{\gamma_i}e'\left(\frac{q_I^*}{\gamma_i}\right) + \alpha b(Q) \tag{C2}$$

$$0 = (r-\bar{c}) - \frac{1}{\gamma_i}e'\left(\frac{q_S^*}{\gamma_i}\right) + \alpha b(Q). \tag{C3}$$

The equilibrium supply quantity is denoted by q_I^* if she has invested in the intense style and q_S^* if she has not. It immediately follows from equations (C2) and (C3) that physicians supply more care when they invest, so $q_I^* > q_S^*$.

1. *Proof of Proposition 1*

Proposition 1 states:

PROPOSITION 1: *There exists a threshold productivity γ^* such that physicians invest if and only if $\gamma > \gamma^*$. The threshold decreases in the reimbursement rate r and in the weight placed on patient benefits α. Aggregate supply increases in the* *reimbursement rate, with a slope given by*

$$\begin{aligned}\frac{dQ}{dr} = & \underbrace{\int_0^{\gamma^*(r)} \frac{dq_S^*(\gamma)}{dr} f(\gamma) d\gamma}_{\text{Standard practice style}} + \underbrace{\int_{\gamma^*(r)}^{\infty} \frac{dq_I^*(\gamma)}{dr} f(\gamma) d\gamma}_{\text{Intensive practice style}} \\ & - \underbrace{\frac{d\gamma^*}{dr} f(\gamma^*) \left[q_I^*(\gamma^*) - q_S^*(\gamma^*) \right]}_{\text{Physicians switching practice styles}} .\end{aligned} \tag{C4}$$

To prove the existence of the threshold, we consider the relationship between the benefits from investing and physician effort costs. A physician prefers to invest if and only if the utility achieved while investing is superior to that achieved without investing. We show that this is true for physicians with sufficiently high productivity, not true for physicians with low productivity, and the net benefit increases monotonically in productivity between these two extremes. The intermediate value theorem then implies the result.

We denote the net utility gain from investing in the intense practice style as $\Delta(\gamma)$ for a firm with effort cost γ. This is given by

$$\begin{aligned}\Delta(\gamma) = & (r - \underline{c}) q_I^*(\gamma) - e\left(\frac{q_I^*(\gamma)}{\gamma}\right) + \alpha b(Q) q_I^*(\gamma) - k \\ & - \left\{ (r - \bar{c}) q_S^*(\gamma) - e\left(\frac{q_S^*(\gamma)}{\gamma}\right) + \alpha b(Q) q_S^*(\gamma) \right\}\end{aligned}$$

The net benefit to investing is increasing in productivity whenever its derivative with respect to γ is positive. Invoking the Envelope Theorem, this derivative is:

$$\Delta'(\gamma) = \frac{e'(q_I^*(\gamma)/\gamma) - e'(q_S^*(\gamma)/\gamma)}{\gamma^2}. \tag{C5}$$

Because $q_I^* > q_S^*$ for all values of γ, this derivative is always positive.

To complete the proof, we need to see that $\Delta(\gamma) < 0$ for a low value of γ and $\Delta(\gamma) > 0$ for a high value. Because $e(0) = 0$, there exists a sufficiently high $G \in (0, \infty)$ such that $q_I^*(G)$ is large enough to ensure that $q_I^*(G)(\underline{c} - \bar{c}) \geq k$ so the investment is worthwhile. To ensure that $\Delta(\gamma) < 0$ at some point, we look to the opposite extreme of the productivity distribution. As productivity approaches zero, so does production. So there exists $\varepsilon > 0$ such that quantity $q_I^*(\varepsilon)$ at this productivity level is sufficiently low that the incremental revenues from investing do not cover the cost of the investment, or $q_I^*(\varepsilon)(\underline{c} - \bar{c}) < k$. At this effort cost $\gamma = \varepsilon$, the net income from investing is lower than the net income when not investing, while the effort cost is still increasing with the investment, since $q_I^* > q_S^*$, so $\Delta(\varepsilon) < 0$.

This proves of the statement about the existence of the γ^* threshold. We now demonstrate the second statement, regarding the relationship between γ^* and the reimbursement rate r. To determine how the investment threshold moves with r, we first note that the threshold itself is defined by $\Delta(\gamma^*) = 0$, or

$$(r - \underline{c})q_I^*(\gamma^*) - e\left(\frac{q_I^*(\gamma^*)}{\gamma^*}\right) + \alpha b(Q)q_I^*(\gamma^*) - k$$
$$= (r - \bar{c})q_S^*(\gamma^*) - e\left(\frac{q_S^*(\gamma^*)}{\gamma^*}\right) + \alpha b(Q)q_S^*(\gamma^*)$$

We differentiate this with respect to r, again using the Envelope Theorem, and letting e_I' denote the marginal effort cost for a provider of productivity who chooses to invest, and v_S' the marginal cost for one who doesn't:

$$q_I^*(\gamma^*) + \frac{q_I^*(\gamma^*)}{\gamma^{*2}}e_I'\frac{d\gamma^*}{dr} + \alpha b'(Q)\frac{dQ}{dr}q_I^*(\gamma^*)$$
$$= q_S^*(\gamma^*) + \frac{q_S^*(\gamma^*)}{\gamma^{*2}}e_S'\frac{d\gamma^*}{dr} + \alpha b'(Q)\frac{dQ}{dr}q_S^*(\gamma^*).$$

Solving for the derivative $\frac{d\gamma^*}{dr}$ yields:

$$\text{(C6)} \qquad \frac{d\gamma^*}{dr} = -\left[1 + \alpha b'(Q)\frac{dQ}{dr}\right]\frac{\gamma^{*2}\left[q_I^*(\gamma^*) - q_S^*(\gamma^*)\right]}{q_I^*(\gamma^*)e_I' - q_S^*(\gamma^*)e_S'}$$

Since the fraction on the right-hand side of equation (C6) is always positive, the sign of $d\gamma^*/dr$ depends on whether $1 + \alpha b'(Q)dQ/dr > 0$.

Holding fixed the practice style, a physician's price response is:

$$\text{(C7)} \qquad \frac{dq^*}{dr} = \left[1 + \alpha b'(Q)\frac{dQ}{dr}\right]\frac{\gamma_i^2}{e''\left(q/\gamma_i\right)},$$

whose sign depends on the same expression $1 + \alpha b'(Q)dQ/dr$, since $e''(\cdot) > 0$.

Because of the threshold's existence, aggregate supply can be written as

$$\text{(C8)} \qquad Q(r) = \int_0^{\gamma^*(r)} q_S^*(\gamma)f(\gamma)d\gamma + \int_{\gamma^*(r)}^{\infty} q_I^*(\gamma)f(\gamma)d\gamma,$$

whose derivative is given in (C4). The sign of dQ/dr depends on the signs of dq_S^*/dr, dq_I^*/dr, and $d\gamma^*/dr$. Suppose that $dQ/dr < 0$. Because $b'(Q) < 0$, the expression $1 + \alpha b'(Q)dQ/dr$ that controls the signs of these three derivatives is consequently positive, which means that $dq_S^*/dr > 0$, $dq_I^*/dr > 0$, and $d\gamma^*/dr < 0$. Hence $dQ/dr > 0$, which contradicts the supposition. Thus $dQ/dr \geq 0$, as asserted in the Proposition.

Since $dQ/dr \geq 0$, the expression $1 + \alpha b'(Q)dQ/dr$ is positive unless marginal benefits of care decline very rapidly ($b'(Q)$ is significantly negative) and doctors put a high weight (α) on these benefits. Suppose this were sufficiently true that $1 + \alpha b'(Q)dQ/dr < 0$. Once again, this would mean that $dq_S^*/dr < 0$, $dq_I^*/dr < 0$, and $d\gamma^*/dr > 0$, and hence $dQ/dr < 0$. But, as just shown, $dQ/dr \geq 0$.

This contradiction means that $1 + \alpha b'(Q)dQ/dr \geq 0$, and hence $d\gamma^*/dr < 0$, as asserted in the Proposition. Since $1 + \alpha b'(Q)dQ/dr \geq 0$, we also have $dq_S^*/dr \geq 0$ and $dq_I^*/dr \geq 0$, so $dQ/dr \geq 0$, as also asserted.

Similar logic shows that supply is increasing in α. The investment threshold moves with α according to

$$\frac{d\gamma^*}{d\alpha} = -\left[b(Q) + \alpha b'(Q)\frac{dQ}{d\alpha}\right] \frac{\gamma^{*2}\left[q_I^*(\gamma^*) - q_S^*(\gamma^*)\right]}{q_I^*(\gamma^*)e_I' - q_S^*(\gamma^*)e_S'},$$

which depends on the sign of the same term as does $dq/d\alpha$ within each investment regime:

$$\frac{dq^*}{d\alpha} = \left[b(Q) + \alpha b'(Q)\frac{dQ}{d\alpha}\right] \frac{\gamma_i^2}{e''\left(q/\gamma_i\right)}.$$

If $dQ/d\alpha$ were negative, we would have $dq^*/d\alpha > 0$ and $d\gamma^*/d\alpha < 0$, contradicting $dQ/d\alpha < 0$. If $b'(Q)$ were sufficiently negative and α sufficiently large that $b(Q) + \alpha b'(Q)dQ/d\alpha < 0$, then $dQ/d\alpha < 0$, but the previous sentence demonstrates that $dQ/d\alpha \geq 0$. Thus $b(Q) + \alpha b'(Q)dQ/d\alpha \geq 0$, so $d\gamma^*/d\alpha < 0$, as the Proposition asserts.

2. Calibration

Figure 4 comes from a calibration of this model under the following assumptions:

$$\begin{aligned} e(z) &= \frac{z^2}{1000} \\ b(Q) &= \frac{1}{Q} \\ r_L &= \$200 \\ r_H &= \$210 \\ \underline{c} &= \$70 \\ \bar{c} &= \$100 \\ k &= \$100,000 \\ \alpha &= 0.01 \end{aligned}$$

We assume that productivity γ is distributed according to a generalized Pareto distribution, with parameters 5, 4, and 2.5, and truncated at 5, so that γ takes on values from 2.5 to 5.

D. Protocol for Following Patients in Specific Cohorts

1. *Identifying Patients with Specified Diagnoses*

In order to study the health care provided to comparable groups of patients across space and time, we identify cohorts of patients diagnosed with particular chronic conditions at a given time. We identify patients based on the diagnoses associated with claims filed in 5 percent sample of Medicare Part B beneficiaries discussed in section IC. These patients are organized into cohorts based on the year and location in which they appear to have been diagnosed, as defined based on their first claim including one of the diagnoses specified below.

Cardiac Diagnoses

Cardiovascular disease comes in many forms, which result from different problems with the heart muscle. Coronary artery disease (CAD) occurs when plaque accumulates inside the coronary arteries (the arteries that supply blood to the heart muscle). The plaque buildup results in narrowing of these arteries, which can lead to angina (chest pains), deteriorating cardiac function and arrhythmias. Sufficient narrowing can ultimately occlude these arteries, leading to acute myocardial infarction (AMI, or heart attack).

Congestive heart failure (CHF) is a separate type of cardiovascular disease, associated with poor cardiac function. It occurs when the heart is unable to pump sufficient blood throughout the body, and leads to fatigue, shortness of breath, and fluid buildup in the extremities. CHF is often caused in part by CAD, and both diseases are associated with a variety of risk factors. Obesity, diabetes, smoking, hypertension, high cholesterol (hypercholesterolemia) and fat levels (hyperlipidemia) are all associated with the development of both CAD and CHF. Because of the substantial overlap between patients with CAD and CHF, we initially study them together, along with Medicare beneficiaries with any of these risk factors. We then separate out those with differing manifestations of heart disease: those who have had an AMI (and therefore undoubtedly have CAD), those who have a specific diagnosis (CAD or CHF), and those who have some chance of having cardiovascular disease (due to a diagnosis for one of the risk factors), and examine the impact of price shocks on treatment patterns for these distinct cohorts.

There is substantial overlap in the treatments for CAD, CHF, angina, patients who have experienced an AMI, and those in the broader category at risk for heart disease. We therefore group them together, based on the following ICD-9 diagnoses, some of which benefit from input from Elixhauser et al. (1998). The conditions specified below are not necessarily mutually exclusive, and we will subsequently describe how we identify non-overlapping cohorts from these groups.

- Acute myocardial infarction (AMI) (410)
- Angina: Intermediate coronary syndrome (411.1) and angina pectoris (413)
- Coronary artery disease (CAD) (410–414)
- Congestive heart failure (CHF) (428)
- Chest pain (786.5)
- Hypertension (401.1, 401.9, 402.10, 402.90, 404.10, 404.90, 405.11, 405.19, 405.91, 405.99)
- Arrhythmia (426.10, 426.11, 426.13, 426.2, 426.3, 426.4, 426.51, 426.52, 426.53, 426.6, 426.7, 426.8, 427.0, 427.2, 427.31, 427.60, 427.9, 785.0, V450, V533)
- Diabetes (250)
- At risk for heart disease: chest pain, hypertension, arrhythmia, diabetes, hypercholesterolemia (272.0), hyperglyceridemia (272.1), hyperlipidemia (272.2, 272.4), hyperchylomicronemia (272.3)
- Broadest cardiac cohort: all of the above

We use some of these conditions as exclusion criteria for other cohorts as follows. We exclude patients with a prior AMI from both the CAD and CHF cohorts. We exclude patients with a prior diagnosis in any of these three categories (AMI, CAD, CHF) from the "heart disease risk" cohort.

Back Pain Diagnoses

For these purposes, we use the following list of ICD-9 codes as back pain diagnoses, following Cherkin et al. (1992):

- Dorsopathies (720–724)
- Psychalgia (307.89)
- Sprains and strains of sacroiliac region (846)
- Sprains and strains of other and unspecified parts of back: Lumbar (847.2), Sacrum (847.3), and Unspecified site of back (847.9)
- Anomaly of spine, unspecified (756.10)
- Absence of vertebra, congenital (756.13)
- Anomalies of spine: other (756.19)

Also following Cherkin et al. (1992), we exclude any of the above claims that also record one of the following diagnoses. Patients with these concurrent diagnoses are likely to have back pain with a more specific cause than those with only the diagnoses listed above. These conditions potentially indicate different treatments, so our analysis of back pain treatments may be less appropriate for patients with the following comorbidities:

- Neoplasms (140–239)
- Intraspinal abscess (324.1)

- Inflammatory spondyloarthropathies (720)
- Osteomyelitis (730)
- Vertebral fractures with or without spinal cord injury (805–806)
- Vertebral dislocations (839)
- External causes of injury and poisoning (E-codes)

2. *Outcomes of Interest for Patients with Specific Conditions*

Once we have identified the cohorts of patients who meet criteria 1 and/or 2 in Appendix D1, we locate all of their claims in the carrier files for the two years following the date of diagnosis. All of the outcomes based on these claims are assigned to the cohort in which the patient initially appeared with the diagnosis. Regardless of whether the patient moved or saw health care providers in different locations at any time after we first observe the diagnosis, the cohort assignment remains unchanged.

Maintaining the cohorts over time enables us to avoid any bias induced by which follow-up care patients receive after their initial diagnosis. It is extremely likely that, depending on initial characteristics of the diagnosis—such as the location, time, or applicable reimbursement rate—patients would receive follow-up care from different providers. For instance, patients may be more likely to see orthopedic specialists after reimbursement rates have increased in their home region, even if the orthopedists are located in a different region. If we assigned this decision to the region where the orthopedist is located, we would induce a bias based on the price difference between the location of diagnosis and the specialist's location. To avoid this, we evaluate all of the care received by a patient in a particular diagnostic cohort together, using only information from the time of diagnosis. This is likely to mute our results, since some patients in diagnosis cohorts with different reimbursement rates are likely to receive follow-up care (specialists, images, laboratories, etc.) from the same providers.

The outcomes of interest are defined based on the Medicare billing code in the subsequent claims. The relevant billing codes are those listed below, based on the *Current Procedural Terminology* coding system (American Medical Association, 1992–2005). This is the coding system used for Medicare reimbursement of carrier claims.[14] We calculate separate variables indicating whether each service were provided within one year or two years of diagnosis. Section D1 presents codes for evaluation and management services that we measure for all of the patient cohorts.

[14]Medicare's implementation of the CPT, together with the Relative Value Units assigned to each service, is is provided by CMS at `http://www.cms.gov/PhysicianFeeSched/01_overview.asp` (accessed October 16, 2011).

Outcomes of Interest for Cardiac Patients

We examine the following set of outcomes for the various heart disease cohorts, as defined in Appendix D1.

- Left heart catheterization: 93511–93529, 93571, 93572
- Right heart catheterization: 93501, 93503, 93508, 93526, 93527, 93528, 93529, 93561, 93562
- Right or left heart catheterization
- Stent: 92980–92989
- Any catheterization: right or left heart catheterization, or stent
- Stress test: 93015, 93016, 93017, 93018, 78460
- Nuclear imaging: 78460, 78472, 78473
- Echocardiogram: 93300–93350
- Coronary artery bypass graft: 33500–33545

Outcomes of Interest for Back Pain Patients

For patients in our back pain cohorts, as defined in section D1, we measure the following outcomes, following Weiner et al. (2006) for guidance:

- Physical therapy: 97001–98999
- CAT scan: 72131, 72132, 72133
- MRI: 72148, 72149
- X-ray: 72100–72120
- Advanced imaging: MRI or CAT scan
- All imaging: X-ray, MRI, or CAT scan
- Myelogram or chemonucleolysis: 72265, 72270, 62292
- Open diskectomy: 63071–63079
- Percutaneous diskectomy: 62287
- Laminectomy or laminotomy: 63005, 63017, 63030, 63042, 63047
- Arthrodesis (spinal fusion): 22630
- Facet lumbar or sacral injection: 64475, 64476, 64442, 64443
- Other injection: 62311, 64483, 64484, 27096, 62289
- Any injection: Facet lumbar, sacral, or other injection

Arthrodesis involves fusing two vertebra together to inhibit motion that might be the source of pain. Diskectomy is the removal of part of an intervertebral disk, which may be herniated and causing pain by exerting pressure on a nerve. A laminectomy involves the excision of part of a vertebra (the lamina), and in a laminotomy only part of the lamina is removed.

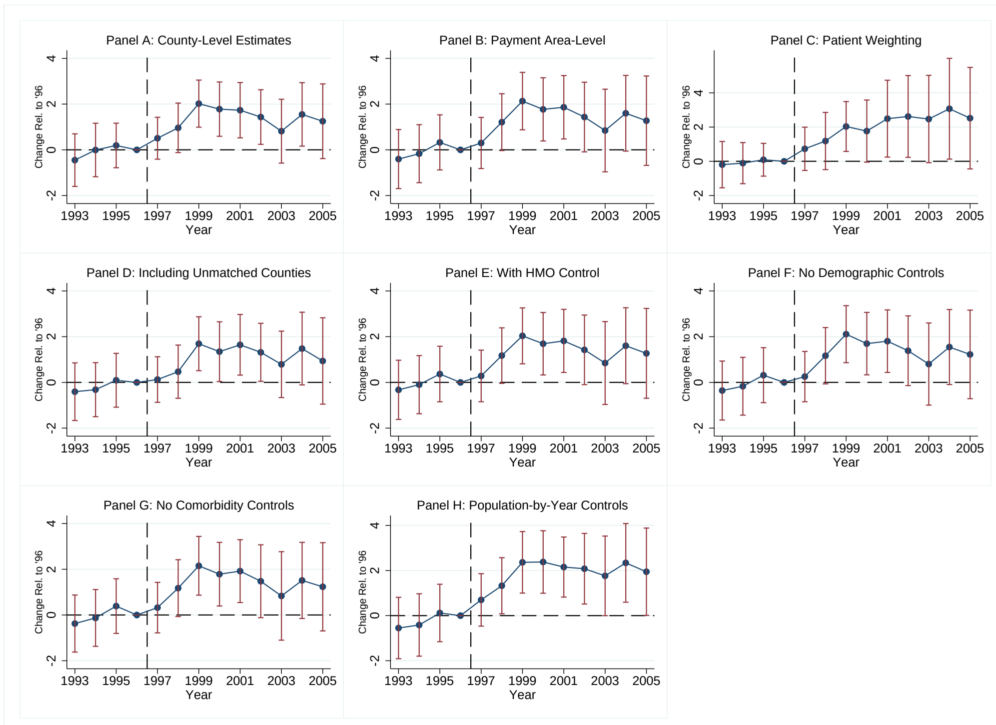
Outcomes of Interest for All Patients

For all patients in the various cohorts defined in Appendix D1, we measure the following outcomes:

- Outpatient evaluation and management: 99201–99205, 99211–99215, 99241–99245, 99271–99275, 99381–99397, 99401–99429
- Inpatient evaluation and management: 99217–99239, 99251–99263, 99281–99289
- Any evaluation and management: Outpatient evaluation and management, inpatient evaluation and management

3. Hip Fracture Treatments

Theory predicts that supply elasticities will be small for services that are relevant, and associated with large benefits, for clearly defined populations. We test this prediction by looking at care for beneficiaries diagnosed with hip fractures. In columns 1 through 3 of Appendix Table D.6 we estimate the effect of price changes on the provision of fracture-specific treatments and general office visits to these beneficiaries. Column 1 shows that, as theory predicts, fracture-specific treatments do not respond to prices. Columns 2 and 3 show that general office visits exhibit substantial price responsiveness (estimated in levels and logs respectively).



Appendix Figure D.1. Impact of Price Change on Supply

Note: These graphs show coefficients and associated bootstrap standard errors from ordinary least squares regressions in which log health care quantity supplied per Medicare patient is the dependent variable. This quantity is regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, as interacted with indicator variables for each year. In panel 1, this regression is run at the county level, as described in section IA, and coefficients correspond to β_p parameters in equation (2). In all subsequent panels, it is run at the payment area level after partialing out the controls listed below, as described in section IB, and coefficients correspond to θ_p parameters in equation (2). The controls include county fixed effects, state-by-year effects, a set of year dummy variables interacted with each county's 1990 urban population share (except for panel 8, in which this is replaced by log 1990 population) and an indicator for metropolitan status, the fraction of beneficiaries aged 65–59, 70–74, 75–79, and 80–84, black, Hispanic, female, eligible for Medicare due to end-stage renal disease or due to disability (except for panel 6), with 2 or more, 3 or more, 4 or more, and 6 or more comorbidities as defined by Elixhauser et al. (1998) (except for panel 7), and enrolled in an HMO (in panel 5). Panel 3 weights the regressions by average patient population from 1993–1996, and panel 4 drops the matching criterion described in section IA. Standard errors are calculated using the bootstrap method described in Appendix B.1. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county population: Census Bureau.

Appendix Table D.1— Effect of Reimbursement Rates on Log Health Care Per Patient

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Aggregate Health Care Supply: Ln(Relative Value Units Per Patient)						
	County Level	Baseline	Weighted	Unmatched Counties	w/ HMO Control	No Demog. Controls	No Comorb. Controls	Population Controls
Price change × Post-1997	1.405**	1.442*	2.145**	1.246*	1.361*	1.385*	1.407*	2.105***
	(0.632)	(0.751)	(0.999)	(0.691)	(0.757)	(0.751)	(0.732)	(0.813)
Old MPLs	177	177	177	200	177	177	177	177
Estimation	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Standard Errors	Clustered	Bootstrap	Bootstrap	Bootstrap	Bootstrap	Bootstrap	Bootstrap	Bootstrap
Observations	28,340	2,301	2,301	2,600	2,301	2,301	2,301	2,301

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which log health care quantity supplied per Medicare patient is the dependent variable. This quantity is regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, as interacted with an indicator for years after the payment area consolidation (1997–2005). In column 1, this regression is run at the county level, as described in section IA. In columns 2 through 8, it is run at the payment area level after partialing out the following controls, as described in section IB: county fixed effects, state-by-year effects, and a set of year dummy variables interacted with the county's 1990 urban population share and an indicator for metropolitan status. For all regressions except column 4, we restrict the sample to counties satisfying the matching criterion described in section IA. Column 5 adds as a control the share of Medicare beneficiaries enrolled in an HMO. The demographic controls used in all regressions except column 6 are the fraction of the county's sample beneficiary pool aged 65–59, 70–74, 75–79, and 80–84, the fraction black, Hispanic, female, eligible for Medicare due to end-stage renal disease or due to disability. All regressions except column 7 control for the share of beneficiaries with 2 or more, 3 or more, 4 or more, and 6 or more comorbidities as defined by Elixhauser et al. (1998). Column 8 controls for year interacted with county population instead of urban share. Standard errors are calculated with the bootstrap from Appendix B.1. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.2— Differential Effects of Supply Response

Cuts by:	Outcome: Log RVUs Per Patient Direction of Change	 Private and Medicare
Price Change × Short-Run	1.224	
	(1.062)	
× Negative Shock	-1.127	
	(2.267)	
× Medicare		0.728
		(0.577)
× Private		-0.062
		(0.971)
Price Change × Medium-Run	2.966*	
	(1.553)	
× Negative Shock	-2.637	
	(2.936)	
× Medicare		1.938***
		(0.718)
× Private		-0.630
		(1.348)
Price Change × Long-Run	1.485	
	(1.786)	
× Negative Shock	-0.057	
	(3.784)	
× Medicare		1.380**
		(0.778)
× Private		1.414
		(0.921)
Observations:	2,301	3,894

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which log health care quantity supplied per Medicare or private patient is the dependent variable. Private sector data are for patients aged 45 to 64 in the ThompsonReuters MarketScan "MedStat" database. See notes to Table 2 for further details and sources.

Appendix Table D.3— Differential Effects of Supply Response

	Outcome: Log RVUs Per Patient	
Cuts by:	Direction of Change	Private and Medicare
Price Change × Post-1997	1.759	
	(1.426)	
× Negative Shock	-0.875	
	(2.911)	
× Medicare		1.353**
		(0.650)
× Private		0.408
		(0.762)
Observations:	2,301	3,894

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which log health care quantity supplied per Medicare or private patient is the dependent variable. Private sector data are for patients aged 45 to 64 in the ThompsonReuters MarketScan "MedStat" database. See notes to Table 2 for further details and sources.

Appendix Table D.4— Effect of Reimbursement Rates on the Level of Care Provision by Service Category

	(1)	(2)	(3)	(4)	(5)	(6)
			Outcomes: RVUs by BETOS Category			
Service Category:	Total RVUs	Procedures: More Elective	Procedures: Less Elective	Evaluation & Management	Diagnostic Testing	Imaging Services
Price change ×	16.68*	10.57	-0.64	3.30	0.31	0.42
Short Run	(9.62)	(7.34)	(1.20)	(3.23)	(0.32)	(1.12)
Price change ×	44.70***	26.97**	1.18	7.68*	0.66	1.48
Medium Run	(15.41)	(11.71)	(1.73)	(4.69)	(0.46)	(2.17)
Price change ×	32.22*	21.90**	0.67	1.84	0.18	3.35
Long Run	(16.77)	(10.63)	(1.24)	(6.03)	(0.70)	(2.98)
Sample Mean	18.41	6.00	0.88	7.93	0.40	1.34
Implied Med. Run Elasticity	2.43	4.49	1.34	0.97	1.65	1.10
Implied Long Run Elasticity	1.75	3.65	0.76	0.23	0.45	2.5
Observations	2,301	2,301	2,301	2,301	2,301	2,301
Old MPLs	177	177	177	177	177	177

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which the quantities of health care supplied in different categories (as measured in Relative Value Units) are the dependent variables. These quantities are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, as interacted with indicators for time relative to the payment area consolidation. "Short Run" following the consolidation refers to 1997 and 1998, "Medium Run" refers to 1999 and 2000, while "Long Run" refers to 2001 through 2005. The regressions are run at the payment area level after partialing out the following controls, as described in section IB: county fixed effects, state-by-year effects, a set of year dummy variables interacted with the county's 1990 urban population share and an indicator for metropolitan status, the fraction of the county's sample beneficiary pool aged 65–59, 70–74, 75–79, and 80–84, the fraction black, Hispanic, female, eligible for Medicare due to end-stage renal disease or due to disability, and the share of beneficiaries with 2 or more, 3 or more, 4 or more, and 6 or more comorbidities as defined by Elixhauser et al. (1998). Standard errors are calculated with the bootstrap from Appendix B.1. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.5— Effect of Reimbursement Rates on Care Provision by Service Category

	(1)	(2)	(3)	(4)	(5)	(6)
			Outcomes: RVUs by BETOS Category			
Service Category:	Total RVUs	Procedures: More Elective	Procedures: Less Elective	Evaluation & Management	Diagnostic Testing	Imaging Services
Price change × Post-1997	31.54**	20.51**	0.49	3.47	0.32	2.28
	(14.01)	(9.43)	(1.14)	(4.75)	(0.52)	(2.26)
Sample Mean	18.41	6.00	0.88	7.93	0.40	1.34
Implied Elasticity	1.71	3.42	0.56	0.44	0.8	1.70
Observations	2,301	2,301	2,301	2,301	2,301	2,301
Old MPLs	177	177	177	177	177	177

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which the quantities of health care supplied in different categories (as measured in Relative Value Units) are the dependent variables. These quantities are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, as interacted with an indicator for years after the payment area consolidation (1997–2005). The regressions are run at the payment area level after partialing out the following controls, as described in section IB: county fixed effects, state-by-year effects, a set of year dummy variables interacted with the county's 1990 urban population share and an indicator for metropolitan status, the fraction of the county's sample beneficiary pool aged 65–59, 70–74, 75–79, and 80–84, the fraction black, Hispanic, female, eligible for Medicare due to end-stage renal disease or due to disability, and the share of beneficiaries with 2 or more, 3 or more, 4 or more, and 6 or more comorbidities as defined by Elixhauser et al. (1998). Standard errors are calculated with the bootstrap from Appendix B.1. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.6— Effect of Reimbursement Rate on Patients with Fractures

	(1) Hip-Fracture Treatment	(2) Office Visit Count	(3) Log Office Visit Count
Price Change ×	0.218	6.703	0.642
Short Run	(0.227)	(7.745)	(0.434)
Price Change ×	0.126	7.358	0.797*
Medium Run	(0.305)	(7.644)	(0.417)
Price Change ×	-0.232	14.81	1.105***
Long Run	(0.268)	(9.465)	(0.424)
Sample Mean	0.472	20.77	2.650
Observations	96,308	96,308	96,308

Note: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. This table reports coefficients from ordinary least squares regressions in which measures of the health care received by patients with hip fractures (cohorts defined in Appendix D1) are the dependent variables. The sample is restricted to patients living in counties that satisfied our matching requirements, which are described in the text (the results are essentially unchanged when we run these regressions using an unrestricted sample of individuals with cardiovascular disease). These outcomes are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, in the county where the patient was first diagnosed, as interacted with indicators for time relative to the payment area consolidation. "Short Run" following the consolidation refers to the cohorts of individuals diagnosed in 1997 and 1998, "Medium Run" refers to 1999 and 2000, while "Long Run" refers to 2001 through 2005. All specifications control for county fixed effects, state-by-year effects, a set of year dummy variables interacted with an indicator whether the patient resides in a metropolitan area, and indicators for the patient's age race, gender, and whether or not the individual was eligible for Medicare due to end-stage renal disease. The results are robust to controlling additionally for each patient's health as proxied for by a set of indicators for having the individual comorbidities defined by Elixhauser et al. (1998), as well as having 2 or more, 3 or more, 4 or more, and 6 or more comorbidities. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county population: Census Bureau.

Appendix Table D.7— Effect of Reimbursement Rate on Patients with Fractures

	(1) Hip Fracture Treatment	(2) Office Visit Count	(3) Log Office Visit Count
Price change × Post-1997	0.0107	10.15	0.872**
	(0.226)	(7.089)	(0.345)
Sample Mean	0.472	20.77	2.650
Observations	96,308	96,308	96,308

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which measures of the health care received by patients with hip fractures (cohorts defined in Appendix D1) are the dependent variables. The sample is restricted to patients living in counties that satisfied our matching requirements, which are described in the text (the results are essentially unchanged when we run these regressions using an unrestricted sample of individuals with cardiovascular disease). These outcomes are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, in the county where the patient was first diagnosed, as interacted with an indicator for years after the consolidation. All specifications control for county fixed effects, state-by-year effects, a set of year dummy variables interacted with an indicator whether the patient resides in a metropolitan area, and indicators for the patient's age race, gender, and whether or not the individual was eligible for Medicare due to end-stage renal disease. The results are robust to controlling additionally for each patient's health as proxied for by a set of indicators for having the individual comorbidities defined by Elixhauser et al. (1998), as well as having 2 or more, 3 or more, 4 or more, and 6 or more comorbidities. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county population: Census Bureau.

Appendix Table D.8— Potential Margins of Response

	(1)	(2)	(3)	(4)	(5)	(6)
	Outcome					
	Baseline RVUs Per Patient	RVUs Per Service	Services Per Patient	Num. of Patients	RVUs Per Doctor	Doctors Per Patient
Price change ×	0.817	0.383	0.396	-0.442	-0.341	1.188**
Short Run	(0.596)	(0.546)	(0.596)	(0.599)	(0.767)	(0.540)
Price change ×	2.012***	1.598**	0.329	-0.438	1.375	0.671
Medium Run	(0.770)	(0.662)	(0.703)	(0.820)	(1.016)	(0.537)
Price change ×	1.464*	1.247*	0.202	-1.039	0.905	0.588
Long Run	(0.884)	(0.754)	(0.757)	(1.011)	(1.050)	(0.676)
Sample Mean	18.41	1.16	16.07	755	99.5	0.199
Observations	2,301	2,301	2,301	2,301	2,301	2,301
Old MPLs	177	177	177	177	177	177

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which different aspects of health care supply are the dependent variables. These quantities are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, as interacted with indicators for time relative to the payment area consolidation. "Short Run" following the consolidation refers to 1997 and 1998, "Medium Run" refers to 1999 and 2000, while "Long Run" refers to 2001 through 2005. These regressions are run at the payment area level after partialing out the following controls, as described in section IB: county fixed effects, state-by-year effects, a set of year dummy variables interacted with the county's 1990 urban population share and an indicator for metropolitan status, the fraction of the county's sample beneficiary pool aged 65–59, 70–74, 75–79, and 80–84, the fraction black, Hispanic, female, eligible for Medicare due to end-stage renal disease or due to disability, and the share of beneficiaries with 2 or more, 3 or more, 4 or more, and 6 or more comorbidities as defined by Elixhauser et al. (1998). Standard errors are calculated with the bootstrap from Appendix B.1. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.9— Potential Margins of Response

	(1)	(2)	(3)	(4)	(5)	(6)
	Outcome					
	Baseline RVUs Per Patient	RVUs Per Service	Services Per Patient	Num. of Patients	RVUs Per Doctor	Doctors Per Patient
Price change × Post-1997	1.442*	1.133**	0.273	-0.772	0.733	0.740
	(0.751)	(0.555)	(0.616)	(0.779)	(0.906)	(0.558)
Sample Mean	18.41	1.16	16.07	755	99.5	0.199
Observations	2,301	2,301	2,301	2,301	2,301	2,301
Old MPLs	177	177	177	177	177	177

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which different aspects of health care supply are the dependent variables. These quantities are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, as interacted with an indicator for years after the payment area consolidation (1997–2005). These regressions are run at the payment area level after partialing out the following controls, as described in section IB: county fixed effects, state-by-year effects, a set of year dummy variables interacted with the county's 1990 urban population share and an indicator for metropolitan status, the fraction of the county's sample beneficiary pool aged 65–59, 70–74, 75–79, and 80–84, the fraction black, Hispanic, female, eligible for Medicare due to end-stage renal disease or due to disability, and the share of beneficiaries with 2 or more, 3 or more, 4 or more, and 6 or more comorbidities as defined by Elixhauser et al. (1998). Standard errors are calculated with the bootstrap from Appendix B.1. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.10— Effect of Reimbursement Rates on MRI Provision and Ownership

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome:	RVUs	RVUs	RVUs	RVUs	RVUs	Physicians	Physicians
MRI Category:	All MRIs	Head/Neck	Non-Head/Neck	All MRIs	All MRIs	All MRIs	All MRIs
Provider Types:	All MRI Providers			Non-Radiologists	Radiologists	Non-Radiologists	Radiologists
Price change × Short Run	1.17*	-0.15	1.32*	0.91	0.26	0.0016	0.0019
	(0.71)	(0.14)	(0.78)	(0.72)	(0.21)	(0.0040)	(0.0050)
Price change × Medium Run	3.13	0.51	2.62	2.99	0.14	0.0067	-0.0066
	(1.95)	(0.38)	(1.62)	(2.02)	(0.36)	(0.0055)	(0.0075)
Price change × Long Run	3.17*	0.53	2.64*	1.50**	1.67	0.0052	-0.0117
	(1.90)	(0.43)	(1.56)	(0.71)	(1.42)	(0.0048)	(0.0081)
Sample Mean	0.148	0.062	0.086	0.019	0.129	0.00049	0.00338
Observations	2,301	2,301	2,301	2,301	2,301	2,301	2,301
Old MPLs	177	177	177	177	177	177	177

Note: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. This table reports coefficients from ordinary least squares regressions in which the dependent variables are related to the provision of magnetic resonance imaging (MRI) services to Medicare beneficiaries. In columns 1 through 5 provision is measured in terms of Relative Value Units per patient. In column 1 this represents total MRI-related RVUs. In columns 2 and 3 the total is divided into those associated with MRIs to the head/neck region and all other MRIs. In columns 4 and 5 the total is divided into those provided by non-radiologists and those provided by radiologists. Non-radiologist physician ownership of MRI imaging is defined in section VB, following the method outlined in Baker (2010). In columns 6 and 7 the dependent variables are measures of the numbers of non-radiologist and radiologist MDs associated with these services. These variables are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, as interacted with indicators for time relative to the payment area consolidation. "Short Run" following the consolidation refers to 1997 and 1998, "Medium Run" refers to 1999 and 2000, while "Long Run" refers to 2001 through 2005. These regressions are run at the payment area level after partialing out the following controls, as described in section IB: county fixed effects, state-by-year effects, a set of year dummy variables interacted with the county's 1990 urban population share and an indicator for metropolitan status, the fraction of the county's sample beneficiary pool aged 65–59, 70–74, 75–79, and 80–84, the fraction black, Hispanic, female, eligible for Medicare due to end-stage renal disease or due to disability, and the share of beneficiaries with 2 or more, 3 or more, 4 or more, and 6 or more comorbidities as defined by Elixhauser et al. (1998). Standard errors are calculated with the bootstrap from Appendix B.1. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.11— Effect of Reimbursement Rates on MRI Provision and Ownership

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome:	RVUs	RVUs	RVUs	RVUs	RVUs	Physicians	Physicians
MRI Category:	All MRIs	Head/Neck	Non-Head/Neck	All MRIs	All MRIs	All MRIs	All MRIs
Provider Types:	All MRI Providers			Non-Radiologists	Radiologists	Non-Radiologists	Radiologists
Price change × Post-1997	2.72*	0.37	2.34*	1.70*	1.01	0.0046	-0.0075
	(1.62)	(0.31)	(1.39)	(0.97)	(0.81)	(0.0038)	(0.0066)
Sample Mean	0.148	0.062	0.086	0.019	0.129	0.00049	0.00338
Observations	2,301	2,301	2,301	2,301	2,301	2,301	2,301
Old MPLs	177	177	177	177	177	177	177

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which the dependent variables are related to the provision of magnetic resonance imaging (MRI) services to Medicare beneficiaries. In columns 1 through 5 provision is measured in terms of Relative Value Units per patient. In column 1 this represents total MRI-related RVUs. In columns 2 and 3 the total is divided into those associated with MRIs to the head/neck region and all other MRIs. In columns 4 and 5 the total is divided into those provided by non-radiologists and those provided by radiologists. Non-radiologist physician ownership of MRI imaging is defined in section VB, following the method outlined in Baker (2010). In columns 6 and 7 the dependent variables are measures of the numbers of non-radiologist and radiologist MDs associated with these services. These variables are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, as interacted with an indicator for years after the payment area consolidation (1997–2005). These regressions are run at the payment area level after partialing out the following controls, as described in section IB: county fixed effects, state-by-year effects, a set of year dummy variables interacted with the county's 1990 urban population share and an indicator for metropolitan status, the fraction of the county's sample beneficiary pool aged 65–59, 70–74, 75–79, and 80–84, the fraction black, Hispanic, female, eligible for Medicare due to end-stage renal disease or due to disability, and the share of beneficiaries with 2 or more, 3 or more, 4 or more, and 6 or more comorbidities as defined by Elixhauser et al. (1998). Standard errors are calculated with the bootstrap from Appendix B.1. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.12— Effect of Reimbursement Rates on Back Pain Treatment

	(1) Log Total RVUs	(2) Any MRI	(3) Physician-Owned MRI	(4) CT Scan	(5) Evaluation & Management	(6) Physical Therapy	(7) Injection	(8) Surgery
Price change × Short Run	0.021 (0.315)	0.010 (0.053)	-0.034 (0.152)	0.031 (0.035)	2.11 (2.11)	0.354** (0.145)	0.057 (0.038)	0.006 (0.031)
Price change × Medium Run	0.490* (0.289)	0.079 (0.086)	0.495 (0.485)	0.089** (0.045)	10.23*** (2.61)	0.203 (0.185)	-0.058 (0.044)	0.019 (0.039)
Price change × Long Run	0.415 (0.326)	0.020 (0.104)	0.994 (0.749)	0.068 (0.042)	6.13** (3.08)	0.149 (0.248)	-0.016 (0.035)	0.030 (0.028)
Sample Mean	67.3 RVUs	0.0891	0.402	0.039	12.4	0.202	0.0355	0.0221
Implied Elasticity	0.42	0.23	2.47	1.75	0.49	0.74	-0.46	1.35
Observations	475,229	475,834	42,392	475,834	475,834	475,834	475,834	475,834

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from regressions in which the treatment received by each Medicare patient in the back pain cohorts defined in Appendix D1 are the dependent variables. The sample is restricted to patients living in counties that satisfy our matching criterion, as described in the text (the results are essentially unchanged when we include the complete cohort defined in Appendix D1). The dependent variables are expressed as indicators for having received a given treatment at least once in the year after diagnosis, with the exception of column 5, which is a count of office visits. Column 3 is conditional on having some MRI taken during the year following diagnosis; all other columns include the entire cohort. These variables are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, in the county where the patient was first diagnosed, as interacted with indicators for time relative to the payment area consolidation. "Short Run" following the consolidation refers to the cohorts of individuals diagnosed in 1997 and 1998, "Medium Run" refers to 1999 and 2000, while "Long Run" refers to 2001 through 2005. All specifications control for county fixed effects, state-by-year effects, a set of year dummy variables interacted with an indicator whether the patient resides in a metropolitan area, and indicators for the patient's age race, gender, and whether or not the individual was eligible for Medicare due to end-stage renal disease. The results are robust to controlling additionally for each patient's health as proxied for by a set of indicators for having the individual comorbidities defined by Elixhauser et al. (1998), as well as having 2 or more, 3 or more, 4 or more, and 6 or more comorbidities. Standard errors are clustered by pre-consolidation payment area. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county population: Census Bureau.

Appendix Table D.13— Effect of Reimbursement Rates on Back Pain Treatment

	(1) Log Total RVUs	(2) Any MRI	(3) Physician-Owned MRI	(4) CT Scan	(5) Evaluation & Management	(6) Physical Therapy	(7) Injection	(8) Surgery
Price change × Post-1997	0.327	0.031	0.685	0.063**	6.01***	0.216	-0.006	0.021
	(0.264)	(0.067)	(0.498)	(0.031)	(2.30)	(0.195)	(0.028)	(0.025)
Sample Mean	67.3 RVUs	0.0891	0.402	0.039	12.4	0.202	0.0355	0.0221
Implied Elasticity	0.33	0.35	1.70	1.62	0.48	1.07	-0.17	0.95
Observations	475,229	475,834	42,392	475,834	475,834	475,834	475,834	475,834

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from regressions in which the treatment received by each Medicare patient in the back pain cohorts defined in Appendix D1 are the dependent variables. The sample is restricted to patients living in counties that satisfy our matching criterion, as described in the text (the results are essentially unchanged when we include the complete cohort defined in Appendix D1). The dependent variables are expressed as indicators for having received a given treatment at least once in the year after diagnosis, with the exception of column 5, which is a count of office visits. Column 3 is conditional on having some MRI taken during the year following diagnosis; all other columns include the entire cohort. These variables are regressed on reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, in the county where the patient was first diagnosed, as interacted with an indicator for being diagnosed after the payment area consolidation. All specifications control for county fixed effects, state-by-year effects, a set of year dummy variables interacted with an indicator whether the patient resides in a metropolitan area, and indicators for the patient's age race, gender, and whether or not the individual was eligible for Medicare due to end-stage renal disease. The results are robust to controlling additionally for each patient's health as proxied for by a set of indicators for having the individual comorbidities defined by Elixhauser et al. (1998), as well as having 2 or more, 3 or more, 4 or more, and 6 or more comorbidities. Standard errors are clustered by pre-consolidation payment area. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county population: Census Bureau.

Appendix Table D.14— Effect of Reimbursement Rates on Treatment of Cardiovascular Disease

	(1) Log Care	(2) Total Care	(3) Cath	(4) Stent	(5) Angioplasty	(6) Evaluation & Management	(7) Echo	(8) Stress Test
Price Change × Short Run	0.593**	40.78	0.121***	0.0163	0.0281	6.800***	0.101	0.130**
	(0.275)	(27.86)	(0.0445)	(0.0149)	(0.0178)	(2.423)	(0.105)	(0.0618)
Price Change × Medium Run	0.849***	74.20**	0.0602	0.00387	0.0519**	9.510***	0.230**	0.151**
	(0.288)	(30.44)	(0.0533)	(0.0178)	(0.0212)	(3.021)	(0.105)	(0.0671)
Price Change × Long Run	0.977***	58.25**	0.115***	-0.0135	0.0257*	6.067**	0.0772	0.121*
	(0.333)	(23.31)	(0.0314)	(0.0154)	(0.0149)	(2.695)	(0.0930)	(0.0620)
Sample Mean	3.209	54.33	0.0534	0.00797	0.00856	9.219	0.153	0.112
Implied Elasticity	0.98	1.07	2.15	-1.69	3.00	0.66	0.50	1.08
Observations	801,150	810,330	810,330	810,330	810,330	807,921	810,330	810,330

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. This table reports coefficients from ordinary least squares regressions in which the treatments received by patients with cardiovascular disease are the dependent variables. The sample is restricted to patients living in counties that satisfy our matching criterion, as described in the text (the results are essentially unchanged when we include the complete cohort defined in Appendix D1). The dependent variable in columns 1 and 2 is total quantity of care, expressed in logs and levels, and in columns 3 through 8 is an indicator for receiving the relevant treatment in the year after diagnosis (excepting physician visits, reported in column 6, which are expressed as counts). These quantities, measured for each patient, are regressed on the reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, in the county where the patient was first diagnosed, as interacted with indicators for time relative to the payment area consolidation. "Short Run" following the consolidation refers to the cohorts of individuals diagnosed in 1997 and 1998, "Medium Run" refers to 1999 and 2000, while "Long Run" refers to 2001 through 2005. All specifications control for county fixed effects, state-by-year effects, a set of year dummy variables interacted with an indicator whether the patient resides in a metropolitan area, and indicators for the patient's age race, gender, and whether or not the individual was eligible for Medicare due to end-stage renal disease. The results are robust to controlling additionally for each patient's health as proxied for by a set of indicators for having the individual comorbidities defined by Elixhauser et al. (1998), as well as having 2 or more, 3 or more, 4 or more, and 6 or more comorbidities. Standard errors are clustered by pre-consolidation payment area. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.15— Effect of Reimbursement Rates on Treatment of Cardiovascular Disease

	(1) Log Care	(2) Total Care	(3) Cath	(4) Stent	(5) Angioplasty	(6) Evaluation & Management	(7) Echo	(8) Stress Test
Price Change	0.861***	57.59***	0.105***	-0.00300	0.0317**	6.957***	0.115	0.129**
× Post-1997	(0.265)	(21.10)	(0.0283)	(0.0117)	(0.0145)	(2.507)	(0.0882)	(0.0506)
Sample Mean	3.209	54.33	0.0534	0.00797	0.00856	9.219	0.153	0.112
Implied Elasticity	0.86	1.06	1.97	-0.38	3.70	0.75	0.75	1.15
Observations	801,150	810,330	810,330	810,330	810,330	807,921	810,330	810,330

Note: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. This table reports coefficients from ordinary least squares regressions in which the treatments received by patients with cardiovascular disease are the dependent variables. The sample is restricted to patients living in counties that satisfy our matching criterion, as described in the text (the results are essentially unchanged when we include the complete cohort defined in Appendix D1). The dependent variable in columns 1 and 2 is total quantity of care, expressed in logs and levels, and in columns 3 through 8 is an indicator for receiving the relevant treatment in the year after diagnosis (excepting physician visits, reported in column 6, which are expressed as counts). These quantities, measured for each patient, are regressed on the reimbursement rate shocks resulting from the consolidation of Medicare's fee schedule areas in 1997, in the county where the patient was first diagnosed, as interacted with an indicator for being diagnosed after the payment area consolidation. All specifications control for county fixed effects, state-by-year effects, a set of year dummy variables interacted with an indicator whether the patient resides in a metropolitan area, and indicators for the patient's age race, gender, and whether or not the individual was eligible for Medicare due to end-stage renal disease. The results are robust to controlling additionally for each patient's health as proxied for by a set of indicators for having the individual comorbidities defined by Elixhauser et al. (1998), as well as having 2 or more, 3 or more, 4 or more, and 6 or more comorbidities. Standard errors are clustered by pre-consolidation payment area. Sources: Price change: *Federal Register*, various issues; Medicare claims data: Medicare Research Identifiable Files, 5 percent sample, described in section IC; county characteristics: Ruggles et al. (2010).

Appendix Table D.16— Summary Statistics for Patient Cohorts

Patient Cohort:	Cardiovascular Disease		Myocardial Infarction		Back Pain	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Number of patients	1,372,791		264,716		475,834	
County characteristics						
Price change	0.00	(0.015)	0.00	(0.015)	0.00	(0.006)
Population (thousands)	816	(1,520)	801	(1,488)	443	(509)
Part B care in year following diagnosis						
Total quantity (RVUs)	56	(149)	134	(161)	67	(180)
Total charges	$1,948	($3,543)	$4,833	($5,318)	$2,465	($3,967)
Evaluation and Management visits	9	(11)	21	(19)	12	(13)
Any cardiac catheterization?	0.05		0.32			
Any cardiac stent?	0.013		0.12			
Any cardiac stress test?	0.11		0.24			
Any magnetic resonance image?					0.09	
Any physical therapy?					0.20	
Any steroid injection?					0.04	
Any spinal surgery?					0.02	
Hospital care in year following diagnosis						
Any hospitalization?	0.15		0.34		0.18	
Any hospitalization for condition?	0.11		0.12		0.03	
Hospitalizations	0.23	(0.69)	0.66	(1.24)	0.30	(0.79)
Hospitalizations for condition	0.16	(0.55)	0.16	(0.46)	0.03	(0.20)
Charges in all admissions	$4,367	($21,363)	$14,973	($43,458)	$4,930	($21,221)
Charges in admissions for condition	$3,129	($17,541)	$4,677	($22,269)	$476	($4,773)
Patient-level controls at time of diagnosis						
Age	67.2	(5.8)	70.8	(6.9)	72.1	(7.2)
Number of comorbidities	1.8	(1.5)	4.1	(2.6)	2.0	(1.9)

Note: Source: Price change: *Federal Register*, various issues; county population: Census Bureau; Patient data: Medicare Research Identifiable Files, 5 percent sample, described in section IC.

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