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Effects of Payment Reform in More versus Less Competitive Markets

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Abstract

Policymakers are increasingly interested in reducing healthcare costs and inefficiencies through innovative payment strategies. These strategies may have heterogeneous impacts across geographic areas, potentially reducing or exacerbating geographic variation in healthcare spending. In this paper, we exploit a major payment reform for home health care to examine whether reductions in reimbursement lead to differential changes in treatment intensity and provider costs depending on the level of competition in a market. Using Medicare claims, we find that while providers in more competitive markets had higher average costs in the pre-reform period, these markets experienced larger proportional reductions in treatment intensity and costs after the reform relative to less competitive markets. This led to a convergence in spending across geographic areas. We find that much of the reduction in provider costs is driven by greater exit of "high-cost" providers in more competitive markets.

1. Introduction

With the passage of the Patient Protection and Affordable Care Act (ACA), policy makers are increasingly looking to reduce both health care costs and inefficiencies in care by restructuring the ways that Medicare pays health care providers. High costs and inefficiencies have long been attributed to the traditional "cost-based" reimbursement model, where health care providers are paid separately for each service provided. In addition, competition has been shown to *increase* costs under cost-based reimbursement, with health care providers competing for patients based on quality and amenities which generate higher

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costs (Robinson & Luft, 1987; Zwanziger & Melnick, 1988). In this way, competition may also drive geographic variation in costs of care since there is considerable variation in market concentration across areas.

Over the past 30 years, Medicare has progressively moved away from cost-based reimbursement towards prospective payment, where a health care provider receives a set payment for an episode of care based on the characteristics of the patient. These payment reforms occurred in 1983 for hospitals and in the late 1990s and early 2000s for providers of post-acute care (e.g., skilled nursing facilities, home health agencies, and inpatient rehabilitation facilities). Extensive evidence shows that the shift to prospective payment had varying effects on health care costs across setting, with more "prospective" reforms and those reducing marginal payments leading to larger cost reductions (Grabowski, Afendulis, & McGuire, 2011; P.J. Huckfeldt, Sood, Escarce, Grabowski, & Newhouse, 2014; Newhouse & Byrne, 1988; N. Sood, Huckfeldt, Grabowski, Newhouse, & Escarce, 2013). In addition, there is some evidence that the relationship between competition and quality (or costs) also changed after prospective payment. For example, data from California show that costs fell more for providers in the most competitive markets after the Inpatient Prospective Payment System was implemented in 1983 (Meltzer, Chung, & Basu, 2002). However, the implementation of the Inpatient Prospective Payment System coincided with the implementation of selective contracting and rapid penetration of managed care in California. Thus, it is unclear the extent to which the differential effects on costs were related to implementation of prospective payment versus other contemporaneous trends.

In this paper we revisit the question of whether provider payment reforms, which reduce the marginal reimbursement to health care providers, may have a differential effect depending on the level of provider competition in a health care market. We start with the premise that differences in the level of competition across health care markets is an important source of geographic variation in health care costs, with markets with greater competition under cost-based reimbursement having higher costs or intensity of care. Prior research also suggests that greater competition in health care markets with administered prices might lead to socially wasteful spending (Gaynor, 2006). We next develop a stylized model that evaluates how the impact of payment reform on costs or intensity of care might vary by the level of competition in the market. We predict that payment reform reduces costs more in more competitive markets. Thus, it is possible that payment reform can simultaneously reduce costs and reduce geographic variation in care as it will lead to convergence in costs across more and less competitive markets.

We empirically test our predictions by investigating a significant Medicare payment reform for home health agencies: the 1997 Interim Payment System (IPS). The IPS offers an interesting case study as it imposed limits on payments to home health agencies in what was a cost-based reimbursement system, dramatically reducing reimbursement to home health agencies by nearly 50 percent (US Government Accountability Office, 2000). Moreover, there is evidence that post-acute care is a key driver of the still-substantial geographic variation in Medicare spending (Newhouse & Garber, 2013), suggesting significant scope for payment reforms targeted at post-acute care in reducing overall geographic variation in spending. Although several studies have analyzed the effects of IPS, none have looked at how the effects of the IPS on costs or intensity of care varied by the initial level of competition in the market (P.J. Huckfeldt et al., 2014; Peter J Huckfeldt, Sood, Romley, Malchiodi, & Escarce, 2013; Liu, Long, & Dowling, 2002; McCall, Komisar, Petersons, & Moore, 2001; Murtaugh, McCall, Moore, & Meadow, 2003; Porell, Liu, & Brungo, 2006). In this paper we add to this literature by analyzing how the effects of IPS varied by the level of competition. We also analyze the pathways or mechanisms that might explain the heterogeneous impact of IPS across markets with different levels of competition.

The empirical results are consistent with the predictions from the theoretical model. We find that there was significant variation in costs by level of competition in the pre-IPS period, with more competitive markets having higher costs. After the IPS, costs declined in all markets but there were larger declines in costs in more competitive markets. The decline in costs was driven by both changes in the probability of any home health use (extensive margin) and a decline in the number of home health days among existing users (intensive margin). As a result of the heterogeneous response to the payment reform, costs and the number of home health days converged in more and less competitive markets and the significant variation in costs or intensity of care by level of competition in the pre-IPS period nearly disappeared in the post-IPS period.

Although the empirical findings are consistent with our theoretical model, a competing explanation for our findings is that IPS payment limits gave greater financial incentives in more competitive markets. We find evidence that IPS payment limits had greater “bite” in more competitive markets. However, we find larger cost reductions in more competitive markets even after controlling for heterogeneity in the reform’s bite across areas. These results suggest that the heterogeneous impacts of IPS by level of competition are not only driven by differences in the bite of IPS payment limits by level of competition, but also by differences in responsiveness by level of competition for a given financial incentive. Finally, we show that the larger impact of IPS in more competitive markets is driven by two factors. First, we observe greater exit of home health agencies in more competitive markets. Second, the home health agencies that exited more competitive markets were more likely to be “high-cost” agencies. Thus, payment reform serves to eliminate some of the most inefficient providers, especially those that are operating in highly competitive markets.

Overall these findings imply that payment reform is not only an important tool for reducing health care costs but it can affect geographic variation in care and health system efficiency by changing incentives and influencing market dynamics. Under the ACA, Medicare is adopting new provider payment reforms such as bundled payment and accountable care organizations, which represent further shifts towards capitation. The extent to which these reforms can further reduce costs and improve efficiency – and potentially reduce variation in health care spending- depends in part on the differential effects of such reforms across markets with different levels of competition.

The rest of the paper proceeds as follows. Section 2 describes the IPS. Section 3 builds a conceptual framework. Section 4 describes the data. Section 5 discusses our empirical strategy and section 6 discusses the results.

2. Background

From 1989 to 1996, Medicare home health expenditures more than quintupled, rising from $3.4 billion to $19.2 billion. In addition, between 1990 and 1996 the number of beneficiaries using the home health benefit almost doubled from 1.9 million to 3.7 million and the number of visits per patient grew from 33 visits to 76 visits (United States Congress, 2000). Much of this growth was spurred by the 1988 Duggan v. Bowen court case, which drastically broadened the eligibility criteria for the Medicare home health benefit. In response to rising costs, the Balanced Budget Act of 1997 (BBA) mandated that the home health payment policy be reformed. The BBA called for a Prospective Payment System (PPS) and immediately enacted an Interim Payment System (IPS) to address the rising costs while the PPS was being developed. The IPS went into effect in October 1997 and lasted for 3 years before being replaced by the PPS in October 2000.

Before the IPS, Medicare home health payment policy was a cost based reimbursement system subject to a per-visit limit on costs. This limit was set at the lower of an agency's "reasonable costs" or 112% of the national average of per visit costs. The implementation of IPS imposed stricter per-visit cost limits (reduction in average reimbursement) and introduced a per-beneficiary total annual cost limit (reduction in marginal reimbursement). Specifically, IPS introduced per-visit limits equal to 105% of the national median cost per visit for newer home health agencies that entered the market after 1994. Older home health agencies faced a limit that was a weighted average of the agency's average per patient costs in 1994 (75%) and their census division per patient costs (25%). This means that firms with costs above the average cost in their census region faced a limit lower than their historical costs, which would be binding; while a firm with costs lower than the average cost in their region faced a limit above their historical costs, which would not be binding.[1] Consequently, we would expect to see a larger reduction in costs after IPS for firms with historical costs above the average cost in their region. A home health agency received payment equal to the lower of its actual costs, its per-visit cost limit, or the per-beneficiary cost limit.

McCall et al. (2001) and McKnight (2006) found a large decrease in home health utilization and the number of visits per user following IPS. Huckfeldt et al. (2014) found that the IPS reduced average payments and that this decline in reimbursement decreased utilization of home health services with little change in readmission and mortality. The decline in use of home health care coupled with lack of changes in readmission rates and mortality suggests that the IPS increased efficiency in the home health care industry. While prior work has investigated heterogeneous effects of the IPS by geography, such work has focused on variation in the average reimbursement change after IPS across markets which stems from payment limits being based on average census division costs (McKnight, 2006). One study does look at entry and exit effects by level of competition (as measured by the number of home health agencies in a market) and find that markets with more home health agencies experienced more supply changes after IPS (Porell et al., 2006). However, no studies have

[1]For example, if a high cost firm had historical average costs of $200 and the average cost in the region was $150, the firm would face a cost limit of $187.5. Similarly, if a low cost firm had historical average costs of $100 and was also in the $150 average cost region, it would face an average per visit cost limit of $112.5, which would not be binding.

looked at how the impact of IPS on costs or utilization varies by level of competition, which is the focus of this paper.

Other related work has investigated trends in hospital costs in California during a period when California experienced several important cost containment measures including the introduction of Medicare inpatient prospective system, introduction of selective contracting for Medicaid patients and diffusion of managed care in private insurance markets. This literature finds that during this time reduction in costs were largest for the most competitive markets (Meltzer et al., 2002; Zwanziger & Melnick, 1988). We examine whether there was a differential impact of IPS in more versus less competitive markets. The IPS provides an important case study due to the large magnitude of overall reductions in payments. Moreover, the wide variation in home health competition across markets generates an ideal context for studying how competition affects responses to payment reform. Understanding how the effects of prior Medicare payment reforms varied across more and less competitive markets provide important evidence on the potential effects of reforms underway, and how they may affect geographic variation in Medicare spending.

3. Conceptual Model

In this paper, we are interested in how agencies adjust their intensity of care (in this context intensity can be viewed as the number of visits per episode of care or costs) in response to payment reform across markets with different levels of competition. We develop a conceptual model based on papers by Brekke, Siciliani, and Straume (2011) and Hodgkin and McGuire (1994). We build upon these models by incorporating the use of average and marginal reimbursement from Hodgkin and McGuire (1994) into the analysis of quality competition from Brekke, Siciliani, and Straume (2011). Hodgkin and McGuire (1994) predicts how hospitals will adjust intensity of care in response to changes in marginal or average reimbursement but is silent on how these effects may vary with market competition. Brekke, Siciliani, and Straume (2011) develop a model of the effects of market competition on hospital quality. Our model bridges these two models to fill the gap in the literature and evaluates how the effects of payment reform vary with competition.

In our model, price is regulated and takes the form $P = \alpha + \beta * c(q_i)$, where α is average reimbursement, β is marginal reimbursement, and q_i is the intensity of care provided by firm i. This formulation allows Medicare's payment of home health agencies to occur on a spectrum ranging from cost based reimbursement system ($\beta = 1$ *and* $\alpha = 0$) to prospective payment ($\alpha > 0$ *and* $\beta = 0$). Firm costs are separable and the marginal cost of an additional patient is constant for any given level of intensity, $C = c(q_i, X_i) = c(q_i) * X(q_i, q_{-i})$ where q_{-i} is a vector of the intensity of care of all other firms in the market, $X(q_i, q_{-i})$ is the demand for firm i and $c(q_i)$ is the cost of intensity per patient. Firms maximize profits (results are similar for firms with altruistic motives), as in equation (1) below:

$$\pi_{\mathrm{i}} = (\alpha + \beta * c(q_i))\, X_i(q_i, q_{-i}) - c(q_i) X_i(q_i, q_{-i}) \quad (1)$$

With the first order condition for intensity allocation being:

$$\frac{\partial \pi}{\partial q_i}=\alpha\frac{\partial X_i}{\partial q_i}+\beta\left(\frac{\partial c}{\partial q_i}X_i+c(q_i)\frac{\partial X_i}{\partial q_i}\right)-\left(\frac{\partial c}{\partial q_i}X_i+c(q_i)\frac{\partial X_i}{\partial q_i}\right)=0 \quad (2)$$

The model is explained in detail and formally derived in Appendix A. We summarize the key propositions relevant for the empirical analysis as follows.

Proposition 1

The intensity of care increases with number of firms.

(See the appendix for a formal proof). To understand why this relationship is positive, we consider the first order condition, which simplifies to:

$$\text{Profit Marin}(q)*\frac{\partial X_i}{\partial q_i}=\frac{\partial c}{\partial q_i}(1-\beta)*X_i \quad (3)$$

The right hand side (RHS) of the equation is the marginal cost of increasing intensity and the left hand side (LHS) of the equation is the marginal benefit of increasing intensity. The marginal benefit curve slopes downwards as profit margins decline with intensity. The marginal benefit term or the LHS is independent of the number of firms as the profit margin is a function of reimbursement policies and the slope of marginal cost curve while and the responsiveness of demand to intensity is a function of patient preferences (see expression for $\frac{\partial X_i}{\partial q_i}$ derived in the Appendix). However, the number of firms in the market does affect the RHS as an increase in the number of firms reduces the number of inframarginal patients a firm has. Thus the marginal cost curve for intensity shifts downwards as the number of firms rises (see Appendix Figure 1) and consequently intensity is higher in more competitive markets.

Proposition 2

A decline in marginal reimbursement has a larger effect on intensity of care in more competitive markets.

(See the appendix for a formal proof.) A decrease in marginal reimbursement reduces the marginal benefit of intensity since decreasing reimbursement reduces profit margins (see first order condition above). This reduction in profit margins is higher in more competitive markets as equilibrium intensity is higher in more competitive markets and $c(q_i)$ increases with intensity. Similarly, a decrease in reimbursement also increases the marginal costs of intensity as providing care to inframarginal patients now has a larger effect on profits. Again this shift produces a larger effect in more competitive markets as equilibrium intensity is higher in more competitive markets and $\frac{\partial c}{\partial q_i}$ increases with intensity. This result is illustrated in Appendix Figure 1 and discussed in the corresponding section in the Appendix.

Proposition 3

Reducing marginal and average reimbursement reduces intensity of care.

(See the appendix for a formal proof). As seen in equation (3), the marginal benefit of intensity of care increases with the profit margin per patient. Since reducing marginal or average reimbursement reduces the profit margin, it reduces the returns to intensity of care.

Proposition 4

Reducing average and marginal reimbursement will lead to greater firm exit in more competitive markets.

(See the appendix for a formal proof). The intuition for this result is as follows. Firms will exit the market if profits fall below zero. This determines minimum threshold levels of marginal and average reimbursements below which firms will exit the market. These thresholds are an increasing function of intensity of care. In Proposition 1 we determined that intensity of care increases with competition, which implies that the minimum average or marginal payment thresholds for participation are higher in more competitive markets. Thus, reductions in reimbursement are more likely to lead to firm exit in more competitive markets. The above assumes that firm exit is non-zero, that is, due to internal friction and inefficiency, some firms are unable to reduce intensity sufficiently to keep profits above the minimum participation thresholds.

Motivated by these propositions we expect to see the following patterns in our data:

1. More competitive markets have higher intensity of care (and consequently, higher costs).
2. Because IPS lowered both average and marginal reimbursement we expect to see a decrease in intensity of care for all markets.
3. Because the effects of changes in marginal reimbursement are magnified in markets with more competition we expect to see a greater decrease in intensity of care (and costs) following the IPS in more competitive markets. This implies a convergence in the costs or intensity of care in more versus less competitive markets after the reform.
4. Because the effects of changes in average and marginal reimbursement on firm exit are magnified in markets with more competition we expect to see greater firm exit following the IPS in more competitive markets. Similarly, we expect to see greater exit of firms with higher intensity of care (costs) following the IPS.

It is important to note that the model is silent on the effects of competition on patient outcomes. On the one hand, one can argue that if patients value intensity it must improve patient outcomes. However, on the other hand one can argue that patients might be uninformed and even though they value higher intensity care, beyond a certain level, changes in intensity of care do not improve patient outcomes and represent “wasteful” spending. Thus, in our empirical models we will evaluate both changes in intensity of care and also changes in patient outcomes.

4. Data

4.1. Home Health Payments, Costs, and Days

The primary source of data for this paper comes from a 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care. In our main analysis, we restrict the sample to individuals who were discharged from an acute care hospital for stroke between 1996 and 2000[2] and we include individuals discharged for hip fracture and lower extremity joint replacement in sensitivity analyses. We focus on these three conditions because these conditions account for a significant proportion of home health use. We use the Medicare claims to obtain the total number of days that beneficiaries received home health visits and total Medicare payments for home health during the 90-day post-acute period following each individual's initial hospital discharge. Any additional acute hospital stay occurring within the 90-day follow-up period is considered a readmission.

Costs to home health providers are computed using data on facility costs from Medicare cost reports. To construct total costs for each 90-day post-acute episode, we multiply the number of visits from the claims data by the facility's average calendar year cost per visit.

4.2. Conditions

Our data contains hospital discharges for stroke, hip fracture, and lower extremity joint replacement. We focus on stroke for the majority of our results. We do this for simplicity and because stroke represents the largest number of hospital discharges in our data in addition to having a higher intensity of home health care compared to hip fracture and joint replacement. We test the sensitivity of our main results for hip fractures and joint replacement and find very similar results as we will show below. While the conditions treated by home health care are diverse, diseases of the circulatory system account for the largest share of Medicare home health patients during our study period (31.4% in 1999), followed by injury and poisonings (15.9%), and then diseases of the musculoskeletal system and connective tissues (14.1%) (Centers for Medicare and Medicaid Services, 2001). The conditions contained in our sample– stroke, hip fracture, and lower extremity joint replacement, respectively—represent these three disease classes.[3] These conditions also cover a range of treatment intensity and severity of disease (for example, stroke is associated with the highest mortality rate, while joint replacement is a condition with low mortality and hip replacement falls in between the two conditions), making the results more representative of the range of conditions treated with home health care.

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[2]Stroke patients are defined as those with a principal diagnosis in the acute hospital stay of intracerebral hemorrhage (diagnosis code 431.xx), occlusion and stenosis of precerebral arteries with infarction (433.x1), occlusion of cerebral arteries with infarction (434.x1), or acute but ill-defined cerebrovascular disease (436.xx). Hip fracture patients are defined as patients with a primary diagnosis of fractures of the neck or the femur (820.xx). Lower extremity joint replacement patients were defined as patients with a primary diagnosis for joint replacement, excluding hip fracture patients and patients with reattachment procedure.

[3]Specifically, in more recent data from 2008–2013, stroke, hip fractures, and lower extremity joint replacement represented about 16% (3% stroke, 4 % hip fracture, 9% joint replacement) of Medicare home health patients and about 11% (3% stroke, 3.5% hip fracture, 4% joint replacement) of Medicare home health days (authors' calculations from MEDPAR and HHA base claims files 2008–2013).

4.3. Patient and Provider Characteristics

We use the Medicare denominator file to obtain demographic variables for each individual including gender, age (5-year age categories), race, Medicaid coverage, county of residence, and urban/rural status, as well as information about whether death occurred within 90 days of the initial hospital discharge. We use the hospital claims from the initial acute episode to measure comorbidities, as defined by Elixhauser, Steiner, Harris, and Coffey (1998), and complications during the index hospitalization. In the case of stroke, we also use the hospital claims to determine whether the stroke was hemorrhagic or ischemic. In a hemorrhagic stroke an artery in the brain ruptures while an ischemic stroke occurs when a blood vessel to the brain becomes blocked by a clot. The main descriptive statistics for our data for stroke discharges are shown in Table 1. The complete set of comorbidities and complications that are included as controls in our analysis, as well as other patient and provider characteristics, can be found in Appendix Table 1 for stroke, hip and joint discharges. HSAs are grouped into the least competitive and most competitive markets based on whether they have above or below median HHI. Patients in both high and low competition markets have similar demographic characteristics prior to the introduction of IPS, except that the most competitive HSA's are more likely to be urban areas and the least competitive HSA's are more likely to be rural areas. Although patient demographics, comorbidities, and complications are similar across areas, home health outcome variables and agency characteristics vary between markets with high and low levels of competition. The most competitive markets have a greater percentage of for-profit agencies and higher intensity of care. These patterns across high and low competition markets are markedly similar for all three conditions (stroke, hip fracture, and joint replacement) as shown in Appendix Table 1. Stroke discharges have the highest intensity of home health care (as measured by home health days) in the baseline year, followed by hip fracture and joint replacement discharges. The reverse is true for the likelihood of receiving any home health care.

Provider characteristics for the acute care hospital are derived from the CMS Medicare Provider of Services file and Acute Impact file. These provider-level databases include information about ownership status, number of beds, wage index, average daily census, acute case-mix index, DSH patient share, and Medicare patient share.[4]

4.4. Market Competition

The empirical analysis compares changes in home health use and costs across areas with high and low levels of competition. Our primary measure of the level of competition in the market is the Herfindahl–Hirschman Index (HHI). Though many measures of competition exist, HHI captures both the number of firms in the market and the relative market share of those firms and is the industry standard (Baker, 2001; Rhoades, 1995). We define markets using Hospital Service Areas (HSA) as defined by the National Center for Health Statistics (M Makuc, Haglund, Ingram, Kleinman, & Feldman, 1991; National Cancer Institute, 2008). An HSA is defined as one or more counties in which the residents receive the

[4]The data have unique provider identifiers for each home health agency operating in a particular location. However, the data do not have any information on ownership or participation in a chain. Thus, while two or more home health agencies may be under the same ownership, we are unable to account for this in our market concentration measures.

majority of their hospitalizations. Since home health care is typically received after a hospitalization we believe that the market definition for hospitals is a good approximation of the market for home health care. As we will show in Section 6.2, the results are also robust to an alternative market definition in which we split HSAs that cross state lines into separate markets (or exclude these HSAs from the sample) to account for the potential effects of state-based home health regulations on competition and outcomes.

The HHI is the sum of the squared market shares for home health providers within each HSA. Each home health agency's market share is calculated separately by condition (stroke, hip fracture, or joint replacement) and is defined as the proportion of Medicare patients residing in the HSA who receive post-acute care (during the 90-days following their hospitalization) from that home health agency. We also compute the Four-Firm Concentration Ratio as the sum of the market shares for the four most dominant home health agencies within an HSA as a secondary measure of competition. We exclude small HSAs from our analysis sample that contain fewer than 28 home health claims (representing the bottom 25 percent of HSAs) where it is difficult to obtain a precise measure of competition. In some specifications, we examine firm exit and define a home health agency as exiting the Medicare market when there are no longer any Medicare claims for that provider. Figure 1 shows that HHI and the Four-Firm Concentration Ratio vary greatly across the home health industry; we will use this variation to study the differential effect of payment reform across more and less competitive markets.

4.5. Sample Restrictions

We exclude individuals who died during the initial hospital stay for stroke, hip fracture, or joint replacement. We also exclude individuals under age 65, those enrolled in Medicare managed care plans, and those residing in Maryland since Maryland did not adopt prospective payment. We conduct our analysis at the discharge level and observe outcomes for a 90-day follow-up period. For stroke, our main analysis sample contains 1,178,430 post-acute episodes resulting from 1,178,430 unique stroke discharges over the study period. The other conditions have somewhat smaller analysis samples.

5. Empirical Strategy

5.1. Primary specification

We perform OLS regression of home health outcomes on the level of competition interacted with a post-IPS indicator and controls taking the form:

$$Y_{\mathrm{ijt}}=\gamma(HHI_j^{\mathrm{Pre}}\cdot \mathrm{Post}_t)+\delta_j+\mu_t+X_{\mathrm{ijt}}\beta+\varepsilon_{\mathrm{ijt}} \quad (4)$$

where Y_{ijt} is an outcome such as the number of home health days, provider costs, or the probability of any home health care for patient i in market j discharged in quarter t. $Post_t$ is a binary variable indicating the time periods following the introduction of IPS. HHI_j^{Pre} is the baseline HHI in market j in the quarter prior to the introduction of IPS. Our identifying assumption is that trends in the outcome during the pre-period are parallel across markets with high or low HHI and would have continued in the absence of IPS. In some specifications, we include indicators for HHI quantiles rather than a continuous measure of HHI. HHI Quantile 1 refers to the lowest quantile of HHI (i.e. highest level of competition). We also control for quarter fixed effects (μ_t), market fixed (δ_j) effects and time-varying patient level characteristics and market level characteristics (X_{ijt}). The key coefficient of interest is γ. Since the IPS has an overall negative effect on outcomes, we predict that γ will be positive since less competitive markets (high HHI) will experience smaller negative effects from IPS (Proposition 2). Standard errors are clustered at the market-level (HSA).

5.2. Robustness checks

Event study estimates—We estimate an event study version of the primary specification where we add in interactions of HHI with each quarter leading up to and following the introduction of IPS to test our identifying assumption of parallel trends in outcomes across markets with different levels of HHI. The omitted interaction term is the quarter before IPS is introduced (quarter 3 of 1997). We expect the coefficients on the interaction terms for the quarters leading up to the IPS to be statistically insignificant, implying that pre-IPS trends in outcomes were similar in more versus less competitive markets. We expect the coefficients on the interaction terms for the quarters after IPS to be positive and significant suggesting that IPS had smaller negative effects in less competitive markets.

Urban-Rural—Prior research and our data suggest that the level of competition in a market is strongly correlated with the market's status as urban or rural. More densely populated urban markets are likely to be more competitive while rural areas have a more dispersed population and are therefore more likely to be less competitive. An analysis of changes in health outcomes after payment reform based on levels of competition could actually be capturing the difference in responsiveness between urban and rural markets. To test for this, we estimate our analysis for both urban and rural areas separately.

Alternative market definition—Geographic factors affecting competition may not only be driven by urban-rural differences but may also be influenced by state-based home health regulations. To address this, we repeat the main analysis using an alternative market definition in which we split HSAs that cross state lines into separate state-specific markets. Splitting HSAs creates two or three new sub-regions (or modified HSAs) within the original HSA, with the boundaries occurring along the state lines. We also repeat the main analysis excluding HSAs that cross state lines from the sample. About 15% of HSAs cross state lines. Standard errors are clustered at the modified HSA × state-level.

Geographic variation in average reimbursement change—The method of payment reform instituted by the IPS imposed varying levels of reimbursement reductions for home health agencies depending on how long they had been in the market and the census averages of costs for their district. Firms that entered the market after 1994 were subject to a maximum per patient reimbursement of 105% of the national median in 1994. Agencies that had entered the market before 1994 were subject to a per-patient reimbursement limit which was a weighted average of the firm's average per patient costs in 1994 (75%) and the firm's census division weighted average of per patient costs (25%). Because of this, agencies with costs higher than the regional average faced larger reductions in reimbursement (since the payment limit was binding) than agencies with average or below-average costs (since the payment limit was not binding), which could affect their responses to the reform (see footnote 1). To account for this, we introduce a measure, IPS “Bite”. In a similar spirit as McKnight (2006), IPS Bite is defined as the difference between the average number of home health days in a HSA and the average number of home health days in the HSA’s census division. HSAs with more home health days than the average census region home health days (i.e., large positive value for IPS Bite) are likely to be areas where the per-patient payment limit was most binding and, consequently, IPS reduced payment the most. We plot how IPS “Bite” varies with HHI to determine whether there is a systematic relationship between the payment reduction and the level of competition in the market. We then control for the IPS “Bite” by including a triple-interaction term between post-IPS, HHI and IPS “Bite”.

5.3. Mechanisms

In addition to characterizing the heterogeneous effects of payment reform by level of competition, we also want to understand the underlying mechanisms driving these differences. As discussed in the theoretical framework section, home health agencies may respond to payment reform by reducing the intensity of care or by exiting the market. We study each of these mechanisms.

First, we estimate equation 6 using the number of home health providers as the outcome variable. We also estimate models defining the outcome variable as the log number of providers. Changes in the number of home health agencies could be driven both by reductions in entry and an increased rate of exit.

Next, we compare the characteristics of exiting home health agencies (agencies that were in operation in 1996 but exited after IPS) with “stayer” home health agencies (agencies that were operating during the entire study period from 1996–2000), in order to identify changes in agency composition after the IPS that may have affected practice patterns. Specifically, we look at average home health days, Medicare payments, provider costs, and the demographic characteristics of patients seen by agencies.

In the third set of analyses, we directly investigate how much of the effect of the IPS occurred through a changing composition of home health agencies. Specifically, we estimate equation 6 for the home health days and provider costs outcomes, limiting the sample to just the agencies that stayed in the sample after IPS and compare the results to those for the full sample. Any differences in results between the two samples are driven by changes in agency composition due to exiting firms.

6. Results

6.1. Differential effects of IPS by level of competition

Figure 2 and Table 2 test a primary hypothesis generated by the conceptual model: that the IPS would have a greater impact on intensity of care (measured by the number of days of home health care) and costs in more competitive markets. Figure 2 shows reductions in average home health days, costs, and the probability of using home health for the case of stroke discharges across HSAs with different levels of competition during the period following the introduction of IPS but before the implementation of PPS (the introduction of IPS is indicated by a red vertical line after the third quarter of 1997). Consistent with the theoretical model and prior literature, the most competitive markets (HHI quantile 1) exhibit both the highest costs and days under cost-based reimbursement prior to the IPS and the largest reductions in costs and days after the IPS, converging towards the other HHI quartiles in the post-reform period. Figure 2 in the appendix shows the corresponding figure for two important patient outcomes: readmissions and mortality. In contrast to the results for intensity of care and costs we find little or no impact of the IPS on these outcomes and we find no differential effects by the level of competition. These results are consistent with (P.J. Huckfeldt et al., 2014) who also found large changes in costs but no change in patient outcomes after the IPS.

Table 2 displays the results from the analogous regressions for all three conditions (stroke, hip fracture, and joint replacement) for home health days, provider costs, and probability of any home health use on the interaction of HHI quantiles with a "post-IPS" indicator variable. The omitted quantile is the least competitive HSAs (HHI quantile 4). All of the regressions include fixed effects, quarter year fixed effects, and time varying patient and market level controls. In Appendix Table 2, we also show results from four specifications that progressively add controls for the case of stroke discharges: the first includes just HSA fixed effects, the second adds a linear time trend, the third replaces the linear time trend with quarter-year fixed effects, and the fourth specification adds time-varying patient and market-level controls (our main specification).

The results are markedly similar across conditions in both magnitudes and statistical significance. For all conditions, we observe a larger reduction in home health days and costs after the introduction of IPS in markets with higher levels of competition relative to the least competitive markets in Quantile 4 (as shown in Figure 2). For example, for stroke, we observe the largest reductions in home health days for the most competitive markets: home heath days fell by about 2.5 more days than the least competitive markets, and fell 1.5 more days more than the second quantile. The reduction in home health days after the IPS for the third quantile was not statistically different from the fourth quantile. For stroke, all quantiles also experienced a decline in costs, with home health agencies in the most competitive quantiles seeing a decline in costs of $220 more per patient than in the least competitive quantile. Home health agencies in the second quantile experienced an additional reduction of $84 in costs than agencies in the least competitive quantile. Hip fracture and joint replacement discharges had cost reductions of a similar magnitude. We find no significant difference between the reduction in provider costs for the third and fourth quantiles across all conditions. Although there was an overall reduction in the probability of using any home health care, we only find statistically significant differences in the magnitude of the reduction across different levels of competition for joint replacement discharges. However, although these results are significant they are small. In Appendix Table 3 (Panel A), we re-estimate the regressions to estimate proportional changes using log outcomes. The results are qualitatively similar. The lack of a differential change in probability of any home health implies that the competition effect on home health days is driven by changes in home health days conditional on use.

It is possible that payment reductions due to IPS led to substitution from home health care to other types of post-acute care services or longer stays in acute hospitals. In Appendix Table 4, we examine whether there was substitution of home health care to skilled nursing facilities (SNFs), inpatient rehabilitation facilities (IRFs), long term care hospitals (LTCHs), and acute care length of stay for all three conditions. Overall, we find little evidence of substitution to other post-acute or acute settings that is differential by level of home health competition. For example, while we find larger reductions in home health care days in areas with higher levels of competition, we do not find a differential increase in the use of SNFs or IRFs in these same areas, and only a relatively small differential increase in acute length of stay in the most competitive markets. One exception may be a slight substitution effect for long term care facilities. However, since long term care facilities are used in less than 1% of discharges, this is unlikely to have a significant offsetting effect on the differential reduction in home health costs from IPS.

Since the main results for stroke are very similar to the other conditions (hip fractures and joint replacement), we focus on stroke for the majority of robustness tests and secondary analyses in the remainder of the paper.

6.2 Alternative specifications

Event study—In Table 3, we estimate a regression for stroke that includes leads and lags of the policy to ensure that our findings in Table 2 are not driven by differential trends in outcomes in the pre-IPS period. Specifically, in the odd-numbered columns, the event-study replaces the $HHI_j^{\text{Pre}} \times \text{Post}_t$ variable in Equation 6 with a full set of quarter dummies interacted with the HHI measure. Each coefficient estimate gives the difference in the outcome variables (home health days, costs, or probability of any use) in high HHI versus low HHI areas relative to the omitted reference period: quarter 3 of 1997 (the quarter before IPS is introduced). We find no evidence of differences in trends by level of competition in the pre-IPS period, as reflected in the statistically insignificant coefficients prior to quarter 3 of 1997. However, there are significant differences in the trends immediately when IPS is introduced, as the coefficients for home health days and costs become positive and statistically significant in quarter 4 of 1997. The positive coefficients for the interaction terms indicate that there was a smaller reduction in the outcome variables in high HHI areas after the introduction of IPS. An advantage of the event-study specification is that a structural break is not imposed in any particular year. Still, the model identifies a trend break immediately when IPS is introduced.

Results stratified by urban status—Our data and prior research suggests that the level of competition might be correlated with urban/rural status, and thus the results could be related to other unobserved differences between urban and rural areas rather than competition. To investigate this, we re-estimate the main analysis for stroke separately for urban and non-urban HSAs (results shown in Table 4). To categorize our data into urban and non-urban groups we use data from the National Center for Health Statistics (NCHS). Table

4 shows that urban and non-urban areas exhibit patterns that are similar to the pooled sample in Table 2 – in both urban and non-urban areas the IPS had larger negative effects on costs and days in more competitive markets.

Although both urban and non-urban areas exhibit similar patterns the magnitude of the effects estimated are larger in the urban HSAs. We also re-estimate our main results splitting HSAs that cross state lines. We find that our results are largely robust to this alternative market definition and also to excluding HSAs that cross state lines from the sample. These estimates are reported in Appendix Table 5.

Heterogeneous effects by IPS "Bite"—The IPS reduced reimbursement by different amounts for home health agencies depending on how long the firm has been in the market, as well as their average costs relative to census division costs. To account for this difference in reimbursement changes across HSAs, we introduce a measure called IPS "bite" which is the difference between the HSA's average number of home health days and the census division's average number of home health days. As discussed above, this measure predicts how much of an impact IPS had on reimbursement, since HSAs with average days exceeding their census region's average days would be more likely to have a payment limit that was below their average costs and, consequently, would see a larger reduction in reimbursement. Figure 3 shows the relationship between HHI and IPS "bite". There is a slight negative correlation meaning that a larger reduction in payment (i.e., larger IPS bite) is associated with more competitive HSAs. This is not surprising given the fact that competition is positively associated with costs. This suggests that correlation between IPS "bite" and competition could explain some of our results.

We explore this issue further in Table 5 for stroke discharges by including an interaction between Post-IPS and IPS-bite, and a triple-interaction between HHI Quantile, Post-IPS, and IPS bite. We find that the coefficient on the interaction between Post-IPS and IPS-bite is negative and significant. This is consistent with prior research which also finds that the IPS led to larger declines in costs in areas with larger bite (P.J. Huckfeldt et al., 2014; McKnight, 2006). We find that after controlling for the IPS bite, the differential effect for the most competitive markets is reduced slightly. Home health days are reduced by approximately 1 day more for markets in the first quantile of HHI compared to the fourth quantile (columns 2 and 3) relative to the 2.5 day reduction that we estimate without controlling for IPS bite (column 1). Similarly, including the IPS "bite" interactions reduces the magnitude of the difference in reduction of provider costs between quantile 1 and quantile 4 to approximately $130 (columns 5 and 6) rather than $220 (column 4). While accounting for IPS bite does affect the magnitude of the effect of competition it does not change our overall result that competition amplifies the impact of the payment change.

Since payment limits for a home health agency under IPS is a function of its own costs in 1994 and average costs in the census division where the agency was located, another possibility is that IPS payment might be more binding in more competitive markets if more competitive markets experienced higher cost growth between 1994 and the implementation of IPS in quarter 4 of 1997. Although our data does not go back to 1994, we can examine two years (1996 and 1997) of pre-IPS home health outcome trends in Figure 2. In the two years leading up to IPS, we find little growth in all home health outcomes. More importantly, these trends are uncorrelated with the level of competition, as we observe that all outcomes were growing at the same rate across HHI Quantiles. Thus, we believe that the analysis supports the conclusion that home health agencies in more competitive areas were both more responsive to the change in marginal reimbursement from IPS and that they faced larger financial incentives to respond to IPS due to the correlation between competition and IPS-bite. However, due to data limitations that prevent us from measuring the precise financial incentive faced by each home health agency, we are unable to fully disentangle these two mechanisms. Finally, we find that the coefficients on the triple interaction between HHI Quantile, Post-IPS, and IPS bite are statistically insignificant suggesting that IPS bite or average reimbursement changes do not affect how competition mediates the impact of IPS on costs.

6.3. Mechanisms through which competition amplifies effect of IPS

Market exit—We find substantial evidence that the IPS response varied with the level of market competition. Figure 4 shows that HSAs in the most competitive quantile experienced the largest reduction in the number of home health agencies after IPS while the other quantiles appear to have experienced much smaller reductions.

In Table 6 we present both the level and log effect estimates of regressing the number of home health providers on the same variables and controls as Table 2. We construct the HHI and compute the number of providers separately for each of the three conditions. As we would expect, these results are not very sensitive to the condition since the number of providers is virtually the same for all conditions. For all conditions, we find progressively greater reductions in the number of HH providers after IPS as the level of competition increases. For stroke, compared to the lowest competition markets (quantile 4), markets in the third competition quantile lost approximately 0.4 more agencies, markets in the second quantile lost 1 to 1.2 more agencies, and the most competitive markets lost about 4 to 5.6 additional agencies. In total, the number of agencies in the most competitive markets fell by 4.3 agencies compared to an *increase* of 1.6 agencies in the least competitive markets (see Appendix Table 6, column 2). The log effect results follow the same pattern as the level effects for all conditions. For stroke, we find that markets in the first quantile experience a 13.7% greater decrease in the number of providers after IPS than markets in the fourth quantile. In Appendix Table 6 we show a more comprehensive table of the effects of IPS on the number of providers focusing only on stroke discharges that features progressive inclusion of control variables, inclusion of IPS “bite”, and a comparison between urban and non-urban HSA’s. Comparing urban and non-urban HSAs in columns 5 and 6, we find that the number of agencies in competitive markets in urban areas fell more than in non-urban competitive markets, however we find the same general pattern across competition levels for both categories. Including the IPS bite interaction terms attenuated the estimates slightly but did not change the pattern by competition levels.

Changing composition of home health agencies in the sample—The results in Table 6 show that reductions in the number of home health agencies after the IPS were greater in more competitive markets. Table 7 displays characteristics of staying firms and exiting firms in markets with high and low competition. In the least competitive HSAs (columns 3 and 4) there is very little difference in baseline year characteristics between exiting and staying firms. In the most competitive HSAs (columns 1 and 2) we find larger differences, with exiting firms having about 8 more home health days and $500 more in Medicare payments and costs than staying firms in the baseline year (1996). Although exiting agencies provided more home health days and incurred higher costs, there is almost no difference in 90-day mortality and rehospitalization rates suggesting that exiting firms may have over-provided care intensity (as measured by days). In both more and less competitive HSA's, exiting firms are much more likely to have for-profit ownership status than non-exiting firms and this is particularly true in the most competitive markets, suggesting that for-profit firms may be operating more inefficiently. Overall, these results suggest that payment reform is more likely to induce inefficient firms to exit the market when they are operating in high competition markets. Additionally, we re-estimate the analysis from Table 6 by ownership status. These results are shown in Appendix Table 7 for stroke discharges. Consistent with the above results, we find that the effect of IPS on agency exit is driven by for-profit firms.

Finally, in Table 8 we show results from repeating our analysis for stroke from Table 2, excluding firms that exited the market after IPS was introduced. In order to assess differences in home health days and costs between patients who receive care from exiting or staying firms, we restrict the sample to individuals who received any home health care after a stroke discharge. Excluding exiting firms attenuates the extra reduction in home health days in the most competitive markets, from a reduction of about 4 days receiving home health to a 2.4 day reduction (columns 1 and 2). Once we control for IPS bite, the estimates become attenuated and insignificant (column 4). This result implies that much of the difference in the reduction of home health days we found across levels of competition is likely due to home health agency exit rather than changes in internal structure. For provider costs, we also find a progressive attenuation in the estimates as the sample is limited to agencies staying in the market and when we include the IPS bite interaction terms. However, the extra reduction in the most competitive markets after IPS remains statistically significant (column 8). This result suggests that market exit plays an important role in reducing costs.

7. Conclusion

Cost-based payment of health care providers has been widely acknowledged as a driver of over-use of health care and the growth of health care costs in the US. Competition has been acknowledged to exacerbate this problem, with providers in more competitive markets attracting patients by providing more services and amenities, generating geographic variation in costs. In this paper, we examined whether the effects of reforms that shift provider payment away from fee-for-service towards more capitated models depend on the level of market competition. We developed a theoretical model generating predictions that reducing marginal reimbursement will have a greater effect on the intensity of care and costs in more competitive markets. Our empirical results are consistent with this prediction, with larger reductions after the IPS in the probability of receiving home health care and the intensity of care in more competitive markets. Overall these results suggest that payment reform can play an important role in reducing geographic variation in care across more and less competitive markets.

An alternative explanation for our findings is that IPS payment limits were more binding in more competitive markets. In particular, payment limits for a home health agency under IPS was a function of its own costs in 1994 and average costs in the census division where the agency was located. The IPS payment limits could be more binding in more competitive markets if more competitive markets had higher costs relative to their census division average or if more competitive markets experienced higher cost growth between 1994 and the implementation of IPS in 1997. Contrary to the above hypothesis, in the two years leading up to IPS, we find little correlation between growth in costs and level of competition. However, we do not have data from 1994 so we cannot rule out the possibility of correlation between competition and cost growth during that period. Consistent with the above hypothesis, we find that more competitive markets have higher costs relative to their census division suggesting that IPS payment limits had greater "bite" in more competitive markets. Though, after controlling for a measure of the reform's bite, we find that payment changes still led to larger responses in more competitive markets. We conclude that more competitive markets both faced larger financial incentives under this reform *and* were more responsive to these financial incentives. However, without the data to compute the precise financial incentive faced by each home health agency, we cannot fully disentangle these two mechanisms' contributions to our findings.

We do not find a similar convergence in patient outcomes across markets with varying levels of competition suggesting that the reduction in costs might have improved efficiency. We also find a larger reduction in the number of home health agencies in more competitive markets and that exiting providers were more likely to provide high-intensity and high-cost care. Further, much of the reduction in more competitive markets comes from the exit of such providers.

Our analysis has several policy implications. First, our results indicate that payment reform is an important tool for controlling health care costs in general. We find that reductions in marginal and average reimbursement reduce intensity of care and lead to exit of high-cost firms, which could have long lasting effects on costs for both public and private payers. Second, we show that payment reform might be an important tool for reducing geographic variation in costs: we find that payment reform leads to a larger reduction in costs in more competitive markets and more competitive markets tend to have higher costs. This naturally raises the question of whether these reductions in costs could come at the expense of patient outcomes. Evidence from the existing literature on the health effects of payment reform is somewhat mixed (Cutler, 1995; Kahn et al., 1990; Kosecoff et al., 1990; Rubenstein et al., 1990; Shen, 2003). We find little or no changes in both mortality and readmissions, suggesting that the IPS for home health care had little effect on patient outcomes. Similarly, Huckfeldt et al. (2014) and McKnight (2006) also find that home health payment reform leads to reductions in costs or intensity of care and is not associated with adverse health outcomes (P.J. Huckfeldt et al., 2014; McKnight, 2006). Similar results were found by studies assessing payment reform in the inpatient rehabilitation facility market and in the post-acute care market in general (McCall, Korb, Petersons, & Moore, 2003; Neeraj Sood, Buntin, & Escarce, 2008). Overall these results suggest that both policies that reduce marginal payments such as bundled payment systems as well as policies that reduce average reimbursement such as reductions in Medicare payment rates could be effective tools for improving the efficiency of Medicare spending.

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Appendix

Appendix A: Model Derivations

In this section, we formally derive the model and proofs of the main propositions. We are interested in modeling how agencies adjust their intensity of care (in this context intensity can be viewed as the number of visits per episode of care or costs) in response to payment reform across markets with different levels of competition. We develop a conceptual model based on papers by Brekke, Siciliani, and Straume (2011) and Hodgkin and McGuire(1994). Brekke, Siciliani, and Straume model competition and quality under regulated prices and Hodgkin and McGuire model responses to payment reform, switching to a prospective payment system. In this model, we introduce the concept of marginal and average reimbursement from Hodgkin and McGuire to the theoretical framework built in Brekke, Siciliani and Straume to create predictions for how responses to payment reform are likely to vary with market structure.

Changes in an agency's intensity of care can have two effects on demand – a market stealing effect (attracting a patient from another home health agency) and a market expansion effect (attracting a patient from another post-acute care provider or a patient who was not planning on getting any post-acute care). To illustrate and isolate these effects we consider two types of patients. The first, H type patients have a high value of home health care. These are patients who are much more suited to home health care; they get a large amount of utility from remaining in their homes and will not switch to other post-acute options as long as home health care is provided at a baseline level of intensity. We assume this market is saturated such that increasing intensity will not draw any new H type patients into the market, increasing intensity will only steal them from other firms. So changes in demand by H type patients isolates the market stealing effect of changes in intensity of care. The second, L type patients have a lower value of home health care. These patients are willing to utilize other types of post-acute care, like nursing homes, or forgo post-acute care if home health intensity is not high enough. To isolate the market expansion effect we assume that the L type patient market is never saturated; increasing intensity will draw in new L type patients to the market but will not steal L types from other firms. We can model patient utility as:

$$U^s = \begin{cases} V - t\,|x - z_i| + kq_i, & H\ \text{type} \\ v - t\,|x - z_i| + kq_i, & L\ \text{type} \end{cases}$$

Where V or v is the value that the patient puts on home health service at a baseline intensity that we arbitrarily set as $\underline{q} \equiv 0$ for convenience. The extra utility that a patient gets from a firm providing intensity above $\underline{q}$ is kq_i. For simplicity, let $k \equiv 1$. The disutility of "mismatch costs" is $t|x - z_i|$. Firm demand is derived using a Salop circle model, classically the circle represents the physical distance between each firm, but since home health patients do not travel to the agency providing them service we think of the circle as a "firm specialization" space. The distance between firms represents the different sets of skills or attributes that firms may have. Thus the "distance" could be based on clinical condition of the patient and specialization of home health agency in treating that condition or it could more generally reflect differences in patient preferences for receiving care from a particular agency. Thus, x denotes the mix of home health agency attributes preferred by the patient, z_i indicates the mix of attributes characterizing the agency i, and $x - z_i$ represents how good of a fit a patient is for a specific home health agency, t is the marginal cost of the "distance" between the patients' preferences and an agency's attributes. The smaller the "distance" between the firm and the patient, the better the fit and lower the mismatch cost.

In our model, price is regulated and takes the form $P = \alpha + \beta * c(q_i)$, where α is average reimbursement and β is marginal reimbursement. This formulation allows Medicare's payment of home health agencies to occur on a spectrum ranging from cost based reimbursement system ($\beta = 1$ *and* $\alpha = 0$) to prospective payment ($\alpha > 0$ *and* $\beta = 0$). Firm costs are separable and the marginal cost of an additional patient is constant for any given level of intensity, $C = c(q_i, X_i) = c(q_i) * X(q_i, q_{-i})$ where $X(q_i, q_{-i})$ is the demand for firm i and $c(q_i)$ is the cost of intensity per patient.

We normalize patient density on the circle and the total length of the circle to one. There are n firms evenly distributed about the circle, such that their distance apart is equal to $1/n$. The patient population is split between H and L types where a fraction λ are H type and $1-\lambda$ are L type. To find demand for each patient type, we first find their point of indifference along the circle between the first firm, i, and a second firm, j, for H type:

$$V - tx_i^H + q_i = V - t\left(\frac{1}{n} - x_i^H\right) + q_j$$
$$x_i^H = \frac{q_i - q_j + \frac{t}{n}}{2t} \qquad (1)$$

And for L type patients where agencies have a local monopoly patients are indifferent between receiving home health care and the outside option whose utility is normalized to zero:

$$v - tx_i^L + q_i = 0$$
$$x_i^L = \frac{v + q_i}{t} \qquad (2)$$

Total demand is given by multiplying (1) and (2) by two times the fraction of H or L type patients.

$$X_i = 2\lambda x_i^H + 2(1-\lambda) x_i^L = \frac{2(1-\lambda)v + (2-\lambda)q_i - \lambda q_j}{t} + \frac{\lambda}{n} \quad (3)$$

The combination of having H and L type patients in the model separates the "market stealing" and "market expansion" effects of an agency increasing its intensity of care. When a firm increases its intensity, it "steals" H type patients from other agencies and "expands" the market by attracting new L type patients who otherwise would not receive home health. We gain greater insight from looking at how demand changes with intensity:

$$\frac{\partial X_i}{\partial q_i} = \frac{2-\lambda}{t} > 0 \quad \frac{\partial X_i^H}{\partial q_i} = \frac{\lambda}{t} > 0 \quad \frac{\partial X_i^L}{\partial q_i} = \frac{2(1-\lambda)}{t} > 0$$

Both the "market stealing" (the second inequality) and the "market growth" (the third inequality) components of demand contribute a positive, constant return to intensity. In addition, the market growth is usually the primary driver of the return to intensity; only at high levels of H types in the market ($\lambda > 2/3$) does the "market stealing" component over power the "market growth" component. We also look at how demand changes with number of firms:

$$\frac{\partial X_i}{\partial n} = -\frac{\lambda}{n^2} < 0 \quad \frac{\partial X_i^H}{\partial n} = -\frac{\lambda}{n^2} < 0 \quad \frac{\partial X_i^L}{\partial n} = 0$$

As the number of firms increase, there is a decrease in demand for each firm coming from the H type patients switching to new agencies, but no effect from the L type patients.

For the initial analysis in this model we assume that firms are profit maximizing, while in reality they may exhibit altruistic behavior. A version of our model that includes altruism follows after our main theoretical findings. We find that our predictions are similar to the for-profit analysis presented here except when firms exhibit a high degree of altruism. However, the empirical literature suggests that the level of altruism in hospitals and post-acute care providers is not great enough to differentiate for profit from nonprofit utility maximizing actions. Pauly (1987) reviews theoretical and empirical literature and finds no significant differences in market behavior between for profit and nonprofit firms (Pauly, 1987). More recently, Duggan (2000) finds that nonprofit hospitals are no more altruistic than for profit hospitals and that they respond similarly to pricing incentives.(Duggan, 2000) Additionally, Sloan, Picone, Taylor, and Chou (2001) find no difference in outcomes for for-profit vs nonprofit hospitals (Sloan, Picone, Taylor, & Chou, 2001). For these reasons, we restrict our main analysis to classic for-profit profit maximization and treat altruism as a perturbation from the for-profit model.

Firms profit maximize, as in (4):

$$\pi_i = (\alpha + \beta * c(q_i))\, X_i(q_i, q_{-i}) - c(q_i) X_i(q_i, q_{-i}) \quad (4)$$

With the first order condition for intensity allocation being:

$$\frac{\partial \pi}{\partial q_i}=\alpha\frac{\partial X_i}{\partial q_i}+\beta\left(\frac{\partial c}{\partial q_i}X_i+c(q_i)\frac{\partial X_i}{\partial q_i}\right)-\left(\frac{\partial c}{\partial q_i}X_i+c(q_i)\frac{\partial X_i}{\partial q_i}\right)=0 \quad (5)$$

We substitute equation (3) into (5) and set $q_i=q_j$ to solve for optimum intensity q*.

Proposition 1

The intensity of care increases with number of firms.

To solve for dq/dn we take the total derivative of the first order condition:

$$dq: -\left(\left((1-\beta)\frac{\partial c}{\partial q_i}\right)\frac{2(1-\lambda)}{t}+(1-\beta)\frac{\partial c}{\partial q_i}\left(\frac{2-\lambda}{t}\right)+(1-\beta)X_i\frac{\partial^2 c}{\partial q_i^2}\right)$$

$$dn: \left((1-\beta)\frac{\partial c}{\partial q_i}\right)\frac{\lambda}{n^2}$$

$$d\alpha: \frac{2-\lambda}{t}$$

$$d\beta: c(q_i)\left(\frac{2-\lambda}{t}\right)+\left(\frac{2(1-\lambda)v+2(1-\lambda)q_i}{t}+\frac{\lambda}{n}\right)\frac{\partial c}{\partial q_i}$$

We can see that dq is simply the second order condition of profit maximization, and is, by definition, always less than zero.

$$\frac{dq_i}{dn}=\frac{\left((1-\beta)\frac{\partial c}{\partial q_i}\right)\frac{\lambda}{n^2}}{\left((1-\beta)\frac{\partial c}{\partial q_i}\right)\frac{2(1-\lambda)}{t}+(1-\beta)\frac{\partial c}{\partial q_i}\left(\frac{2-\lambda}{t}\right)+(1-\beta)X_i\frac{\partial^2 c}{\partial q_i^2}} \geq 0$$

The denominator is the negative of the second order condition therefore is positive, so the sign is determined by the numerator. The numerator is also positive given that costs are increasing and there is a non-zero amount of *H t*ype patients in the market.

Proposition 2

A decline in marginal reimbursement has larger effect on intensity of care in more competitive markets.

To see this, consider how dq/dn changes with marginal reimbursement:

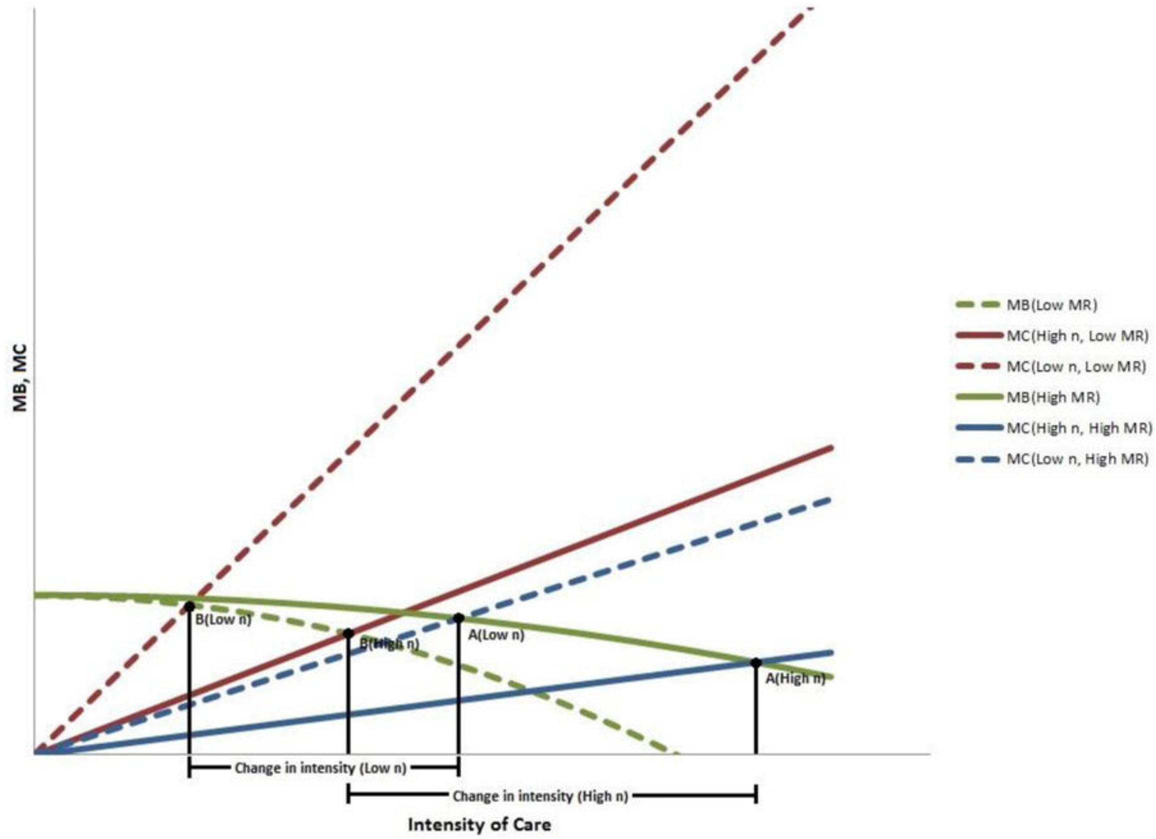
$$\frac{\partial}{\partial \beta}\left(\frac{dq_i}{dn}\right)=\frac{\frac{\partial c}{\partial q_i}\frac{\lambda}{n^2}}{\frac{\partial c}{\partial q_i}\left(\frac{\partial X_i^L}{\partial q_i}+\frac{\partial X_i}{\partial q}\right)+X_i\frac{\partial^2 c}{\partial q_i^2}} \geq 0$$

To understand why this relationship is positive, we look back to the first order condition, which simplifies to:

$$\text{Profit Margin}(q) * \frac{\partial X_i}{\partial q_i} = \frac{\partial c}{\partial q_i}(1 - \beta) * X_i$$

The right hand side (RHS) of the equation is the marginal cost of increasing intensity and the left hand side (LHS) of the equation is the marginal benefit of increasing intensity. An increase in intensity decreases profits because it increases the marginal cost of providing care for inframarginal patients (RHS). However an increase in intensity raises profits because it increases demand and firms enjoy a positive margin on the marginal patients (LHS). The marginal benefit curve slopes downwards as profit margins decline with intensity. The marginal benefit term or the LHS is independent of the number of firms as the profit margin is a function of reimbursement policies and the slope of marginal cost curve while and the responsiveness of demand to intensity is a function of patient preferences (see expression for $\frac{\partial X_i}{\partial q_i}$ derived earlier in the theory section). However, the number of firms in the market does affect the RHS as an increase in the number of firms reduces the number of inframarginal patients a firm has. Thus the marginal cost curve for intensity shifts downwards as the number of firms rises (see Appendix Figure 1) and consequently intensity is higher in more competitive markets.

A decrease in marginal reimbursement pivots the marginal benefit curve for intensity downwards as increases in intensity have a smaller effect on profit margins when marginal reimbursement is higher. This has a larger effect on intensity in more competitive markets, as equilibrium intensity is higher in more competitive markets. Similarly, a decrease in reimbursement also pivots the marginal cost curve for intensity upward as providing care to inframarginal patients now has a larger effect on profits. Again this upward pivot induces a larger effect on intensity in more competitive markets, as equilibrium intensity is higher in more competitive markets. This effect is shown in Appendix Figure 1. In the figure, the points labeled A denote the level of intensity before a decrease in marginal reimbursement. It is clear that intensity of care in the market with more competition leads to a higher baseline level of intensity. When marginal reimbursement decreases, the marginal benefit curve pivots downwards and the marginal cost curves pivot upward as previously stated. A new equilibrium level of intensity is achieved at the points labeled B. The change in intensity for less competitive markets (low n) is less than the change in intensity for competitive markets (high n) as predicted.



Appendix Figure 1. A Decline in Marginal Reimbursement has a Larger Effect on Intensity of Care in More Competitive Markets

Note: The green MB lines represent the marginal benefit of intensity, which is decreasing in intensity of care and is independent of the number of firms in the market. The blue and red MC lines represent the marginal cost of intensity. Because marginal cost is dependent on the number of firms, there are two sets of lines, one for low levels of competition (dashed lines) and one for high levels of competition (solid lines).

Proposition 3

Reducing marginal and average reimbursement reduces intensity of care.

This proposition is fairly intuitive and can be derived easily from the total derivative of the first order condition:

$$\frac{dq_i}{d\alpha}=\frac{\frac{2-\lambda}{t}}{\left((1-\beta)\frac{\partial c}{\partial q_i}\right)\frac{2(1-\lambda)}{t}+(1-\beta)\frac{\partial c}{\partial q_i}\frac{2-\lambda}{t}+(1-\beta)X_i\frac{\partial^2 c}{\partial q_i^2}}>0$$

$$\frac{dq_i}{d\beta}=\frac{c(q_i)\frac{2-\lambda}{t}+X_i\frac{\partial c}{\partial q_i}}{\left((1-\beta)\frac{\partial c}{\partial q_i}\right)\frac{2(1-\lambda)}{t}+(1-\beta)\frac{\partial c}{\partial q_i}\frac{2-\lambda}{t}+(1-\beta)X_i\frac{\partial^2 c}{\partial q_i^2}}>0$$

Proposition 4

More competitive markets will experience greater firm exit.

Immediately after payment change is enacted, firms will adjust their intensity to profit maximize but in the months and years post payment change firms will exit the market if profits fall below zero:

$$\pi_{\mathrm{i}} = (\alpha + \beta * c(q_i))\, X_i(q_i, q_{-i}) - c(q_i) X_i(q_i, q_{-i}) < 0$$

Solving for α and β, we obtain threshold levels of average and marginal reimbursement below which firms will leave the market:

$$\alpha < (1 - \beta) c(q_i)$$
$$\beta < \left(1 - \frac{\alpha}{c(q_i)}\right)$$

In Proposition 1 we determined that intensity of care increases with the number of firms and thus more competitive markets will have higher levels of intensity. The marginal cost of an additional patient is increasing with intensity, therefore costs in more competitive markets will be higher. A higher marginal cost raises the payment threshold for exit in these markets making it more likely that reductions to average and marginal reimbursement from IPS will surpass these thresholds and cause firms to exit.

Altruism

Although there is evidence that many not-for-profit health care organizations behave as profit maximizing firms, we include a model that takes into account the altruistic behavior that may be displayed by not-for-profit home health agencies. To account for this, we include the value the firm gets from providing services to patients as a fraction of the value the consumers get, $\theta * B(q_i, q_{-i})$, where B is the total benefit patients receive from home care (the consumer surplus) and θ is a number between zero and one. To calculate the patient benefit, we integrate over the utility of patients for receiving care:

$$B_i(q_i, q_{-i}) = 2\lambda \int_0^{\frac{1}{2t}(q_i - q_j + \frac{t}{n})} (V + q_i - tx)dx + 2(1 - \lambda) \int_0^{\frac{v + q_i}{t}} (v + q_i - tx)dx \quad (6)$$

Differentiating with respect to quality gives:

$$\frac{\partial B_i}{\partial q_i} = X_i(q_i, q_{-i}) + \frac{\lambda}{t}\left(V + \frac{q_i + q_j}{2} - \frac{t}{2n}\right) > 0 \quad (7)$$

There are two components that make up the change in patient benefit from a change in quality, the first part, $X_i(q_i, q_{-i})$, is the utility gained from all the existing patients experiencing increased quality, this is the inframarginal effect. The second part is a marginal effect from the new patients an increase in quality draws in. This marginal effect is dependent only upon H type customer utility, this is because the "switchers" have a strictly positive net increase in utility from treatment while the marginal L type consumers have a utility increase of zero at the margin. We add in the altruistic value of patient benefit that the home health firm receives, (6), into the firm's utility function:

$$\pi_{\mathrm{i}}=(\alpha+\beta * c(q_i))\, X_i(q_i, q_{-i})+\theta B(q_i, q_{-i}) - c(q_i)X_i(q_i, q_{-i})$$

With the first order condition for intensity allocation being:

$$\frac{\partial \pi}{\partial q_i}=\alpha\frac{\partial X_i}{\partial q_i}+\beta\left(\frac{\partial c}{\partial q_i}X_i+c(q_i)\frac{\partial X_i}{\partial q_i}\right)+\theta\frac{\partial B}{\partial q_i}-\left(\frac{\partial c}{\partial q_i}X_i+c(q_i)\frac{\partial X_i}{\partial q_i}\right)=0 \quad (8)$$

We substitute equations (3) and (7) into (8) and set $q_i=q_j$ to solve for optimum intensity q*. The total differentiation of equation (8) that is used to estimate how intensity changes with the number of firms in the market and with changes to marginal and average reimbursement becomes:

$$dq\text{:} -\left(\left((1-\beta)\frac{\partial c}{\partial q_i}-\theta\right)\frac{2(1-\lambda)}{t}-\theta\frac{\lambda}{t}+(1-\beta)\frac{\partial c}{\partial q_i}\left(\frac{2-\lambda}{t}\right)+(1-\beta)X_i\frac{\partial^2 c}{\partial q_i^2}\right)$$
$$dn\text{:} \left((1-\beta)\frac{\partial c}{\partial q_i}-\frac{\theta}{2}\right)\frac{\lambda}{n^2}$$
$$d\alpha\text{:}\frac{2-\lambda}{t}$$
$$d\beta\text{:}c(q_i)\left(\frac{2-\lambda}{t}\right)+\left(\frac{2(1-\lambda)v+2(1-\lambda)q_i}{t}+\frac{\lambda}{n}\right)\frac{\partial c}{\partial q_i}$$
$$d\theta\text{:}\frac{2(1-\lambda)v+2(1-\lambda)q_i}{t}+\frac{\lambda}{n}+\frac{\lambda}{t}\left(V+q_i-\frac{t}{2n}\right)$$

We find that intensity of care increases with the number of firms only for certain θ:

$$\frac{dq_i}{dn}=\frac{\left((1-\beta)\frac{\partial c}{\partial q_i}-\frac{\theta}{2}\right)\frac{\lambda}{n^2}}{\left((1-\beta)\frac{\partial c}{\partial q_i}-\theta\right)\frac{2(1-\lambda)}{t}-\theta\frac{\lambda}{t}+(1-\beta)\frac{\partial c}{\partial q_i}\left(\frac{2-\lambda}{t}\right)+(1-\beta)X_i\frac{\partial^2 c}{\partial q_i^2}}$$

If a firm is above a certain threshold altruism level the sign is negative. Otherwise for modest levels of altruism we find the same result as for a profit maximizing firm. The threshold level of altruism is:

$$\overline{\theta}=2(1-\beta)\frac{\partial c}{\partial q_i}$$

For a profit maximizing firm, we found that intensity of care increased as the number of firms in the market increased due to increased competition. Although this result applies to altruistic firms up to the altruistic threshold, very altruistic firms are predicted to actually decrease quality as the number of firms increases. In the profit maximizing case, we obtained a positive relationship due to the fact that when the number of firms increased, the demand for each firm decreases, this lower demand increases marginal profits which makes it more profitable to increase intensity of care in order to attract more patients. Altruistic firms a have a second effect coming into play. Because they value the patient benefit, lower demand from an increase in firms also lowers the marginal patient benefit for high intensity of care giving the hospital less incentive to increase intensity of care. At high enough levels of altruism, this lowered patient benefit effect overshadows the increased marginal profit effect and firms actually decrease quality.

Our estimates of how intensity of care changes with the marginal and average reimbursement remain unchanged in sign, as payments increase (decrease) intensity of care increases (decreases). Similarly, effects on firm exit remain mostly unchanged. Threshold levels of average and marginal reimbursement, below which firms will leave the market in the long run, are lowered by the inclusion of the welfare term, θB.

Introducing the parameter, θ, lets us analyze the effect of changes in the level of altruism have on intensity:

$$\frac{dq_i}{d\theta} = \frac{X_i + \frac{\lambda}{t}\left(V + q_i - \frac{t}{2n}\right)}{\left((1-\beta)\frac{\partial c}{\partial q_i} - \theta\right)\frac{2(1-\lambda)}{t} - \theta\frac{\lambda}{t} + (1-\beta)\frac{\partial c}{\partial q_i}\frac{2-\lambda}{t} + (1-\beta)X_i\frac{\partial^2 c}{\partial q_i^2}} > 0$$

Although quality responsiveness to market competition is lowered by altruism, overall altruism leads to higher quality due to the value firms place on patient wellbeing. Altruistic firms are willing to forgo profits in order to provide higher quality and provide higher levels of equilibrium quality than do profit maximizing firms with the same level of reimbursement. Including altruism in our analysis leads to similar, though smaller in magnitude, results as profit maximizing firms except for at high levels of altruism. Prior research suggests that non-profit firms do not behave very altruistically and therefore we expect to see results similar to those of for-profit firms.

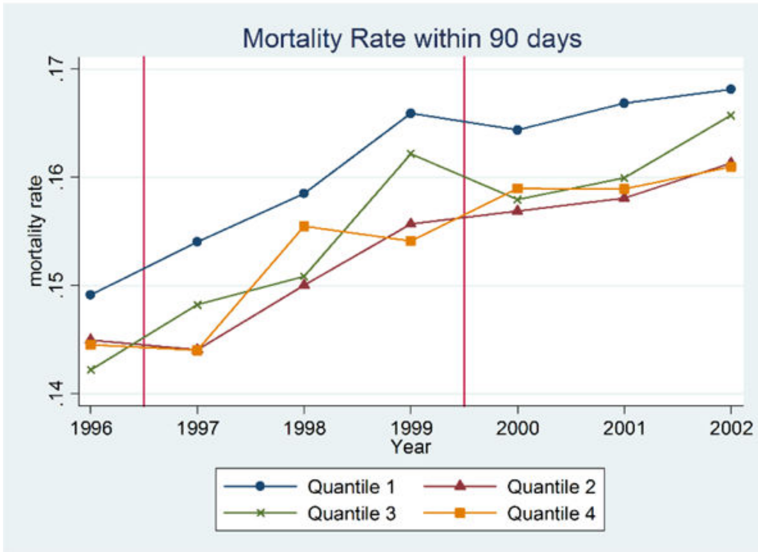
Motivated by these propositions and our subsequent analysis of altruistic behavior we expect to see the following patterns in our data:

1. More competitive markets have higher intensity of care (and consequently, higher costs).
2. Because IPS lowered both average and marginal reimbursement we expect to see a decrease in intensity of care for all markets.
3. Because the effects of changes in marginal reimbursement are magnified in markets with more competition we expect to see a greater decrease in intensity of care (and costs) following the IPS in more competitive markets. This implies a convergence in the costs or intensity of care in more versus less competitive markets after the reform.
4. Altruism, if present, is likely to reduce the magnitude of effects from payment reform. Thus we expect to find the largest effects in for-profit home health agencies and smaller effects in non-profit and government run agencies.
5. More competitive markets will have greater firm exit.

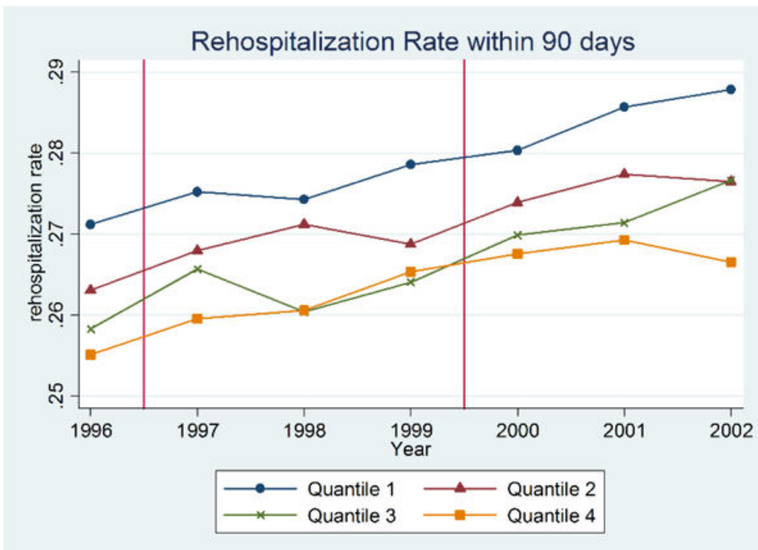
One caveat is that the model is silent on the effects of competition on patient outcomes. The model predicts changes in intensity of care only and not patient outcomes. On the one hand, one can argue that if patients value intensity it must improve patient outcomes. However, on the other hand one can argue that patients might be uninformed and even though they value higher intensity care, beyond a certain level, changes in intensity of care do not improve patient outcomes and represent "wasteful" spending. Thus, in our empirical models we will evaluate both changes in intensity of care and also changes in patient outcomes.

Appendix B: Supplementary Tables and Figures

A:



B:



Appendix Figure 2. Effects of IPS on Health Outcomes for Stroke, 1996–2000

Panel A: Mortality Rate

Panel B: Readmissions Rate

Notes: Quantile 1 are HSAs with low HHI (most competitive), Quantile 4 are HSAs with high HHI (least competitive). Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000; sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland. Data is aggregated to annual level.

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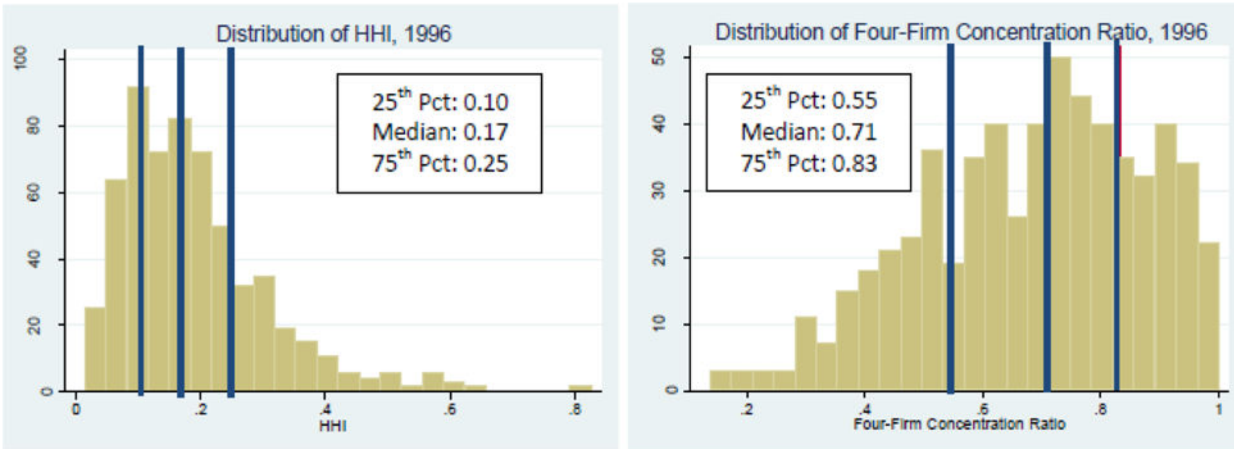

Figure 1. Distribution of Home Health HHI and Four-Firm Concentration Ratio across HSAs, 1996

Notes: Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Home Health market share is defined by the patient's residence; markets are defined based on the stroke sample; sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

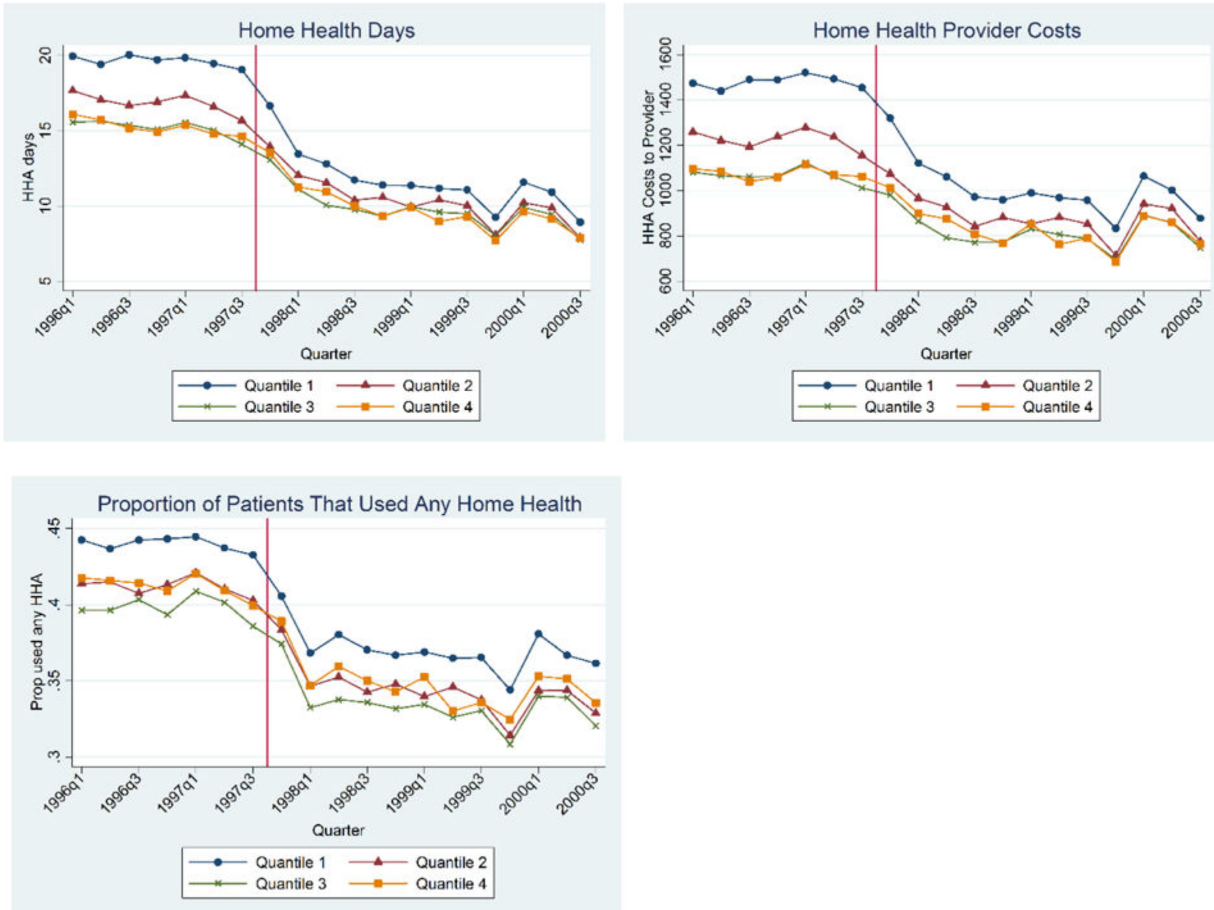

Figure 2. Trends in Home Health Outcomes for Stroke by Level of Competition, 1996–2000

Notes: Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Quantile 1 are HSAs with low HHI (most competitive), Quantile 4 are HSAs with high HHI (least competitive); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

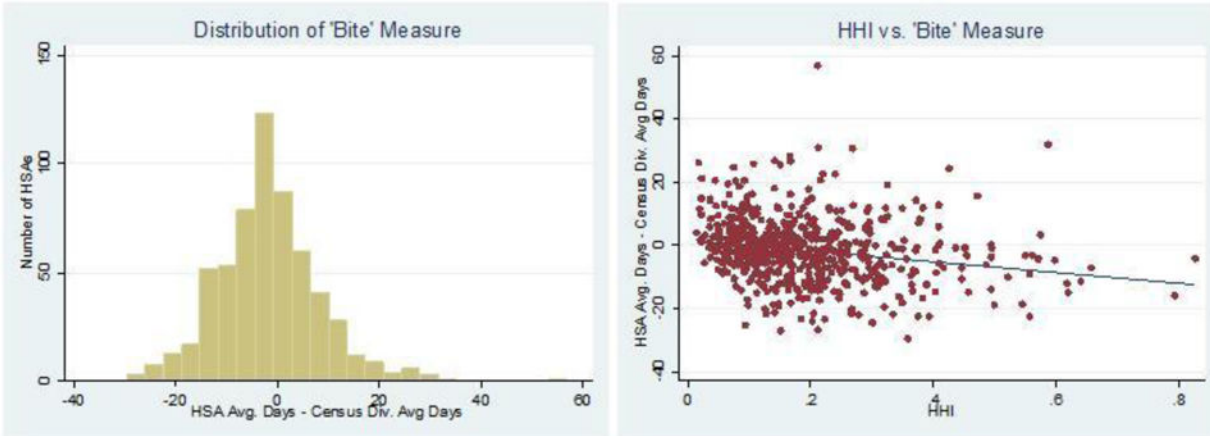

Figure 3. Relationship between HHI and IPS "Bite"

Notes: Observations are at the HSA-level. Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs).

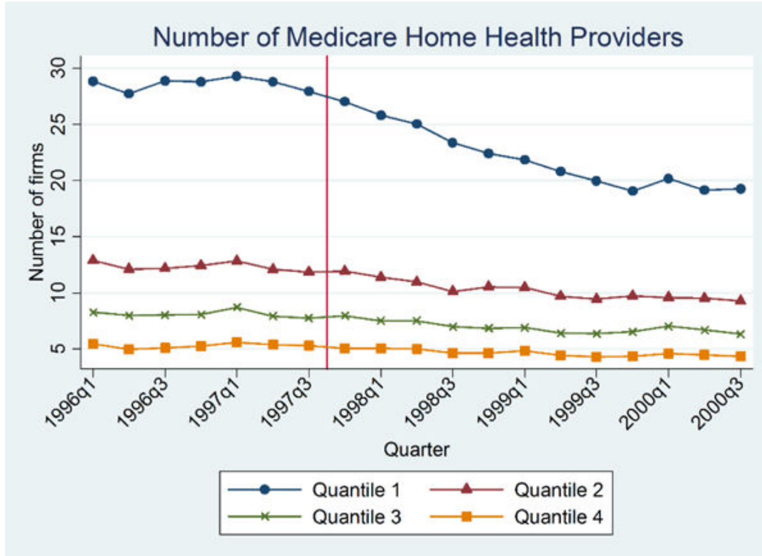

Figure 4. Trends in Number of Home Health Providers by Level of Competition, 1996–2000

Notes: Quantile 1 are HSAs with low HHI (most competitive), Quantile 4 are HSAs with high HHI (least competitive). Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. HHI and number of providers is defined for stroke sample; sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Table 1

Descriptive Statistics for Stroke Discharges, 1996

Sample:	Most Competitive HSAs (1)	Least Competitive HSAs (2)
Competition Measures, 1996		
Herfindahl-Hirschman Index (HHI)	0.104	0.281
Four-Firm Concentration Ratio	0.533	0.835
Outcomes		
Home Health (HH) Days, 1996	19.693	16.488
Change in HH Days, 1996–1998	*−7.803*	*−5.750*
Any Home Health 1996 (%)	0.421	0.415
Change in Any Home Health, 1996–1998	*−0.075*	*-0.070*
HH Provider Costs. 1996	1342.596	1106.996
Change in HH Provider Costs, 1996–1998	*−418.341*	*−268.872*
90-Day Mortality, 1996 (%)	0.150	0.146
Change in 90-Day Mortality, 1996–1998	*0.006*	*0.011*
90-Day Rehospitalization, 1996 (%)	0.269	0.260
Change in 90-Day Rehospitalization, 1996–1998	*0.004*	*0.005*
Patient Characteristics, 1996		
Age	78.864	78.894
Male (%)	0.404	0.413
White (%)	0.863	0.881
Medicaid (%)	0.223	0.226
Urban (%)	0.604	0.328
Rural (%)	0.169	0.383
Adjacent to Metro Area (%)	0.227	0.289
Any Co-Morbidities (%)	0.655	0.651
Number of Co-Morbidities	1.045	1.033
Any Complications (%)	0.208	0.205
Hemorrhagic or Ischemic Stroke (%)	0.073	0.072
Home Health Agency Characteristics, 1996		
Non-Profit Ownership (%)	0.469	0.560
For-Profit Ownership (%)	0.412	0.250
Government Ownership (%)	0.119	0.190
Number of Observations, 1996		
HH Claims Per HSA	286.91	93.34
Stroke Claims Per HSA	664.77	231.06
Number of HH Medicare Providers Per HSA	39.71	13.11
Total HH Claims	86,074	28,003
Total Stroke Claims	199,432	69,317
Number of HSAs	300	300

Notes: Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Summary statistics are computed at the HSA-level for the stroke sample. The sample is split into the most competitive HSAs with below median HHI and the least competitive HSAs with above median HHI; sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Table 2

Effects of IPS on Home Health Outcomes, 1996−2000

Sub-Sample:	**Stroke**			**Hip Fracture**			**Joint Replacement**		
Dependent variable:	**HH Days**	**HH Provider Costs**	**Any Home Health**	**HH Days**	**HH Provider Costs**	**Any Home Health**	**HH Days**	**HH Provider Costs**	**Any Home Health**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
HHI Quantile1*Post	−2.515 *** (0.482)	−220.370 *** (27.726)	−0.003 (0.004)	−2.545 *** (0.459)	−230.195 *** (28.929)	−0.005 (0.005)	−2.048 *** (0.329)	−183.538 *** (23.273)	−0.015 ** (0.006)
HHI Quantile2*Post	−0.994 ** (0.401)	−83.668 *** (23.613)	−0.003 (0.004)	−1.044 ** (0.414)	−86.969 *** (23.609)	−0.007 (0.005)	−0.758 ** (0.314)	−77.887 *** (23.780)	−0.016 ** (0.007)
HHI Quantile3*Post	0.098 (0.407)	−1.792 (23.913)	0.003 (0.005)	−0.294 (0.375)	−23.541 (23.136)	−0.001 (0.005)	−0.243 (0.374)	−25.067 (23.249)	−0.011 (0.008)
Dep. Var. Mean (pre-IPS)	17.82	1,311.62	0.42	17.70	1,309.30	0.49	16.19	1,213.25	0.67
F-test	12.06 [0.000]	27.19 [0.000]	0.71 [0.548]	11.86 [0.000]	23.79 [0.000]	0.79 [0.502]	14.80 [0.000]	25.50 [0.000]	2.31 [0.075]
Observations	1,160,516	1,160,516	1,160,516	894,015	894,015	894,015	1,030,686	1,030,686	1,030,686

Notes:

*** p<0.01

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HAS-level; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland. The HHI varies by the three diagnosis types. We include quarter-year fixed effects, HSA fixed effects, controls.

Table 3

Effects of IPS on Home Health Outcomes for Stroke with Leads and Lags

Dependent variable:	**HH Days**		**HH Provider Costs**		**Any Home Health**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
HHI*Post	10.041*** (2.022)		917.614*** (114.363)		0.012 (0.016)	
Post	−8.146*** (0.430)		−493.953*** (23.502)		−0.068*** (0.003)	
HHI*1996q1		2.246 (1.929)		85.533 (135.041)		0.022 (0.026)
HHI*1996q2		3.379* (1.965)		153.308 (138.980)		0.026 (0.025)
HHI*1996q3		−0.673 (1.825)		−138.96 (130.714)		0.022 (0.025)
HHI*1996q4		0.592 (2.021)		−7.478 (151.562)		0.008 (0.028)
HHI*1997q1		1.419 (1.913)		33.769 (134.776)		0.044* (0.026)
HHI*1997q2		0.137 (1.644)		−74.998 (121.232)		0.024 (0.028)
HHI*1997q4		5.481*** (1.698)		358.717*** (122.410)		0.044* (0.027)
HHI*1998q1		9.977*** (1.989)		726.035*** (138.670)		0.044* (0.026)
HHI*1998q2		10.914*** (2.378)		863.341*** (145.158)		0.032 (0.027)
HHI*1998q3		11.247*** (2.568)		944.842*** (160.389)		0.031 (0.030)
HHI*1998q4		10.226*** (2.493)		888.843*** (161.001)		0.022 (0.028)
HHI*1999q1		13.664*** (2.761)		1,115.242*** (172.913)		0.042 (0.030)
HHI*1999q2		11.326*** (2.683)		923.120*** (173.238)		0.004 (0.031)
HHI*1999q3		11.425*** (2.682)		950.154*** (167.860)		0.007 (0.031)

Dependent variable:	**HH Days**		**HH Provider Costs**		**Any Home Health**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
HHI*1999q4		13.342*** (2.601)		1,135.461*** (161.717)		0.055* (0.029)
HHI*2000q1		11.898*** (2.849)		976.913*** (180.282)		0.014 (0.034)
HHI*2000q2		12.562*** (2.591)		1,126.491*** (166.155)		0.075** (0.032)
HHI*2000q3		14.409*** (2.770)		1,191.468*** (168.927)		0.015 (0.032)

Notes:

*** p<0.01,

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HAS-level; regressions include either a “post” indicator (columns 1, 3, 5) or quarter-year FE (in columns 2,4, 6), HSA FE, and full set of control variables; each interaction term in columns 1, 3, and 5 represents HHI*quarter (q1, q2, q2 or q4); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland; N=1,160,516.

Table 4

Effects of IPS on Home Health Outcomes for Stroke for Urban vs. Non-Urban HSAs

	Urban HSAs			Non-Urban HSAs		
Dependent variable:	**HH Days**	**HH Provider Costs**	**Any Home Health**	**HH Days**	**HH Provider Costs**	**Any Home Health**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
HHI Quantile1*Post	−2.794 *** (0.611)	−241.389 *** (34.370)	−0.003 (0.005)	−2.555 *** (0.843)	−149.588 *** (51.062)	−0.008 (0.008)
HHI Quantile2*Post	−1.761 *** (0.548)	−123.490 *** (29.755)	−0.007 (0.005)	−0.245 (0.800)	−2.258 (50.513)	0.007 (0.009)
HHI Quantile3*Post	−0.176 (0.442)	−33.451 (26.924)	0 (0.006)	−0.024 (0.735)	6.73 (45.386)	0.004 (0.009)
Quarter-year FE	Y	Y	Y	Y	Y	Y
HSA FE	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y
F-test	9.65 [0.000]	19.11 [0.000]	0.84 [0.476]	4.61 [0.004]	5.66 [0.001]	2.06 [0.105]
Observations	927,419	927,419	927,419	181,274	181,274	181,274

Notes:

*** p<0.01

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HSA-level; Urban/Non-Urban definitions come from SEER-Medicare matched to NCHS HSAs; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Table 5

Effects of IPS on Home Health Outcomes for Stroke Controlling for Payment Change, 1996–2000

Dependent variable:	HH Days			HH Provider Costs			Any Home Health		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HHI Quantile1*Post	−2.515 *** (0.482)	−0.998 ** (0.427)	−0.943 ** (0.449)	−220.370 *** (27.726)	−133.349 *** (24.992)	−130.237 *** (26.740)	−0.003 (0.004)	0.001 (0.004)	0.003 (0.005)
HHI Quantile2*Post	−0.994 ** (0.401)	−0.313 (0.337)	−0.257 (0.382)	−83.668 *** (23.613)	−44.614 ** (19.721)	−42.496 * (22.260)	−0.003 (0.004)	−0.001 (0.004)	0.001 (0.005)
HHI Quantile3*Post	0.098 (0.407)	0.297 (0.290)	0.319 (0.346)	−1.792 (23.913)	9.594 (19.100)	12.919 (23.700)	0.003 (0.005)	0.004 (0.005)	0.005 (0.005)
HHI Quantile1*Post*Bite			−0.068 (0.062)			−5.618 (3.461)			0.000 (0.001)
HHI Quantile2*Post*Bite			0.045 (0.042)			2.65 (2.042)			0.001 * (0.001)
HHI Quantile3*Post*Bite			0.008 (0.036)			1.123 (2.385)			0.000 0.000
Post*Bite	N	Y	Y	N	Y	Y	N	Y	Y
Quarter-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
F-test	12.06 [0.000]	3.49 [0.016]	2.86 [0.036]	27.19 [0.000]	13.63 [0.000]	12.33 [0.000]	0.71 [0.548]	0.36 [0.780]	0.43 [0.731]
Observations	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516

Notes:

*** p<0.01,

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HAS-level; "Bite" is defined as the average days per person in the HSA minus the average days per person in the Census Division; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Table 6

Effects of IPS on Number of Home Health Providers

Dependent variable:	Number of HH Providers			Log(Number of HH Providers)		
Sub-Sample:	Stroke	Hip	Joint	Stroke	Hip	Joint
	(1)	(2)	(3)	(4)	(5)	(6)
HHI Quantile1*Post	−5.537 *** (0.452)	−4.276 *** (0.404)	−4.042 *** (0.330)	−0.137 *** (0.018)	−0.115 *** (0.018)	−0.165 *** (0.019)
HHI Quantile2*Post	−1.200 *** (0.148)	−1.044 *** (0.129)	−1.082 *** (0.148)	−0.066 *** (0.018)	−0.078 *** (0.020)	−0.093 *** (0.019)
HHI Quantile3*Post	−0.430 *** (0.117)	−0.398 *** (0.120)	−0.433 *** (0.137)	−0.032 * (0.019)	−0.032 (0.021)	−0.042 ** (0.019)
Dep. Var. Mean (pre-IPS)	13.59	12.60	13.67	2.26	2.18	2.32
F-test	78.47 [0.000]	61.78 [0.000]	62.83 [0.000]	21.57 [0.000]	15.85 [0.000]	30.39 [0.000]
Observations	11,391	11,350	11,342	11,391	11,350	11,342

Notes:

*** p<0.01,

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HAS-level; the regressions are at the HAS-level and include quarter-year fixed effects, HSA fixed effects, controls; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland. The HHI varies by the three diagnosis types. The number of providers represents the number of providers with positive claims for each diagnosis type.

Table 7

Characteristics of Exiting vs. Stayer Home Health Providers for Stroke, 1996

	Most Competitive HSAs		Least Competitive HSAs	
	Stayer Firms	**Exiting Firms**	**Stayer Firms**	**Exiting Firms**
Characteristics, 1996	**(1)**	**(2)**	**(3)**	**(4)**
Home Health Days	41.361	49.292	37.959	39.609
Home Health Medicare Payments	2,881.274	3,374.920	2,385.136	2,485.309
Home Health Provider Costs	3,090.284	3,527.404	2,629.066	2,698.481
90−Day Mortality (%)	0.053	0.050	0.057	0.060
90−Day Rehospitalization (%)	0.302	0.303	0.302	0.297
Age	78.689	78.769	78.541	79.079
Male (%)	0.393	0.376	0.396	0.384
White (%)	0.821	0.803	0.854	0.881
Medicaid (%)	0.171	0.208	0.197	0.169
Urban (%)	0.827	0.803	0.502	0.464
Rural (%)	0.055	0.068	0.239	0.308
Adjacent to Metro Area (%)	0.118	0.129	0.258	0.228
Non-Profit Home Health Agency (%)	0.645	0.317	0.637	0.398
For-Profit Home Health Agency (%)	0.283	0.616	0.213	0.398
Government Home Health Agency (%)	0.072	0.066	0.150	0.205
Non-Profit Acute Discharging Hospital (%)	0.768	0.664	0.704	0.722
For-Profit Acute Discharging Hospital (%)	0.099	0.193	0.078	0.102
Government Acute Discharging Hospital (%)	0.133	0.143	0.218	0.176
Number of Home Health Firms	2,984	2,879	1,589	850

Notes: Means are computed at the individual-level for patients who received any home health care. Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. The sample is split into the most competitive HSAs with below median HHI and the least competitive HSAs with above median HHI; sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Table 8

Effects of IPS on Home Health Outcomes for Exiting vs. Stayer Providers for Stroke

Panel A: Level Effects

Dependent variable:	**Home Health Days**				**Home Health Provider Costs**			
	Full Sample	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
HHI Quantile1*Post	−3.994*** (0.742)	−2.392*** (0.684)	−1.849*** (0.659)	−0.597 (0.579)	−389.543*** (46.074)	−293.446*** (47.330)	−268.759*** (42.094)	−196.841*** (43.992)
HHI Quantile2*Post	−2.080*** (0.665)	−1.821** (0.705)	−1.022* (0.544)	−0.856 (0.566)	−180.562*** (47.008)	−163.229*** (50.943)	−120.954*** (39.058)	−111.283** (43.218)
HHI Quantile3*Post	−0.364 (0.650)	−0.321 (0.709)	−0.026 (0.484)	0.022 (0.542)	−32.457 (44.460)	−20.736 (50.013)	−13.417 (39.403)	−2.245 (44.516)
Post*Bite	N	N	Y	Y	N	N	Y	Y
Quarter-year FE	Y	Y	Y	Y	Y	Y	Y	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y
F-test	12.36 [0.000]	5.77 [0.001]	3.82 [0.010]	1.24 [0.293]	29.95 [0.000]	17.95 [0.000]	18.00 [0.000]	10.53 [0.000]
Observations	421,490	347,642	421,490	347,642	421,490	347,642	421,490	347,642

Panel B: Log Effects

Dependent variable:	**Log (Home Health Days)**				**Log (Home Health Provider Costs)**			
	Full Sample	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
HHI Quantile1*Post	−0.057*** (0.016)	−0.036** (0.017)	−0.024 (0.015)	−0.008 (0.016)	−0.112*** (0.016)	−0.093*** (0.018)	−0.076*** (0.015)	−0.063*** (0.017)
HHI Quantile2*Post	−0.029* (0.017)	−0.029* (0.017)	−0.013 (0.015)	−0.014 (0.016)	−0.054*** (0.017)	−0.055*** (0.019)	−0.036** (0.015)	−0.039** (0.017)
HHI Quantile3*Post	0.01 (0.018)	0.012 (0.020)	0.016 (0.016)	0.017 (0.018)	−0.004 (0.018)	−0.002 (0.021)	0.002 (0.017)	0.004 (0.019)
Post*Bite	N	N	Y	Y	N	N	Y	Y
Quarter-year FE	Y	Y	Y	Y	Y	Y	Y	Y

Panel B: Log Effects

Dependent variable:	**Log (Home Health Days)**				**Log (Home Health Provider Costs)**			
	Full Sample	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**	**Full Sample**	**Excl. Exiting Firms**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y
F-test	8.23 [0.000]	3.71 [0.012]	2.98 [0.031]	1.45 [0.226]	24.91 [0.000]	13.68 [0.000]	13.85 [0.000]	7.44 [0.000]
Observations	421,449	347,601	421,449	347,601	421,490	347,642	421,490	347,642

Notes:

*** p<0.01,

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HSA-level; Sample includes individuals who received any home health care; Odd columns include patients using home health providers that were in the sample from 1996 through 2000: Q3 and providers that were in the sample in 1996 but exited after IPS; Even columns exclude providers that were in the sample in 1996 but exited after IPS. “Bite” is defined as the average days per person in the HSA minus the average days per person in the Census Division; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Appendix Table 1

Complete Descriptive Statistics for Outcomes and Covariates

Panel A: Stroke Discharges		
Sample:	Most Competitive HSAs (1)	Least Competitive HSAs (2)
Competition Measures, 1996		
HHI	0.104	0.281
Four-Firm Concentration Ratio	0.533	0.835
Outcomes		
Home Health Days, 1996	19.693	16.488
Change in HH Days, 1996–1998	*−7.803*	*−5.750*
Any Home Health, 1996 (%)	0.421	0.415
Change in Any Home Health, 1996–1998	*−0.075*	*−0.070*
Home Health Medicare Payments, 1996	1264.064	1010.762
Change in HH Medicare Payments, 1996–1998	*−460.440*	*−310.973*
Home Health Provider Costs, 1996	1343.596	1106.996
Change in HH Provider Costs, 1996–1998	*−418.341*	*−268.872*
90-Day Mortality, 1996 (%)	0.150	0.146
Change in 90-Day Mortality, 1996–1998	*0.006*	*0.011*
90-Day Rehospitalization, 1996 (%)	0.269	0.260
Change in 90-Day Rehospitalization, 1996–1998	*0.004*	*0.005*
Patient Demographics, 1996		
Age	78.864	78.894
Male (%)	0.404	0.413
White (%)	0.863	0.881
Medicaid (%)	0.223	0.226
Urban (%)	0.604	0.328
Rural (%)	0.169	0.383
Adjacent to Metro Area (%)	0.227	0.289
Condition-Specific Characteristics, 1996		
Hemorrhagic or Ischemic Stroke (%)	0.073	0.072
Patient Co-Morbidities, 1996		
CHF (%)	0.146	0.142
Valvular Disease (%)	0.098	0.097
Pulmonary Circ. Disorders (%)	0.008	0.008
Peripheral Vascular Disorders (%)	0.068	0.072
Paralysis (%)	0.007	0.007
Other Neurological Disorders (%)	0.003	0.003
Diabetes- Uncomplicated (%)	0.215	0.216
Diabetes- Complicated (%)	0.039	0.036

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Panel A: Stroke Discharges		
	Most Competitive HSAs	**Least Competitive HSAs**
Sample:	**(1)**	**(2)**
Hypothyroidism (%)	0.068	0.069
Renal Failure (%)	0.019	0.016
Liver disease (%)	0.004	0.003
Peptic ulcer disease excl bleeding (%)	0.002	0.002
AIDS (%)	0.000	0.000
Lymphoma (%)	0.003	0.003
Metastatic cancer (%)	0.009	0.011
Solid tumor without metastasis (%)	0.016	0.016
Rheumatoid Arthritis (%)	0.016	0.017
Coagulopathy (%)	0.011	0.009
Obesity (%)	0.017	0.018
Weight Loss (%)	0.023	0.020
Fluid and electrolyte disorders (%)	0.149	0.142
Blood Loss Anemia (%)	0.006	0.005
Deficiency Anemias (%)	0.056	0.057
Alcohol Abuse (%)	0.013	0.013
Drug Abuse (%)	0.001	0.001
Psychoses (%)	0.017	0.015
Depression (%)	0.033	0.036
Patient Complications, 1996		
Post-operative Pulmonary Compromise (%)	0.013	0.011
Post-operative Gastrointestinal Hemorrhage (%)	0.011	0.010
Cellulitis or Decubitus Ulcer (%)	0.018	0.017
Septicemia (%)	0.001	0.001
Pneumonia (%)	0.055	0.056
Mechanical Complications due to a Device, Implant, or Graft	0.007	0.007
Shock or Arrest in the Hospital (%)	0.003	0.003
Post-operative Myocardial Infarction (%)	0.008	0.009
Post-operative Cardiac Abnormalities other than AMI (%)	0.002	0.002
Venous Thrombosis and Pulmonary Embolism (%)	0.004	0.004
Procedure-related Perforation or Laceration (%)	0.004	0.004
Acute Renal Failure (%)	0.004	0.004
Delirium (%)	0.014	0.013
Dementia (%)	0.097	0.095
Miscellaneous Complications (%)	0.001	0.002
Hip Replacement (%)	0.000	0.001
Acute Hospital Characteristics, 1996		
Non-Profit Ownership (%)	0.668	0.679

Panel A: Stroke Discharges

Sample:	Most Competitive HSAs (1)	Least Competitive HSAs (2)
For-Profit Ownership (%)	0.120	0.077
Government Ownership (%)	0.212	0.245
Acute Wage Index	0.918	0.878
Daily Census	146.529	117.231
Number of Beds	242.831	200.683
Acute Case Mix Index	1.382	1.312
Resident to Avg. Daily Census Ratio	0.060	0.040
DSH Patient Percentage	0.232	0.237
Medicare Days for Prev. Year (%)	0.549	0.555
Other Descriptive Statistics, 1996		
Home Health Claims Per HSA	286.91	93.34
Stroke Claims Per HSA	664.77	231.06
Number of Home Health Medicare Providers Per HSA	39.71	13.11
Total Home Health Claims	86,074	28,003
Total Stroke Claims	199,432	69,317
Number of HSAs	300	300

Panel B: Hip Discharges

Sample:	Most Competitive HSAs (1)	Least Competitive HSAs (2)
Competition Measures, 1996		
HHI	0.107	0.282
Four-Firm Concentration Ratio	0.546	0.828
Outcomes		
Home Health Days, 1996	19.269	16.481
Change in HH Days, 1996–1998	*−7.139*	*−5.369*
Any Home Health, 1996 (%)	0.476	0.477
Change in Any Home Health, 1996–1998	*−0.066*	*−0.065*
Home Health Medicare Payments, 1996	1236.366	1009.668
Change in HH Medicare Payments, 1996–1998	*−416.037*	*−284.329*
Home Health Provider Costs, 1996	1314.063	1091.338
Change in HH Provider Costs, 1996–1998	*−364.906*	*−225.530*
90-Day Mortality, 1996 (%)	0.109	0.106
Change in 90-Day Mortality, 1996–1998	*0.007*	*0.011*
90-Day Rehospitalization, 1996 (%)	0.224	0.217
Change in 90-Day Rehospitalization, 1996–1998	*0.008*	*0.008*
Patient Demographics, 1996		
Age	82.758	82.648

Panel B: Hip Discharges

Sample:	Most Competitive HSAs (1)	Least Competitive HSAs (2)
Male (%)	0.216	0.216
White (%)	0.938	0.944
Medicaid (%)	0.239	0.259
Urban (%)	0.607	0.344
Rural (%)	0.166	0.391
Adjacent to Metro Area (%)	0.227	0.265
Patient Co-Morbidities, 1996		
CHF (%)	0.152	0.158
Valvular Disease (%)	0.059	0.059
Pulmonary Circ. Disorders (%)	0.009	0.009
Peripheral Vascular Disorders (%)	0.046	0.047
Paralysis (%)	0.024	0.026
Other Neurological Disorders (%)	0.156	0.150
Diabetes- Uncomplicated (%)	0.119	0.117
Diabetes- Complicated (%)	0.015	0.015
Hypothyroidism (%)	0.085	0.077
Renal Failure (%)	0.012	0.010
Liver disease (%)	0.006	0.005
Peptic ulcer disease excl bleeding (%)	0.002	0.002
AIDS (%)	0.000	0.000
Lymphoma (%)	0.004	0.004
Metastatic cancer (%)	0.006	0.007
Solid tumor without metastasis (%)	0.015	0.014
Rheumatoid Arthritis (%)	0.023	0.025
Coagulopathy (%)	0.016	0.014
Obesity (%)	0.006	0.008
Weight Loss (%)	0.026	0.024
Fluid and electrolyte disorders (%)	0.188	0.174
Blood Loss Anemia (%)	0.023	0.028
Deficiency Anemias (%)	0.105	0.101
Alcohol Abuse (%)	0.014	0.013
Drug Abuse (%)	0.001	0.001
Psychoses (%)	0.024	0.023
Depression (%)	0.036	0.037
Patient Complications, 1996		
Post-operative Pulmonary Compromise (%)	0.010	0.009
Post-operative Gastrointestinal Hemorrhage (%)	0.007	0.008
Cellulitis or Decubitus Ulcer (%)	0.020	0.018
Septicemia (%)	0.000	0.000
Pneumonia (%)	0.036	0.038

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Panel B: Hip Discharges

Sample:	Most Competitive HSAs (1)	Least Competitive HSAs (2)
Mechanical Complications due to a Device, Implant, or Graft	0.009	0.011
Shock or Arrest in the Hospital (%)	0.002	0.002
Post-operative Myocardial Infarction (%)	0.006	0.006
Post-operative Cardiac Abnormalities other than AMI (%)	0.002	0.002
Venous Thrombosis and Pulmonary Embolism (%)	0.005	0.004
Procedure-related Perforation or Laceration (%)	0.002	0.003
Acute Renal Failure (%)	0.004	0.003
Delirium (%)	0.015	0.015
Dementia (%)	0.209	0.206
Miscellaneous Complications (%)	0.007	0.008
Acute Hospital Characteristics, 1996		
Non-Profit Ownership (%)	0.697	0.703
For-Profit Ownership (%)	0.130	0.071
Government Ownership (%)	0.174	0.226
Acute Wage Index	0.920	0.886
Daily Census	147.084	117.883
Number of Beds	245.884	203.651
Acute Case Mix Index	1.398	1.327
Resident to Avg. Daily Census Ratio	0.054	0.033
DSH Patient Percentage	0.217	0.233
Medicare Days for Prev. Year (%)	0.548	0.550
Observation, 1996		
Home Health Claims Per HSA	247.16	78.93
Hip Claims Per HSA	500.56	168.86
Number of Home Health Medicare Providers Per HSA	37.89	12.42
Total Home Health Claims	73,902	23,600
Total Hip Claims	149,667	50,490
Number of HSAs	300	300

Panel C: Joint Discharges

Sample:	Most Competitive HSAs (1)	Least Competitive HSAs (2)
Competition Measures, 1996		
HHI	0.124	0.303
Four-Firm Concentration Ratio	0.594	0.846
Outcomes		
Home Health Days, 1996	17.228	15.157
Change in HH Days, 1996–1998	*−5.433*	*−4.016*
Any Home Health, 1996 (%)	0.647	0.651

Panel C: Joint Discharges

	Most Competitive HSAs	Least Competitive HSAs
Sample:	**(1)**	**(2)**
Change in Any Home Health, 1996–1998	*−0.070*	*−0.053*
Home Health Medicare Payments, 1996	1140.013	953.974
Change in HH Medicare Payments, 1996–1998	*−318.346*	*−202.248*
Home Health Provider Costs, 1996	1187.111	1023.849
Change in HH Provider Costs, 1996–1998	*−248.665*	*−127.283*
90-Day Mortality, 1996 (%)	0.008	0.008
Change in 90-Day Mortality, 1996–1998	*0.001*	*0.001*
90-Day Rehospitalization, 1996 (%)	0.122	0.122
Change in 90-Day Rehospitalization, 1996–1998	*0.004*	*−0.001*
Patient Demographics, 1996		
Age	74.878	74.802
Male (%)	0.347	0.351
White (%)	0.926	0.935
Medicaid (%)	0.098	0.097
Urban (%)	0.580	0.361
Rural (%)	0.184	0.373
Adjacent to Metro Area (%)	0.236	0.266
Patient Co-Morbidities, 1996		
CHF (%)	0.043	0.044
Valvular Disease (%)	0.035	0.033
Pulmonary Circ. Disorders (%)	0.005	0.005
Peripheral Vascular Disorders (%)	0.021	0.020
Paralysis (%)	0.004	0.004
Other Neurological Disorders (%)	0.021	0.020
Diabetes- Uncomplicated (%)	0.110	0.111
Diabetes- Complicated (%)	0.007	0.007
Hypothyroidism (%)	0.082	0.081
Renal Failure (%)	0.004	0.004
Liver disease (%)	0.003	0.003
Peptic ulcer disease excl bleeding (%)	0.002	0.002
AIDS (%)	0.000	0.000
Lymphoma (%)	0.003	0.002
Metastatic cancer (%)	0.001	0.001
Solid tumor without metastasis (%)	0.006	0.006
Rheumatoid Arthritis (%)	0.025	0.026
Coagulopathy (%)	0.008	0.007
Obesity (%)	0.041	0.048
Weight Loss (%)	0.003	0.003
Fluid and electrolyte disorders (%)	0.076	0.072
Blood Loss Anemia (%)	0.017	0.019

Panel C: Joint Discharges

Sample:	Most Competitive HSAs (1)	Least Competitive HSAs (2)
Deficiency Anemias (%)	0.071	0.063
Alcohol Abuse (%)	0.004	0.004
Drug Abuse (%)	0.001	0.001
Psychoses (%)	0.006	0.005
Depression (%)	0.016	0.018
Patient Complications, 1996		
Post-operative Pulmonary Compromise (%)	0.004	0.004
Post-operative Gastrointestinal Hemorrhage (%)	0.003	0.003
Cellulitis or Decubitus Ulcer (%)	0.005	0.004
Septicemia (%)	0.000	0.000
Pneumonia (%)	0.007	0.008
Mechanical Complications due to a Device, Implant, or Graft	0.017	0.016
Shock or Arrest in the Hospital (%)	0.001	0.001
Post-operative Myocardial Infarction (%)	0.003	0.003
Post-operative Cardiac Abnormalities other than AMI (%)	0.001	0.001
Venous Thrombosis and Pulmonary Embolism (%)	0.006	0.005
Procedure-related Perforation or Laceration (%)	0.001	0.001
Acute Renal Failure (%)	0.001	0.001
Delirium (%)	0.010	0.009
Dementia (%)	0.009	0.009
Miscellaneous Complications (%)	0.014	0.017
Hip Replacement (%)	0.351	0.364
Acute Hospital Characteristics, 1996		
Non-Profit Ownership (%)	0.738	0.752
For-Profit Ownership (%)	0.116	0.084
Government Ownership (%)	0.146	0.164
Acute Wage Index	0.935	0.905
Daily Census	173.991	147.500
Number of Beds	284.414	242.760
Acute Case Mix Index	1.470	1.427
Resident to Avg. Daily Census Ratio	0.081	0.065
DSH Patient Percentage	0.201	0.204
Medicare Days for Prev. Year (%)	0.541	0.547
Observation, 1996		
Home Health Claims Per HSA	360.00	140.63
Joint Claims Per HSA	522.34	221.72
Number of Home Health Medicare Providers Per HSA	37.81	14.98
Total Home Health Claims	107,639	41,907
Total Joint Claims	156,179	66,073
Number of HSAs	300	300

Notes: Summary statistics are computed at the HSA-level. Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. The sample is split into the most competitive HSAs with below median HHI and the least competitive HSAs with above median HHI; sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Appendix Table 2

Effects of IPS on Home Health Outcomes for Stroke, 1996–2000

Dependent variable:	HH Days				HH Provider Costs				Any Home Health			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HHI Quantile1*Post	−2.437*** (0.480)	−2.433*** (0.480)	−2.443*** (0.481)	−2.515*** (0.482)	−219.663*** (27.397)	−219.507*** (27.381)	−220.140*** (27.408)	−220.370*** (27.726)	−0.003 (0.004)	−0.003 (0.004)	−0.003 (0.004)	−0.003 (0.004)
HHI Quantile2*Post	−0.973** (0.392)	−0.973** (0.391)	−0.974** (0.391)	−0.994** (0.401)	−91.347*** (24.434)	−91.350*** (24.380)	−91.384*** (24.385)	−83.668*** (23.613)	−0.001 (0.005)	−0.001 (0.005)	−0.001 (0.005)	−0.003 (0.004)
HHI Quantile3*Post	0.099 (0.401)	0.109 (0.400)	0.104 (0.400)	0.098 (0.407)	−1.083 (23.460)	−0.691 (23.415)	−0.985 (23.417)	−1.792 (23.913)	0.003 (0.005)	0.003 (0.005)	0.003 (0.005)	0.003 (0.005)
Post	−5.435*** (0.283)	−2.041*** (0.297)			−245.507*** (17.163)	−104.583*** (19.141)			−0.066*** (0.003)	−0.045*** (0.004)		
Linear trend t	N	Y	N	N	N	Y	N	N	N	Y	N	N
Quarter-year FE	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	N	N	Y	N	N	N	Y	N	N	N	Y
F-test	11.65 [0.000]	11.70 [0.000]	11.72 [0.000]	12.06 [0.000]	28.30 [0.000]	28.36 [0.000]	28.38 [0.000]	27.19 [0.000]	0.49 [0.688]	0.50 [0.683]	0.50 [0.683]	0.71 [0.548]
Observations	1,178,430	1,178,430	1,178,430	1,160,516	1,178,430	1,178,430	1,178,430	1,160,516	1,178,430	1,178,430	1,178,430	1,160,516

Notes:

*** p<0.01,

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HAS-level; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Appendix Table 3

Effects of IPS on Home Health Outcomes for Stroke, 1996−2000: Alternative Outcome Measures

Panel A: Log Effects of IPS on Days and Provider Costs

Dependent variable:	HH Days (Cond'l on Use)	Log (HH Days)	HH Provider Costs (Cond'l on Use)	Log (HH Provider Costs)
	(1)	(2)	(3)	(4)
HHI Quantile1*Post	−4.252 *** (0.782)	−0.056 *** (0.017)	−414.831 *** (47.197)	−0.116 *** (0.016)
HHI Quantile2*Post	−1.999; (0.664)	−0.027 (0.017)	−176.262 *** (46.621)	−0.053 *** (0.017)
HHI Quantile3*Post	−0.287 (0.648)	0.013 (0.018)	−33.685 (43.880)	−0.003 (0.018)
Linear trend t	N	N	N	N
Quarter-year FE	Y	Y	Y	Y
HSA FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
F-test	12.63 [0.000]	8.53 [0.000]	31.78 [0.000]	27.77 [0.000]
Observations	443,211	443,211	443,255	443,255

Panel B: Log Effects of IPS on Days and Provider Costs by Urban vs. Non-Urban

Urban HSAs

Dependent variable:	HH Days (Cond'l on Use)	Log (HH Days)	HH Provider Costs (Cond'l on Use)	Log (HH Provider Costs)
	(1)	(2)	(3)	(4)
HHI Quantile1*Post	−4.373 *** (0.998)	−0.061 *** (0.020)	−439.621 *** (56.264)	−0.125 *** (0.018)
HHI Quantile2*Post	−2.424 *** (0.892)	−0.033 (0.021)	−192.787 *** (51.437)	−0.056 *** (0.019)
HHI Quantile3*Post	−0.451 (0.728)	−0.007 (0.020)	−90.485 (55.379)	−0.032 (0.020)
Quarter-year FE	Y	Y	Y	Y

Panel B: Log Effects of IPS on Days and Provider Costs by Urban vs. Non-Urban

Urban HSAs

Dependent variable:	HH Days (Cond'l on Use)	Log (HH Days)	HH Provider Costs (Cond'l on Use)	Log (HH Provider Costs)
	(1)	(2)	(3)	(4)
HSA FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
F-test	8.23 [0.000]	4.86 [0.003]	21.23 [0.000]	19.51 [0.000]
Observations	360,663	360,663	360,700	360,700

Non-Urban HSAs

Dependent variable:	HH Days (Cond'l on Use)	Log (HH Days)	HH Provider Costs (Cond'l on Use)	Log (HH Provider Costs)
	(1)	(2)	(3)	(4)
HHI Quantile1*Post	−5.366*** (1.370)	−0.092*** (0.032)	−308.126*** (91.864)	−0.109*** (0.036)
HHI Quantile2*Post	−1.905 (1.340)	−0.028 (0.032)	−65.56 (92.057)	−0.028 (0.036)
HHI Quantile3*Post	−1.618 (1.190)	−0.041 (0.031)	−52.88 (81.489)	−0.03 (0.035)
Quarter-year FE	Y	Y	Y	Y
HSA FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
F-test	5.29 [0.001]	3.12 [0.026]	4.89 [0.003]	4.40 [0.005]
Observations	66,364	66,364	66,370	66,370

Panel C: Log Effects of IPS on Days and Provider Costs Controlling for "Bite"

Dependent variable:	HH Days (Cond'l on Use)			Log (HH Days)			HH Provider Costs (Cond'l on Use)			Log (HH Provider Costs)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HHI Quantile1*Post	−4.252*** (0.782)	−1.967*** (0.699)	−1.909*** (0.727)	−0.056*** (0.017)	−0.021 (0.015)	−0.014 (0.016)	−414.831*** (47.197)	−284.585*** (44.007)	−285.116*** (46.156)	−0.116*** (0.016)	−0.078*** (0.015)	−0.074*** (0.015)

Panel C: Log Effects of IPS on Days and Provider Costs Controlling for "Bite"

Dependent variable:	HH Days (Cond'l on Use)			Log (HH Days)			HH Provider Costs (Cond'l on Use)			Log (HH Provider Costs)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HHI Quantile2*Post	−1.999*** (0.664)	−0.899* (0.540)	−0.905 (0.576)	−0.027 (0.017)	−0.01 (0.015)	−0.003 (0.016)	−176.262*** (46.621)	−113.560*** (38.860)	−120.894*** (42.851)	−0.053*** (0.017)	−0.035** (0.015)	−0.031** (0.016)
HHI Quantile3*Post	−0.287 (0.648)	0.063 (0.472)	0.004 (0.555)	0.013 (0.018)	0.019 (0.016)	0.023 (0.017)	−33.685 (43.880)	−13.715 (39.067)	−18.794 (45.025)	−0.003 (0.018)	0.003 (0.016)	0.005 (0.017)
HHI Quantile1*Post*Bite						0.001 (0.002)						0.000 (0.002)
HHI Quantile2*Post*Bite						0.003* (0.002)						0.002 (0.002)
HHI Quantile3*Post*Bite						0.001 (0.002)						0.001 (0.002)
Post*Bite	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
Quarter-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F-test	12.63 [0.000]	3.79 [0.010]	3.22 [0.023]	8.53 [0.000]	3.02 [0.029]	2.44 [0.064]	31.78 [0.000]	17.92 [0.000]	16.93 [0.000]	27.77 [0.000]	15.26 [0.000]	13.99 [0.000]
Observations	443,211	443,211	443,211	443,211	443,211	443,211	443,255	443,255	443,255	443,255	443,255	443,255

Notes:

*** p<0.01,

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HAS-level; Sample includes individuals who received any home health care. "Bite" is defined as the average days per person in the HSA minus the average days per person in the Census Division; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Appendix Table 4

Effects of IPS on Acute Length of Stay and Utilization of Other Post-Acute Care

Panel A: Stroke

Dependent variable:	**Any Use**			**Days**				**Costs**			
	Skilled Nursing Facility	**Inpatient Rehab. Facility**	**Long Term Care Hospital**	**Skilled Nursing Facility**	**Inpatient Rehab. Facility**	**Long Term Care Hospital**	**Acute Hospital (Initial)**	**Skilled Nursing Facility**	**Inpatient Rehab. Facility**	**Long Term Care Hospital**	**Acute Hospital (Initial)**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
HHI Quantile1*Post	−0.027*** (0.006)	0.006 (0.004)	0.005*** (0.001)	−0.796*** (0.241)	0.105 (0.104)	0.166*** (0.038)	0.176* (0.093)	−672.325*** (142.886)	18.417 (86.908)	127.155*** (30.137)	55.072 (78.361)
HHI Quantile2*Post	−0.012* (0.007)	0.006 (0.005)	0.002 (0.001)	−0.386 (0.275)	0.166 (0.108)	0.062 (0.043)	−0.043 (0.115)	−160.823 (160.192)	94.888 (84.736)	62.452* (33.477)	21.947 (83.421)
HHI Quantile3*Post	−0.015*** (0.006)	0.000 (0.005)	0.002 (0.001)	−0.731*** (0.250)	0.036 (0.111)	0.045 (0.035)	0.032 (0.091)	−381.699*** (126.139)	−0.569 (90.250)	41.683 (26.754)	6.044 (68.771)
Dep. Var. Mean (pre-IPS)	0.41	0.22	0.009	15.06	4.67	0.31	7.05	5,496.98	3,457.42	238.88	5,999.55
F-test	7.67 [0.000]	1.37 [0.250]	7.34 [0.000]	4.42 [0.004]	1.02 [0.384]	6.42 [0.000]	1.69 [0.168]	8.18 [0.000]	0.67 [0.572]	6.35 [0.000]	0.21 [0.891]
Observations	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516	1,160,516

Panel B: Hip Fractures

Dependent variable:	**Any Use**			**Days**				**Costs**			
	Skilled Nursing Facility	**Inpatient Rehab. Facility**	**Long Term Care Hospital**	**Skilled Nursing Facility**	**Inpatient Rehab. Facility**	**Long Term Care Hospital**	**Acute Hospital (Initial)**	**Skilled Nursing Facility**	**Inpatient Rehab. Facility**	**Long Term Care Hospital**	**Acute Hospital (Initial)**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
HHI Quantile1*Post	−0.014** (0.007)	0.000 (0.006)	0.005*** (0.001)	−0.041 (0.366)	0.023 (0.107)	0.142*** (0.037)	0.206*** (0.078)	−463.269** (179.349)	89.605 (88.106)	92.308*** (27.928)	87.987 (104.600)
HHI Quantile2*Post	−0.007 (0.008)	0.002 (0.007)	0.002 (0.001)	−0.024 (0.369)	−0.007 (0.121)	0.040 (0.035)	0.059 (0.094)	−242.924 (164.689)	61.416 (96.740)	24.709 (22.429)	52.957 (111.093)
HHI Quantile3*Post	−0.001 (0.007)	−0.004 (0.007)	0.000 (0.002)	0.323 (0.369)	−0.038 (0.108)	0.010 (0.040)	0.016 (0.092)	209.976 (250.168)	−18.494 (89.013)	12.655 (23.939)	96.408 (99.503)
Dep. Var. Mean (pre-IPS)	0.69	0.19	0.007	25.59	3.26	0.22	6.90	8,1185.00	2,194.15	147.56	8,043.21
F-test	1.86 [0.135]	0.26 [0.851]	6.23 [0.000]	0.58 [0.626]	0.15 [0.932]	5.25 [0.001]	2.75 [0.042]	3.44 [0.017]	0.94 [0.422]	4.07 [0.007]	0.36 [0.785]
Observations	894,015	894,015	894,015	894,015	894,015	894,015	894,015	894,015	894,015	894,015	894,015

Panel C: Joint Replacement

Dependent variable:	Any Use			Days				Costs			
	Skilled Nursing Facility	Inpatient Rehab. Facility	Long Term Care Hospital	Skilled Nursing Facility	Inpatient Rehab. Facility	Long Term Care Hospital	Acute Hospital (Initial)	Skilled Nursing Facility	Inpatient Rehab. Facility	Long Term Care Hospital	Acute Hospital (Initial)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
HHI Quantile1*Post	−0.016 (0.013)	0.007 (0.010)	0.002*** (0.001)	−0.271* (0.146)	0.018 (0.092)	0.048*** (0.014)	0.070 (0.046)	−145.957** (72.844)	69.722 (78.026)	32.118*** (10.980)	−154.115 (114.843)
HHI Quantile2*Post	−0.02 (0.012)	0.024** (0.010)	0.000 (0.001)	−0.216 (0.139)	0.170* (0.096)	0.008 (0.016)	−0.015 (0.044)	−90.387 (57.516)	158.603** (79.783)	9.632 (9.137)	−167.481 (116.809)
HHI Quantile3*Post	−0.016 (0.012)	0.006 (0.010)	0.001* 0.000	−0.273** (0.137)	0.063 (0.089)	0.020** (0.010)	0.051 (0.047)	−35.863 (86.415)	22.869 (74.805)	16.340** (6.945)	−85.719 (115.824)
Dep. Var. Mean (pre-IPS)	0.36	0.27	0.002	5.35	3.01	0.05	5.12	2,171.83	2,080.32	34.45	10,546.48
F-test	0.98 [0.400]	2.37 [0.070]	4.17 [0.006]	1.63 [0.181]	1.24 [0.296]	4.72 [0.003]	1.52 [0.209]	1.55 [0.200]	1.71 [0.165]	4.41 [0.004]	0.89 [0.448]
Observations	1,030,686	1,030,686	1,030,686	1,030,686	1,030,686	1,030,686	1,030,686	1,030,686	1,030,686	1,030,686	1,030,686

Notes:

*** p<0.01,

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HAS-level; regressions include HSA fixed effects, quarter-year fixed effects, and controls. The F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs in bottom 25% of HSAs in terms of number of claims; sample excludes beneficiaries<65 and residents of Maryland

Appendix Table 5

Effects of IPS on Home Health Outcomes for Stroke, Splitting HSAs by State

Panel A: Home Health Outcomes

Dependent variable:	HH Days					HH Provider Costs					Any Home Health				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
HHI Quantile1*Post	−2.249*** (0.485)	−2.248*** (0.485)	−2.257*** (0.485)	−2.322*** (0.489)	−2.407*** (0.543)	−225.847*** (27.891)	−225.807*** (27.868)	−226.483*** (27.876)	−226.888*** (28.088)	−221.026*** (31.059)	−0.002 (0.004)	−0.002 (0.004)	−0.002 (0.004)	−0.002 (0.004)	−0.001 (0.005)
HHI Quantile2*Post	−0.579 (0.395)	−0.584 (0.394)	−0.582 (0.394)	−0.616 (0.407)	−0.644 (0.463)	−75.157*** (24.849)	−75.370*** (24.788)	−75.227*** (24.800)	−69.346*** (23.852)	−75.379*** (27.305)	0.002 (0.005)	0.002 (0.005)	0.002 (0.005)	0.000 (0.005)	0.001 (0.005)
HHI Quantile3*Post	−0.200 (0.420)	−0.189 (0.419)	−0.191 (0.419)	−0.206 (0.425)	−0.281 (0.440)	−30.815 (24.862)	−30.375 (24.822)	−30.635 (24.811)	−31.277 (25.056)	−20.888 (26.936)	−0.003 (0.005)	−0.003 (0.005)	−0.003 (0.005)	−0.003 (0.005)	0.001 (0.005)
Post	−5.547*** (0.309)	−2.141*** (0.322)				−238.094*** (18.466)	−96.677*** (20.399)				−0.066*** (0.003)	−0.045*** (0.004)			
Linear trend t	N	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N
Quarter-year FE	N	N	Y	Y	Y	N	N	Y	Y	Y	N	N	Y	Y	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	N	N	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y
Excl. HSAs that cross state boundaries	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	Y
F-test	8.40 [0.000]	8.44 [0.000]	8.47 [0.000]	8.84 [0.000]	7.38 [0.000]	25.18 [0.000]	25.23 [0.000]	25.31 [0.000]	25.06 [0.000]	20.07 [0.000]	0.42 [0.738]	0.41 [0.747]	0.42 [0.739]	0.21 [0.890]	0.14 [0.936]
Observations	1,178,102	1,178,102	1,178,102	1,160,224	986,852	1,178,102	1,178,102	1,178,102	1,160,224	986,852	1,178,102	1,178,102	1,178,102	1,160,224	986,852

Panel B: Number of Home Health Providers

Dependent variable:	Number of HH Providers					Log(Number of HH Providers)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HHI Quantile1*Post	−5.511*** (0.461)	−5.509*** (0.461)	−5.509*** (0.461)	−5.142*** (0.411)	−5.875*** (0.516)	−0.144*** (0.018)	−0.143*** (0.018)	−0.143*** (0.018)	−0.138*** (0.019)	−0.131*** (0.020)
HHI Quantile2*Post	−1.275*** (0.118)	−1.273*** (0.118)	−1.273*** (0.118)	−1.078*** (0.120)	−1.155*** (0.161)	−0.069*** (0.019)	−0.069*** (0.019)	−0.069*** (0.019)	−0.064*** (0.019)	−0.049** (0.020)
HHI Quantile3*Post	−0.480*** (0.087)	−0.478*** (0.087)	−0.478*** (0.087)	−0.414*** (0.095)	−0.258** (0.123)	−0.035* (0.019)	−0.035* (0.019)	−0.035* (0.019)	−0.033* (0.019)	−0.004 (0.021)
Post	−0.524*** (0.054)	1.512*** (0.168)				−0.151*** (0.014)	0.032* (0.017)			
Linear trend t	N	Y	N	N	N	N	Y	N	N	N
Quarter-year FE	N	N	Y	Y	Y	N	N	Y	Y	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	N	N	Y	Y	N	N	N	Y	Y
Excl. HSAs that cross state boundaries	N	N	N	N	Y	N	N	N	N	Y
F-test	83.38 [0.000]	83.35 [0.000]	83.24 [0.000]	87.44 [0.000]	66.43 [0.000]	24.01 [0.000]	23.95 [0.000]	23.91 [0.000]	21.46 [0.000]	19.34 [0.000]
Observations	12,926	12,926	12,926	12,920	9,662	12,926	12,926	12,926	12,920	9,662

Notes:

*** p<0.01,

** p<0.05,

* p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. HSAs that cross state lines are split into separate HSA × state areas. In Columns 5, 10, and 15, HSAs that cross state lines are excluded from the sample. Clustered standard errors at the HSA × state-level; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs in bottom 25% of HSAs in terms of number of claims; sample excludes beneficiaries<65 and residents of Maryland.

Appendix Table 6

Effects of IPS on Number of Home Health Providers for Stroke

Panel A: Level Effects

Dependent variable:	Number of HH Providers						
Specification:	**Full Sample**				**Urban**	**Non-Urban**	**Controlling for Bite**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
HHI Quantile1*Post	−5.969*** (0.509)	−5.968*** (0.509)	−5.968*** (0.509)	−5.537*** (0.452)	−8.476*** (0.822)	−1.666*** (0.173)	−4.938*** (0.456)
HHI Quantile2*Post	−1.464*** (0.142)	−1.464*** (0.142)	−1.464*** (0.142)	−1.200*** (0.148)	−2.455*** (0.269)	−0.661*** (0.111)	−0.910*** (0.147)
HHI Quantile3*Post	−0.527*** (0.105)	−0.526*** (0.105)	−0.526*** (0.105)	−0.430*** (0.117)	−0.797*** (0.227)	−0.278*** (0.107)	−0.235* (0.120)
Post	−0.655*** (0.066)	1.626*** (0.190)					
Linear trend t	N	Y	N	N	N	N	N
Year FE	N	N	Y	Y	Y	Y	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y
Controls	N	N	N	Y	Y	Y	Y
F-test	77.44 [0.000]	77.40 [0.000]	77.29 [0.000]	78.47 [0.000]	58.85 [0.000]	35.71 [0.000]	54.21 [0.000]
Observations	11,396	11,396	11,396	11,391	5,394	5,795	11,391

Panel B: Log Effects

Dependent variable:	Log (Number of Providers)			
	Full Sample	**Urban**	**Non-Urban**	**Controlling for Bite**
	(1)	**(2)**	**(3)**	**(4)**
HHI Quantile1*Post	−0.137*** (0.018)	−0.177*** (0.023)	−0.147*** (0.031)	−0.108*** (0.020)
HHI Quantile2*Post	−0.066*** (0.018)	−0.100*** (0.019)	−0.084*** (0.031)	−0.049** (0.020)
HHI Quantile3*Post	−0.032* (0.019)	−0.028 (0.020)	−0.051 (0.033)	−0.005 (0.022)
Year FE	Y	Y	Y	Y
HSA FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
F-test	21.57 [0.000]	24.56 [0.000]	8.08 [0.000]	11.90 [0.000]
Observations	11,391	5,394	5,795	11,391

Notes:

*** $p<0.01$,

** $p<0.05$,

*p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HAS-level; the regressions for number of HH providers are at the HAS-level; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.

Appendix Table 7

Effects of IPS on Number of Home Health Providers for Stroke, by Ownership Status

Panel A: Level Effects

Dependent variable:	**Number of HH Providers**							
	All		**For-Profit**		**Non-Profit**		**Government**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
HHI Quantile1*Post	−5.515*** (0.448)	−5.537*** (0.452)	−4.122*** (0.354)	−4.138*** (0.356)	−1.212*** (0.192)	−1.216*** (0.193)	−0.165*** (0.055)	−0.166*** (0.055)
HHI Quantile2*Post	−1.172*** (0.150)	−1.200*** (0.148)	−0.503*** (0.125)	−0.522*** (0.124)	−0.395*** (0.097)	−0.402*** (0.097)	−0.267*** (0.058)	−0.270*** (0.058)
HHI Quantile3*Post	−0.358*** (0.123)	−0.430*** (0.117)	−0.173* (0.097)	−0.222** (0.095)	−0.081 (0.084)	−0.098 (0.084)	−0.102** (0.049)	−0.108** (0.049)
Post	−0.532*** (0.097)		−0.330*** (0.078)		−0.116** (0.053)		−0.091*** (0.033)	
Quarter-year FE	N	Y	N	Y	N	Y	N	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y
Dep. Var. Mean (pre-IPS)	13.59		6.62		5.41		1.54	
F-test	78.09 [0.000]	78.47 [0.000]	54.25 [0.000]	54.26 [0.000]	18.50 [0.000]	18.52 [0.000]	7.97 [0.000]	8.15 [0.000]
	11,391	11,391	11,391	11,391	11,391	11,391	11,391	11,391

Panel B: Log Effects

Dependent variable:	**Log(Number of HH Providers)**							
	All		**For-Profit**		**Non-Profit**		**Government**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
HHI Quantile1*Post	−0.135*** (0.018)	−0.137*** (0.018)	−0.248*** (0.031)	−0.245*** (0.031)	−0.087*** (0.024)	−0.088*** (0.024)	−0.076** (0.033)	−0.077** (0.033)
HHI Quantile2*Post	−0.064*** (0.019)	−0.066*** (0.018)	−0.134*** (0.035)	−0.134*** (0.035)	−0.063** (0.027)	−0.065** (0.027)	−0.128*** (0.032)	−0.130*** (0.032)
HHI Quantile3*Post	−0.026 (0.019)	−0.032* (0.019)	−0.071** (0.033)	−0.078** (0.033)	−0.023 (0.026)	−0.026 (0.026)	−0.079*** (0.030)	−0.082*** (0.030)
Post	−0.138*** (0.015)		−0.100*** (0.026)		−0.050*** (0.018)		−0.018 (0.023)	
Quarter-year FE	N	Y	N	Y	N	Y	N	Y
HSA FE	Y	Y	Y	Y	Y	Y	Y	Y
Dep. Var. Mean (pre-IPS)	2.26		1.43		1.36		0.60	
F-test	21.95 [0.000]	21.57 [0.000]	25.58 [0.000]	24.16 [0.000]	5.05 [0.002]	5.02 [0.002]	5.45 [0.001]	5.63 [0.001]
	11,391	11,391	9,864	9,864	10,793	10,793	7,478	7,478

Notes:

*** p<0.01,

** p<0.05,

*p<0.1.

Data are from 100 percent sample of Medicare claims from the Medicare standard analytic file (SAF) for home health care between 1996 and 2000. Clustered standard errors at the HSA-level; the regressions for number of HH providers are at the HSA-level; the F-test tests the joint significance of HHI Quantile1*Post, HHI Quantile2*Post, HHI Quantile3*Post (p-value in brackets); sample excludes HSAs with fewer than 28 HH claims (bottom 25% of HSAs); sample excludes beneficiaries<65 and residents of Maryland.