Health Care Providers' Response to Payment Incentives: Evidence from Medicare Home Health Care

by

Hyun Jee Kim

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Doctoral Committee:

Professor Ruth E. Dunkle, Co-Chair
Professor Edward C. Norton, Co-Chair
Associate Professor Martha J. Bailey
Assistant Professor Luke Shaefer

To My Parents

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CHAPTER I

INTRODUCTION

Scholars have long debated which payment system best provides incentives to health care providers to deliver efficient health care services. Health care providers have an incentive to strategically adjust the quantity and quality of services in order to increase profits. The recent heated debates over health care reform and cuts to government spending have made this issue even more salient.

This dissertation addresses health care providers' behavioral responses to incentives built into payment systems. In particular, my dissertation focuses on the home health care industry, and addresses how home health agencies have strategically navigated the Medicare reimbursement system. Examining Medicare home health care allows a unique opportunity to explore health care providers' response to payment systems. That is because home health care has undergone drastic changes in its payment system as the government has struggled to develop a payment system that prevents home health care agencies from providing care based on profit motives only.

Since 2001, Medicare home health care has been under the prospective payment system (PPS). The PPS makes a pre-determined and fixed payment for each patient based on the health condition of the patient at the admission to care. Because home health agencies have to bear the full cost of extra treatments beyond the payment under the PPS, officials expected this payment system to control the rising costs. Surprisingly, however, just the

opposite occurred. Under the prospective payment scheme, Medicare home health care spending continued to rise dramatically because of the payment incentives embedded in the PPS (MedPAC, 2011).

Medicare home health care is also an essential research topic due to its increasingly important role in Medicare health services. A large and growing number of Medicare beneficiaries have been using home health services. The number of Medicare home health patients increased by more than 30 percent between 2000 and 2009, and in 2009, roughly 9.4 percent of the entire Medicare beneficiary population received home health care (MedPAC, 2011).

Medicare home health care service also has important implications for the use of close substitutes such as informal care and nursing home care. For example, formal home health care can replace family or friend caregivers, who provide unpaid care for their relatives. While this may free informal caregivers from their burdensome duties, it increases total health care expenditures. Additionally, home health care may replace more expensive skilled nursing home care by allowing patients to receive necessary medical care at home. This substitution is likely to save dollars. That is, Medicare home health care's influence on total health care spending is greater than what it seems because of its spillover effect.

This dissertation consists of three papers that examine how the Medicare home health reimbursement system has influenced home health agencies' service provision patterns. In the first paper, I address this issue in the context of the unexpected increase in total Medicare home health spending under the prospective payment system that was introduced to control rising home health spending. I examine the underlying forces behind the growth in the three factors that contributed to the total spending increase: 1) the number of Medicare home health patients, 2) the number of episodes per patient, and 3) the payment amount per episode. Using the Medicare Claims and Provider of Services File from 1999 to 2009, I find strong empirical support that the prospective payment system provided unintended incentives such that home health agencies adjusted their service provision patterns to further

increase profits. This led to an increase in all three factors, independent of the health needs of patients. In particular, the number of Medicare home health patients contributed the most to the total spending increase among the three factors. In addition, many profit maximizing behaviors were most evident among for-profit home health agencies. Furthermore, the incentives built into the prospective payment system attracted a substantial number of for-profit agencies to the market. These new agencies pursued profitable home health provision patterns more than agencies established prior to the prospective payment system. Overall, the increase in the for-profit market share accounts for about one-third of the increase in total Medicare spending between 2001 and 2009.

The second paper focuses on the interaction between for-profit and non-profit home health agencies in a market. Building on the existing economic theory of for-profit and non-profit behavior in competition, I propose three mechanisms that explain how behavior changes over time. First, health care providers continue to enter the market if they perceive opportunities for high-profit margins, and those new entrants pursue profit-seeking behaviors more than incumbents. Second, profit-seeking behaviors among new entrants encourage neighboring incumbents to resemble new entrants' behaviors. Third, existing, chain-affiliated health care providers learn profit-seeking behaviors from others in the chain. I then test these three mechanisms using data on home health agencies that operated under the Medicare prospective payment system, and find that the proposed mechanisms explain the changes in behaviors of for-profit and non-profit home health agencies over time.

The third paper has a more narrow focus, concentrating on Medicare home health care patients who have diabetes with long-term (or current) use of insulin. These patients are often perceived as the most costly patients and are therefore eligible for outlier payments. This paper examines how Medicare's introduction of the 10 percent per-agency cap on outlier payments affected these patients. This policy restricts total outlier payments for each home health agency to no more than 10 percent of that agency's total prospective payments from Medicare each year. While the intention of this cap is to control excessively

increasing outlier payments, it can ultimately produce undesirable incentives. In essence, the 10 percent cap could penalize agencies that accepted and treated clinically complex, and thus costly patients. Using the Medicare Claims and Provider of Services File from 2008 to 2010, this study finds that the 10 percent cap dramatically decreased the number of home health service visits for diabetic patients who had the need for insulin injection. The 10 percent cap also compelled agencies to drop the sickest patients and send them to more costly health care settings such as nursing homes and hospitals. These findings seem to suggest that the net effect of the 10 percent cap on total health spending is ambiguous.

Though Medicare home health care spending amounts to over 18.9 billion dollars of government spending a year and despite the fact that over 3.3 million beneficiaries utilize the service, it has received little scholarly attention. In addition, Medicare home health care has significant implications on total Medicare spending because it is a close substitute of other types of health care including informal care, nursing home care, and inpatient care. A greater understanding of this important topic can lead to the provision of more appropriate care at a lower cost.

CHAPTER II

HEALTH CARE SPENDING GROWTH UNDER THE PROSPECTIVE PAYMENT SYSTEM: EVIDENCE FROM MEDICARE HOME HEALTH CARE

2.1 Introduction

Escalating health care spending has become a major concern in the United States over the last few decades. One of the strategies employed by policymakers to curb this rising spending has been to implement new payment systems. However, this sometimes results in unintended consequences due to a supply-side moral hazard problem. The moral hazard problem arises with the payment policy because the government cannot directly observe the health status of patients, forcing the government to rely on health care providers to supply appropriate levels of care. Yet, health care providers will strategically respond to payment systems in order to increase profits, which can significantly increase health care spending independent of the health needs of patients. Thus, policymakers must pay special attention to the incentives embedded in the payment systems.

This study addresses this issue-how health care providers respond to financial incentives embedded in payment systems and how that could increase health spending-in the context of a change in the Medicare home health payment system. In October 2000, Medicare home health care adopted the prospective payment system (PPS), which made pre-determined

payments based on patient health status, to control the rapidly increasing Medicare home health spending. Despite this change, total Medicare home health spending rose by 7.79 percent annually in real terms over the next nine years, which was significantly higher than the 3.68 percent annual growth rate in the aggregate Medicare spending during the same period (CMS, 2011). That is, Medicare failed to achieve its stated goal of controlling costs. In particular, this study examines the growth in the three factors that contributed to the significant increase in aggregate Medicare home health spending: 1) the number of Medicare home health patients, 2) the number of episodes per patient (an episode is the unit of a payment period used by Medicare home health care, which is 60 days), and 3) the payment amount per episode. Furthermore, I examine how each home health agency's ownership status and establishment year affected its response to the supply-side incentives embedded in the PPS.

Using the Medicare Claims and Provider of Services Files from 1999 to 2009, I find that home health agencies responded to financial incentives embedded in the Medicare home health PPS and this led to unintended increases in all three factors, independent of the health needs of patients. In particular, among the three factors, the number of Medicare home health patients contributed the most to the total spending increase. Relatively generous prospective payment rates encouraged home health agencies to increase the number of patients they treated. The PPS also allowed patients to receive home health services over multiple renewable episodes, but provided vague guidelines about recertification decisions. Thus, agencies could easily recertify another episode of care and increase the number of episodes per patient to serve a profit-maximizing motive. Home health agencies also clearly adjusted service provision practices, which increased the payment amount per episode. For example, the non-linear pricing for therapy visits led to a predictable clumping at 10 therapy visits or more because the marginal revenue of the tenth visit, roughly 2,000 dollars, was almost twenty times higher than the marginal cost. This dynamic caused agencies to shift their service provision toward therapy visits and away from relatively less profitable

services such as home health aide visits.

I also find that most of these profit-seeking behaviors (i.e.,service provision patterns that increase a providers profit but do not necessarily correspond to a patients health needs) were significantly more evident among for-profit home health agencies than among non-profit agencies. Furthermore, the incentives built into the PPS continued to attract a number of for-profit home health agencies to the market. Compared to counterpart for-profit agencies established prior to the PPS, those new for-profit agencies that entered the market under the PPS were more likely to pursue profitable service provision patterns. These profit-seeking behaviors of new agencies further contributed to Medicare home health spending growth, and partially explain why home health service provision patterns of agencies changed gradually over time under the PPS. Overall, the increase in the for-profit market share under the PPS accounts for about one-third of the increase in total Medicare spending increase between 2001 and 2009.

2.2 Medicare Home Health PPS

Medicare home health spending has fluctuated significantly under the different payment systems over the last two decades. Medicare home health greatly expanded during the 1990s under the fee-for-service payment system. The fee-for-service payment system reimbursed home health agencies for full costs incurred for treating patients and did not limit the number of annual Medicare home health visits per patient (see Table 2.1 for a brief description of each payment system). Thus, agencies had a weak incentive to provide efficient care, which led to a significant increase in total home health expenditure under the fee-for-service payment system (see Figure 2.1) (CMS, 2011; McKnight, 2006).

Faced with the radical growth of Medicare home health care, the government decided to adopt the PPS. However, it took the government three years to revamp the payment system. In the meantime, the interim payment system (IPS) was implemented on a temporary basis with the goal of immediately curbing home health care spending (MedPAC, 2012). The

IPS introduced an agency-specific limit on the annual per-patient payment amount and the limit was highly restrictive. The restrictive IPS led to the bankruptcy of about 30 percent of home health agencies in the late 1990s, and as shown in Figure 2.1, home health care expenditures drastically dropped (CMS, 2011; MedPAC, 2010).

In 2000, the Center for Medicare and Medicaid Services (CMS) introduced the PPS. Like the IPS, the PPS made predetermined payments, but the amount of payments varied based on patient health condition. Each year, the PPS set the home health base payment rate at the amount that would be paid per episode for an average home health patient residing in an average market (MedPAC, 2007). The PPS also classified all Medicare home health patients into 80 groups based on patients' health conditions and needs at admission to care, and assigned specific case-mix weight to each group. The PPS then determines the payment amount per episode for each patient every 60 days based on home health base payment rate, a patient's case-mix weight, and each region's wage index reflecting regional differences in the input-price level (MedPAC, 2007). Because the payment amounts were fixed, home health agencies had to bear the full cost of extra treatments, and thus the PPS was expected to control rising spending.

Interestingly, although the Medicare home health payment system was termed a prospective system, the Medicare home health PPS had several important retrospective features that caused payment amounts to vary depending on actual treatment levels. For instance, the PPS made a significant amount of extra payments for episodes with 10 or more therapy visits. It also made extra payments (known as high-cost outlier payments) in addition to the prospective payments if each episode's imputed treatment cost was higher than a threshold amount for each case-mix group (HCFA, 2000). These two retrospective features encouraged agencies to increase the amount of care for extremely ill patients given that the fixed payment rate under the PPS could lead agencies to avoid patients whose health care costs were significantly higher than payment amounts. In addition, if a patient received four or fewer visits per episode, the PPS would make a per-visit low-utilization payment by service

type that was the same for all patients, regardless of health status. This retrospective feature saved Medicare money by making a smaller amount of payments instead of standard prospective payments for patients who require a low number of service visits.

The main intention behind the introduction of the PPS was to curb the rising home health spending that had occurred under the fee-for-service payment system. For this reason, Medicare set the home health base rate each year such that home health spending under the PPS stays the same as the drastically reduced level of spending under the IPS. Surprisingly, however, just the opposite occurred. Under the prospective payment scheme, the number of patients, the number of episodes per patient, and the payment amount per episode increased, leading to a significant increase in Medicare home health care spending, from $8.51 billion in 2001 to $15.46 billion in 2009 (CMS, 2011).

Despite the dramatic increase in Medicare home health spending under the PPS, no studies have so far examined the underlying forces behind the increase in three components of total Medicare home health spending. Instead, previous studies have examined the implications of the PPS on other health care costs. Among those studies, Grabowski, Afendulis, and McGuire (2011) is most relevant to this study. Grabowski and colleagues (2011) focused on Medicare skilled nursing care that experienced a significant spending growth under the PPS, and examined how the PPS affected the number of Medicare residents in a facility, the average length of stay, and the intensity of care. They found that skilled nursing facilities clearly adjusted service provision patterns in response to retrospective features built into the PPS, contributing to the growth in skilled nursing home spending. However, their findings are potentially limited in that they used data from the state of New York only in order to understand changes in the service provision intensity. Given that large geographical differences in health care practice for post-acute sector services, their findings may not be generalizable. Taking a similar approach to Grabowski and colleagues (2011), but using nationally representative panel data across 11 years, my study addresses how home health agencies responded to financial incentives embedded in

the PPS and increased the number of patients, the number of episodes, and the payment amount per episode, but in the context of Medicare home health care.

Furthermore, I examine how agencies' ownership status, for-profit or non-profit, influenced their responses to the financial incentives of the PPS. Organizational theories predict that non-profits would be less responsive to financial incentives than for-profits for two reasons. First, for-profit firms have to distribute profits to their shareholders and therefore have a strong incentive to take advantage of financial incentives. In contrast, non-profit firms have no well-defined shareholders and often have different operating goals such as maximizing the quantity and quality of services (Sloan, 2000). Second, employees in non-profits tended to be more altruistic decision-makers and thus would be less responsive to financial incentives (Duggan, 2000).

Previous studies empirically examined this issue, and their results were mixed. Dafny (2005) examined how hospitals upcoded Medicare patients to more profitable diagnosis codes. She found that this upcoding practice was particularly intense among for-profit hospitals. In contrast, Duggan (2000) found that non-profit hospitals were responsive to financial incentives as much as for-profits were. He examined how much for-profit and non-profit hospitals increased the proportion of poor patients in response to the public program that financially supported hospitals serving a disproportionately high fraction of low-income patients. He found that for-profits' behaviors were not different from non-profits. In the same vein, this study also examines how for-profit and non-profit health care providers differently responded to financial incentives, but in the context of the home health care industry.

2.3 Model of Agency Response to PPS

Changes in demographics and substitutable health services have affected demand for home health services to a certain degree. However, the demand for home health services has not been influenced by price shocks created by the PPS because Medicare home health

services are free to all patients. For this reason, this paper focuses on the supply-side response to the PPS, not the demand-side response.

In this section, I present conceptual models that explain how agencies responded to financial incentives embedded in the PPS. The models show how agencies adjusted their decisions about the number of patients to treat (the extensive margin), the number of episodes of care per patient, and the number of service visits per episode to provide (the intensive margin). Finally, I illustrate how new agencies that entered the market under the PPS made different decisions on the intensive margin from existing agencies.

2.3.1 Number of Medicare Home Health Patients

This section illustrates how agencies increased the proportion of Medicare beneficiaries utilizing home health service under the PPS. Specifically, I show that for-profit agency market share in each state was positively associated with the state's price elasticity of home health supply. That is, during the transition from IPS to PPS, the proportion of home health patients increased to a greater degree in states with more for-profit agencies and fewer non-profit agencies. (The PPS drove payment rates higher than they had been under the IPS by adding new features, including case-mix adjustments and the provision of the extra payments for intensive treatments.) This suggests that agencies increased the proportion of home health patients to increase profits under relatively generous prospective payment rates, given the assumption that for-profit agencies are more likely to prioritize profit increase than non-profits.

There has been large state variation in for-profit home health agency market share. Certain states have had a more business-friendly environment, for example, low state corporate tax rates or more lenient regulations (e.g. no certificate of need (CON) program for home health agencies), and thus have attracted more for-profit agencies. For example, in the state of Texas, which had relatively low corporate tax rates and no CON, 81.94 and 93.35 percent of the agencies were for-profit in 2000 and 2009. In contrast, New Jersey with relatively

high corporate tax rates and CON had 14.81 and 23.53 percent of for-profit agencies in the corresponding years.

The state variation in for-profit market share results in differences in the slopes of the state-level market supply curves. To explain this, I first start with a for-profit and non-profit agency's short-run supply curve. A for-profit agency has a more elastic supply curve because for-profit agencies tend to be more responsive to changes in government reimbursement rates (FitzGerald et al., 2006; Sloan, 2000) (see Figure 2.2 (a)). Therefore, states with a higher for-profit market share end up having a flatter market supply curve. That is, the market supply curve in Texas is more elastic than that in New Jersey (see Figure 2.2 (b)). I assume that 1) the demand curve for home health service is completely inelastic with respect to payment rates because Medicare does not require home health patients to make any payments, and 2) there is always excess demand for home health care. The generous prospective payment rates enabled agencies to make positive profit margins which attracted new agencies to the market (MedPAC, 2011). In particular, states with a higher for-profit market share experienced more entries of new agencies due to their business-friendly environment. Thus, the market supply curve in Texas shifted to the right to a greater degree (see Figure 2.2 (c)).

2.3.2 Number of Episodes per Patient

Another factor that contributed to the total spending increase was the increase in the number of episodes per patient. The PPS allowed patients to receive services over an unlimited number of renewable episodes as long as agencies obtained a physician's permission for the recertification of an additional episode of care. However, there were only vague guidelines about recertification decisions (i.e., a patient had to be home-bound and in need of skilled care) and physicians relied on information provided by agencies in making these decisions (Henkemeyer, 2012; MedPAC, 2012). Thus, home health agencies could easily increase the number of episodes for each patient. This tendency might have been stronger

for relatively profitable patients because agencies found it more profitable to recertify less costly patients, given their limited resources. This tendency might be also stronger among for-profit agencies.

2.3.3 Payment Amount per Episode

The PPS also affected agency decisions about the type and number of service visits to provide, thereby increasing the payment amount per episode.

2.3.3.1 Types of Service Visits

A home health agency adjusts which type of services to provide(skilled nursing visits, therapy visits, or home health aide visits), considering each service's profitability and effect on patient health.

The agency has a strong incentive to provide therapy visits for an increasing number of episodes if the agency foresees the opportunity to provide 10 or more therapy visits because the marginal benefit of the 10th therapy visit is high. Therapy visits can also have a significant influence on patient health. By contrast, home health aide visits are not compensated for the extra number of visits. In addition, agencies do not perceive home health aide services, which involve non-medical assistance related to eating, dressing, and bathing, as directly relevant to patient health status. Agencies thus have a strong incentive to refrain from providing home health aide visits as they seek to maximize profits. Skilled nursing visits are also uncompensated for extra visits, but can have a significant effect on patient health. Therefore, agencies have only a moderate level of incentive to provide skilled nursing visits. For-profit agencies may be more likely to provide therapy visits and less likely to provide home health aide visits, because of these services' profitability and effect on patient health.

2.3.3.2 Number of Service Visits

In this section, I explain how agencies adjust the number of service visits under the PPS, using a graphical illustration of an agency's optimal choice regarding the number of home health service visits per episode (Ellis & McGuire, 1986). For simplicity, I make several assumptions in this illustration. First, a patient receives therapy visits only, but an agency's optimal therapy visits derived from this model should also work for a patient who receives therapy visits along with other types of home health services. An agency chooses the optimal number of therapy visits for a single patient, without consideration of the patient composition (in terms of their severity of illness) within the agency. In addition, a home health agency cares about both its profits and patient health status at the end of an episode of care in its utility.

My graphical illustration of an agency's decision starts with a Medicare home health reimbursement schedule for a patient who received therapy visits only. As discussed above, the Medicare home health PPS had retrospective features and thus the reimbursement amount per episode changed as the number of therapy visits increased (see Figure 2.3 (a)). Refer to Appendix A.1 for a more detailed explanation about how the reimbursement schedule was determined.

The agency's profits per episode also changed as the number of therapy visits increased (see Figure 2.3 (b)). The profit curves slope down more because the cost of one therapy visit was \$105 and I subtract $\$105 \times V^T$ from Medicare reimbursement amounts (HCFA, 2000).

Next, I add the agency's indifference curve, which is convex to the origin because the agency cares about both its profit and patient health status at the end of an episode of care (which is a positive linear function of the number of therapy visits) (see Figure 2.3 (c)). The agency chooses the number of therapy visits that maximizes its utility given its profit function. Therefore, the agency chooses to provide a number of therapy visits that corresponds to point E, the equilibrium point.

The profit incentives built into the reimbursement system encourages the agency to provide a certain number of therapy visits. For example, the agency enjoys a higher level of utility when it provides 5 therapy visits rather than 4, and 10 visits rather than 9, regardless of its preference for profit relative to patient health status (see Figure 2.3 (d)).

For-profit and non-profit agencies make different decisions in terms of the number of therapy visits per episode provided. If a for-profit agency prioritizes profit more than a non-profit agency does, then the for-profit agency has a flatter indifference curve. Therefore, a for-profit agency provides fewer service visits (closer to 10 and closer to 5) than a non-profit agency does (see Figure 2.3 (e)).

2.3.4 Service Provision among New Home Health Agencies

Many home health agencies, mostly for-profits (95.73 percent), entered the market under the PPS. New agencies might adopt profitable service provision patterns (i.e., a higher likelihood of recertifying another episode of care and adjusting the number of service visits to increase the payment amount per episode) more than existing agencies established prior to the PPS. I suggest two explanations for this phenomenon. First, new agencies might have entered the home health market under the PPS because they knew the PPS would enable them to achieve high profit margins. Thus, new entrants would become more engaged with profit-seeking behaviors. Second, existing home health agencies might have more stable budget sources (Choi & Davitt, 2009) given that they survived the restrictive payment rates under the IPS. Therefore, financial incentives built into the PPS might be less attractive to existing agencies than to new ones.

Given that many agencies continued to enter the market under the PPS, if new agencies pursued profitable service provisions more than did existing agencies, the entry of new agencies would make a significant contribution to Medicare home health spending growth. In addition, profit-seeking behaviors among new agencies may partially explain why home health service provision patterns changed gradually over time under the PPS.

2.3.5 Hypotheses

The conceptual framework leads to four testable hypotheses. First, agencies increased the proportion of home health patients to increase profits. Second, agencies treated their patients for a higher number of episodes of care to increase profits, and this tendency was stronger among for-profit agencies. Third, agencies adjusted the types and number of service visits, which increased the payment amount per episode, and the degree of the adjustment was greater among for-profit agencies. Fourth, agencies that entered the market under the PPS, mostly for-profits, were more likely to pursue profitable service provision patterns than existing agencies.

2.4 Data

This study uses data from: 1) the CMS 5% Limited Data Set-Denominator File from 1999 to 2009, 2) the CMS 5% Limited Data Set-Home Health Agency File from 1999 to 2009, 3) the CMS Provider of Services File-Home Health Agency from 1999 to 2009, and 4) the Integrated Public Use Microdata Series-Current Population Survey (IPUM-CPS) from 1994, and 1999 to 2009 (King et al., 2010). The first dataset, which was extracted from Medicare claims, is a panel of 5 percent of Medicare beneficiaries and contains basic demographic information such as age, race, gender, and date of death, as well as Medicare HMO enrollment status. The second dataset, which was also taken from Medicare claims, is also a panel of 5 percent of Medicare home health patients and contains administrative information about each patient's Medicare home health care service use (CMS, 2012). The third dataset was extracted from the Online Survey and Certification Reporting System/Quality Improvement Evaluation System collected by the CMS Regional Offices (Choi & Davitt, 2009; CMS, 2012). It is a panel of all Medicare/Medicaid-certified home health agencies across the nation and includes their basic agency information such as location, ownership type, and initial date of Medicare certification. The last dataset, extracted

from the Current Population Survey, contains sampled individuals' basic demographic information not available in the CMS 5% Limited Data Set-Denominator File, such as marital status, residence with any child, and living below poverty lines each year.

I combine the first two datasets using each beneficiary's ID number, and create a complete Medicare claim dataset. The home health agency provider number enables me to merge the combined Medicare claim dataset and the CMS Provider of Services File, resulting in a patient-agency linked, unbalanced panel data set. Each observation in this dataset corresponds to a patient's unique episode of care. I use the merged dataset for my analysis of the number of episodes per patient and the payment amount per episode. For my analysis of the number of patients, I use both a dataset of patient-episode level data and IPUM-CPS data.

I limit my sample to Medicare beneficiaries who were 65 or older. I drop beneficiaries who were enrolled in Medicare HMOs because Medicare HMOs were not directly influenced by Medicare reimbursement system changes. In addition, I exclude those beneficiaries who had zero Medicare payments, received zero Medicare home health service visits, or had any positive non-Medicare payment amount. I also exclude beneficiaries who resided in Puerto Rico, the U.S. Island Areas, or unidentified counties. Medicare home health patients whose agency information was not found in the CMS Provider of Services File-Home Health Agency were also dropped. Additionally, I exclude one of the records in cases in which two episodes had the same service start and end date and referred to the same episode, but had separate records due to significant changes in the patient's health condition or the existence of an unclean claim. Furthermore, I drop episodes of care for beneficiaries who died earlier, but received home health visits after their date of death. I further exclude episodes in which home health care was interrupted because a patient was readmitted to a hospital, entered a nursing home, died, and so on. Finally, I drop observations with missing values for the variables used in my analysis.

I use data from 1999 through 2009 for my analysis of the number of Medicare patients

and collapse the data to a higher level of aggregation (state-year cells). I use data from 2001 through 2009, for my analysis of the number of episodes per patient and the payment amount per episode because the concept of episode was introduced with the implementation of the PPS in 2001. This unbalanced panel data set had 1,778,368 patient-episode observations, which translates to 614,779 unique patients.

2.5 Empirical Strategy

Each of the following empirical models corresponds to one of my hypotheses.

2.5.1 Number of Patients

Hypothesis 1: Agencies increased the proportion of home health patients to increase profits.

To address this hypothesis, I examine whether states with a relatively high for-profit market share had higher price elasticity of home health supply. Given the assumption that for-profit agencies are more likely to prioritize profit increase than non-profits, this hypothesis indicates that agencies increased the proportion of home health patients with the intention of increasing profits under the PPS.

I test whether differences in the price elasticity of home health supply across states are explained by each state's home health market ownership structure, which I measure by for-profit agency market share, for-profit hospital market share, and the presence of a CON program for home health agencies in each state in 2000. (No state experienced a change in the presence or absence of CON programs for home health agencies during the PPS.)

In particular, I pick the year 2000 to avoid possible endogeneity problems, in which an increase in the proportion of home health patients drives the increase in for-profit agencies during the PPS. However, each state's unobservable heterogeneity might have simultaneously affected the state's price elasticity of home health supply and home health market structure in 2000.

To address the endogeneity problem more rigorously, I further examine how for-profit hospital market share in 2000 is associated with price elasticity of home health supply. Grabowski and Hirth (2003) argued that non-profit hospital market share (and thus for-profit hospital market share) is likely based on historical factors such as each city's age, voluntarism, and charitable provision. Likewise, for-profit home health agency market share is likely to depend on each region's historical factors, and thus be highly correlated with for-profit hospital market share that might not be directly influenced by changes in the number of home health patients.

As another way to address the endogeneity problem, I check how the presence of CON program affected price elasticity. States with CON program are expected to have a lower for-profit market share because CON prevents new agencies (mostly for-profits) from entering the market under the PPS.

The basic estimating equation takes the following form:

$$Y_s = \alpha + \gamma_1 M_s + X_s B + \varepsilon_s \tag{2.1}$$

where Y_s refers to price elasticity of home health supply in state s, $(\%\Delta User_s/\%\Delta P_s)$, measuring the proportional change in the fraction of Medicare beneficiaries utilizing home health services in each state s divided by the proportional change in reimbursement rate in that state s between 2000 and 2009. M_s can represent for-profit agency market share, for-profit hospital market share, or the presence of a CON program for home health agencies in each state in 2000. X_s includes various demographic characteristics of each state's beneficiaries in 2000, including gender and age (65-69, 70-74, 75-79, 80-89, and 90+) distribution, race composition (white, black, and others), the proportion of married beneficiaries, the proportion of dual-eligible beneficiaries, the proportion of beneficiaries who resided with any child, and the proportion of beneficiaries who died. γ_1 measures how each state's home health market ownership structure influenced price elasticity of home health supply. γ_1 is expected to be positive in cases when M_s is for-profit agency market share or

for-profit hospital market share.

2.5.2 Number of Episodes per Patient

Hypothesis 2: Agencies treated their patients for a higher number of episodes of care to increase profits, and this tendency was stronger among for-profit agencies.

To address this hypothesis, I examine whether the profitability of treating a patient influenced an agency's recertification decision. It may seem ideal to run a regression of each patient's likelihood of recertification on his/her profitability. However, this relationship is endogenous. This is because the unreported patient health status becomes confounded with patient profitability and likelihood of recertification. In essence, I do not have access to detailed enough information about patient health status to control for it in my regression. For example, no information was available regarding changes in patient health status during the middle or end of an episode of care or the presence of specific health conditions not categorized by CMS. However, both of these factors affect patient profitability and likelihood of recertification. A decline in patient health status during an episode, for instance, generally requires an agency to provide extra service visits not reflected in the case-mix group rate assigned at the time of admission, thus lowering the profitability of that patient during that particular episode.

To address this endogenous relationship, I limit my sample to episodes where only four or five visits were provided. If patients received fewer than five home health visits, then they became eligible for low-cost outlier payments. Low-cost outlier payment rates were much lower than standard prospective payment rates, and thus agencies perceive patients who received four visits unprofitable compared to patients with five visits. However, there was only one visit difference between patients with four and five visits. Therefore, I expect to see little variation in unobservable heterogeneous health conditions among patients and therefore endogeneity is not a significant concern.

With this limited sample, I estimate regression (2.2) and then compute the marginal

effect of low-cost outlier patients on the likelihood of recertification each year, which measures how each low-cost outlier patient's likelihood of recertification changed over time compared to a non low-cost outlier patient's.

$$Pr(recert)_{ijkt} = \beta_0 + \sum_{t=2002}^{t=2009} \beta_{1t} year_t + \beta_2 lupa_{ijkt} + \sum_{t=2002}^{t=2009} \beta_{3t} year_t \times lupa_{ijkt} + XB + state_s + \varepsilon_{ijkt} \quad (2.2)$$

where i, j, k and t refer to a patient, agency, episode, and year. $Pr(recert)$ is a dummy variable indicating whether a patient was recertified for a subsequent episode of care. $year$ is year dummy variables (2001-reference group). $lupa$ represents a dummy variable indicating whether a patient was a low-cost outlier patient. X refers to each patient and agency's basic characteristics, Herfindahl-Hirschman Index (the measure of level of market concentration), and seasonality. I also include state fixed effects $state_s$ because each state might have different regulations that influence Medicare home health service provision. (Refer to the Appendix A.2 for more specific explanation of each control variable.)

In addition, in order to check whether for-profit and non-profit agencies exhibited different trends in recertification of low-cost outlier patient, I add the three-way interaction term between year dummy variables, the indicator of low-cost outlier patient, and the indicator of agency ownership. The coefficient of the interaction term measures how each low-cost outlier patient's likelihood of recertification in non-profit agencies differed over time compared to for-profit agencies. This marginal effect is expected to be positive.

2.5.3 Payment Amount Per Episode

Hypothesis 3: Agencies adjusted the types and number of services, which increased the payment amount per episode, and the degree of the adjustment was greater among for-profit agencies.

2.5.3.1 Types of Service Visits

Payment incentives built into the PPS encouraged agencies to adjust the type of home health services. To examine this hypothesis, I run regression (2.3) where $outcome_{ijkt}$ represents dummy variables which indicate whether each patient received at least one skilled nursing, therapy, and home health aide visit in each episode. I then compute the marginal effect of year dummy variables on outcome variables, which measures how each patient's likelihood of receiving any skilled nursing, therapy, and home health aide visits per episode changed over time. The marginal effect is expected to be positive if $outcome_{ijkt}$ is the likelihood of receiving any therapy visits, but negative for the likelihood of receiving any home health aide visits. I also examine whether for-profit and non-profit agencies exhibited different trends in adjusting the type of home health service by computing the marginal effect of non-profit agencies compared to for-profit agencies on outcome variables each year.

$$Pr(outcome_{ijkt}) = \Phi(\beta_0 + \sum_{t=2002}^{t=2009} \beta_{1t} year_t + \beta_2 ownership_{jkt} + \sum_{t=2002}^{t=2009} \beta_{3t} year_t \times ownership_{jkt} + XB + state_s) \quad (2.3)$$

2.5.3.2 Number of Service Visits

The non-linear pricing for home health service visits led agencies to target a certain number of service visits. To address this hypothesis, I investigate whether agencies targeted 10 or more therapy visits (for patients who received at least one therapy visit) under the PPS. I also examine whether this tendency was greater among for-profit agencies.

For this examination, I utilize the Dinardo, Fortin, and Lemieux's (hereafter DFL) decomposition (1996). The use of the DFL method is ideal because it enables to check changes in the entire distribution of the number of service visits over time (Dinardo, 2002). The DFL method visually decomposes the difference in the distribution of the number of

service visits between 2001 and 2007 into two parts: differences attributable to changes in 1) the observable variables affecting the number of service visits (composition effects) and 2) the number of service visit determination mechanism (structure effects)(Olson, 1998). In particular, I focus on structure effects that measure the agencies' response to the payment incentives and examine whether agencies intentionally increased the provision of 10 or more therapy visits between 2001 and 2007.

I also use the DFP method to address how for-profit and non-profit agencies were different in their adjustment in the number of service visits in 2001 and 2007. The differences in the distribution of the number of service visits between for-profit and non-profit agencies are decomposed into composition and structure effects. Structure effects address whether for-profit agencies were more likely to target 10 or more therapy visits, taking into account the observable variables. (Refer to Appendix A.3 for more specific information of the use of the DFL method.)

2.5.4 Service Provision among New Home Health Agencies

Hypothesis 4: Agencies that entered the market under the PPS were more likely to pursue profitable service provision patterns than existing agencies.

New home health agencies might have started their businesses under the PPS because they recognized that the incentives built into the PPS would enable them to achieve high profit margins. Furthermore, existing agencies might have enjoyed more stable budget sources, which would have provided weaker incentives for following profitable home health service provision patterns. Consequently, new agencies would have been more likely than existing agencies to follow the specific home health provision patterns that lead to high profits. To examine this hypothesis, I limit my sample to home health episodes that occurred in 2007, and I examine how home health service provision patterns (i.e., likelihood of recertification, providing 7-9 therapy visits per episodes, and providing 10-13 therapy visits per episode) differed depending on the starting year of each home health agency, by

agency ownership type. As a robustness check, I also limit my sample to home health episodes that occurred in 2005 and 2006, and conduct the same analysis. The basic estimating equation takes the following form:

$$Pr(outcome_{ijkt}) = \Phi(\beta_0 + \sum_{n=2001}^{2007} \beta_{1n} establishmentyear_{jn} + XB) \qquad (2.4)$$

where $establishmentyear_{jn}$ is a vector of dummy variables that represent the starting year (n) of each home health agency (reference group: $n \leq 2000$, i.e., agencies that entered the market prior to the PPS).

I estimate regression (2.4) and compute the marginal effect of each agency's establishment year, which measures how each new agency's home health service provision patterns varied depending on the establishment year. The reference group for this measurement is agencies established prior to the PPS. The marginal effect is expected to be positive when $outcome_{ijk}$ is a profitable home health service provision pattern and vice versa.

2.6 Results

2.6.1 Number of Patients

As my conceptual model predicted, states with a relatively high for-profit market share tended to have a relatively high price elasticity of home health supply (see Table 2.2). This result consistently holds in all three regressions where I use a different measure of for-profit market share to deal with the endogeneity problem.

First, for-profit agency market share had a positive association with price elasticity: the one percentage point increase in for-profit agency market share was associated with the increase in price elasticity of home health supply by .0052. However, this estimate might be biased due to unobservable state characteristics. To address this potential endogeneity problem, I also examine the association between for-profit hospital market share and price elasticity. They turn out to have a stronger positive association: the one percentage point in-

crease in for-profit hospital market share predicts the higher price elasticity by .010. Lastly, I also check the association between the presence of CON program in each state and price elasticity of home health supply. The result shows that states with no CON program had higher price elasticity of home health supply. Without a state's control over the establishment of new home health agencies, new agencies (mostly for-profits) were more likely to enter the market under the PPS and increased for-profit market share.

These results indicate that the proportion of Medicare beneficiaries using home health services increased to a greater degree in states with more for-profit agencies and fewer non-profit agencies. That is, agencies increased the proportion of home health patients to increase profits, assuming that for-profits are more likely interested in profit increase.

2.6.2 Number of Episodes Per Patient

Interestingly, a low-cost outlier patients' likelihood of recertification was higher than a non low-cost outlier patients' during the early years of the PPS (see Figure 2.4). For example, in 2003, patients who received four visits were more likely to get recertified for another episode of care by 4.49 percentage points, as compared to those with five visits. This is inconsistent with my prediction that agencies were more likely to recertify profitable patients. It is not clear why agencies were more likely to recertify unprofitable patients during the early years of the PPS.

However, this discrepancy in the likelihood of recertification between patients who received four and five visits decreased gradually over time. Actually, the difference was not significant any longer after 2005. Assuming that agencies gradually learned how to increase profits under the PPS, the described change suggests that agencies increasingly chose not to recertify low-cost outlier patients probably because those patients were relatively unprofitable. This result is consistent with my hypothesis that agencies were more likely to recertify a subsequent episode of care for more profitable patients.

There was a clear difference between for-profit and non-profit agencies' recertification

behaviors. During the early years of the PPS, for-profit agencies were more likely to re-certify a low-cost outlier patients than non-profits were. However, for-profits drastically decreased the recertification of low-cost patients compared to non low-cost patients over time. Actually, starting in 2009, for-profits recertified patients non low-cost patients more than low-cost patients. That is, for-profits were more likely to recertify non low-cost outlier patients who were more profitable. In contrast, non-profits were consistently more likely to recertify low-cost patients than non low-cost patients, and this tendency did not change over time. (The regression result regarding the difference between for-profits and non-profits is available upon the request.)

2.6.3 Payment Amount Per Episode

2.6.3.1 Types of Service Visits

Agencies sought to increase each patient's payment amount per episode by adjusting the types of home health service provided. For example, each patient's likelihood of receiving any home health aide visits (which were not compensated for extra visits provided) decreased gradually under the PPS, whereas the likelihood of any therapy visits (which promised a substantial marginal benefit for the 10th therapy visit) increased (see Figure 2.5 (b) and Figure 2.5 (c)). Furthermore, each patient's likelihood of receiving any skilled nursing visits (a core service that agencies did not receive compensation for extra visits provided) increased only slightly until 2005, and in fact has started to decrease since then (see Figure 2.5 (a)). However, this slight change in the predicted likelihood was not significant most years, which might be due to a ceiling effect. That is, the proportion of episodes with any skilled nursing visit is already close to 1, and there is little room left for the proportion to increase or decrease. Thus, it is hard to examine an agency's actual adjustment of skilled nursing visit provision in response to the PPS.

The influence of an agency's ownership status on its adjustment of the type of services provided was not in line with my hypothesis. The likelihood of providing any therapy,

home health aide, and skilled nursing visit did not differ among for-profit and non-profit agencies during most years of the PPS. (The regression result regarding the difference between for-profits and non-profits is available upon the request.) This is inconsistent with my hypothesis that for-profit agencies would seek to provide more therapy visits but less home health aide visits than non-profit agencies. One possible explanation for these unexpected results is that there might be unobservable differences between for-profit and non-profit agencies in patient health conditions. For instance, for-profit agencies might be more likely to serve patients who had unmeasured needs for home health aide visits. If so, the regression estimate could be biased.

2.6.3.2 Number of Service Visits

Home health agencies adjusted the number of service visits provided per episode in order to maximize payment per episode. First, agencies gradually increased the likelihood of providing 10-13 therapy visits under the PPS, which set the marginal benefit for the 10th therapy visit substantially high while the marginal benefit for all other numbers of therapy visits was zero. The DFL decomposition result illustrates that there is a big bump in the distribution at 10-13 therapy visits and the bump became more significant between 2001 and 2007 (see Figure 2.6 (a)). The counterfactual distribution shows what the distribution of the number of therapy visits would be in 2001 with observable characteristics of the year 2001, holding the number of therapy visit determination mechanism (agencies' response to payment incentives) in 2007 fixed. Comparing the actual distribution in 2001 and the counterfactual distribution, I find that agencies intentionally decreased provisions with fewer than 10 and more than 15 therapy visits, while increasing provisions with 10 to 13 therapy visits between 2001 and 2007. However, this targeting of 10-13 therapy visits suddenly disappeared in 2008 when Medicare modified the way the number of therapy visits was factored into reimbursement amounts (see Figure 2.6 (b)). Interestingly, the actual distribution in 2008 and the counterfactual distribution (which illustrates what the distribution

would be in 2007, assuming the observables of the year 2007 and the number of therapy visit determination mechanism of the year 2008) are almost the same, indicating that the huge change in the actual distribution between 2007 and 2008 was mostly due to agencies' response to the change in the reimbursement schedule, not changes in observables.

I find clear differences in the number of therapy visits provided between for-profit and non-profit agencies. Comparing the actual distribution of non-profit agencies and the counterfactual distribution (which illustrates what the distribution of therapy visits would be among non-profit agencies, assuming the observables of non-profits and the number of therapy visit determination mechanism of for-profits) in the DFL decomposition, I find that for-profit agencies were generally more likely to provide 10-13 therapy visits and less likely to provide fewer than 10 therapy visits than for-profits (see Figure 2.7). These findings indicate that, as my conceptual model predicted, for-profits were more likely to target 10-13 therapy visits per episode to benefit from the high marginal benefit of the 10th therapy visit.

2.6.4 Service Provision among New Home Health Agencies

For-profit home health agencies that entered the market under the PPS pursued profit-seeking behaviors more than their for-profit counterparts established prior to the PPS (see Figure 2.8). For example, those new for-profit entrants were more likely to recertify another episode of care and provide 10-13 therapy visits per episode, but less likely to provide 7-9 therapy visits per episode. However, new non-profit agencies behaved the same as existing counterparts. These results stayed essentially the same when I limit my sample to 2005, 2006, or 2007. Given that a number of home health agencies, mostly for-profits, continued to enter the market throughout the PPS, the profit-seeking behavior of new for-profit agencies not only contributed to Medicare home health spending growth but also explains the gradual adjustments in home health service provision patterns under the PPS.

2.7 Decomposition

2.7.1 Contribution of Each of the Three Factors to Spending Growth

All three factors, the number of home health patients, the number of episodes per patient, and the payment amount per episode, contributed to the aggregate home health spending increase under the PPS. This section briefly examines the extent to which each of these three components contributed to the total spending increase between 2001 and 2009 using the Oaxaca-Blinder decomposition method. This method estimates how much of the spending increase was attributable to increases in each of the factors (explained variation) and how much was attributable to changes in the relationship between each factor and total spending (unexplained variation) (Barrera-Osorio et al., 2011; Fortin et al., 2011). I focus on the explained variation and analyze the relative contribution of each of the three factors to the total spending increase. (Refer to Appendix A.4 for a more detailed explanation of how I apply this decomposition method to the context of Medicare home health spending increases). The decomposition results suggest that the increase in the proportion of Medicare beneficiaries utilizing home health services contributed the most to the total spending increase under the PPS. The number of episodes per patient and the payment amount per episode contributed the second most and the least to the total spending increase between 2001 and 2009, respectively.

2.7.2 Contribution of For-Profit Market Share Increase to Spending Growth

The for-profit agency market share increased from 48 percent to 60 percent between 2001 and 2009. This increase in for-profit market share further accelerated total home health spending growth because new for-profit agencies that entered the market under the PPS were more likely to adopt profitable service provision patterns than existing agencies. This phenomenon leads to the following question: how much did the increase in the for-profit market share contribute to the increase in total Medicare home health spending?

To answer this question, I collapse the 2001 to 2009 data into the state level (N=459) and run a regression of four different dependent variables (home health spending per Medicare beneficiary, proportion of home health patients, number of episodes per patient, and payment amount per episode in each state in each year. These four terms are represented in the following equation, $\frac{Total\,Spending}{\#Medicare\,Beneficiary} = \frac{\#Patients}{\#Medicare\,Beneficiary} \times \frac{\#Episodes}{Patient} \times \frac{Payment}{Episode}$ on each state's for-profit market share in each year. I also control for each state's basic demographic characteristics, state indicators, and year dummy variables. The coefficient of for-profit market share is then obtained in each of the four separate regressions (see Table 2.3, column (1)). I also compute the change in the value of the four factors between 2001 and 2009 (see Table 2.3, Column (2)). Then the implied contribution of the increase in for-profit market share to the actual change in the four factors from 2001 to 2009 is calculated. This calculation is equal to the coefficient estimates in the first column times the change in the for-profit market share between 2001 and 2009 (12 percent increase) (see Table 2.3, Column (3)). In the last column, I show how much the for-profit market share increase contributed to the increase in each of the four factors by dividing the implied contribution in the third column by the change in each factor in the second column.

This approach suggests that the increase in the for-profit market share explains about one third of the increase in total spending between 2001 and 2009. For the same period, the for-profit market share increase explains roughly 34, 42, and 19 percent of the increase in the proportion of home health patients, the number of episodes per patient, and payment amount per episode, respectively. However, this result is suggestive because the causal influence of for-profit share on each of the four factors might not be clear.

2.8 Discussion

The Medicare home health PPS, the system that was introduced to curb rising Medicare home health spending, provided unintended supply-side incentives that contributed heavily to an increase in the number of Medicare home health patients, the number of episodes per

patient, and the payment amount per episode, all of which led to a significant increase in total Medicare home health spending. In particular, the rising number of Medicare home health patients contributed the most to the total spending increase.

The proportion of Medicare beneficiaries utilizing home health services dramatically increased under relatively generous prospective reimbursement rates. This increase was more salient in states with a relatively high number of for-profit agencies per capita and a relatively high for-profit market share. This suggests that home health agencies increased the number of patients to increase profits in response to relatively generous prospective reimbursement rates. In addition, limited guidelines on eligibility criteria for Medicare home health care enabled agencies to admit patients who might not have needed home health care, contributing to the increase in the number of patients.

Total Medicare home health spending was also significantly inflated by the increasing number of episodes per patient. Agencies increased profits by providing a greater number of episodes of care for more profitable patients. In addition, loose CMS guidelines about recertification decisions allowed agencies to easily recertify an additional episode of care and thus increase their profits. Although regulations stipulated that a physician be involved in the recertification decision process, anecdotally, most physicians made these decisions based on information provided by agencies via phone conversations (Brega et al., 2002).

Agencies also manipulated the system by adjusting the type and number of service visits to raise the payment amount per episode. For instance, agencies targeted 10-13 therapy visits per episode to benefit from the high marginal benefit of the 10th therapy visit. This dynamic also caused agencies to shift their service provision toward therapy visits and away from relatively less profitable home health services such as skilled nursing or home health aide visits.

Throughout this study, I find that for-profit agencies were more likely to adopt profitable service provision patterns under the PPS. Given that the start-up cost of a home health agency is relatively low, it is likely that the incentives built into the PPS attracted an

increasing number of for-profit agencies. This is important because new for-profit agencies prioritized profits more strongly and thus contributed significantly to the increase in total Medicare home health spending. Overall, the for-profit market share increase under the PPS accounts for about one third of the total spending increase. Had the home health industry been dominated by non-profit agencies, the increase in total spending might have been lower.

Interestingly, an increase in all three components of total Medicare home health spending could be viewed as desirable. Medicare home health care holds the potential to create savings in total Medicare spending because it is substitutable with more costly health care services. Home health care can replace more expensive skilled nursing home or inpatient care by allowing patients to receive necessary medical care at home. This substitution would lower health spending, an important benefit given the current anti-spending political environment (Benjamin, 1993). While such an expansion of home health care spending may be beneficial, an increase in home health spending caused by the inadvertent inclusion of improper incentives is undesirable and wasteful of resources. Future reimbursement policies must be carefully structured to encourage home health agencies to effectively balance cost efficiency and quality of care.

Table 2.1: Major Changes to the Medicare Home Health Reimbursement System

	Fee-For-Service System	Interim Payment System	Prospective Payment System
Time Period	1965 (Medicare Establishment Year) to Sep, 1997	Oct, 1997 to Sep, 2000	Oct, 2000 to Present
Payment Amount	Actual costs with service-specific per-visit limit, but not with per-beneficiary limits	The lowest of 1)actual cost 2)new-per-visit limits or 3)annual per-patient limit which was the weighted average of each agency's 1994 average per-patient cost and the census region's 1994 average per-patient cost*	The fixed payment corresponding to patient's case-mix with additional adjustment for low number of visits or usually high-cost outliers
Payment Period			Every 60 days

*Most agencies fell under the annual per-patient limit which was the same across all patients regardless of their health condition or duration of care.

Table 2.2: Factors Associated with State Variation in Price Elasticity of Home Health Supply

	$\%\Delta User_s/\%\Delta P_s$
FP HHA mktshr (0-100)	.0052(.0016)***
FP HOSP mktshr (0-100)	.010(.0030)***
CON	-.12(.066)*

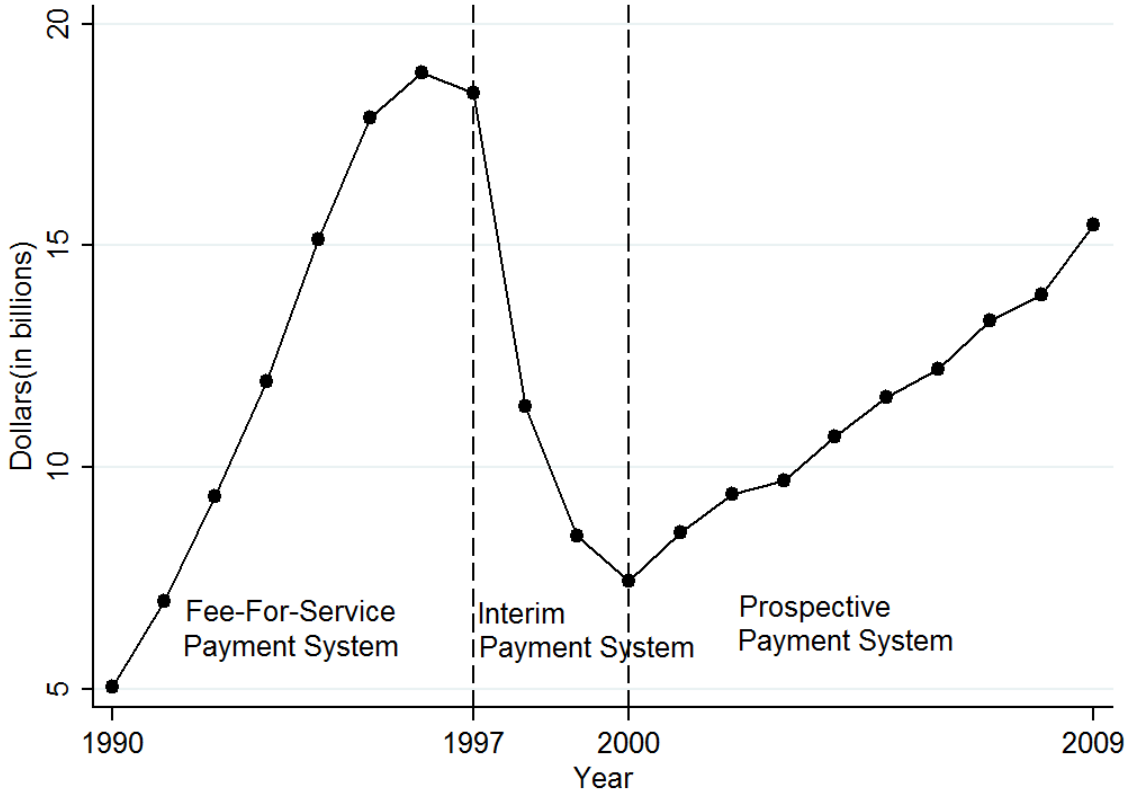
Note: Other control variables include age distribution(65-69-reference group, 70-74, 75-79, 80-89, and 90+), race composition(white-reference group, black, and others), the proportion of female beneficiaries, the proportion of married beneficiaries, the proportion of dual-eligible beneficiaries, the proportion of beneficiaries who resided with any child, and the proportion of beneficiaries who died in 2000. Equations are estimated using an ordinary least squares regression.
*p≤0.1, **p≤0.05, ***p≤0.01

Table 2.3: Contribution of the For-Profit Market Share Increase to the Total Spending Increase between 2001 and 2009

Factor	(1) For-Profit Market Share (0-100)	(2) Change from 2001 to 2009	(3) For-Profit Contribution (=(1)×(2))	(3)/(2)
Proportion of Home Health Patients	.00049(.00017)***	.017	.0058	.34
Episodes per Patient	.0046(.0020)**	.13	.055	.42
Payment per Episode (in Thousand Dollars)	.0035(.0021)*	.22	.042	.19
Total Spending per Beneficiary (in Thousand Dollars)	.0032(.0010)***	.12	.039	.33

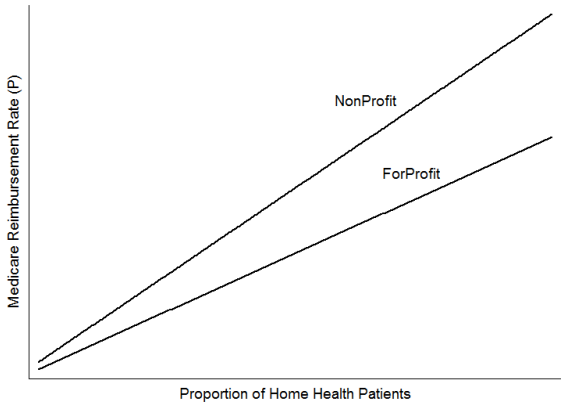
Note: *p≤0.1, **p≤0.05, ***p≤0.01

Figure 2.1: Medicare Home Health Spending under the Different Systems

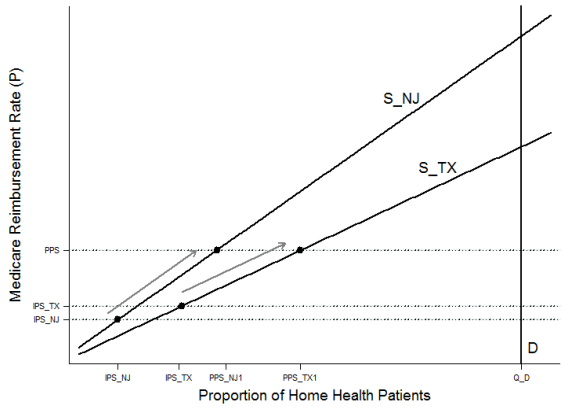


Note: 1) Source: Medicare and Medicaid Research Review, 2011 Statistical Supplement. 2) Medicare home health care was under the fee-for-service payment system until September, 1997; the interim payment system between October, 1997-September, 2000; and has been under the prospective payment system since October, 2000. 3) All numbers are in 2001 real dollars.

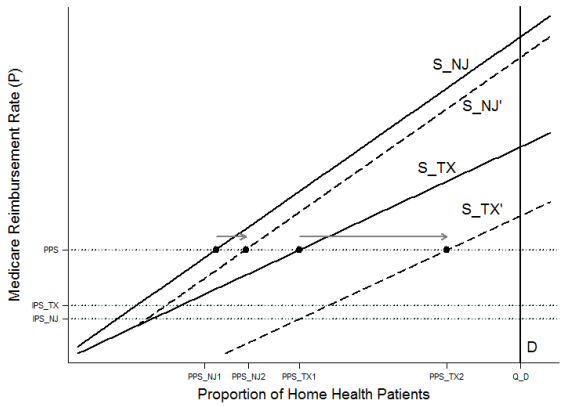
Figure 2.2: Proportion of Medicare Beneficiaries Utilizing Home Health Services



(a) For-Profit and Non-Profit Agency's Short-Run Supply Curve: a for-profit agency has a more elastic supply curve because for-profit agencies tend to be more responsive to changes in government reimbursement rates.

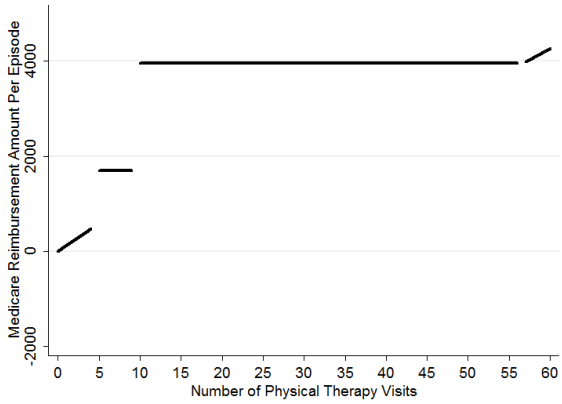


(b) State-Level Market Supply Curve (1): Texas with a higher for-profit market share, had a higher interim payment rate and a more elastic supply curve than did New Jersey.

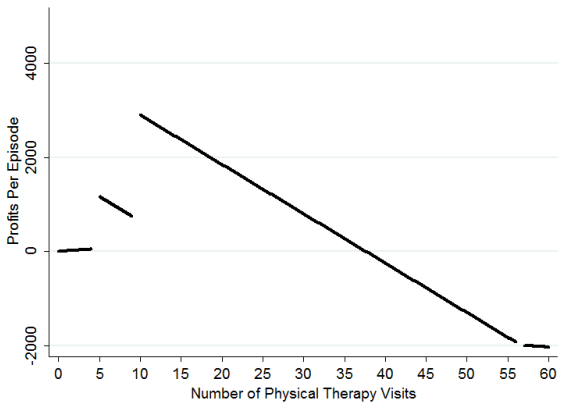


(c) State-Level Market Supply Curve (2): Texas attracted more new agencies to the market and thus Texas' supply curve shifted to the right to a greater degree.

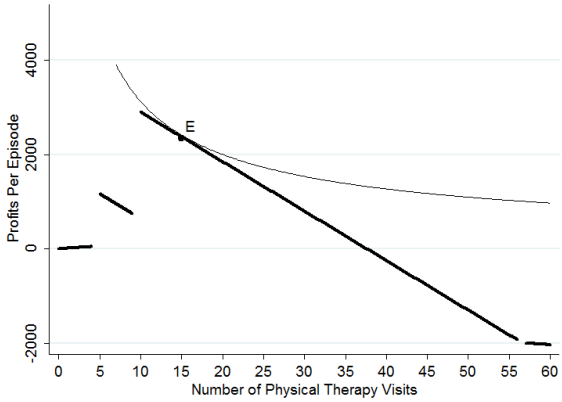
Figure 2.3: Number of Therapy Visits per Episode in 2001



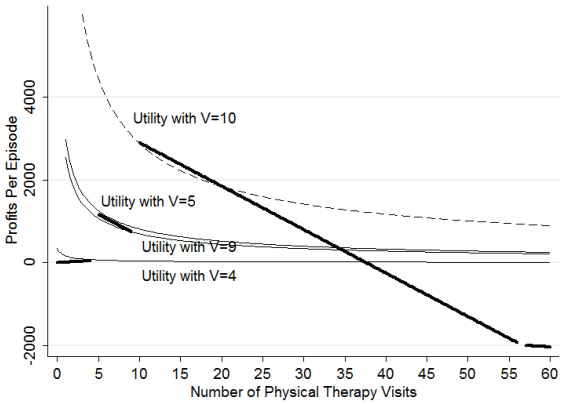
(a) Medicare Prospective Reimbursement Schedule



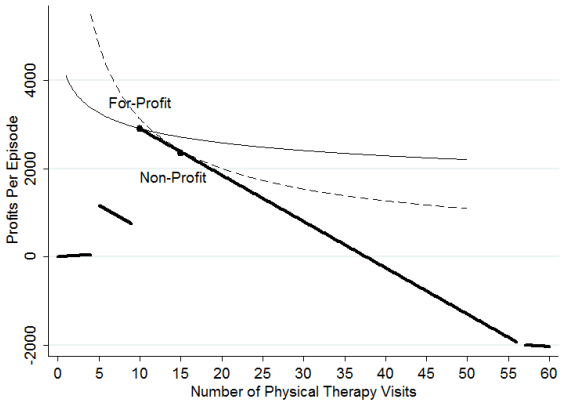
(b) Profit



(c) Number of Visits

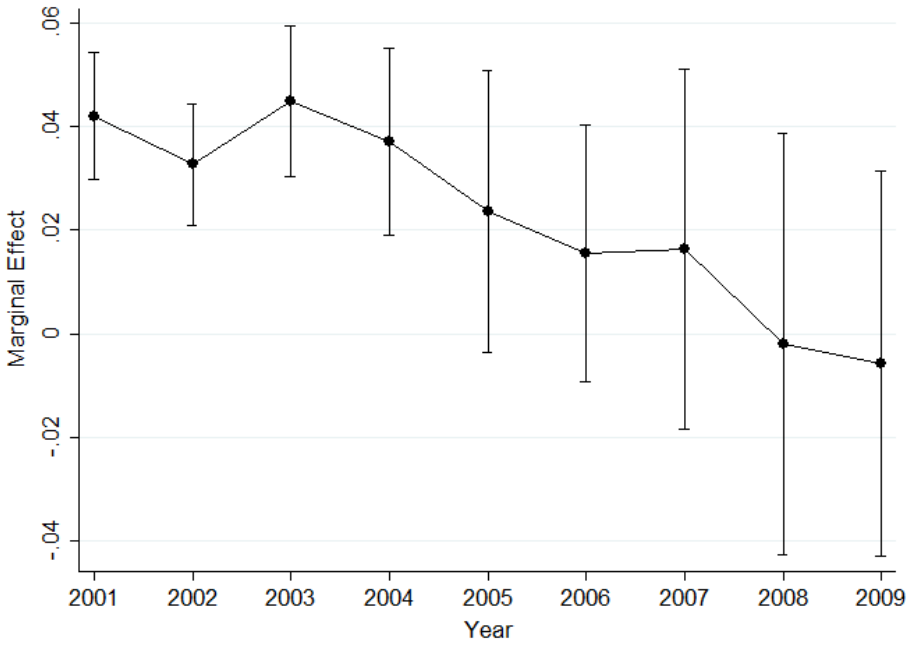


(d) Number of Visits: 4 vs 5 and 9 vs 10



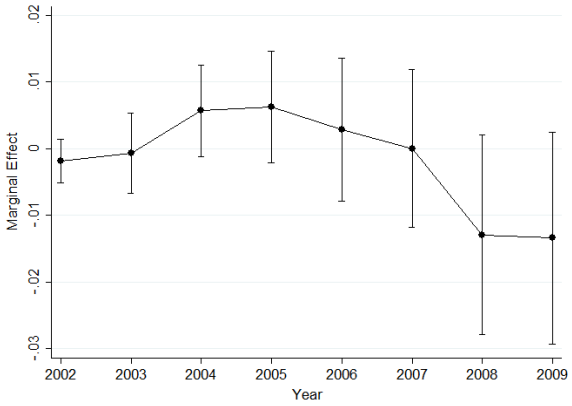
(e) Number of Visits: For-Profit vs Non-Profit

Figure 2.4: Marginal Effects (and 95% Confidence Intervals) of Low-cost Outlier Patients (Reference Group: Non Low-cost Outlier Patients) on the Likelihood of Recertification of Each Episode of Care

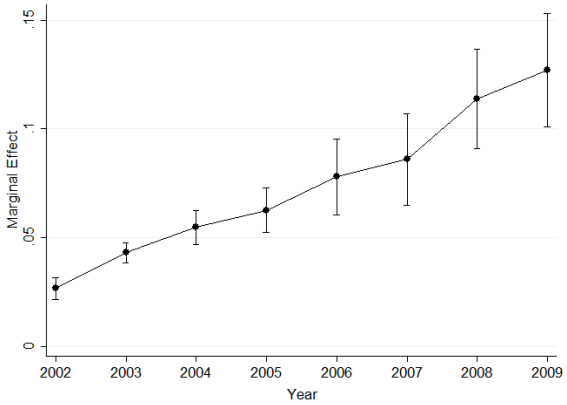


Note: I restrict the sample to episodes where four or five visits were provided.

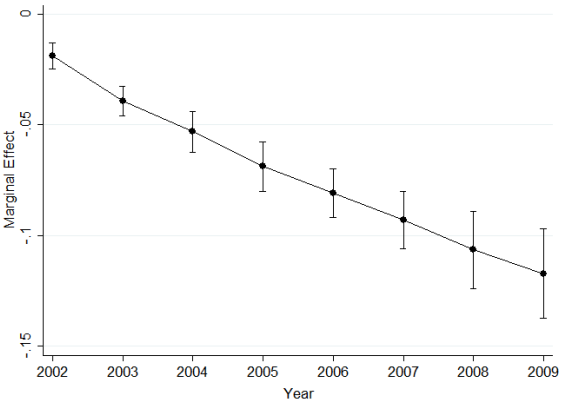
Figure 2.5: Likelihood of Providing Any Skilled Nursing, Therapy, and Home Health Aide Visits per Episode between 2001 and 2009



(a) Any Skilled Nursing Visits

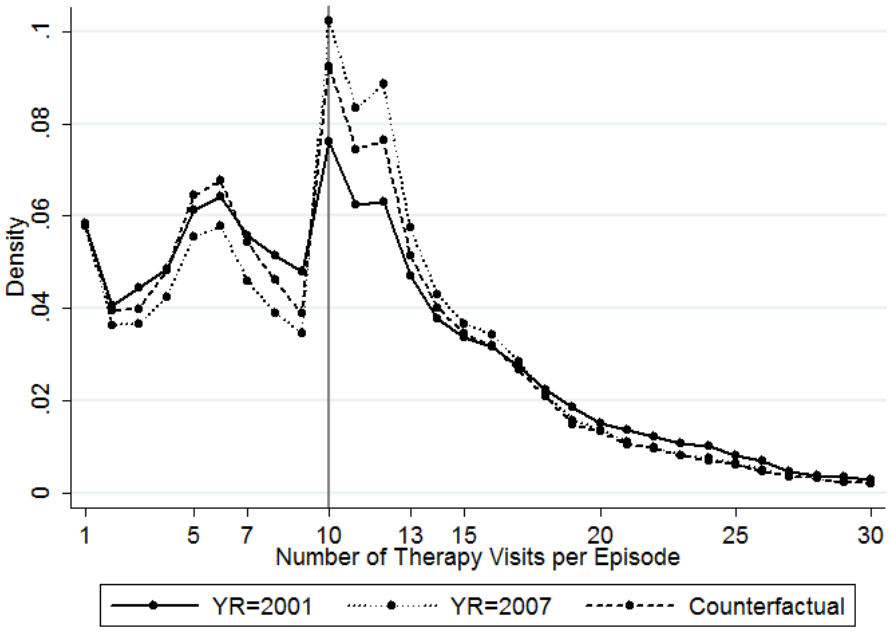


(b) Any Therapy Visits

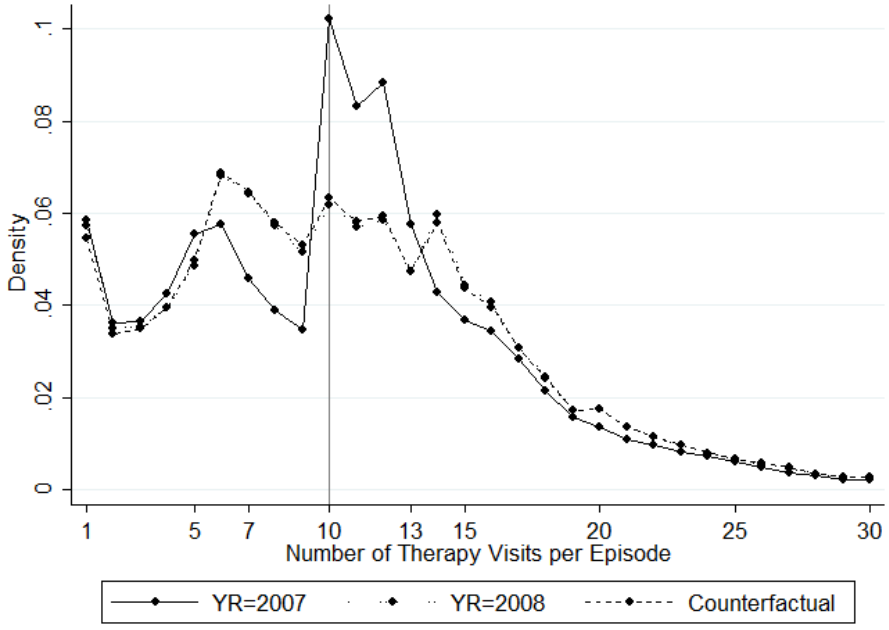


(c) Any Home Health Aide Visits

Figure 2.6: PDF of the Number of Therapy Visits by Year



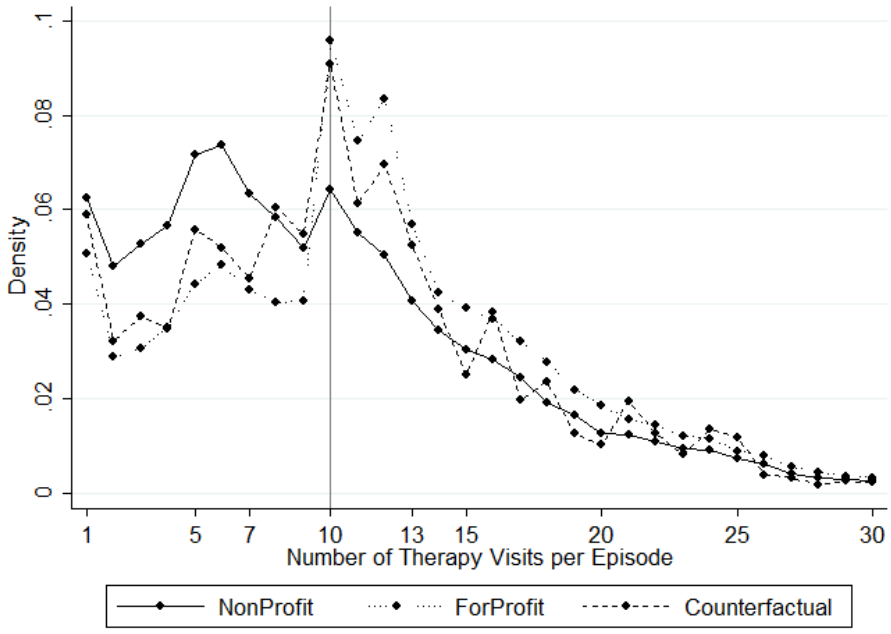
(a) Year: 2001 vs 2007



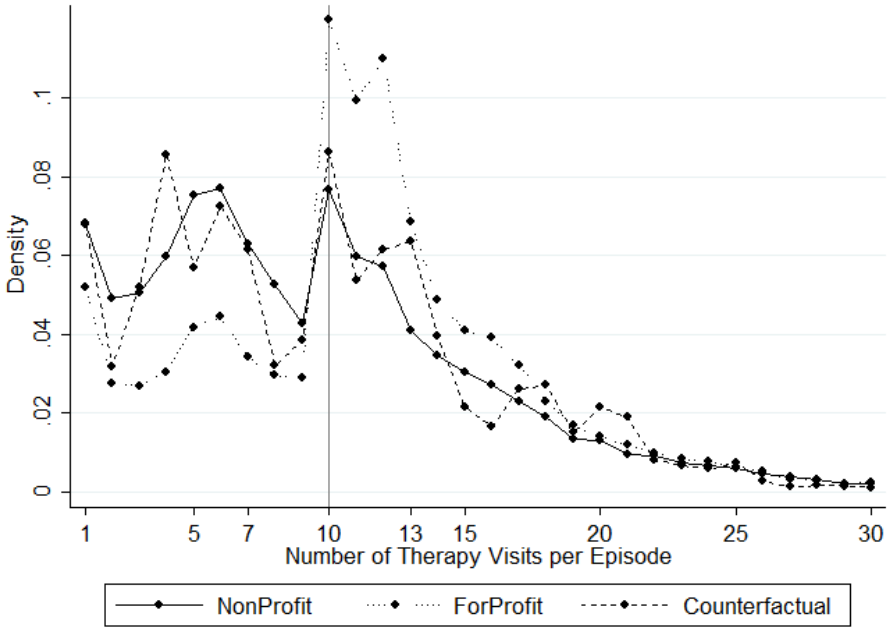
(b) Year: 2007 vs 2008

Note: 1) In Figure 2.6 (a), 'YR=2001' and 'YR=2007' represent the actual distribution of the number of therapy visits in 2001 and 2007, respectively. 'Counterfactual' illustrates what the distribution of the number of therapy visits would be in 2001 with observable characteristics of the year 2001, holding the number of therapy visit determination mechanism in 2007 fixed. 2) In Figure 2.6 (b), 'YR=2007' and 'YR=2008' represent the actual distribution of the number of therapy visits in 2007 and 2008, respectively. 'Counterfactual' illustrates what the distribution of the number of therapy visits would be in 2007 with observable characteristics of the year 2007, holding the number of therapy visit determination mechanism in 2008 fixed. 3) In Figures 2.6 (a) and 2.6 (b), I restrict the sample to episodes with at least one therapy visit provided and to episodes ineligible for low-cost or high-cost outlier payments.

Figure 2.7: PDF of the Number of Therapy Visits by Ownership Type



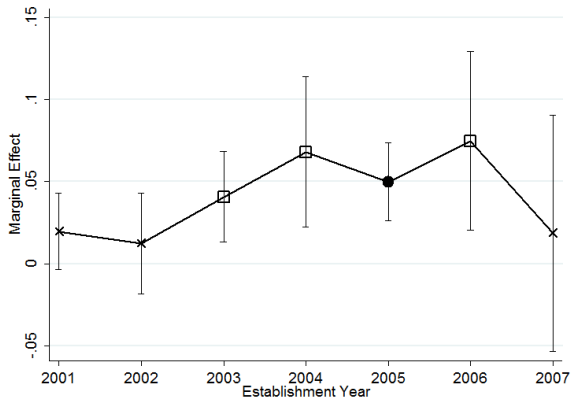
(a) Year: 2001



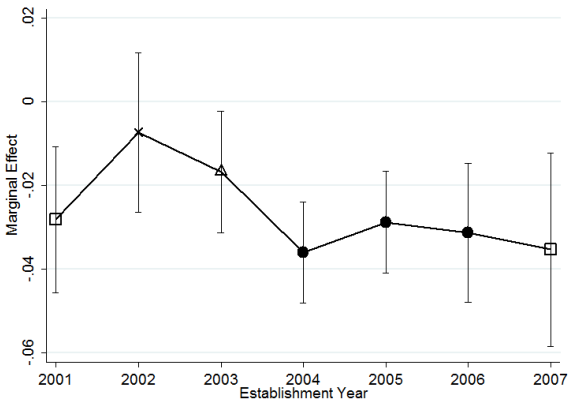
(b) Year: 2007

Note: 1) 'NonProfit' and 'ForProfit' represent the actual distribution of the number of therapy visits among non-profit and for-profit agencies, respectively. 'Counterfactual' illustrates what the distribution of the number of therapy visits would be among non-profit agencies, assuming the observable characteristics of non-profit agencies and the number of therapy visit determination mechanism of for-profit agencies. 2) In Figures 2.7 (a) and 2.7 (b), I restrict the sample to episodes with at least one therapy visit provided and to episodes ineligible for low-cost or high-cost outlier payments.

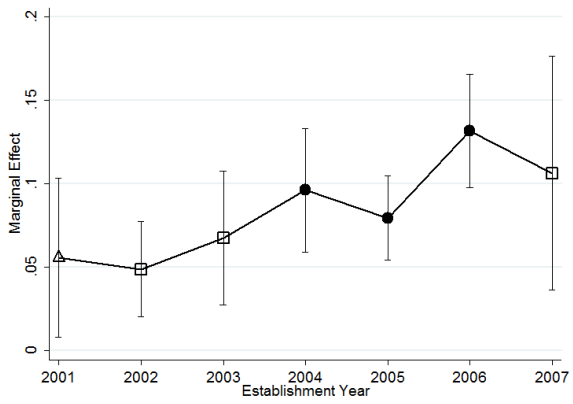
Figure 2.8: Marginal Effects (and 95% Confidence Interval) of Establishment Year (Reference Group: before 2001) on Service Provisions in 2007: For-Profit Home Health Agencies



(a) Recertification



(b) Providing 7-9 Therapy Visits



(c) Providing 10-13 Therapy Visits

Note: 1) The reference group is agencies that entered the market prior to the PPS (i.e. before 2001) 2) In Figures 2.8 (b) and 2.8 (c), I restrict the sample to episodes that provided at least one therapy visit and were ineligible for low-cost or high-cost outlier payments.

CHAPTER III

MARKET OWNERSHIP STRUCTURE AND SERVICE PROVISION PATTERN CHANGE OVER TIME: EVIDENCE FROM MEDICARE HOME HEALTH CARE

3.1 Introduction

Many studies have explored how a health care provider's ownership status influences its service provision patterns. More recently, recognizing that each health care provider operates in a market with the varied mix of for-profit and non-profit health care providers who might potentially compete with each other, many studies have addressed the influence of for-profit market share on service provision patterns across for-profit and non-profit health care providers (Grabowski & Hirth, 2003; Horwitz & Nichols, 2009). However, most study has addressed the cross-sectional effect of for-profit market share. Virtually no study has examined the effect of for-profit market share over time, but this is a glaring omission given that it typically takes time for health care providers to adjust service provision patterns.

This study suggests three mechanisms behind the gradual change in the influence of for-profit market share on service provision patterns over time. First, health care providers continue to enter the market if they perceive opportunities for high-profit margins, and

those new entrants strategically pursue profit-seeking service provision patterns (i.e.,service provision patterns that increase a providers profit but do not necessarily correspond to a patients health needs) more than incumbents. Second, profit-seeking behaviors among new entrants encourage neighboring incumbents to imitate new entrants' behaviors. Third, existing, chain-affiliated health care providers learn profit-seeking behaviors from others in the chain.

I address this issue in the context of the Medicare home health care market under the prospective payment system (PPS). In 2001, Medicare home health care introduced the PPS, which made pre-determined payments based on patient health status, to control its rapidly rising spending. However, retrospective features built into the PPS enabled home health agencies to pursue profitable service provision patterns. Using seven years of Medicare Claims and Provider of Service Files of Home Health Agencies, I examine how for-profit market share affected each agency's provision of profitable services over time under the PPS, and I further investigate whether the proposed mechanisms explain the gradual change in the influence of for-profit market share.

My study finds that the influence of for-profit market share on profitable home health service provisions (i.e., recertifying an episode of care and aiming for 10 or more therapy visits per episode) increased gradually in for-profit and non-profit agencies over time under the PPS. In other words, agencies incrementally adopted profitable service provision patterns to compensate for losses stemming from the intense competition provoked by the behaviors of for-profit home health agencies.

I also find that the suggested mechanisms, in particular the first and the last one, explain the gradual change in the influence of for-profit market share on home health service provision patterns over time under the PPS, particularly among for-profit agencies. The PPS attracted many for-profit agencies to the market, and those new for-profits engaged in profit-seeking service provision practices to a greater degree. In addition, the profit-seeking behaviors of new agencies led neighboring existing for-profit agencies to mimic those be-

haviors, but this result was valid only for one type of profit-seeking behavior. Lastly, chain-affiliated existing for-profits were more likely to resemble profit-seeking behaviors of other agencies in their chain. Regarding non-profit agencies, the suggested mechanisms do not explain it.

This study contributes to the extant literature in a number of ways. First, this study is the first to address changes in the effect of for-profit market share on service provision patterns over time. Again, examining changes in the effect over time is important because health care providers typically takes time to adjust service provision patterns. Second, this study is also the first to propose the mechanisms behind the increased effect of for-profit market share over time. These mechanisms can potentially explain behaviors of other health care providers such as hospitals or nursing homes. Third, it is the first to examine the effect of for-profit market share on service provision patterns of health care providers with different ownership structures in the context of Medicare home health care.

3.2 Background

3.2.1 Incentives built in the PPS

Medicare home health spending increased drastically under the fee-for-service payment system that paid the incurred cost of patient care. To address this problem, Medicare home health care introduced the PPS in 2000. The PPS made fixed and predetermined payments that correspond to a patient's case-mix group that a home health agency determined based on a patient's health conditions at the start of an episode of care. An episode of 60 days is the unit Medicare home health care uses for a payment period. Because payments per episode were fixed, agencies had to bear the burden of the full cost of extra treatments. Hence, officials expected the PPS to restrict rising costs that had been occurring under the fee-for-service payment system.

However, unintended incentives built into the Medicare home health PPS enabled agen-

cies to manipulate the reimbursement system. Specifically, many home health agencies focused on four types of home health provision patterns and thus provided excessive services, independent of patient needs. The four types of home health provision patterns include 1) increasing the likelihood of recertifying episode of care, 2) increasing the likelihood of providing 10-13 therapy visits per episode, 3) decreasing the likelihood of providing 7-9 therapy visits per episode, and 4) decreasing the likelihood of providing fewer than five visits (regardless of service type) per episode.

Specific explanations of each type of home health service provision pattern follow. First, home health agencies were increasingly likely to recertify an episode of care for each patient independent of patient health. The PPS allowed a patient to receive an unlimited number of episodes of care as long as a physician recertified episode of care. However, guidelines about recertification decisions "beneficiaries must need part-time or intermittent skilled care to treat their illnesses or injuries and must be unable to leave their homes without considerable effort, (MedPAC, 2011, p.177)" were not well-defined. Physicians often made recertification decisions based on information provided by an agency. Therefore, agencies could easily recertify an episode of care for each patient to increase profits.

Agencies also strategically adjusted the number of service visits per episode they provided. They took advantage of retrospective features embedded in the PPS, which adjusted reimbursement amounts based on treatment levels provided. For example, agencies dramatically increased the proportion of episodes with at least 10 therapy visits and decreased the proportion of episodes with 7 to 9 therapy visits. This was because the PPS reimbursed a significantly higher amount for episodes involving 10 or more therapy visits. Moreover, agencies drastically decreased the proportion of patients who received fewer than five visits per episode (called a low-cost outlier episode). Medicare would make a per-visit payment (called a low-cost outlier payment) for a low-cost outlier episode, instead of a standard prospective payment. However, these low-cost outlier payments were generally perceived as unprofitable because their payment rates were much lower than standard prospective

payment rates. (See Figure 3.1 that illustrates the reimbursement schedule for an imaginary home health patient who received physical therapy visits from a home health agency located in Ann Arbor in 2001.)

In sum, home health agencies focused on these four types of home health service provision patterns to increase profits relatively easily under the PPS.

3.2.2 Past studies

To date, virtually no studies have examined how for-profit market share affected service provision among health care providers with different ownership structure longitudinally. Using eight years of data, Horwitz and Nichols (2009) examined the influence of for-profit hospital market share on the types of medical services provided by for-profit, non-profit, and government hospitals, but their analysis did not address time trends in the influence of for-profit hospital market share. They found that non-profit hospitals in higher for-profit markets tended to provide more profitable services, such as open-heart surgery or magnetic resonance imaging, but fewer unprofitable services, such as HIV-AIDS or psychiatric emergency services, than did non-profit hospitals in markets with fewer for-profits. Horwitz and Nichols (2009) also found that non-profit hospitals in markets with high for-profit market share were more likely to provide home health services when the Medicare reimbursement system made home health services profitable. Likewise, they were less likely to offer home health services when reimbursement rates were restrictive. However, their findings regarding home health services were confined to hospital-based home health agencies which make up only a small fraction of all Medicare-certified home health agencies (17.44 percent in 2007). In addition, they only examined whether or not each hospital offered home health services given different levels of for-profit market share. In contrast, I address adjustments in four types of home health service provision patterns, which discussed above, among both hospital-based and free-standing agencies. I also go beyond the prior literature by investigating changes in the influence of for-profit market share over time, which could

occur through the entry of new health care providers to the market or through the learning process.

3.3 Conceptual Framework

My conceptual framework addresses 1) the influence of for-profit agency market share on home health service provision patterns across for-profit and non-profit agencies over time and 2) three mechanisms behind the gradual change in the influence of for-profit market share on home health service provision patterns.

When examining agencies in isolation, home health service provision patterns across for-profit and non-profit agencies are clearly distinguishable due to their different operational goals. For-profit agencies must distribute profits to individual shareholders and thus have a strong incentive to follow profitable home health provision patterns (Sloan, 2000). In contrast, non-profit agencies do not have well-defined shareholders and thus have a weaker incentive to maximize profits (Golberstein et al., 2009). Instead, non-profits seek to maximize the quantity and quality of health care (Horwitz & Nichols, 2009; Newhouse, 1970). Consequently, non-profits are less likely to pursue profitable home health service provision patterns.

However, this distinction in home health service provision patterns across for-profit and non-profit agencies becomes unclear once we consider competition across agencies in a market. According to the firm output maximization model, non-profit home health agencies are more likely to behave like for-profits in a market with more for-profits because non-profits face the constraint of a zero-profit condition (Horwitz & Nichols, 2009; Newhouse, 1970). For example, under the PPS, as an increasing number of for-profit home health agencies entered the market, the competition among agencies rose, and consequently, non-profit agencies were predicted to lose their patients to for-profit competitors. This would have left non-profits with not only fewer but also the less profitable patients because for-profit agencies are likely to attract more profitable patients through strategies such as creaming,

skimping, and dumping (Ellis, 1998; Horwitz & Nichols, 2009)). Accordingly, non-profit revenues would decrease under this intense competition. Therefore, facing a zero-profit constraint, non-profits might be driven to behave more like their for-profit counterparts and adopt profitable service provision patterns. For-profit market share might also influence home health service provision patterns among for-profit agencies. That is, as home health market competition intensifies with more for-profits, each for-profit agency is more likely to follow profitable home health service provision patterns to survive.

However, the effect of for-profit market share on home health service provision patterns might not be found in the cross-sectional analysis. This is more so if an analysis focuses on the first several years after a certain policy change because it typically takes time for home health agencies to adjust service provision patterns responding to the competition provoked by behaviors of for-profit agencies. However, if I focus instead on a longer duration, then the effect of for-profit market share might become more significant over time.

I propose three mechanisms behind the gradual change in the influence of for-profit market share on home health service provision patterns. First, the entry of new home health agencies to the market might explain this gradual adjustment in home health service provision patterns over time if new agencies behaved differently from existing ones (i.e., agencies established prior to the PPS). A substantially high number of home health agencies, mostly for-profits (95.73 percent), entered the market under the PPS (refer to Figure 3.2). New home health agencies would engage in profit-seeking behaviors to a greater degree due to the following three reasons. First, new agencies might enter the home health market under the PPS because they know the PPS would enable them to achieve high-profit margins. Second, existing home health agencies might have more stable budget sources (Choi & Davitt, 2009) given that they survived the restrictive payment rates under the interim payment system. Therefore, financial incentives built into the PPS might be less attractive to existing agencies than to new ones. Third, new home health agencies tended to be inefficient firms, facing higher input-costs (e.g., higher nurse or therapist wage). The

supply of nurses and therapists is limited in a local market in the short-run, which might cause agencies to compete each other to hire a qualified workforce in the market. Given this competitive market, new agencies, which entered the market later and had not built a firm relationship with local nurses and therapists, might have to pay higher wages to employ the same quality of nurses or therapists. Therefore, new agencies would have adopted profit-increasing service provision patterns to a greater degree, but profits would be still low because the costs for the new firms tend to be higher.

In addition, new home health agencies might have influenced home health provision patterns among existing agencies. If new agencies with strong profit motive attracted profitable patients, neighboring existing agencies would have to serve less profitable patients only. If so, existing for-profit and non-profit agencies might be forced to follow profitable home health provision patterns. Alternatively, existing agencies might identify profitable home health service provision patterns by observing new agencies' behaviors and voluntarily adopting those patterns. Either through competition or learning, as new agencies pursued profits to a greater degree, existing agencies' home health provision patterns would more closely resemble those of new agencies.

Furthermore, if an existing agency was affiliated with a chain, its home health provision patterns would be influenced not only by neighboring new entrants, but also by other agencies in the same chain. Agencies in one chain would be likely to follow similar home health provision patterns because they operated under the same policies. In addition, the chain might distribute the same booklets (such as annual reports) to all agencies in the chain or might provide identical training to workers across agencies. All of these would encourage agencies affiliated with the same chain to resemble each other in terms of home health service provision patterns.

In sum, I suggest that the gradual adjustment in home health service provision patterns under the PPS is explained by three mechanisms: the entry of new home health agencies to the market, the influence of new agencies on existing agencies, and the fact that chain-

affiliated agencies learned profitable service provision patterns from other agencies in the same chain.

This conceptual framework leads to the following hypotheses. First, the influence of for-profit market share on home health service provision patterns grew gradually over time under the PPS. Second, agencies that entered the market under the PPS were more likely to follow profitable home health provision patterns than existing agencies. Third, new home health agencies influenced home health provision patterns among neighboring existing agencies. Fourth, chain-affiliated agencies adjusted home health service provision patterns as a result of learning from the experiences of other agencies in the same chain.

3.4 Empirical Strategy

To examine these hypotheses, I must first define the market for the home health care industry. I use the Hospital Referral Region (HRR), developed by the Dartmouth Atlas of Health Care, as a local market for home health care. The Dartmouth Atlas of Health Care divided the United States into 306 HRRs such that each HRR contains major referral hospitals in which both major cardiovascular surgical procedures and neurosurgery are performed (Chandra & Staiger, 2007; Dartmouth Atlas, 2012). The HRR-level analysis has been used widely because individual HRRs reflect patient commuting patterns, which can overcome limitations in studies that arbitrarily use a market definition of political boundaries, such as states and counties (Chandra & Staiger, 2007). Although originally developed to identify a hospital market, the HRR works well as a home health market for two reasons. First, empirical examination supports the use of the HRR as a home health market. Using my datasets, I identify the county of residence of the patients treated by each home health agency and find that the market for each home health agency closely resembles the HRR. Second, the HRR represents the market for tertiary medical care and is closely linked to geographic variation in health care usage. Given that many home health patients have had prior hospital stays, using the HRR for a home health market is justifiable.

Each of the following empirical models corresponds to one of my hypotheses.

3.4.1 Influence of for-profit market share over time

Hypothesis 1: The influence of for-profit market share on home health service provision patterns grew gradually over time under the PPS.

A higher for-profit market share would increase competition. This in turn would encourage non-profit agencies to adopt profitable home health service provision patterns to a greater degree upon a zero-profit condition. The intense competition in a market with higher for-profit market share would also drive for-profit agencies to pursue profitable home health service provision practices to a greater degree. However, the cross-sectional effect of for-profit market share on service provision patterns might be found not at all or only in later years of this study because the adjustments in service provision patterns would have occurred gradually and I examine the initial years of the PPS (2001 to 2007). By contrast, the effect of for-profit market share might be significant in the longitudinal analysis if home health agencies incrementally adopted profitable home health service provision patterns over time.

To address this hypothesis, I estimate regression (3.1). In particular, following Grabowski and Hirth (2003)'s approach, I estimate regression (3.1) by agency ownership type for each patient, and thus exclude indicators of each home health agency's ownership type, in order to avoid a potentially high multicollinearity between the ownership type of each home health agency and for-profit market share.

$$\begin{aligned} Pr(Y_{ijkt}) = {} & \beta_0 + \beta_1 LinearYear_t + \beta_2 FPMarketShare_{ht} \\ & + \beta_{12} LinearYear_t \times FPMarketShare_{ht} + \beta_3 HHI_{ht} + \beta_4 Agency_{jt} \\ & + \beta_5 Patient_{ijkt} + \beta_6 Seasonality_k + HRR_h + \varepsilon_{ijkt} \end{aligned} \tag{3.1}$$

where i , j , k , h , and t refer to patient, home health agency, episode, hospital referral region, and year, respectively. $Pr(Y)$ refers to four aspects of home health service provision, namely, the likelihood of recertification (i.e., the likelihood of being recertified for another episode of care at the end of the current episode of care), the likelihood of receiving 10-13 therapy visits, the likelihood of receiving 7-9 therapy visits, and the likelihood of receiving fewer than 5 visits (regardless of service type). $LinearYear$ is a linear year variable. $FPMarketShare$ represents for-profit market share in the HRR in which an agency was located. HHI is the Herfindahl-Hirschman Index (HHI), which measures level of market concentration. HHI is calculated as the sum of the squares of each agency's share of total episodes within each HRR in each year, and thus it ranges between 0 and 1.

$Agency$ represents a vector of each home health agency's basic characteristics, such as number of employed nurses, physical therapists, and home health aides, and facility-based status. $Patient$ refers to a vector of each patient's basic characteristics including age, race/ethnicity, gender, the Medicare buy-in program participation status (a proxy of being low-income given that the program helps pay Medicare premiums for low-income Medicare beneficiaries (FamiliesUSA, 1999), indicator for prior hospitalization or nursing stay, indicators for most frequent major health diagnoses, and level of functional limitations. I also control for $Seasonality$, an indicator variable for the first (reference group), second, third, and last quarter of each year. Anecdotally, Medicare beneficiaries' use of Medicare home health care varies depending on the season, which can affect an agency's behaviors.

I also included HRR , HRR fixed effects, to address the potentially endogenous relationship between for-profit market share and each agency's home health service provision pattern. An HRR with a particularly business-friendly environment might attract more for-profit home health agencies to the market, and thus have relatively high for-profit market share. Those HRRs might also be more likely to condone inappropriate home health service provisions that do not necessarily correspond to patient health. Including HRR fixed effects addresses this endogenous relationship by controlling for fixed unobservable char-

acteristics in each home health market.

One caveat with the fixed effect approach is that HRR fixed effects cannot control for time-varying unobservable heterogeneity across home health markets that might be correlated with for-profit market share. However, the environment that affects each region's home health care industry is unlikely to change over time. Grabowski and Hirth (2003) argued that non-profit hospital market share (and thus for-profit hospital market share) is likely based on historical factors such as each city's age, volunteerism, and charitable provisions. Since for-profit home health agency market share depends on these same factors, they are also unlikely to change. I found that states like Texas and Louisiana that experienced rapid growth in Medicare home health care provision under the fee-for-service payment system observed similarly dramatic expansions under the PPS. By contrast, states like New Jersey and Massachusetts experienced similarly small expansions of Medicare home health care provision under both payment systems. That is, the business environment that affected Medicare home health care provision in each region remained the same over time. Therefore, I conclude that for-profit home health agency market share is not correlated with changes in unobserved characteristics in individual HRRs. The fixed effect approach could also have been limited if the within-HRR change in for-profit market share was small because the influence of for-profit market share is identified solely in terms of changes within each HRR over time. However, fortunately, for-profit market share within each HRR changed greatly under the PPS, providing sufficient variation.

I estimate separate linear probability models for each dependent variable. In fact, all results are essentially the same if I estimate probit models instead. However, I prefer the individual OLS results due to the more straightforward inference with the interaction term estimates. The standard errors are clustered on HRR.

The coefficient of my interest, β_{12}, measures changes in the influence of for-profit home health agency market share on each agency's home health service provision patterns over time, and is expected to be positive when Y is a profitable home health service provision

pattern (i.e., recertifying another episode of care and providing 10-13 therapy visits per episode).

3.4.2 Service provision among new home health agencies

Hypothesis 2: Agencies that entered the market under the PPS were more likely to follow profitable home health provision patterns than existing agencies.

The entry of new home health agencies to the market explains the gradual adjustments in home health service provision patterns among agencies under the PPS. New home health agencies might have started their businesses under the PPS because they recognized that the incentives built into the PPS would enable them to achieve high profit margins. Furthermore, existing agencies might have enjoyed more stable budget sources, which would have provided weaker incentives for following profitable home health service provision patterns. New agencies might be more inefficient firms with higher input costs, and therefore had to pursue profitable service provision patterns to a greater degree. Consequently, new agencies would have been more likely than existing agencies to follow the specific home health provision patterns that lead to high profits.

To examine this hypothesis, I limit my sample to home health episodes that occurred in 2007 and examine how home health service provision patterns differed depending on the starting year of each home health agency, by agency ownership type. The basic estimating equations take the following form:

$$Pr(Y_{ijk}) = \beta_0 + \sum_{n=2001}^{2007} \beta_{1n} EntryYear_{jn} + \beta_2 Agency_j + \beta_3 Patient_{ijk} + \beta_4 Seasonality_k + HRR_h + \varepsilon_{ijk} \quad (3.2)$$

where $EntryYear$ is a vector of dummy variables that represent the starting year (n) of each home health agency (reference group: $n \leq 2000$, i.e., agencies that entered the market

prior to the PPS). The coefficient of my interest, β_{1n}, measures how each new agency's home health service provision patterns varied depending on the year of establishment(n) compared to the patterns of agencies established prior to the PPS. β_{1n} is expected to be positive when Y is a profitable home health service provision pattern (i.e., recertifying another episode of care and providing 10-13 therapy visits per episode).

One caveat to this approach is that I examine only agencies that survived until 2007 in this analysis. On average, it is likely that survived agencies pursed profit-seeking behaviors to a greater degree because those who were not aggressive enough might find it hard to survive in a market. Therefore, the results can be upward biased. To address this limitation, I also restrict my sample to home health episodes that occurred in 2004, 2005, and 2006, and run the same analysis.

3.4.3 Influence of new entrants on home health service provision among existing agencies

Hypothesis 3: New home health agencies influenced home health provision patterns among neighboring existing agencies.

In the presence of new home health agencies, existing home health agencies in the same market might have adopted profitable home health provision patterns either through competition or through a learning process. To examine this hypothesis, I evaluate the importance of new agencies' home health service provision patterns in determining each existing for-profit and non-profit agency's service provision practice. Thus, I limit my sample to episodes served by existing agencies, and further exclude episodes in HRRs with no entrants. The basic estimating equations follow:

$$Pr(Y_{ijkt}) = \beta_0 + \beta_1 \overline{Y_{ht-1}^{newfp}} + \beta_2 \overline{Y_{ht-1}^{existingfp}} + \beta_3 \overline{Y_{ht-1}^{nfp}} + \beta_4 Year_t + \beta_5 HHI_{ht} + \beta_6 Agency_{jt} + \beta_7 Patient_{ijkt} + \beta_8 Seasonality_k + HRR_h + \varepsilon_{ijkt} \quad (3.3)$$

where $Pr(Y)$ represents existing agency's home health service provision patterns. $\overline{Y_{ht-1}^{newfp}}$ is the proportion of specific home health service provision practice (Y) of new for-profit agencies in HRR h in year $t-1$. I assume existing agencies followed the past year's home health service provision practices of new for-profit agencies because it might take time for agencies to adjust their service provision patterns. Likewise, $\overline{Y_{ht-1}^{existingfp}}$ and $\overline{Y_{ht-1}^{nfp}}$ are the proportion of specific home health service provision practice (Y) of existing for-profit agencies and non-profit agencies in HRR h in year $t-1$, respectively. The coefficient of my interest, β_1 , measures how average home health provision behavior among new agencies in a HRR affected service provision practice among existing agencies in the same HRR and is expected to be positive.

3.4.4 Learning from the practices of agencies in the same chain

Hypothesis 4: Existing chain-affiliated agencies adjusted home health service provision patterns as a result of learning from the experiences of other agencies in the chain.

If an existing agency was affiliated with a chain, it would have identified profitable home health service provision patterns based on the experiences of other agencies in the chain. To examine this hypothesis, I limit my sample to episodes served by existing, chain-affiliated agencies and evaluate the importance of home health service provision patterns among other agencies (including both existing and new ones) in the chain in determining each agency's service provision practice, by agency ownership type. The basic estimating equations follow:

$$Pr(Y_{ijkt}) = \beta_0 + \beta_1 \overline{Y_{-jct-1}} + \beta_2 Year_t + \beta_3 HHI_{ht} + \beta_4 Agency_{jt} + \beta_5 Patient_{ijkt} + \beta_6 Seasonality_k + HRR_h + \varepsilon_{ijkt} \quad (3.4)$$

where $\overline{Y_{-jct-1}}$ is the proportion of specific home health service provision practice among agencies (excluding agency j) in the chain c in year $t-1$. The coefficient of my interest, β_1 , measures how each chain-affiliated agency's home health service provision patterns were affected by the average service provision pattern among agencies in the chain, and is expected to be positive.

3.5 Data

3.5.1 Datasets

I use data from: 1) the CMS 5% Limited Data Set-Denominator File from 2001 to 2007, 2) the CMS 5% Limited Data Set-Home Health Agency File from 2001 to 2007, and 3) the CMS Provider of Service File-Home Health Agency from 2001 to 2007. I use data from 2001 through 2007 because the concept of episode was introduced with the implementation of the PPS in 2001 and CMS partially revised its home health reimbursement system in 2008. The first dataset, which was extracted from Medicare claims, is a panel of 5 percent of Medicare beneficiaries and contains their basic demographic information such as age, race, gender, and date of death, as well as Medicare HMO enrollment status. The second dataset, which was also taken from Medicare claims, is also a panel of 5 percent of Medicare home health patients and contains administrative information about each patient's Medicare home health care service use (CMS, 2012). The last dataset was extracted from the Online Survey and Certification Reporting System/ Quality Improvement Evaluation System collected by the CMS Regional Offices (Choi & Davitt, 2009; CMS, 2012).

It is a panel of all Medicare/Medicaid-certified home health agencies across the nation and includes their basic agency information like location, ownership type, and date of initial Medicare certification. I combine the first two datasets using each beneficiary's ID number, and create a complete Medicare claim dataset. The home health agency provider number enables me to merge the combined Medicare claim dataset and CMS Provider of Service File, resulting in a patient-agency linked, unbalanced panel data set. Each observation in this dataset corresponds to a patient's unique episode of care.

I limit my sample to Medicare beneficiaries who were 65 or older. I also drop beneficiaries who were enrolled in Medicare HMOs because Medicare HMOs were not directly influenced by Medicare reimbursement system changes. I further exclude those beneficiaries with zero Medicare payments, zero Medicare home health service visits, or positive non-Medicare payment amount as well as beneficiaries who resided in Puerto Rico, the U.S. Island Areas, or unidentified county areas. Medicare home health patients whose agency information was not found in the CMS Provider of Service File-Home Health Agency were also dropped. Additionally, I exclude one of the records in cases in which two episodes had the same service start and end date and referred to the same episode, but had separate records due to significant changes in the patient's health condition or the existence of an unclean claim. I drop as well episodes of care for beneficiaries who died earlier, but received home health visits after their date of death. I further exclude episodes in which home health care was interrupted because a patient was readmitted to a hospital, entered a nursing home, died, and so forth. I also exclude episodes that were treated by government home health agencies. Finally, I drop observations with missing values for the variables used in my analysis. These selection criteria created an unbalanced panel data set with 1,290,573 patient-episode observations, which translated to 498,798 unique patients.

3.5.2 Key independent variable

The key independent variable is for-profit market share in the HRR in which an agency was located. I compute for-profit market share as the proportion of for-profit home health admissions out of total home health admissions in each HRR. Average for-profit market share rose significantly under the PPS, from 0.49 in 2001 to 0.60 in 2007.

3.6 Results

3.6.1 Influence of for-profit market share over time

The influence of for-profit market share on home health service provision increased gradually over time, as predicted in my conceptual model.

In particular, the effect of for-profit market share on profitable service provision patterns became increasingly stronger over time for both for-profit and non-profit agencies' patients. For example, in 2001, the one-percentage point increase in for-profit market share predicted 1.4 percentage point lower likelihood of recertification among for-profit agencies (See Table 3.1, Column (1)). However, the influence of for-profit market share on the likelihood of recertification gradually became stronger towards a positive direction over time: Each year, the influence of for-profit market share on the likelihood of recertification increased by 2.5 percentage points. I also find the similar pattern in the influence of for-profit market share on the likelihood of providing 10-13 therapy visits for both for-profit and non-profit agencies' patients (See Table 3.1, Column (2)).

The effect of for-profit market share on unprofitable home health service provision (each patient's likelihood of receiving 7 to 9 therapy visits or of receiving fewer than five visits) also became stronger over time towards a negative direction, but the coefficient estimates are not statistically significant (See Table 3.1, Column (5)-(8)).

Overall, the results suggest that both for-profit and non-profit agencies were increasingly likely to focus on recertification and the provision of 10 to 13 therapy visits to in-

crease profits and thereby buffer the losses incurred from the intense competition caused by higher for-profit market share.

3.6.2 Service provision among new home health agencies

For-profit home health agencies that entered the market under the PPS pursued profit-seeking service provision patterns to a greater degree than their for-profit counterparts established prior to the PPS. For instance, a patient's likelihood of recertification was higher if the patient was treated by for-profit agencies established in 2004 and 2006, as compared to existing for-profit agencies, by 3.64 percentage points and 3.67 percentage points, respectively (See Figure 3.3). The likelihood of providing 10-13 therapy visits was also higher among for-profit agencies that entered the market in 2004 and 2006 than it was for existing agencies, by 6.89 percentage points and 10.85 percentage points, respectively. In addition, new for-profit agencies were less likely than existing ones to pursue unprofitable home health service provisions including providing 7-9 therapy visits and providing fewer than 5 visits. However, as discussed above, this finding might be driven partially by the fact that I limit my sample to agencies that could survive until 2007. To address this limitation, I also restrict my sample to episodes that occurred in 2004, 2005, and 2006, and run the same analysis. The results were basically same.

Interestingly, overall, agencies that entered the market later years were more likely to engage in profit-seeking behaviors to a greater degree. The coefficients estimates for entry year of 2001 and 2006 are statistically different such that I can reject $\beta_{1,2001} = \beta_{1,2006}$ at conventional levels of significance for all regressions except the one with the likelihood of providing 7-9 therapy visits. This explains the gradual adjustments in home health service provision patterns under the PPS.

However, this trend was not found among new non-profit agencies. Actually, only a few non-profit agencies (N=252) entered the market under the PPS, and coefficients in regressions of new non-profit agencies have a much higher standard error. As an alternative

to check how new non-profit agencies behaved, I pool all episodes in one regression and include an interaction between each agency's entry years with its ownership type. However, the coefficient estimates are too imprecise.

3.6.3 Influence of new entrants on home health service provision among existing agencies

New for-profit agencies affected neighboring existing agencies' service provision patterns only to a small degree. For example, if the average likelihood of recertification among new for-profit agencies in year $t-1$ was high, then existing for-profit and non-profit agencies in the same market were also more likely to recertify an episode of care in year t. However, this relationship is not statistically significant at the conventional levels of significance (See Table 3.2, Column (1) and (2)). This suggests that both existing for-profit and non-profit agencies were not influenced by new entrants' service provision patterns, which is inconsistent with my prediction.

New for-profit agencies had a small effect on existing for-profit agencies' provision of 10-13 therapy visits. The one percentage point higher average likelihood of providing 10-13 therapy visits per episode among new for-profit agencies in year $t-1$ was associated with the 2.6 percentage point higher likelihood of providing 10-13 therapy visits among existing for-profit agencies in year t. However, existing non-profit agencies' provision of 10-13 therapy visits was not influenced by new for-profits' 10-13 therapy visit provision. Actually, the coefficient for non-profit agencies is negative although it was not statistically significant.

Likewise, new for-profit agencies did not affect existing agencies' likelihood of providing fewer or equal to 4 visits per episode or 7 to 9 therapy visits per episode.

3.6.4 Learning from the practices of agencies in the same chain

If an existing agency was affiliated with a chain, its home health provision patterns were influenced by the past year's home health service provision practices of other agencies in the chain. However, this relationship was valid only among for-profit agencies. Non-profit agencies, if chain-affiliated, were not affected by service provision patterns of other agencies in the same chain.

For instance, among for-profit agencies, the one percentage point higher likelihood of recertification among other agencies in the chain in year $t-1$ was associated with the 26 percentage point higher average likelihood of recertification for existing agencies in year t (see Table 3.3). I find the same phenomenon in other types of home health service provision including the likelihood of providing 10-13 therapy visits or the likelihood of providing fewer or equal to 4 visits per episode.

3.7 Discussion

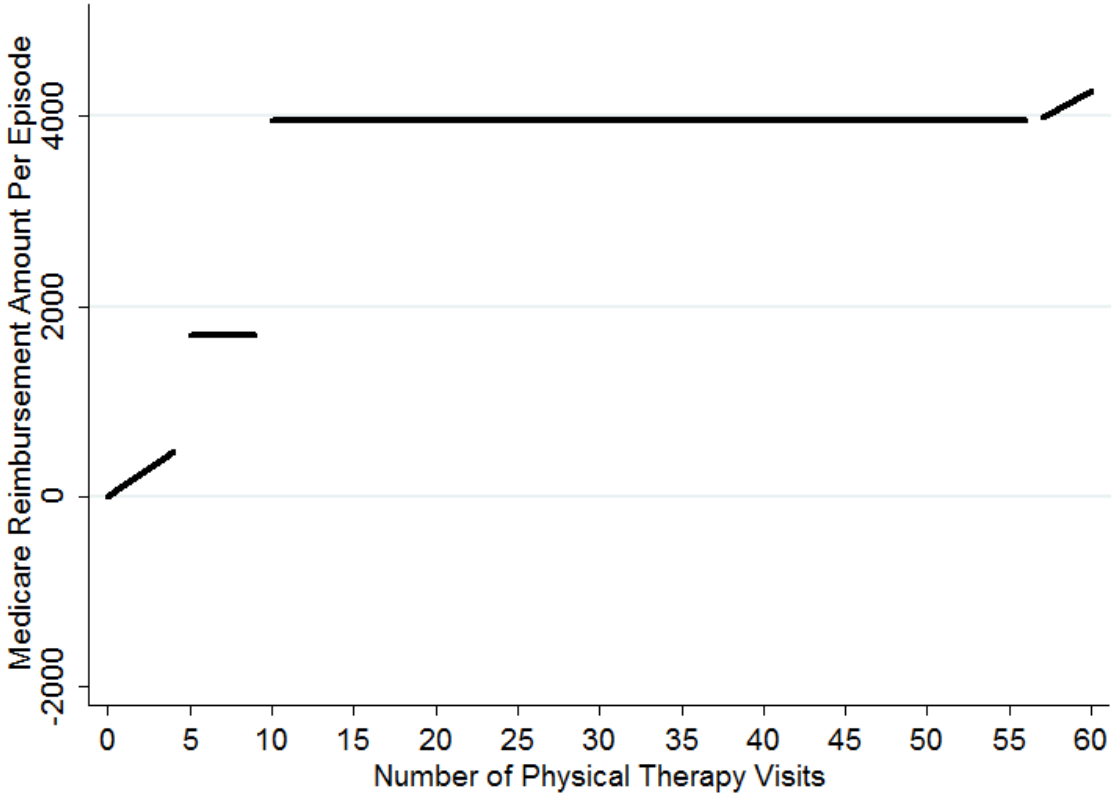
This study finds that the effect of for-profit home health agency market share on profitable home health service provision practices increased over time. I further suggest three mechanisms behind the gradual increase in the effect of for-profit market share over time under the PPS. Those mechanisms include the entry of new home health agencies to the market, the influence of new agencies on existing agencies, and the fact that chain-affiliated agencies learned profitable service provision patterns from other agencies in the same chain. In particular, I find these mechanisms explain the gradual change in the influence of for-profit market share on service provision patterns over time for for-profit agencies, but not for non-profit agencies.

It is necessary to mention a few potential limitations of this study. First, this study cannot perfectly consider patient selection among agencies with different ownership structures. This study controls for an individual patient's main diagnoses and functional limitations,

but does not have access to sufficiently detailed information about patient health status, which may potentially bias estimates. Second, this study does not consider what might happen in other health care settings during the study time period, that is, between 2001 and 2007. Because home health care can be a close substitute for nursing home and hospital care to some degree, changes in those health care settings might influence the provision of home health services. Third, this study cannot control for time-varying unobservable heterogeneity across home health markets that might be correlated with for-profit agencies' market share. As discussed above, however, unobservable heterogeneity is unlikely to change over time.

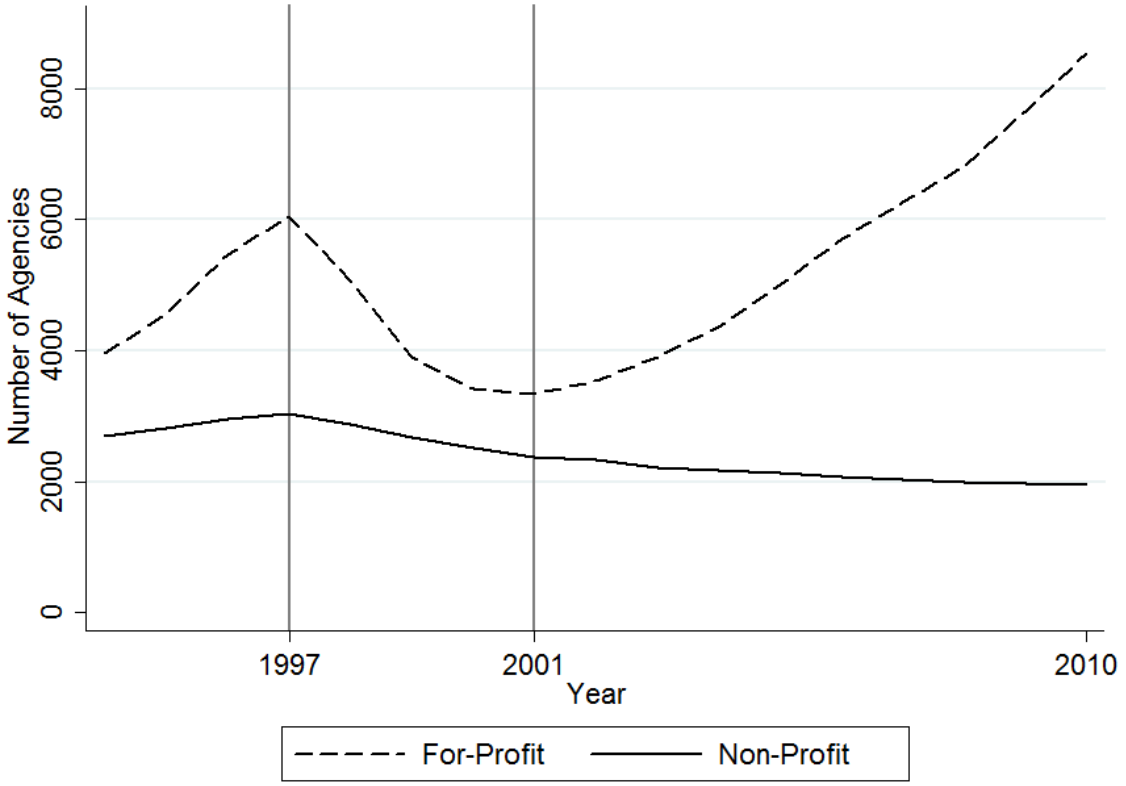
Despite these limitations, this study makes several important contributions. Notably, this is the first study that addresses changes in the effect of for-profit market share over time. In addition, it identifies three mechanisms behind the gradual change in the effect of for-profit market share. Furthermore, it examines the effect of for-profit home health agency market share on service provision across agencies with different ownership type, which has not been studied elsewhere.

Figure 3.1: Medicare Prospective Reimbursement Schedule in 2001



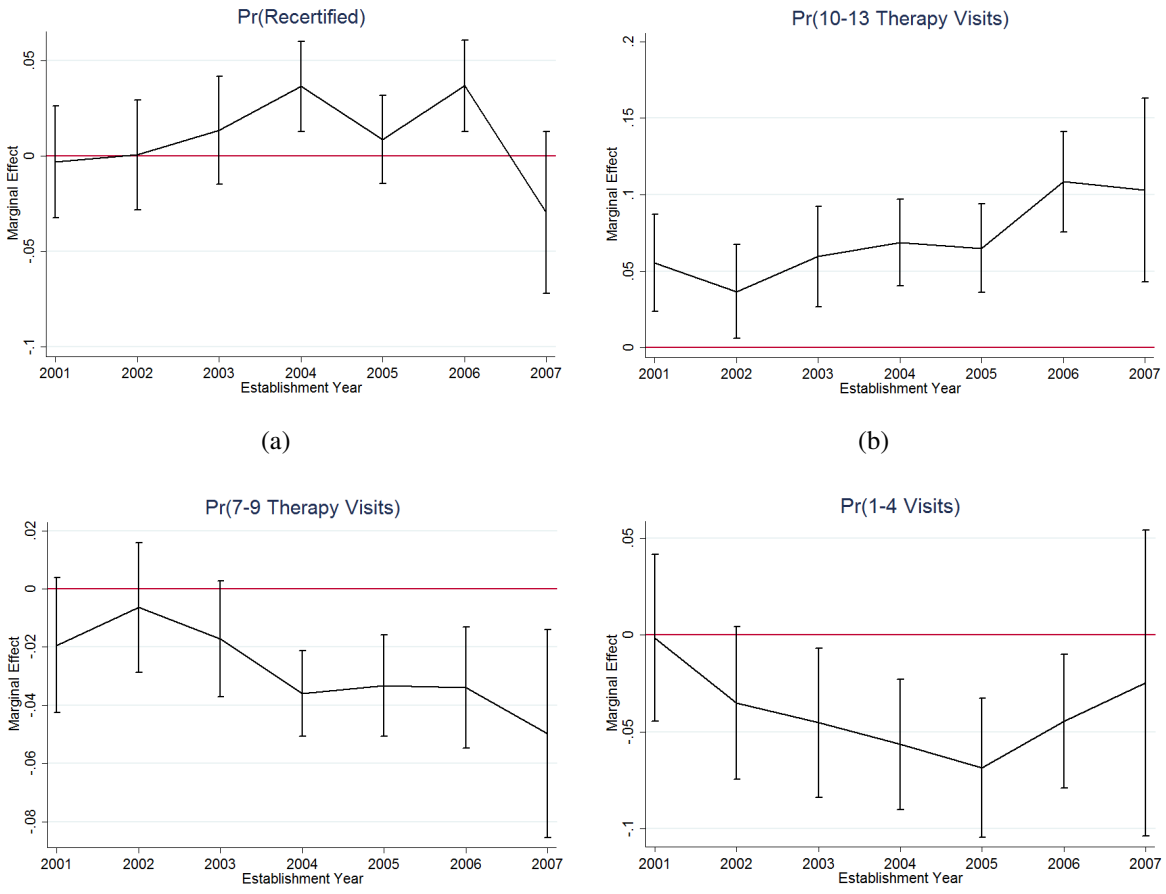
Note: This figure illustrates the Medicare prospective reimbursement schedule for a patient who received physical therapy visits only from a home health agency located in Ann Arbor, MI in 2001. This patient's case-mix group was C1F3S0 when the patient received fewer than 10 therapy visits, but switched to C1F3S2 once the number of therapy visits reached 10.

Figure 3.2: Number of Home Health Agencies, by Ownership Type: 1995-2010



Note: 1)Source: The CMS Provider of Services File- Home Health Agency 1995-2010, 2)Medicare Home Health was under the Fee-For-Service Payment System until 1997, Interim Payment System between 1998-2000, and PPS between 2001-2010. 3)Home health agencies in Puerto Rico and the U.S. Island Areas are excluded.

Figure 3.3: Marginal Effects of Starting Year on Service Provision Pattern among For-Profit Agencies in 2007



Note: The reference group of starting year of each home health agency is $\leq$2000 (i.e., agencies that entered the market prior to the PPS)

Table 3.1: Changes in the Influence of For-Profit Home Health Agency Market Share on Profitable Home Health Service Provision across For-Profit and Non-Profit Agencies over Time

	Pr(Recertification)		Pr(10≤Therapy Visit≤13)		Pr(7≤Therapy Visit≤9)		Pr(Visit≤4)	
Covariate	(1)For-Profit	(2)Non-Profit	(3)For-Profit	(4)Non-Profit	(5)For-Profit	(6)Non-Profit	(7)For-Profit	(8)Non-Profit
Year	$-.014**$	$-.0026*$	.0027	$.0028*$	$-.0072***$	$-.0048***$	$.0064**$	$.0061**$
	(.0038)	(.0015)	(.0033)	(.0015)	(.0024)	(.0017)	(.0031)	(.0026)
FPMarketShare	$-.093*$	$-.14**$	$-.036$	$-.051$	.016	.020	$.084**$	.026
	(.054)	(.039)	(.035)	(.033)	(.021)	(.028)	(.039)	(.049)
Year×FPMarketShare	$.025**$	$.0093**$	$.0075*$	$.013**$	$-.00053$	$-.0047$	$-.0019$	$-.0061$
	(.0045)	(.0046)	(.0037)	(.0043)	(.0030)	(.0036)	(.0015)	(.0052)
Observations	640,782	569,864	186,521	174,590	186,521	174,590	123,344	166,633

Note: I ran all regressions, separately by agency ownership type. Other control variables include patient characteristics (age, race, gender, participation in Medicare Buy-in Program, prior hospitalization or nursing home stay, major health conditions, and level of functional limitation), agency characteristics(number of registered nurses, physical therapists, and home health aides, and facility-based status), Herfindahl-Hirschman Index, and seasonality. Equations are estimated using an ordinary least squares regression. Standard errors shown in parenthesis are clustered on hospital referral region.
*p≤0.1, **p≤0.05, ***p≤0.01

Table 3.2: The Influence of Neighboring New Agencies on Home Health Service Provision Practices among Existing Agencies

	Pr(Recertified)		Pr($10 \leq V^T \leq 13$)		Pr($7 \leq V^T \leq 9$)		Pr(V$\leq$4)	
Covariate	(1)For-Profit	(2)Non-Profit	(3)For-Profit	(4)Non-Profit	(5)For-Profit	(6)Non-Profit	(7)For-Profit	(8)Non-Profit
New FP	.0098	.0093	.026$*$	$-$.0016	.00070	.0076	$-$.0059	$-$.0031
	(.012)	(.0072)	(.015)	(.010)	(.013)	(.010)	(.013)	(.010)
Existing FP	.35$**$	.058$**$	$-$.078	$-$.015	$-$.13$**$	$-$.047	$-$.0072	.018
	(.047)	(.024)	(.036)	(.036)	(.047)	(.033)	(.045)	(.026)
NFP	.030	.19$**$	.0055	$-$.039	.010	$-$.096$**$	.013	$-$.070
	(.020)	(.048)	(.028)	(.050)	(.025)	(.038)	(.026)	(.057)

Note: I ran all regressions, separately by agency ownership type. Other control variables include patient characteristics (age, race, gender, participation in Medicare Buy-in Program, prior hospitalization or nursing home stay, major health conditions, and level of functional limitation), agency characteristics(number of registered nurses, physical therapists, and home health aides and facility-based status), Herfindahl-Hirschman Index, and seasonality. Equations are estimated using an ordinary least squares regression. Standard errors shown in parenthesis are clustered on hospital referral region.

*p$\leq$0.1, **p$\leq$0.05, ***p$\leq$0.01

Table 3.3: The Influence of Other Agencies in the Chain on Existing Individual Agency's Home Health Service Provision Practice

	Average Home Health Provision of Other Agencies in the Chain in Year $t-1$	
	(1)For-Profit	(2)Non-Profit
Pr(Recertified)	$.26**$	.033
	(.033)	(.054)
Pr(10$\leq V^T \leq$13)	$.055*$	$-.014$
	(.024)	(.026)
Pr(7$\leq V^T \leq$9)	.028	.025
	(.028)	(.031)
Pr(V$\leq$4)	$.048**$	.037
	(.013)	(.033)

Note: I ran all regressions, separately by agency ownership type. Other control variables include patient characteristics (age, race, gender, participation in Medicare Buy-in Program, prior hospitalization or nursing home stay, major health conditions, and level of functional limitation), agency characteristics(number of registered nurses, physical therapists, and home health aides and facility-based status), Herfindahl-Hirschman Index, and seasonality. Equations are estimated using an ordinary least squares regression. Standard errors shown in parenthesis are clustered on hospital referral region.
*p$\leq$0.1, **p$\leq$0.05, ***p$\leq$0.01

CHAPTER IV

EFFECTS OF THE MEDICARE HOME HEALTH OUTLIER PAYMENT POLICY ON OLDER ADULTS WITH DIABETES

4.1 Introduction

Medicare home health care has been struggling to find a reimbursement system that achieves a seemingly self-contradictory goal: providing high quality care while minimizing costs. This struggle is exemplified by the 2010 introduction of the 10 percent per-agency cap on outlier payments, which restricts total outlier payments for each home health agency to no more than 10 percent of that agency's total annual prospective payments from Medicare.

The Medicare home health prospective payment system provides fixed payments for each patient, based on patient health condition at the time of admission to home health care. Unfortunately, this can discourage home health agencies from serving high-cost patients whose treatment costs exceed prospective payment rates. To address this problem, Medicare makes outlier payments in addition to prospective payments when a patient requires too many home health visits and incurs high costs. However, some agencies manipulated these outlier payments that increased the marginal benefit of home health visits from zero to positive. Those agencies intentionally increased the number of patients eli-

gible for outlier payments and provided excessive numbers of home health visits for those outlier patients. This led Medicare to introduce the 10 percent per-agency cap on outlier payments.

While the intention of this cap is to control excessively increasing outlier payments, it might also produce undesirable incentives. In essence, the 10 percent cap can penalize agencies that accept and treat clinically complex, and thus costly patients. These agencies can be compelled to either drastically reduce the number of service visits for costly patients or to drop the patients altogether. Some of the dropped patients can then move to other more expensive health care, ultimately increasing total Medicare spending (CMS, 2009).

To address this issue, this study focuses on Medicare home health patients who had diabetes with the need of insulin treatment and examines how those patients were affected by the addition of the 10 percent cap to the Medicare home health prospective payment system. My analysis uses the Medicare Home Health Claim and Provider of Service File of 2008-2010. To identify the influence of the 10 percent cap, I utilize agency variation in the proportion of outlier payments: only agencies that had outlier payments close to or higher than 10 percent would have faced incentives to decrease outlier payments after the implementation of the 10 percent cap.

Using this identification strategy, this study finds that the 10 percent cap compelled agencies to decrease the number of home health visits for outlier patients if agencies' proportion of outlier payments was close to or beyond the 10 percent cap prior to the implementation of the policy. In particular, the decrease in the number of service visits was greater among relatively healthy patients, and vice versa. The 10 percent cap also influenced an agency's decision on the type of patients to treat. That is, agencies dropped the most and the least healthy outlier patients in response to the 10 percent cap. Many healthiest patients were discontinued from home health care because their agencies, with an incentive to decrease outlier payments, determined their outlier patients healthy enough for self-care and dropped them. Agencies also dropped the sickest patients, who greatly contribute to

the increase in outlier payments, and sent them to more costly health care settings such as nursing homes and hospitals.

These findings suggest that the 10 percent cap decreased outlier payments and thus saved Medicare home health spending as intended. However, this policy pushed some home health patients to more expensive health care settings. In addition, the reduction in the number of home health visits among home health patients might lead to a faster decline in patients' health outcomes in the long run. I therefore conclude the net effect of 10 percent cap on total health spending is ambiguous.

4.2 10 Percent Cap on Outlier Payment

In an effort to reduce costs, the Medicare home health prospective payment system provides fixed reimbursement per patient based on each patient's health status. Each patient is sorted into one of many payment groups, and agencies receive the pre-determined reimbursement amount that corresponds with that group, regardless of the incurred expenditure on patients. Unfortunately, this policy discourages home health agencies from treating high-cost patients whose treatment costs would most likely exceed the reimbursement amounts. Thus, certain patient populations might struggle to receive the quantity and quality of care they have required.

To address this problem, Medicare introduced 'outlier payments' to its prospective payment system. That is, if a patient's episode incurs an unusually high cost and thus his estimated cost exceeds a threshold amount, the patient becomes eligible for outlier payments and then the patient's agency receives an extra payment (i.e. outlier payment) in addition to the regular prospective payment (See Table 4.1 for more specific information about the calculation of outlier payments) (HCFA, 2000). The outlier payment amount is set as a proportion (80 percent) of estimated cost beyond the threshold amount. Agencies may find outlier payments attractive, because the marginal benefit of one visit increases from zero to positive once their patients qualify for outlier payments. Therefore, outlier payments might

encourage agencies to provide extra service visits for patients whose estimated treatment costs are high enough in order to make them eligible for outlier payments (HCFA, 2000; MedPAC, 2011). Agencies might also want to increase the number of service visits as much as possible for each patient eligible for outlier payments.

In fact, many home health agencies manipulated outlier payments, and as a result there has been a dramatic rise in outlier payments in a few counties. For example, in 2008, 52 percent of all outlier payments nationwide were made to agencies in one county, Miami-Dade in Florida, where only 2 percent of all home health patients resided. In the same year, 23 other counties exhibited similar outlier payment patterns to that of Miami-Dade County (MedPAC, 2010; OIG, 2009). Government policy has taken a few actions to deal with these fraud issues, such as curtailing fraudulent payments for agencies whose claims for outlier payments seemed implausibly high. The government has also increased the threshold amount. However, adjusting the threshold amount failed to curb rising outlier payments and was perceived to be inappropriate, because all agencies, not just those suspected of fraud, were penalized (CMS, 2009; MedPAC, 2010).

As a result, in 2010, the government implemented an agency-level outlier cap, such that in any given year, an individual agency would receive no more than 10 percent of its total home health reimbursement in outlier payments. In other words, if a claim with an outlier payment causes an agency to exceed the 10 percent cap, then Medicare would not make the outlier payment of the claim (CMS, 2009). The government expected that the 10 percent cap would diminish agencies' incentives to provide unnecessary services. The reduction in aggregate outlier payments created by the 10 percent cap would be transferred to aggregate prospective payments, causing the standard prospective payment rate to increase, and thus benefiting agencies serving home health patients with moderate health needs (CMS, 2009). Thus, the intention behind the 10 percent cap was to shift resources from fraudulent agencies to non-fraudulent agencies.

However, the 10 percent cap could penalize agencies that legitimately served costly

patients and therefore could affect the care for expensive patients. One group of patients potentially affected by the 10 percent cap are those with diabetes who need daily injections of insulin and thus greatly rely on home health care to lead independent lives. Many patients with diabetes cannot safely administer their insulin because they have visual, cognitive, or dexterity impairments. If such patients do not have access to informal caregivers, then they must rely on home health visits that provide daily diabetic management. This makes them extremely costly outlier patients. Without home health care insulin management, however, these patients cannot live independently and might end up relying on more expensive health care services, such as skilled nursing homes or inpatient care services (CMS, 2009).

I have located only one study (Litchman, 2010) that investigated the effects of the 10 percent cap. Using descriptive statistics from her clinic's patients with type 1 diabetes (N=97), she concludes that the cap compelled her clinic to reduce the amount of care for 61 percent of patients and discharge seven percent of patients to nursing homes.This study also examines the effects of the 10 percent cap but goes beyond Litchman's study in several aspects. First, rather than looking at one clinic's responses to the 10 percent cap in 2010, I exploit prior year agency-level variation in the proportion of outlier payments and identify the effect of the cap in 2010. Second, I also explore how the degree of the effect varied depending on patient's severity of functional disability. Third, I use the nationally representative sample containing five percent of all Medicare home health patients. Fourth, I include not only type 1 but also type 2 diabetes patients who needed insulin injection in my sample. Type 2 patients account for the majority(90-95 percent) of diabetes patients and many of them require insulin injections like type 1 diabetes patients (American Diabetes Association, 2006). Home health patients with type 2 diabetes could be effected by the 10 percent cap to the same degree if they needed insulin injection. Thus, excluding them from the sample could be glaring omission.

4.3 Expected Effects of the 10 Percent Cap on Diabetes Patients With the Need of Insulin Injection

This section explains how agencies have adjusted care for diabetic patients who need insulin injections (hereafter called diabetes patients) in response to the 10 percent cap.

On average, the 10 percent cap would influence home health services for diabetes patients more strongly than for non-diabetes patients. Diabetes patients tend to require a high number of visits due to their need for daily insulin injections, and thus they are more likely to be eligible for outlier payments. For example, in 2008 Medicare made outlier payments for 39 percent of episodes for diabetes patients, while the corresponding number for non-diabetes patients was less than 3 percent. However, not all diabetes patients would be influenced by the 10 percent cap. Their care would be affected only when their agency's proportion of outlier payments was close to or beyond the 10 percent cap prior to the implementation of the policy. In other words, if the agency's proportion of outlier payments was far below 10 percent, the 10 percent cap would have no effect on care for diabetes patients. The pressure to adjust care for diabetes patients within each agency would increase with the level of outlier payments, if higher than 10 percent.

In particular, the 10 percent cap would affect an agency's decisions in two respects: the number of service visits to provide per episode for a patient of a given severity level (intensive margin) and the types of patients to serve, assuming patient heterogeneity in severity of illness (extensive margin).

First, agencies would decrease the number of home health visits for outlier diabetes patients in response to the 10 percent cap. Without the 10 percent cap in place, agencies, with the goal of profit maximization, would increase the number of service visits as much as possible in order to take advantage of a positive marginal value of one visit among outlier patients. Under the 10 percent cap, however, agencies would be compelled to keep their proportion of outlier payments under 10 percent. Otherwise, they would have to bear the

full cost of extra treatments beyond the 10 percent cap. Therefore, if an agency's outlier payments exceeded the 10 percent cap in prior years, the agency would face pressure to reduce the number of visits for outlier episodes. This reduction in the number of visits could either make a patient no longer eligible for outlier payments or allow them to remain eligible for outlier payments while receiving fewer service visits than before.

Notably, not all diabetes patients would experience the same level of decrease in service visits. That is, the adjustment in the number of visits would vary based on a patient's health status. Agencies would decrease the number of visits to a greater degree among mildly disabled patients, and vice versa. This is because agencies assume that, on average, healthier patients would be less affected by the decrease in the amount of care.

Second, the 10 percent cap would affect agencies' decisions regarding the types of patients to serve. Agencies will most likely drop patients at both ends of the illness severity spectrum, the most and the least healthy patients, and mainly serve patients with a moderate level of illness. Healthier patients would be more likely to be discontinued from home health care because they are expected to be more capable of taking care of themselves without home health care, as compared to patients with more severe diabetes. On the other end of the spectrum, the sickest patients tend to require an extremely high number of visits, and thus greatly contribute to the increase in total outlier payments. However, as discussed above, it would be challenging to decrease the number of visits for sicker patients because even a small reduction in the amount of care could lead to a significant decline in their health. To avoid these high-cost patients, agencies could either send them to nursing homes or hospitals or transfer them to other agencies that have not met the 10 percent cap.

These expected reactions from home health agencies under the 10 percent cap illustrate how hard it is to contain the rising cost of health care. The 10 percent cap will decrease outlier payments and save Medicare home health spending. However, this policy may push sicker home health patients to other, more expensive health care settings, such as nursing homes or hospitals. In addition, patients who receive a significantly reduced number of

home health visits may experience a faster decline in their health and use more costly health services in the long run. These results will ultimately increase total health spending, and this increase could be greater than the immediate savings realized under the 10 percent cap.

Based on this conceptual framework, this paper examines the following two hypotheses. First, the 10 percent cap reduced the number of service visits for diabetes patients if an agency's proportion of outlier payments was close to or beyond the 10 percent cap in prior years. Second, the 10 percent cap affected agency decisions regarding which types of patients to treat if an agency's proportion of outlier payments was close to or beyond the 10 percent cap in prior years. Third, the effect of the 10 percent cap described in the first and second hypothesis was stronger for the healthiest and sickest patients.

4.4 Data

4.4.1 Datasets

Data on each home health patient's demographic and home health service use is from 1) the Center for Medicare and Medicaid Services (CMS) 5% Limited Data Set-Denominator File from 2008 to 2010 and 2) the CMS 5% Limited Data Set-Home Health Agency File from 2008 to 2010. I use data from 2008 through 2010 because Medicare partially revised its home health reimbursement system in 2008. The first dataset, which was extracted from Medicare claims, is a panel of five percent of Medicare beneficiaries and contains their basic demographic information such as age, race, gender, and date of death, as well as Medicare HMO enrollment status. The second dataset, which was also taken from Medicare claims, is also a panel of five percent of Medicare home health patients and contains administrative information about each patient's health condition and home health service use (CMS, 2012). I combine the first two datasets using each beneficiary's ID number, and create a complete Medicare claim dataset.

I obtain each home health agency characteristics from 3) the CMS Provider of Service File-Home Health Agency from 2008 to 2010. This dataset was extracted from the Online Survey and Certification Reporting System/ Quality Improvement Evaluation System collected by the CMS Regional Offices (Choi & Davitt, 2009; CMS, 2012). It is a panel of all Medicare/Medicaid-certified home health agencies across the nation and includes their basic agency information like location, ownership type, and date of initial Medicare certification. The home health agency provider number enables me to merge the combined Medicare claim dataset and CMS Provider of Service File, resulting in a patient-agency linked, unbalanced panel data set. Each observation in this dataset corresponds to a patient's unique episode of care.

My dataset collects five percent of Medicare home health episodes, which may not be representative at an agency level. In other words, the proportion of outlier payments for each agency in the five percent dataset is likely different from the actual proportion. However, the comparison between my dataset and results in the OIG report (2012) that used the 100 percent of Medicare home health claims justifies the use of my dataset for the analysis. For example, 6.69 percent agencies (647 out of 9,665 agencies) in my dataset had outlier payments over the 10 percent cap in 2010, which is close to the corresponding number in the OIG report, 4.21 percent agencies (434 out of 10,316 agencies). Technically, no agencies should have outlier payments exceeding the 10 percent cap in 2010 when the 10 percent cap was implemented, but in 2010, the 10 percent cap on the total outlier payments was not enforced properly.

4.4.2 Change in Each Agency's Proportion of Outlier Payments between 2008 and 2010

As discussed above, in 2010, Medicare did not enforce the 10 percent cap on total outlier payments properly and more than 600 agencies had higher than 10 percent outlier payments (See Figure 4.1). Nevertheless, the cap had decreased the fraction of agencies

with an extremely high proportion of outlier payments. For example, the percentage of agencies with outlier payments higher than 40 percent decreased from 3.07 percent in 2008 to 0.15 percent in 2010. Probably, these agencies with an extremely high proportion of outlier payments prior to 2010 were not able to decrease the proportion to below 10 percent because it might be hard to drastically cut down outlier episodes in one or two years. As a result, the percentage of agencies with 10-40 percent outlier payments stayed almost the same, from 6.34 percent in 2008 to 6.56 percent in 2010.

4.4.3 Diabetes Patients with the Need of Insulin Injection

I identify diabetes patients with the need of insulin injection (termed as 'diabetes patients' hereafter) as those assigned with two ICD-9-CM codes: 250- Diabetes Mellitus and V58.67- Long-term (current) use of insulin. This group of patients accounted for 2.60, 2.75, and 2.74 percent of Medicare home health patients in 2008, 2009, and 2010, respectively.

Medicare home health patients with diabetes and need of insulin injection were different from the rest of home health patients in demographic characteristics, health conditions, home health service use. Also, agencies that served them had different characteristics from those that did not (See Table 4.2). In particular, for this examination, I choose the 2008 data because the 10 percent cap on outlier payments possibly influenced diabetes patients' profile, home health service utilization pattern, and home health agency in 2010.

On average, diabetes patients were more likely to be young, male, and non-white. They were also more likely to participate in a Medicare Buy-in Program. This indicates that diabetes home health patients tended to be low-income given that the program helps low-income Medicare beneficiaries pay Medicare premiums (Families USA, 1999). Diabetes patients tended to have a worse health condition: on average, they had a higher score on the clinical and functional severity index (1-3) at the start of each episode of care. Diabetes patients were much less likely to have inpatient or skilled nursing home stay prior to the admission to home health care.

A diabetes patient's home health service use was more intense. Each had a much higher number of home health visits (mostly skilled nursing visits) per episode, 58.43 visits, while other home health patients had 18 visits. Due to their high number of service visits, diabetes patients were more likely to be eligible for outlier payments. 39.05 percent of diabetes patients' episodes received outlier payments whereas the corresponding number for the rest of the patients was only 2.62 percent.

Agencies that served diabetes patients had different characteristics from those that did not. They were more likely to be for-profits, free-standing, and serve a smaller number of home health episodes. Their average proportion of outlier payments out of total prospective payments was 14.31 percent, which was much higher than 2.44 percent, the corresponding number of agencies that did not serve diabetes patients.

4.5 Empirical Strategy

If a diabetes patient with outlier payments was served by an agency that had outlier payments higher than 10 percent of total home health prospective payments, then the patient would have experienced a more drastic decrease in their home health service visits in 2010. The 10 percent cap might also compel agencies to drop diabetes patients, and as a result, the dropped patients might enter a nursing home or a hospital, be transferred to other agencies, or be discontinued from home health care without receiving any types of formal health services for their insulin injection.

To address these hypotheses, I exploit agency-level variation in the proportion of outlier payments to identify the effect of the 10 percent cap on each patient's home health service use and discharge status. For this empirical analysis, I create a measure of each agency's proportion of outlier payments at a base year. The base year is year 2008 for an agency that served any episodes in 2008, and is year 2009 for an agency that served episodes in 2009, but none in 2008. I drop agencies who had episodes only in 2010. I then create four dummy variables from each agency's proportion of outlier payments at a base year:

they indicate whether each agency's total outlier payments accounted for 0-7 percent, 7-10 percent, 10-40 percent, or more than 40 percent of total prospective payments at a base year. I interact these variables with year dummy variables. I consider these interactions because a diabetes patient would have experienced a more drastic change in home health use in 2010 if the patient was served by an agency that had outlier payments higher than or close to 10 percent of total home health prospective payments at a base year.

I limit my sample to diabetes patients and then estimate the equation (4.1) to understand the effect of the 10 percent cap on each patient's care. In particular, the dependent variable, Y_{ijkt}, in the equation (4.1) reflects the different aspects of care for each patient, including each patient's 1) likelihood of being eligible for outlier payments, 2) number of service visits per episode, and 3) discharge status at the end of each episode (i.e., discontinuation from home health care, hospitalization, nursing home entry, and transfer to another agency.

$$\begin{aligned} Y_{ijkt} = \beta_0 + \sum \beta_{1a} Prop_j^a + \sum \beta_{2t} Year_t + \sum \beta_{3at} Prop_j^a \times Year_t \\ + Agency_{jt}\delta + Patient_{ijkt}\gamma + Seasonality_{kt}\theta + State_s\vartheta + \varepsilon_{ijkt} \end{aligned} \tag{4.1}$$

where i, j, k, and t refer to a patient, agency, episode, and year. $Prop_j^a$ is a set of dummy variables indicating whether an agency j's total outlier payments were 7-10 percent, 10-40 percent, or more than 40 percent of total prospective payments at a base year. $Year_t$ refers to the year dummy variables with the omitted group of year 2008. $Agency_{jt}$ represents each agency's basic characteristics including ownership type (for-profit or non-profit), annual number of episodes served by each agency, and facility-based status. $Patient_{ijkt}$ denotes each patient's basic characteristics including age, gender, race/ethnicity, participation in the Medicare buy-in program, clinical severity, functional severity, and an indicator whether each patient stayed in either a hospital or skilled nursing home prior to a home health admission. I also control for $Seasonality_{kt}$, an indicator variable for the first (reference

group), second, third, and last quarter of each year. I include state fixed effects $State_s$ because each state might have different regulations including certificate of need program for home health care-which regulates the entry of new home health agencies to the market-and Medicaid home and community based care program-which provides home health care at the expense of Medicaid. All of these regulations can differently influence Medicare home health service provision across states. The parameters of interest, β_{3at} measure how the outcome differs in year t compared to the base year depending on which group (a) each agency belonged to at the base year. β_{3at} is expected to be significant if an agency's proportion of outlier payments was close to or beyond the 10 percent cap at the base year.

In order to examine how each patient's health condition influenced the number of visits and discharge status, I also run my regression including the three-way interaction terms between year dummy variables, the measure of each agency's proportion of outlier payments, and the measure of each patient's level of functional disability (with a range of 1(low) to 3(high)). This specification takes the following form:

$$\begin{aligned} Y_{ijkt} = \beta_0 &+ \sum \beta_{1a} Prop_j^a + \sum \beta_{2t} Year_t + \sum \beta_{3f} Function_{ijkt}^f \\ &+ \sum \beta_{4at} Prop_j^a \times Year_t + \sum \beta_{5af} Prop_j^a \times Function_{ijkt}^f + \sum \beta_{6tf} Year_t \times Function_{ijkt}^f \\ &+ \sum \beta_{7atf} Prop_j^a \times Year_t \times Function_{ijkt}^f + Agency_{jt}\delta \\ &+ Patient_{ijkt}\gamma + Seasonality_{kt}\theta + State_s\vartheta + \varepsilon_{ijkt} \end{aligned} \tag{4.2}$$

In particular, I estimate separate linear probability models for each dependent variable. In fact, all results are essentially the same if I estimate probit models instead. However, I prefer the individual OLS results due to the more straightforward inference with the interaction term estimates. Standard errors are clustered on home health agency.

The critical identifying assumption of my empirical strategy is that there were no differential trends between agencies that had low and high proportion of outlier payments.

In other words, the correlation between each agency's proportion of outlier payments and unobserved factors of each patient's home health service use and discharge status did not change contemporaneously with the implementation of the 10 percent cap.

4.6 Results

4.6.1 Effect on the Number of Home Health Service Visits

Diabetes patients experienced greater declines in the number of home health visits between 2008 and 2010 if they were served by agencies whose proportion of outlier payments was close to or beyond the 10 percent in a baseline year. Due to the decreased number of visits, diabetes patients were much less likely to be eligible for outlier payments in 2010. In 2008, if a patient was served by agencies with 10-40 percent (hereafter termed 10-40%) and 40 percent and higher percentage (hereafter termed $\geq$40%) of outlier payments, then the patient's likelihood of being eligible for outlier payments was higher by 62 and 73 percentage points, respectively, compared to patients of agencies with 0-7 percent (hereafter termed 0-7%) of outlier payments. This discrepancy decreased to 42 and 52 percentage points in 2010 due to the implementation of the 10 percent cap (see Table 4.3, Column (1)).

Even if patients remained eligible for outlier payments, the 10 percent cap caused agencies to decrease the number of service visits drastically. In 2008, patients whose agency had 7-10%, 10-40% , and $\geq$40% of outlier payments, received 13, 38, and 70 more visits per episode, respectively, compared to patients served by an agency with 0-7% of outlier payments. This pattern reversed in 2010. When outlier patients were served by agencies with 7-10% of outlier payments, there were 17 fewer visits. Those served by agencies with 10-40% received 3 fewer visits, as compared to patients served by agencies with 0-7% of outlier payments. Patients with agencies with $\geq$40% of outlier payments received only 3 more visits, which is a drastic decrease from 70 more visits in 2008 (see Table 4.3, Column (2)).

The regression results indicate that agencies with 10 or higher percent of outlier payments started to decrease the number of visits in 2009 (see Table 4.3, Column (2)). This might be because the finalized rule of the 10 percent cap was announced in November, 2009. If agencies were at risk of having the proportion of outlier payments over or near the 10 percent level in 2009, they would have started to adjust service provision practices starting at that time.

As a robustness check, I examine the number of service visits for non-outlier diabetes patients, but I do not find the same pattern of service number decreases among this population. This reconfirms my finding that the big decrease in the number of visits among diabetes patients in 2010 was exclusively due to the 10 percent cap.

Agencies' adjustments to the number of visits varied based on each patient's level of functional disability. Severely disabled patients experienced the smallest decrease under the 10 percent cap: outlier patients with a score of two or three on the functional disability index did receive a decreased number of visits, but the decrease was smaller by 23 and 37 visits, respectively, compared to the decrease experienced by mildly disabled patients with a score of one on the index (see Table 4.4, Column (2)).

Common sense suggests that the adjustment of the number of visits depending on each patient's level of functional disability should be stronger among agencies with a higher percentage of outlier payments. However, the adjustment was strong only among agencies with 10-40% of outlier payments, not the ones with $\geq$40% (Table 4.4, Column (2)). One possible explanation for this unexpected finding is that agencies with an extremely high proportion of outlier payments might just choose to drop severely disabled patients instead of decreasing the number of visits for them. Actually, I find that agencies with $\geq$40% of outlier payments were more likely to send their patients to a nursing home if these patients had a high level of functional disability, which will be discussed more in detail in the next section (see Table 4.6, Column (2)).

Surprisingly, the data shows that each patient's level of functional disability had no

effect on the likelihood of being eligible for outlier payments between 2008 and 2010 (see Table 4.4, Column (1)).

4.6.2 Effect on the Types of Patients

The 10 percent cap affected a diabetes patient's discharge status in three ways. First, diabetes patients were more likely to be discontinued from home health care without entering a nursing home or seeking inpatient care under the 10 percent cap. In 2008, an agency with 10-40% and $\geq$40% of outlier payments were less likely to discontinue their patients from home health care, as compared to an agency with 0-7% of outlier payments. In 2010, those agencies' tendency to discontinue their patients from home health care was still lower, but the discrepancy between them and those agencies with 0-7% decreased by roughly 6.10 and 7.49 percentage points, respectively (Table 4.5, Column (1)).

In particular, I find that mildly disabled patients experienced more discontinuation: patients with a score of one on the functional disability index, were more likely to stop receiving home health care, compared to those with a score of three (see Table 4.6, Column (1)). This suggests that agencies might find it easier to discontinue care from relatively healthy patients who are more likely to be able to manage their insulin injections by themselves. These findings suggest that home health services might be partially valued on the margin by those discontinued patients, and therefore, the 10 percent cap might improve the efficiency of home health services as intended. However, it is uncertain how the discontinuation from home health care affects a diabetes patient's health conditions and use of other health services in the long-run.

Under the 10 percent cap, a patient was more likely to leave home health care and instead enter a nursing home (see Table 4.5, Column (2)). The likelihood of entering a nursing home further increased for severely disabled patients with a score of three on the functional disability index (see Table 4.6, Column (2)). The third effect of the 10 percent cap was that each patient was more likely to get readmitted to a hospital under this cap

(see Table 4.5, Column (3)). There are two possible explanations for these findings. For instance, agencies found it challenging to dramatically decrease the number of visits for patients and instead determined to send them to nursing homes or hospitals in order to avoid high cost patients. Another possible explanation is that the dramatic drop in the number of service visits under the 10 percent cap might cause a decline in patients' health, leading patients to nursing home entry or hospitalization.

This finding that some home health patients moved to a more expensive health care setting such as a nursing home or inpatient care indicates that the 10 percent cap had a spillover effect on other types of health care. This presents the possibility that the 10 percent cap might ultimately increase total health care spending despite its contributing to the decrease in Medicare home health spending.

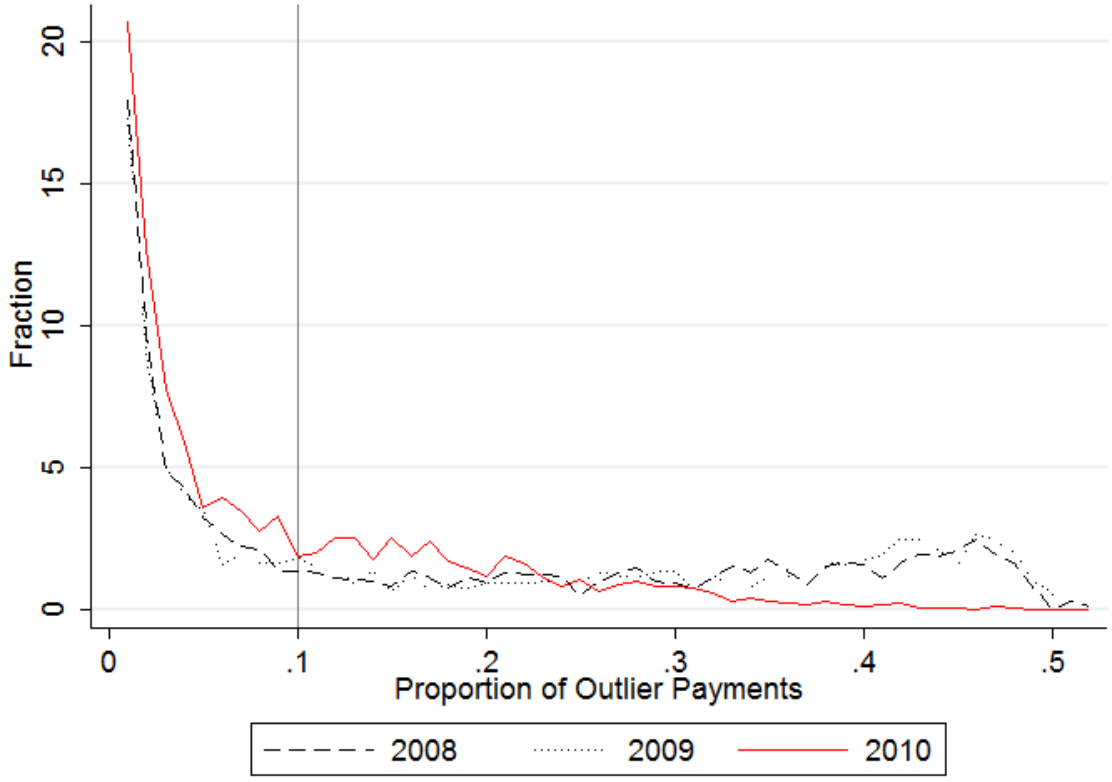
Lastly, a patient's likelihood of being transferred to another agency was not affected by the 10 percent cap (see Table 4.5, Column (4)).

4.7 Discussion

This study finds that the 10 percent cap dramatically decreased the number of service visits for diabetes patients. In particular, patients with a lower level of functional disability experienced the decrease to a greater degree. I also find the 10 percent cap affected an agency's decision on which types of patients to treat. On average, healthier outlier patients were more likely to be determined healthy enough and be discontinued from home health care without receiving any other types of formal health services. This finding, along with the drastic reduction in the number of service visits seems to suggest that the 10 percent cap might improve the efficiency of home health services as intended. However, I also find that the 10 percent cap pushed patients to use more expensive health services, such as nursing homes or inpatient care, which presents the possibility that the 10 percent cap might ultimately increase total health care spending. Moreover, due to the limited availability of the data, I was able to examine only one year after the implementation of the 10 percent

cap. Given that it might take a relatively long time for a patient's health status to be affected by the decreased number of visits or discontinuation from home health care, it is not yet clear how the 10 percent cap would affect a diabetes patient's health condition and use of other health services in the long-run.

Figure 4.1: Proportion of Outlier Payments between 2008 and 2010



Note: In 2010, Medicare did not enforce the 10 percent cap on total outlier payments properly and more than 600 agencies had higher than 10 percent outlier payments.

Table 4.1: Calculation of Outlier Payment

If estimate cost $>$ threshold amount, then outlier payment >0
If estimate cost $\leq$ threshold amount, then outlier payment $=0$

1) Estimate cost is standard per-visit payment rate by service type multiplied by the number of visits by service type.

2) Threshold amount is the sum of prospective payment amount for each patient's payment group and fixed dollar loss amount; fixed dollar loss amount is set as standard prospective payment rate multiplied by fixed dollar loss ratio; CMS updates fixed dollar loss ratio each year, 0.65 in 2008, 0.89 in 2009, and 0.89 in 2010.

3) Outlier payment amount is 80 percent of the difference between estimated cost and threshold amount.

Table 4.2: Patients with/without Diabetes and Use of Insulin in 2008: Patient's Demographic Characteristics, Health Conditions, and Home Health Service Use and Agency's Characteristics

Characteristics	Patients with Diabetes and Use of Insulin	Patients without Diabetes and Use of Insulin
Demographic Factors		
Age	72.52(.25)	77.07(.031)***
Female (%)	57.07(1.09)	63.49(.13) ***
Race		
White (%)	82.29(.84)	93.59(.069)***
Black (%)	17.37(.83)	6.25(0.068)***
Others (%)	0.34(12.71)	0.16 (.011)***
Participation in		
Medicare Buy-in Program (%)	44.18(1.090)	25.75(11.72)***
Observations (# Patients)	2,078	127,851
	Episodes with Diabetes and Use of Insulin	Episodes without Diabetes and Use of Insulin
Health Condition in Each Episode		
Acute Care prior to		
Home Health Care (%)	15.31(4.76)	28.87(.094) ***
Clinical Severity		
1 (%)	2.01(.19)	20.63(.084)***
2 (%)	32.15(.62)	35.15(.099)***
3 (%)	65.8634(.74)	44.22(.10) ***
Functional Severity		
1 (%)	28.46(.60)	28.46(.093)
2 (%)	51.15(.66)	51.26(.10)***
3 (%)	18.38(.51)	20.28(.083)***
Service Use in Each Episode		
Pr(Outlier)(%)	39.05(.64)	2.62(.033)***
Number of Visits	58.43(.82)	18.20(.041)***
Agency Characteristics		
Ownership (%)		
For-Profit (%)	76.55(.56)	62.07(.10)***
Non-Profit (%)	20.01(.53)	33.51(.098)***
Government (%)	3.44(.24)	4.41(.042)***
Facility-Based (%)	10.94(.41)	16.94(.078)***
Size	101.01(2.57)	135.00(.61)***
Proportion of		
Outlier Payments (%)	14.31(.24)	2.44(.015)***
Observations (# Episodes)	5,723	233,952

Notes: Percentages are shown for categorical variables; means are shown for continuous variables with standard errors in parenthese.
*p≤0.1, **p≤0.05, ***p≤0.01 for t-test.

Table 4.3: The Influence of 10 Percent Cap on the Intensity of Service Visits

	(1)	(2)
Covariate	Pr(Outlier)	Number of Service Visits
Year		
2009	.031(.0085)***	22.79(3.95)***
2010	.037(.0099)***	21.19(4.59)***
Proportion of Outlier Payments		
$Prop^{0.07}$	.30(.083)***	12.91(5.23)*
$Prop^{0.1}$	.62(.024)***	37.60(3.31)***
$Prop^{0.4}$	.73(.021)***	70.29(4.07)***
Year $\times$		
Proportion of Outlier Payments		
2009$\times Prop^{0.07}$	.021(.078)	-14.70(9.28)
2010$\times Prop^{0.07}$	.071(.096)	-30.36(6.72)***
2009$\times Prop^{0.1}$	-.048(.019)***	-20.63(4.44)***
2010$\times Prop^{0.1}$	-.20(.027)***	-42.15(5.38)***
2009$\times Prop^{0.4}$	-.046(.012)***	-33.32(4.69)***
2010$\times Prop^{0.4}$	-.21(.032)***	-65.23(6.73)***
R-squared	0.61	0.33
Observations	19,251	6,652

Notes: Equations are estimated using an ordinary least squares regression. Standard errors are clustered on home health agency. Other control variables include 1) agency's characteristics including ownership type, annual number of episodes served by each agency, and facility-based status, 2) each patient's characteristics including age, gender, race/ethnicity, participation in the Medicare buy-in program, clinical severity, functional severity, and acute-care stay prior to home health care, 3) seasonality, and 4) state indicators.
*p$\leq$0.1, **p$\leq$0.05, ***p$\leq$0.01

Table 4.4: The Influence of 10 Percent Cap on the Intensity of Service Visits by Patient's Level of Functional Disabiltiy

	Pr(Outlier)	Number of Service Visits
Covariate	(1)	(2)
Year ×		
Proportion of Outlier Payments		
$2009 \times Prop^{0.1}$	.026(.038)	-26.32(8.03)***
$2010 \times Prop^{0.1}$	-.19(.057)***	-62.40(11.39)***
$2009 \times Prop^{0.4}$	-.019(.027)	-32.14(8.58)***
$2010 \times Prop^{0.4}$	-.24(.065)***	-80.29(13.90)***
Year ×		
Proportion of Outlier Payments ×		
Patient Health		
$2009 \times Prop^{0.1} \times FS^2$	-.11(.045)**	6.02(8.80)
$2009 \times Prop^{0.1} \times FS^3$	-.043(.062)	12.36(14.37)
$2010 \times Prop^{0.1} \times FS^2$	-.024(.065)	23.04(12.47)*
$2010 \times Prop^{0.1} \times FS^3$	-.000084(.081)	36.57(16.43)**
$2009 \times Prop^{0.4} \times FS^2$	-.041(.032)	-2.37(9.68)
$2009 \times Prop^{0.4} \times FS^3$	-.0039(.039)	4.98(15.20)
$2010 \times Prop^{0.4} \times FS^2$	.027(.071)	16.96(14.61)
$2010 \times Prop^{0.4} \times FS^3$	.063(.099)	26.78(18.99)
R-squared	0.61	0.34
Observations	19,251	6,652

Notes: Equations are estimated using an ordinary least squares regression. Standard errors are clustered on home health agency. Other control variables include 1) agency's characteristics including ownership type, annual number of episodes served by each agency, and facility-based status, 2) each patient's characteristics including age, gender, race/ethnicity, participation in the Medicare buy-in program, clinical severity, functional severity, and acute-care stay prior to home health care, 3) seasonality, and 4) state Indicators.

*p≤0.1, **p≤0.05, ***p≤0.01

Table 4.5: The Influence of 10 Percent Cap on the Discharge Status at the End of Each Episode

	(1)	(2)	(3)	(4)
Covariate	Pr(Stop)	Pr(Nursing Home)	Pr(Hospital)	Pr(Transfer)
Year				
2009	.0019(.012)	-.0029(.0021)	-.015(.0041)***	.00045(.0042)
2010	.0096(.012)	-.0038(.0020)*	-.011(.0042)***	-.00036(.0042)
Proportion of Outlier Payments				
$Prop^{0.07}$	-.054(.061)	.0085(.0022)***	-.023(.011)**	.013(.021)
$Prop^{0.1}$	-.19(.018)***	-.0032(.0025)	-.0095(.0067)	-.010(.0062))
$Prop^{0.4}$	-.25(.021)***	-.0056(.0022)***	-.026(.0075)***	.0084(.010)
Year ×				
Proportion of Outlier Payments				
2009×$Prop^{0.07}$	-.075(.072)	.011(.0091)	.031(.019)	-.017(.023)
2010×$Prop^{0.07}$	-.15(.057)**	.026(.016)	.034(.017)**	-.018(.032)
2009×$Prop^{0.1}$	.0078(.017)	.0022(.0031)	.011(.0077)	.0028(.0078)
2010×$Prop^{0.1}$	.061(.021)***	.0074(.0037)**	.012(.0082)	.0065(.0083)
2009×$Prop^{0.4}$	.0081(.019)	.0034(.0022)	.013(.0062)**	-.0077(.012)
2010×$Prop^{0.4}$	.075(.027)***	.0049(.0028)*	.022(.010)**	.0068(.015)
R-squared	.21	.0072	.15	.18
Observations	19,251	19,251	19,251	19,251

Notes: Equations are estimated using an ordinary least squares regression. Standard errors are clustered on home health agency. Other control variables include 1) agency's characteristics including ownership type (for-profit-reference group, non-profit, and government ownership), the annual number of patients served by each agency, and facility-based status and 2) each patient's characteristics including age, gender, race/ethnicity, participation in the Medicare buy-in program, clinical severity, and functional severity.

*p≤0.1, **p≤0.05, ***p≤0.01

Table 4.6: The Influence of 10 Percent Cap on the Discharge Status at the End of Each Episode by Patient's Level of Functional Disability

	(1)	(2)	(3)	(4)
Covariate	Pr(Stop)	Pr(Nursing Home)	Pr(Hospital)	Pr(Transfer)
Year ×				
Proportion of Outlier Payments				
$2009 \times Prop^{0.1}$	.035(.031)	.00075(.0050)	.0099(.013)	-.013(.015)
$2010 \times Prop^{0.1}$	.090(.040)**	.0015(.0056)	.0081(.013)	.00012(.015)
$2009 \times Prop^{0.4}$	.036(.036)	.0013(.0030)	.011(.010)	-.053(.026)**
$2010 \times Prop^{0.4}$	.19(.068)***	.00025(.0029)	.063(.031)**	.014(.040)
Year ×				
Proportion of Outlier Payments ×				
Patient Health				
$2009 \times Prop^{0.1} \times FS^2$	-.024(.037)	-.00091(.0066)	-.0085(.015)	.020(.017)
$2009 \times Prop^{0.1} \times FS^3$	-.092(.051)*	.010(.010)	.031(.022)	.025(.022)
$2010 \times Prop^{0.1} \times FS^2$	-.0056(.049)	.0018(.0072)	.00083(.016)	-.0018(.018)
$2010 \times Prop^{0.1} \times FS^3$	-.15(.059)**	.028(.015)*	.014(.024)	.042(.028)
$2009 \times Prop^{0.4} \times FS^2$	-.038(.042)	-.00085(.0042)	-.0045(.013)	.064(.030)**
$2009 \times Prop^{0.4} \times FS^3$	-.044(.055)	.013(.0071)*	.025(.022)	.024(.036)
$2010 \times Prop^{0.4} \times FS^2$	-.11(.075)	.0013(.0040)	-.045(.034)	.00091(.046)
$2010 \times Prop^{0.4} \times FS^3$	-.24(.082)***	.021(.011)*	-.065(.037)*	-.038(.047)
R-squared	.22	.0090	.012	.011
Observations	19,251	19,251	19,251	19,251

Notes: Equations are estimated using an ordinary least squares regression. Standard errors are clustered on home health agency. Other control variables include 1) agency's characteristics including ownership type (for-profit-reference group, non-profit, and government ownership), the annual number of patients served by each agency, and facility-based status and 2) each patient's characteristics including age, gender, race/ethnicity, participation in the Medicare buy-in program, clinical severity, and functional severity.

*p≤0.1, **p≤0.05, ***p≤0.01

CHAPTER V

Conclusion

5.1 Implication for Health Care Policy

This dissertation regarding home health agencies' responses to the PPS provides implications for health care policy. First, Medicare home health patients bear no responsibility for cost, which contributed to the Medicare home health spending growth under the PPS. The first study shows that home health agencies increased the number of patients, the duration of care per patient, and payment amounts per episode, not necessarily corresponding to patients' need, to increase profits under the PPS. To make matters worse, the overprovision of services was also welcomed by patients because their out-of-pocket cost was zero. This further spurred home health spending. If home health patients had been responsible for even a small amount of deductibles or copayments, the increase in total spending might have been lower.

Second, new home health agencies' entry to the market under the PPS also contributed to the Medicare home health spending growth. Therefore, the Certificate of Need (CON) program for home health care, which regulates the entry of new agencies, might have an important implication for home health spending control. Both the first and second study illustrate that a significant number of agencies entered the market under the PPS. Those new agencies, mostly for-profits, responded to payment incentives in PPS to a greater degree. Furthermore, these entries increased for-profit market share under the PPS, which

in turn encouraged existing agencies to adopt profitable service provision patterns. Given this situation, if all states had implemented CON for home health care, the total spending increase might have been slower.

Third, for-profit agencies were much more responsive to financial incentives embedded in the PPS as compared to non-profit agencies, and therefore for-profits played a main role in home health spending under the PPS. This suggests that the government should pay more attention to for-profit agencies' response to payment incentives. At the same time, government can develop a payment system that would minimize for-profit agencies' profit-seeking behaviors. For example,the government can avoid non-linear pricing (e.g., significant amount of extra payments at the tenth therapy visit) that can distort agencies' incentive to provide the appropriate number of service visits.

Fourth, increased Medicare home health spending could be viewed as desirable. Medicare home health care holds the potential to create savings in total health spending because of its substitutability with more costly health care services such as skilled nursing home or inpatient care. For example, the third study finds that the 10 percent cap, which was introduced to curb increasing outlier payments, pushed home health patients to a more costly health care setting. This might ultimately increase total health care spending. Therefore, policy makers should consider the spillover effect when they try to implement new regulations in home health care.

5.2 Implication for Social Work Practice and Policy

In addition to health care policy implications, this dissertation provides implications for social work practice and policy. This section discusses how findings from this research could be incorporated into social workers' practice and policy advocacy.

First, home health agencies' response to the PPS, mainly discussed in the first study, has directly influenced social workers at a home health care setting. That is, the PPS significantly diminished the role of social workers in home health care. Social workers in a

home health agency typically provide mental health services for patients or connect patients with available social services in their community. Medicare has categorized these services as medical social services. Despite the potential importance of medical social services in patients' health conditions, the PPS encouraged agencies to reduce the provision of medical social services drastically. That is because PPS makes a fixed payment per episode for each patient and does not compensate the provision of medical social service visits separately. Furthermore, medical social service would not have an immediate and notable influence on a patient's health status unlike skilled nursing or therapy visits. Thus, agencies chose to decrease the number of medical social service visits rather than skilled nursing or therapy visits under the PPS.

However, medical social services can be essential to keep patients healthy in the long-run. For instance, depressed home health patients may find it challenging to receive other sources of mental health services except medical social services particularly because they are home bound. Given the negative influence of untreated depression on a patient's health, providing medical social service visits for home health patients can prevent potential adverse outcomes and furthermore might save total health spending. Therefore, social workers can advocate a payment system that does not financially discourage home health agencies from providing medical social services.

Second, social workers can advocate a home health patient's right to receive a high quality of care. All three studies in this dissertation suggest that agencies adjusted service provision patterns in response to the payment incentives embedded in the PPS and this might have a negative effect on a patient. For example, the third paper discusses how the implementation of the 10 percent cap led to a significant reduction in the number of service visits and sent some diabetes patients to either a nursing home or hospital. Social workers can inform both patients and agencies of the potential consequences of agencies' response to the payment system, and help patients receive the appropriate level of care.

5.3 Conclusion

In conclusion, this dissertation examines health care providers' behavioral responses to incentives built into payment systems. In particular, my dissertation focuses on the home health care industry, and addresses how home health agencies have strategically navigated the Medicare reimbursement system. The findings of this dissertation suggest that home health agencies adjusted their service provision patterns responding to the payment incentives, which influenced both the cost and quality of home health care. These research findings can help the government design more sophisticated reimbursement systems that promote an efficient health care system.

APPENDICES

APPENDIX A

A.1 Medicare Home Health Reimbursement Schedule

This section provides more detailed explanation about how a Medicare home health care reimbursement schedule is determined. To illustrate an example of a home health reimbursement schedule, let's imagine a patient who lived in Ann Arbor, MI in 2001 and received physical therapy services from a home health agency. His home health agency assessed his health status and assigned him to the case-mix group C1F1S0 (his clinical severity was low; functional severity was low; and service severity was minimal). This case-mix group was translated to a case-mix weight 0.7169 and its corresponding reimbursement amount $1,691.25 that had been adjusted according to the Ann Arbor wage index. The patient's case-mix group stayed as C1F1S0 for his first 9 therapy visits. However, once the number of therapy visits reached 10, his payment group automatically switched to C1F1S2. That is, his service severity increased from minimal to moderate while his clinical and functional severity stayed low. This new case-mix group pushed his case-mix weight up to 1.6752 and his reimbursement amount to $3,951.98. This retrospective feature built into the prospective reimbursement schedule provided a strong incentive for the patient's agency to provide at least 10 therapy visits such that it could make $2,260.73 ($3,951.98 - $1,691.25) of additional revenue compared to 9 or fewer visits.

The Medicare home health reimbursement system contained further retrospective features, low-cost and high-cost outlier payments. In terms of low-cost outlier payments, for

patients who received 4 or fewer visits per episode, the CMS would make a per-visit low-utilization payment by service type that was the same for all patients, regardless of health status. Thus, in this patient case, if he received 4 or fewer physical therapy visits, his agency would have received $116.81 for each visit instead of the lump-sum payment. In terms of high-cost outlier payments, for patients who required more service visits such that their estimated incurred per-episode cost exceeded a threshold amount, the CMS would make a high-cost outlier payment equal to 80 percent of the estimated incurred per-episode cost beyond the threshold amount. In John's example, once his therapy visit number reached 57, John would become eligible for high-cost outlier payments. Thus, his agency would receive an additional $93.45 for each therapy visit beyond visit 56 in addition to $3,951.98.

A.2 Control Variables

This section provides more specific explanation about the vector of control variables X that refers to each patient and agency's basic characteristics, Herfindahl-Hirschman Index (the measure of level of market concentration), and seasonality.

Each patient's basic characteristics include both demographic and health characteristics. Demographic factors include age, race/ethnicity, gender, and an indicator of participation in the Medicare buy-in program. Participation in the Medicare buy-in program is a proxy of being low-income given that the program helps pay Medicare premiums for low-income Medicare beneficiaries (Families USA, 1999). Patient health conditions include indicators for most frequent major health diagnoses (diabetes, hypertension, heart failure, chronic ulcer of skin, osteoporosis, cardiac dysrhythmias, stroke, dementia, pneumonia, other forms of chronic ischemic heart disease, cancer, mental disorders, arthritis).

Each home health agency's basic characteristics include the number of patients treated by each agency and an indicator of whether each agency was free-standing or facility-based. Unfortunately, the dataset provides no variable that measures the number of patients in each agency. Instead, I use the count of patients treated by each agency in the dataset as a proxy.

Because the dataset samples 5% of all Medicare home health patients, the relative actual number of patients across agencies should be consistent with the measure constructed from my dataset. I also take into account whether each agency was free-standing or facility-based. Facility-based agencies are operated as part of a hospital, rehabilitation facility, or skilled nursing home. The distinction is important because facility-based agencies would enjoy benefits unavailable to free-standing agencies such as referrals of more profitable patients through the affiliated system and a more stable budget source (Choi & Davitt, 2009).

The Herfindahl-Hirschman Index (HHI) measures level of market concentration. HHI is calculated as the sum of the squares of each agency's share of total episodes within each Hospital Referral Region in each year, and thus it ranges between 0 and 1. A higher value of HHI indicates a higher concentration of agencies, but less intense within market competition.

Seasonality includes indicators of four quarter of each year (the firstreference group, second, third, and last quarter of each year).

A.3 DFL decomposition

This section illustrates how the DFL method decomposes the change in the distribution of the number of therapy visits between 2001 and 2007 (Dinardo, 2002; Fortin et al., 2011). The actual distribution of the number of therapy visits in 2001 and 2007 is expressed as followings, respectively.

$$\int f^{2001}(V^T)dV^T \equiv \int f^{2001}(V^T|x)h(x|t=2001)dx \tag{A.1}$$

$$\int f^{2007}(V^T)dV^T \equiv \int f^{2007}(V^T|x)h(x|t=2007)dx \tag{A.2}$$

where V^T represents the number of therapy visits per episode, t refers to year, and x rep-

resents other characteristics affecting the number of therapy visits including patient and agency characteristics, seasonality, and state indicators. $f^{2001}(V^T|x)$ is the therapy visit number determination mechanism in 2001 that maps observables to the number of therapy visit distribution. The density $h(x|t = 2001)$ is the probability density function of observables in 2001.

I then decompose the difference between equations (A.1) and (A.2) :

$$\begin{aligned}\int f^{2007}(V^T)dV^T - \int f^{2001}(V^T)dV^T = &[\int f^{2007}(V^T|x)h(x|t=2007)dx \\ &- \int f^{2007}(V^T|x)h(x|t=2001)dx] \\ &+ [\int f^{2007}(V^T|x)h(x|t=2001)dx \\ &- \int f^{2001}(V^T|x)h(x|t=2001)dx] \qquad \text{(A.3)}\end{aligned}$$

is the counterfactual distribution which indicates what the distribution of the number of therapy visits would be in 2001 if the therapy visit number determination mechanism was the same as in 2007. Thus, the first two terms describe differences in the number of therapy visits caused by the change in observables between 2001 and 2007, holding the therapy visit number determination mechanism in 2007 fixed (composition effects). The last two terms describe the difference in the number of therapy visits between 2001 and 2007 attributable to the change in the therapy visit number determination mechanism between 2001 and 2007, holding the value of observables in 2001 fixed (structure effects). This difference measures agencies' adjustment in the number of therapy visits responding to payment incentives, assuming that there were no omitted variables affecting the number of therapy visits (Olson, 1998).

The DFL method computes the counterfactual distribution, weighting the actual distribution of the 2007 with the following variable ω_i.

$$\int f^{2007}(V^T|x)h(x|t=2001)dx \equiv \int \omega_i f^{2007}(V^T|x)h(x|t=2007)dx \tag{A.4}$$

where

$$\begin{aligned}\omega_i &= \frac{h(x|t=2001)}{h(x|t=2007)} \\ &= \frac{\{Pr(t=2001|x)_i/Pr(t=2001)\}}{\{Pr(t=2007|x)_i/Pr(t=2007)\}}\end{aligned} \tag{A.5}$$

where $Pr(t=2001|X)_i$ and $Pr(t=2007|X)_i$ are computed for each observation i based on a probit model for the probability of the sample for the year 2001. $Pr(t=2001)$ and $Pr(t=2007)$ are the unconditional probabilities that the sample is from 2001 or 2007.

A.4 Oaxaca-Blinder Decomposition

This section provides a more detailed explanation of how I apply the Oaxaca-Blinder decomposition method to examine how much each of the three factors (proportion of home health patients, number of episodes per patient, and payment amount per episode) contributed to the total spending increase between 2001 and 2009.

First, I collapse the 2001 and 2009 data to the state level (N=102) and run regression (A.6) by year.

$$Y_s = \beta_0 + \beta_1 X_{1,s} + \beta_2 X_{2,s} + \beta_3 X_{3,s} + \varepsilon_s \tag{A.6}$$

where s represents each state. Y,X_1,X_2, and X_3 refer to $\frac{Total\,Spending}{\#Medicare\,B}$ (home health spending per beneficiary), $\frac{\#Patients}{\#Medicare\,B}$ (proportion of Medicare beneficiaries utilizing home health services) , $\frac{\#Episodes}{Patient}$ (number of episodes per patient), and $\frac{Payment}{Episode}$ (payment amount per episode), respectively.

Second, using coefficient estimates in regression (A.6) and the value of X_1 , X_2 , and X_3 in 2001 and 2009 (see Table A.1), I decompose the total spending increase between 2001 and 2009 into explained and unexplained components:

$$\begin{aligned} Y_{2009} - Y_{2001} = \{&(X_{1,\,2009} - X_{1,\,2001})\beta_{1,\,2001} \\ &+ (X_{2,\,2009} - X_{2,\,2001})\beta_{2,\,2001} \\ &+ (X_{3,\,2009} - X_{3,\,2001})\beta_{3,\,2001}\} \\ &+ \{(\beta_{1,\,2009} - \beta_{1,\,2001})X_{1,\,2009} \\ &+ (\beta_{2,\,2009} - \beta_{2,\,2001})X_{2,\,2009} \\ &+ (\beta_{3,\,2009} - \beta_{3,\,2001})X_{3,\,2009} \\ &+ (\beta_{0,\,2009} - \beta_{0,\,2001}) \end{aligned} \tag{A.7}$$

where 2001 and 2009 subscripts are identifiers of years 2001 and 2009. The first three terms (explained variation) represent the total spending increase per capita due to changes in each of the three factors, evaluated at the 2001 relationship between total spending per capita and each of the three factors. The next three terms (unexplained variation) represent the total spending increase per capita due to changes in the relationship between total spending per capital and each of the three factors, evaluated at the 2009 value of each of the three factors.

I can also decompose the total spending increase between 2001 and 2009 as follows:

$$
\begin{aligned}
Y_{2009} - Y_{2001} = \{&(X_{1,\,2009} - X_{1,\,2001})\beta_{1,\,2009} \\
&+ (X_{2,\,2009} - X_{2,\,2001})\beta_{2,\,2009} \\
&+ (X_{3,\,2009} - X_{3,\,2001})\beta_{3,\,2009}\} \\
&+ \{(\beta_{1,\,2009} - \beta_{1,\,2001})X_{1,\,2001} \\
&+ (\beta_{2,\,2009} - \beta_{2,\,2001})X_{2,\,2001} \\
&+ (\beta_{3,\,2009} - \beta_{3,\,2001})X_{3,\,2001} \\
&+ (\beta_{0,\,2009} - \beta_{0,\,2001}) \qquad \text{(A.8)}
\end{aligned}
$$

where the first three terms (explained variation) represent the total spending increase per capita due to changes in each of the three factors, evaluated at the 2009 relationship between total spending per capita and each of the three factors. The next three terms (unexplained variation) represent the total spending increase per capita due to changes in the relationship between total spending per capita and each of the three factors, evaluated at the 2001 value of each of the three factors.

In this decomposition approach, I focus on the explained variation and analyze the relative contribution of each of the three factors to the total spending increase. When I decompose using equation (A.7), I find the proportion of home health patients, the number of episodes per patient, and the payment amount per episode contributed approximately 52 (=.047/.092), 28 (=.026/.092), and 20 (=.019/.092) percent to the total spending increase between 2001 and 2009, respectively (see Table A.2, column (a)). When I decompose using equation (A.8), the corresponding contribution percentage of the three factors are 43 (=.053/.123), 31 (=038/.123), and 26 (=.032/.123) percent. In sum, the increase in the proportion of home health patients contributed the most to the total spending increase between 2001 and 2009. The number of episodes per patient and the payment amount per episode contributed the second most and the least to the total spending increase during the

same period.

Table A.1: Means and OLS regression coefficients from home health spending per beneficiary regressions for the years 2001 and 2009

	(1)Mean in 2001	(2)Mean in 2009	(3)Year 2001 Regression Coefficient	(4)Year 2009 Regression Coefficient
Total Spending per Beneficiary	.24	.36		
Three Factors				
Prop of HH Patients	.076	.092	2.85(.097)	3.20(.22)
Episodes per Patient	1.41	1.54	.20(.010)	.29(.018)
Payment per Episode	2.17	2.39	.086(.0055)	.15(.014)
Constant Term			-.44(.017)	-.74(.041)
Adj. R-Square			.99	.98
Sample Size			102	102

Note: Total spending per beneficiary and payment per episode are in 1,000 dollars.

Table A.2: Oaxaca-Blinder Decomposition: Contribution of Each of the Three Factors to the Total Spending Increase between 2001 and 2009

	Using 2001 Coef.		Using 2009 Coef.	
	(a)Explained	(b)Unexplained	(c)Explained	(d)Unexplained
Prop of HH Patients	.047(.015)	.032(.023)	.053(.017)	.026(.019)
Episodes per Patient	.026(.013)	.143(.032)	.038(.019)	0.131(.029)
Payment per Episode	.019(.005)	.148(.036)	.032(.009)	0.134(.033)
Constant Term		-.295(.044)		-0.295(.044)
Total	.092(.026)	.029(.008)	0.123(.034)	-.003(.007)

Note: Explained and Unexplained Variation in columns (a)-(d) are computed based on the values in columns (1)-(4) of Table A.1. Specifically, Explained in (a)=[(2)-(1)]×(3), Unexplained in (b)= [(4)-(3)]×(2), Explained in (c)=[(2)-(1)]×(4), and Unexplained in (d)= [(4)-(3)]×(1).
Payment per episode are in 1,000 dollars.

BIBLIOGRAPHY

BIBLIOGRAPHY

American Diabetes Association (2006). Diagnosis and classification of diabetes mellitus. *Diabetes Care*, 29(suppl 1):s43–s48.

Barrera-Osorio, F., Garcia-Moreno, V., Patrinos, H., & Porta, E. (2011). Using the Oaxaca-Blinder decomposition technique to analyze learning outcomes changes over time: An application to indonesia's results in PISA mathematics. *World Bank Policy Research Working Paper*, No. 5584.

Benjamin, A. (1993). An historical perspective on home care policy. *The Millbank Quarterly*, 71(1):129–166.

Brega, A., Schlenker, R., Hijjazi, K., Neal, S., Belansky, E., & Talkington, S. (2002). Study of Medicare home health practice variations: final report. Final report, University of Colorado, Center for Health Policy Research.

Chandra, A. & Staiger, D. (2007). Productivity spillovers in health care: evidence from the treatment of heart attacks. *Journal of Political Economy*, 115(1):103–140.

Choi, S. & Davitt, J. (2009). Changes in the Medicare home health care market: the impact of reimbursement policy. *Medical Care*, 47(3):302–309.

CMS (2009). Medicare program; home health prospective payment system rate update for calendar year 2010; final rule. federal register. Federal Register Vol. 74, No. 216.

CMS (2011). Medicare & Medicaid statistical supplement 2011. Technical report.

CMS (2012). Standard analytical files-LDS. www.cms.gov.

Dafny, L. (2005). How do hospitals respond to price changes? *American Economic Review*, 5:1525–1547.

Dartmouth Atlas (2012). The Dartmouth Atlas of Health Care. www.dartmouthatlas.org.

Dinardo, J. (2002). Propensity score reweighting and changes in wage distribution.

Dinardo, J., Fortin, N., & Lemieux, T. (1996). Labor market institutions and the distribution of wages, 1973-1992: A semiparametric approach. *Econometrica*, 64(5):1001.

Duggan, M. (2000). Hospital ownership and public medical spending. *Quarterly Journal of Economics*, 115:1525–1547.

Ellis, R. & McGuire, T. (1986). Provider behavior under prospective reimbursement: cost sharing and supply. *Journal of Health Economics*, 5:129151.

Ellis, R. P. (1998). Creaming, skimping and dumping: provider competition on the intensive and extensive margins. *Journal of Health Economics*, 17(5):537 – 555, doi:10.1016/S0167-6296(97)00042-8.

Families USA (1999). The Medicare Buy-In.

FitzGerald, J. D., Mangione, C. M., Boscardin, J., Kominski, G., Hahn, B., & Ettner, S. L. (2006). Impact of changes in Medicare home health care reimbursement on month-to-month home health utilization between 1996 and 2001 for a national sample of patients undergoing orthopedic procedures. *Medical Care*, 44(9).

Fortin, N., Lemieux, T., & Firpo, S. (2011). Chapter 1 - decomposition methods in economics. In Ashenfelter, O. & Card, D., editors, *Handbook of Labor Economics*, volume Volume 4, Part A, pages 1–102. Elsevier.

Golberstein, E., Grabowski, D., Langa, K., & Chernew, M. (2009). Effect of Medicare home health care payment on informal care. *Inquiry*, 46:58–71.

Grabowski, D. & Hirth, R. (2003). Competitive spillovers across non-profit and for-profit nursing homes. *Journal of Health Economics*, 22(1):1 – 22, doi:10.1016/S0167-6296(02)00093-0.

Grabowski, D. C., Afendulis, C. C., & McGuire, T. G. (2011). Medicare prospective payment and the volume and intensity of skilled nursing facility services. *Journal of Health Economics*, 30(4):675 – 684, doi:10.1016/j.jhealeco.2011.05.014.

HCFA (2000). Medicare program; prospective payment system for home health agencies; final rule. Federal Register Vol. 65, No. 128.

Henkemeyer, T. (2012). Personal interview.

Horwitz, J. R. & Nichols, A. (2009). Hospital ownership and medical services: Market mix, spillover effects, and nonprofit objectives. *Journal of Health Economics*, 28(5):924 – 937, doi:10.1016/j.jhealeco.2009.06.008.

King, M., Ruggles, S., Alexander, T., Flood, S., Genadek, K., Schroeder, M., Trampe, B., & Vick, R. (2010). Integrated public use microdata series, current population survey: Version 3.0. [machine-readable database]. Technical report, University of Minnesota, Minneapolis.

Litchman, M. (2010). The impact of a home health medicare policy change on elders with diabetes in a Utah Endocrinology practice. *Poster session presented at the annual meeting of the Gerontological Society of America, New Orleans, LA.*

McKnight, R. (2006). Home care reimbursement, long-term care utilization, and health outcomes. *Journal of Public Economics*, 90:293–323.

MedPAC (2007). Report to the congress: Medicare payment policy. Technical report, Washington, D.C.

MedPAC (2010). Report to the congress: Medicare payment policy. Technical report, Washington, D.C.

MedPAC (2011). Report to the congress: Regional variation in medicare service use. Technical report.

MedPAC (2012). Report to the congress: Medicare payment policy. Technical report, Washington, D.C.

Newhouse, J. P. (1970). Toward a theory of nonprofit institution: An economic model of a hospital. *The American Economic Review*, 60(1):64–74.

OIG (2009). Medicaid and Medicare home health payments for skilled nursing and home health aide services. Technical Report OEI-07-06-00641, DHHS, Office of Inspector General.

Olson, C. A. (1998). A comparison of parametric and semiparametric estimates of the effect of spousal health insurance coverage on weekly hours worked by wives. *Journal of Applied Econometrics*, 13(5):543–565, doi:10.1002/(SICI)1099-1255(1998090)13:5¡543::AID-JAE507¿3.0.CO;2-J.

Sloan, F. A. (2000). Chapter 21 not-for-profit ownership and hospital behavior. volume 1, Part B of *Handbook of Health Economics*, pages 1141 – 1174. Elsevier.