Revenue Cycle Management in the U.S. Hospital Industry

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Health Services Organization and Policy)
in The University of Michigan
2010

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2010

To my parents

Acknowledgements

There are many people who helped and guided me along this journey. First, I want to thank the members of my dissertation committee, Jack Wheeler, Dean Smith, Ilia Dichev, and Amy Dittmar, for their valuable insights and generous support. Special thanks are due to Jack Wheeler, my advisor and chair, for providing guidance, advice, and encouragement as well as research and teaching opportunities throughout my time in the HSOP program. Jack was the best advisor I could have wished for and a constant source of support. Thanks are also due to Dean Smith for helping me define and shape my dissertation research project and for providing valuable feedback numerous times throughout the past two years that I have spent researching and writing this dissertation. Ilia Dichev and Amy Dittmar are some of the best professors of accounting and finance I have had the opportunity to take classes with and learn from. Over the past two years, both volunteered substantial amounts of their time to share their disciplinary perspectives and help me incorporate accounting and finance concepts into my dissertation, for which I am very grateful.

Data from not-for-profit hospitals' audited financial statements were a critical element in my dissertation research and I want to thank Richard Ciccarone and Merritt Research Services, LLC of Cedar Rapids, Iowa for granting me access to their database. I am also grateful to Thomson Reuters for granting me permission to use data from their Medicare Cost Report hospital financial database. The statistical analyses of these data

have benefited from advice by Edward Norton and Omar Alshanqeety, for which I am very thankful.

Chapter 2 of this dissertation was co-authored by Jack Wheeler and published in the November/December 2008 issue of the Journal of Healthcare Management.

Financial support for my doctoral education in the form of research and teaching assistantships was generously provided by Jack Wheeler, Catherine McLaughlin, Scott Greer, Rich Lichtenstein, Leon Wyszewianski, and David Mendez, to all of whom I would like to extend my sincere thanks. I also want to thank the Rackham Graduate School for providing additional financial support in the form of a Rackham International Student Fellowship and a Rackham Pre-Doctoral Fellowship.

Many friends and colleagues have made my time in Ann Arbor both enjoyable and fun, above all the members of my HSOP cohort, Anda Botoseneanu, Jennifer Hefner, Hsien-Chang Lin, Kamilah Neighbors, Emily Nicklett, and Edward Okeke. I also extend my thanks to Monika Bhagat-Kennedy, Anna Bruckmann, Natasha Chang, Sandra Maier, Heidi McGowan, and Kaushik Veeraraghavan for many years of friendship and support.

Finally, I want to thank my family back home in Germany, my parents Ursula and Josef Rauscher, my sister Yvonne, and my brother Jannik, for their love and their support of my decision to pursue my PhD abroad. Being far away from home I am blessed to have met Vijay Singh and his family here in the U.S. who have been a tremendous source of support and much joy to be around.

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Abstract

Revenue cycle management — all clinical and administrative activities related to generating and collecting patient revenue — has gained in importance in today's business environment, in which hospitals are confronted with stricter regulations and billing requirements, underpayments, and greater delays in payments. Despite the continued interest of practitioners, revenue cycle management has not received much attention in health care finance research. The three studies that comprise this dissertation seek to complement anecdotal evidence and fill some of the gaps in the literature by defining and exploring the financial benefits hospitals derive from effectively managing the revenue cycle.

The first study describes current revenue cycle management practices and develops measures of their financial benefits in terms of increases in the amount and the speed of patient revenue collection. Using financial statement information for California hospitals for 2004–2007, correlation analysis shows that hospitals that collect their revenues faster tend to record higher revenues indicating that there is no trade-off but that these financial benefits of effective revenue cycle management often go hand in hand.

The second study explores the determinants of revenue cycle management performance with a particular focus on hospitals' payer mix. Using data from Medicare cost reports and financial statements for bond-issuing, not-for-profit hospitals for 2000–

2007, fixed effects regression analysis finds that hospitals serving more Medicare patients collect somewhat more revenue while also collecting their revenue faster. Higher Medicaid payer mix, on the other hand, is associated with neither the amount nor the speed of revenue collection. Unlike frequently claimed by hospital managers, government payers therefore do not appear to undermine hospitals' ability to generate and collect patient revenue.

The third study analyzes the link between revenue cycle management and hospitals' long-term financial performance. Fixed effects regression analysis of audited financial statement information for bond-issuing, not-for-profit hospitals for 2000–2007 finds that effective revenue cycle management has the potential to boost not-for-profit hospitals' profitability and strengthen their ability to grow equity. This link is particularly strong for measures of operating performance indicating that the pathway through which revenue cycle management improves financial viability focuses on operations.

Chapter 1

Introduction

Despite a recent slowdown, the growth in hospital spending continues to outpace the growth in the resources available to pay for it. Over the past two decades, hospital expenditures have increased by an average of seven percent per year reaching $718.4 billion, or $2,360 per person, in 2008 (Hartman et al. 2010). As a result, there is tremendous pressure on key industry stakeholders to mitigate further growth in hospital spending (D'Cruz and Welter 2008). Government health care programs, such as Medicare and Medicaid, have responded to these pressures by mandating lower increases in hospital reimbursement rates. Consequently, Medicare and Medicaid now frequently pay hospitals less than what it costs to treat their beneficiaries resulting in payment shortfalls for hospitals (American Hospital Association 2009). Hospitals also feel significant pressures to contain health care costs from private health insurers and large employers, which use their market power to squeeze payment and create bureaucratic hassles for health care providers (D'Cruz and Welter 2008).

Historically, hospitals have mainly focused on cost management to deal with these pressures (Gapenski, Vogel, and Langland-Orban 1993). Cost containment efforts alone, however, may not be sufficient in the complex revenue cycle management environment that hospital managers are facing today. Considerable changes in hospital reimbursement including the introduction of Medicare's Prospective Payment System in

the 1980s, the formation of managed care organizations in the 1990s, and the growth in consumer driven health plans in the 2000s have intensified the need for hospitals to maintain and stabilize revenue streams and improve collection efforts (D'Cruz and Welter 2008; Gapenski, Vogel, and Langland-Orban 1993). In today's business environment, cost management has thus diminished as a single predictor of hospitals' financial performance while revenue cycle management has gained in importance.

Hospital revenue cycle management includes all clinical and administrative functions related to the generation, management, and collection of patient care revenue. Although historically focused on back end tasks, such as billing and collections, in recent years hospital financial managers have directed more of their attention to the front end of the revenue cycle including patient scheduling and registration, insurance verification, and preauthorization as well as the core tasks of the revenue cycle including medical documentation and coding (Berger 2008; Rauscher and Wheeler 2008). Up-to-date, well-operated practices at the front end of the revenue cycle allow hospitals to improve their performance at back end tasks and thus generate greater amounts of patient revenue and collect it in a timely fashion (Zelman et al. 2003). Advances in technology, for instance, allow patients to schedule appointments and complete online registration information conveniently over the internet. Likewise, integrating core tasks, such as the documentation of patient care and medical coding, into the revenue cycle has become paramount to insuring appropriate billing and claims collection at the back end. Specialized coding software, for instance, allows hospitals to substantially improve the accuracy of medical coding, which will become even more important once the currently used ICD-9 codes are replaced by more detailed and complex ICD-10 codes.

The importance many hospital financial managers currently attribute to effective revenue cycle management is also reflected in their hiring of external management consultants. Hospitals' need to maintain and stabilize revenue streams and improve collections has thus sparked the creation of a new industry of consultancies that specialize in helping their clients improve their performance at managing the revenue cycle. Examples include AccretiveHealth, McKesson, and Stockamp, to name but a few of the players in this new and growing industry.

Definition of and background on hospital revenue cycle management

For the purpose of this dissertation, hospital revenue cycle management is defined as the practices a hospital designs and implements to maximize both the amount of patient revenue and the speed of patient revenue collection. Due to the complex interrelations among patients, providers, payers, and regulators that characterize the U.S. health care system, the way hospitals manage patient revenues and accounts receivable differs substantially from that in firms in most other industries. First, hospitals differ from other firms in terms of managing their revenues. Unlike the prices charged of customers by most firms, the prices hospitals bill for services are generally not the prices that patients and third-party payers end up paying. Instead, hospitals bill for services based on the price information listed in their charge masters but then grant third-party payers substantial discounts in the form of contractual allowances. An average hospital may have several hundred different contractual relationships with third-party payers, each of which specifies a different set of payment rates for specific services (Berger 2008). Hospitals also generally provide some amount of free care to indigent patients in the form

of charity care, for which they decide to forgo revenue altogether. As a result, the net patient revenues — defined as gross charges minus the sum of contractual allowances and charity care — that hospitals earn are much lower than the charges billed. Moreover, hospitals frequently incur additional revenue write-offs in the form of bad debt expenses whenever patients, in particular self-pay patients and patient enrolled in high-deductible health plans, are able but unwilling to pay their bills.

Second, hospitals differ from firms in other industries in their approach to managing accounts receivable. While in most industries the customer pays the provider directly for the goods or services rendered, hospital care is to a large extent paid for by third-party payers, such as government programs, commercial insurers, and managed care organizations. Investments in accounts receivable are thus an operational necessity for hospitals (Duncan, Swayne, and Ginter 1998) and since most third-party payers are volume purchasers, hospitals are also confronted with the problem of trying to externally control the timely payment of accounts (Zelman et al. 2003). Moreover, given the nature of the demand for hospital care, changes in hospitals' terms of credit are unlikely to stimulate volume and improve profitability and hospitals typically incur all the costs but derive few, if any, of the benefits associated with the extension of credit (Duncan, Swayne, and Ginter 1998). Hence, the applicability of revenue cycle management tools and techniques employed in other industries to the U.S. hospital industry is limited. Instead, hospital managers have developed industry-specific revenue cycle management policies and practices that allow them to maximize both the amount and the speed of patient revenue collection.

Empirical evidence on hospital revenue cycle management

Despite the continued interest of practitioners (Danielson and Fuller 2007; D'Cruz and Welter 2008; May 2004), hospital revenue cycle management has not received much attention in health care finance research. Instead, the overwhelming majority of publications on revenue cycle management are based on the insights and experiences of practitioners working in the field. These publications develop ad hoc performance measures and standards, discuss anecdotal evidence of potentially important factors of effective revenue cycle management, and offer suggestions for improvements at other hospitals based on the experiences gained at the authors' institutions.

The few existing empirical studies of hospital revenue cycle management are mainly exploratory studies that fall in two categories. The first group consists of studies that analyze factors associated with the financial benefits of hospital revenue cycle management performance, such Prince and Ramanan's (1992) paper on hospitals' collection performance. The second group represents studies of hospitals' profitability that include single measures of revenue cycle management performance as explanatory variables, such as average collection periods and mark-up ratios (Cleverley 1990; Cody, Friss, and Hawkinson 1995; Gapenski, Vogel, and Langland-Orban 1993). None of these studies, however, takes into account that effective revenue cycle management may result in not just one but multiple financial benefits. In addition, the empirical methods employed in the above mentioned studies are largely limited to correlation and simple regression analyses and may be improved upon using more advanced econometric techniques.

Scope and structure of the dissertation

This dissertation seeks to complement anecdotal evidence on hospital revenue cycle management and fill some of the gaps in the health care finance literature by defining and exploring the financial benefits of effective revenue cycle management from the perspective of hospitals. It consists of three papers that address the following questions:

1. What are the financial benefits of effective hospital revenue cycle management? Is there a trade-off between the amount of patient revenue hospitals earn and the speed with which they collect patient revenue?
2. What are the determinants of hospital revenue cycle management performance? How does payer mix, in particular the proportion of publicly insured patients, affect hospitals' revenue cycle management performance? Do government payers indeed undermine hospitals' ability to generate and collect patient revenue as is frequently claimed by hospital practitioners?
3. What is the link between revenue cycle management performance and hospitals' long-term financial viability? Does effective revenue cycle management improve hospitals' profitability? Does effective revenue cycle management strengthen hospitals' ability to grow equity capital?

Chapter 2 briefly describes current hospital revenue cycle management practices. It then develops and discusses measures of the financial benefits of effective revenue cycle management in terms of increases in the amount and the speed of patient revenue collection. Then, Chapter 2 seeks to answer the question whether there is a trade-off between the amount of patient revenue hospitals earn and the speed with which revenue

is collected. Are hospitals with lower average collection periods also able to perform well at maximizing the amount of patient revenue they collect? Or is there a trade-off between the amount of patient revenue a hospital collects and its speed of revenue collection?

Chapter 3 analyzes the determinants of hospitals' revenue cycle management performance with a particular focus on payer mix, i.e., the proportions of a hospital's Medicare, Medicaid, privately insured, and uninsured patients. What is the link between payer mix and hospitals' performance at managing the revenue cycle? Are there differences between different payer groups and do government payers indeed undermine hospitals' ability to generate and collect patient care revenue as is frequently claimed by hospital managers?

Chapter 4 explores the long-term financial benefits that hospitals are able to derive from effective revenue cycle management. In particular, Chapter 4 analyzes the link between hospitals' revenue cycle management performance and their profitability and ability to grow equity capital. Does effective revenue cycle management allow hospital managers to remain profitable, build equity capital, and thus strengthen the long-term financial viability of their organizations?

Chapter 5 summarizes the findings and concludes before discussing several potential areas of future research in the field of hospital revenue cycle management.

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Chapter 2

Effective Hospital Revenue Cycle Management: Is There a Trade-off Between the Amount of Patient Revenue and the Speed of Revenue Collection?

Abstract

Effective hospital revenue cycle management practices have gained in importance in today's hospital business environment, in which many hospitals are confronted with stricter regulations and billing requirements, more thorough preauthorization and precertification, underpayments, and greater delays in payments. In this article, we provide a brief description of current hospital revenue cycle management practices. Next, we suggest measures of the financial benefits of revenue cycle management in terms of increases in the amount and speed of patient revenue collection. We consider whether there is a trade-off between the amount of patient revenue a hospital earns and the speed with which revenue is collected.

Using financial statement data from California hospitals for 2004 to 2007, we test empirically the relationships among key financial measures of effective hospital revenue cycle management. We find that hospitals with higher speeds of revenue collection tend to record higher amounts of net patient revenue per adjusted discharge, lower contractual allowances, and lower bad debts. Charity care provision, on the other hand, tends to be higher among hospitals with higher speeds of revenue collection. We conclude that there is no evidence of a trade-off between the amount of patient revenue and the speed of

revenue collection but that these financial benefits of effective hospital revenue cycle management often go hand in hand. We thus provide early indication that these outcomes are complementary, suggesting that effective hospital revenue cycle management achieves multiple positive results.

Introduction

The continuing efforts of public and private third-party payers to contain hospital costs have resulted in stricter regulations and billing requirements, more thorough preauthorization and precertification, underpayments, and greater delays in payments (Anderson 1988; Krantz 2006; Ladewig and Hecht 1993). As a result, short-term financial management, particularly the management of patient revenues and accounts receivable, has significantly gained in importance, and hospitals across the United States increasingly feel the need to implement effective revenue cycle management practices.

Traditionally, hospital revenue cycle management has focused on reducing the average collection period, most frequently measured as days in net accounts receivable, which is equal to net accounts receivable times 365 days divided by net patient revenues. A shorter average collection period implies that the hospital receives cash inflows from providing patient care earlier. Each reduction in days in net accounts receivable translates into a one-time financial benefit by reducing outstanding accounts receivable balances and increasing cash holdings. As a result, the hospital reduces its opportunity costs of having large balances of accounts receivable, which earn no interest income. The cash

that is created on the balance sheet can be invested in interest-bearing financial instruments, or it can reduce the need for short-term borrowing.

One way for hospital financial managers to reduce the average collection period is to write off outstanding patient accounts more quickly (Hammer 2005; Nowicki 2008). This results in smaller balances of net accounts receivable and thus lower days in net accounts receivable. However, writing off patient accounts prematurely reduces operating profits. Evaluating the performance of revenue cycle management solely in terms of the average collection period thus ignores the second important financial benefit of effective revenue cycle management: maximizing the amount of patient revenue the hospital collects. Although the speed with which accounts receivable are converted into cash has important implications for a hospital's liquidity, the magnitude of net patient revenue directly affects profitability and the ability to build equity to ensure the hospital's long-term financial viability (Danielson and Fuller 2007; Wood 2007).

This article briefly describes current hospital revenue cycle management practices. It then develops and discusses measures of effective revenue cycle management in terms of increases in the amount and speed of patient revenue collection. We then seek to answer the question of whether there is a trade-off between the amount of patient revenue a hospital earns and the speed with which revenue is collected.

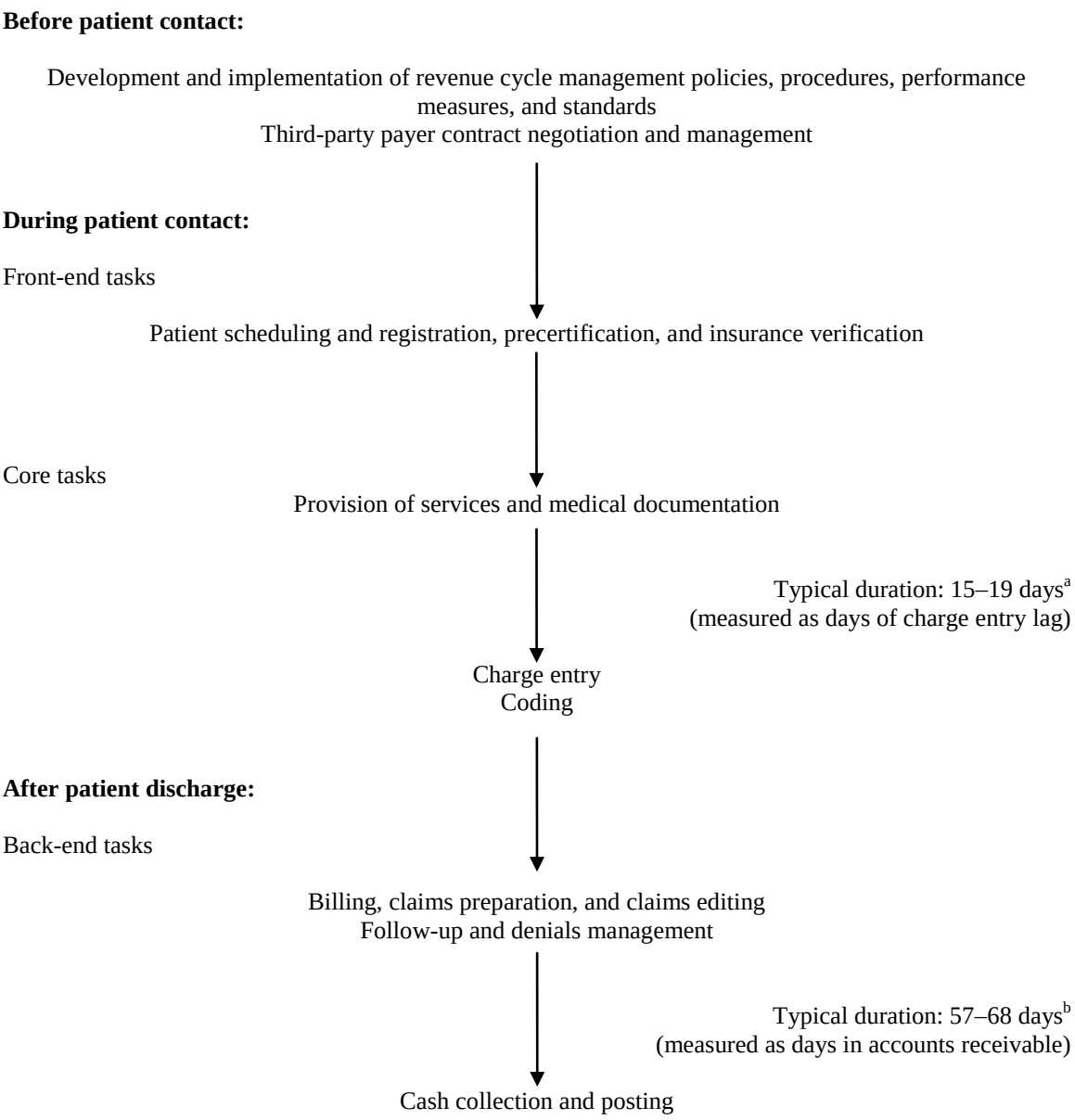
Hospital revenue cycle management

For the purpose of this study, hospital revenue cycle management is defined as the practices a hospital designs and implements to maximize the amount of patient revenue

and the speed of patient revenue collection. Figure 2.1 identifies the most important elements of the hospital revenue cycle, divided into front-end, core, and back-end tasks, that help the hospital achieve these goals.

Effective revenue cycle management requires that the revenue cycle manager, supported by a revenue cycle management team, develop and implement both revenue cycle policies and procedures and performance measures and standards, which are intended not only to standardize and optimize procedures but also to help overcome the silo structure of managing the revenue cycle that can be found in many hospitals (Eldenburg, Schafer, and Zulauf 2004). A crucial aspect is revenue cycle-friendly third-party payer contracting, which includes negotiating patient volumes, prices, and contractual allowances as well as payment terms and timing (Berger 2008; Eldenburg, Schafer, and Zulauf 2004). The objectives of hospitals in contract negotiations with third-party payers have changed in recent years. Although hospitals have traditionally focused on obtaining and maintaining patient volumes, even at the expense of optimal financial performance, many hospitals now aggressively negotiate their financial arrangements with third-party payers to increase both the overall amount of patient revenue and the speed of revenue collection (May 2004).

Figure 2.1: The Hospital Revenue Cycle



Notes: [a] Based on a national academic faculty practice plan survey, average charge entry lags were 19 days for inpatient and 15 days for outpatients (May 2004). Newitt and Robertson (2007) recommend a benchmark of five days for billing turnaround, measured from date of service or discharge. If measured from date of service, this benchmark would imply a charge entry lag of fewer than five days. [b] Median values for days in net accounts receivable have been decreasing steadily since 2000 for all U.S. hospitals. In 2003, the median value for days in net accounts receivable was 57.22 days, down from 68.44 days in 1999 (Solucient 2005). Newitt and Robertson (2007) recommend benchmarks of 52 days or fewer in days in gross account receivable and 48 days or fewer in days in net accounts receivable, whereas Hammer (2005) recommends a benchmark of 55 days or fewer in net accounts receivable.

Although historically focused on billing and collection, in recent years hospital managers have directed more of their attention to the front end of the revenue cycle. Starting with appointment scheduling and continuing through registration, a hospital staff member registers the patient; collects the patient's demographic, clinical, and insurance information; verifies the insurance information; and validates the type of coverage provided by the health plan and the eligibility of the patient for services to be provided, which frequently requires obtaining a referral or preauthorization of services (Cleverley and Cameron 2007).

During registration, two activities are especially important for the hospital to be able to maximize the amount of patient revenue and the speed of revenue collection: computing the deductibles and copayments to provide patients with information about how much they are expected to pay out of pocket and providing patient financial education and counseling to help identify patients who have no or only limited health insurance coverage but may be eligible for a public health insurance program, such as Medicare, Medicaid, or State Children's Health Insurance Program (Rappuhn 2003). These activities reduce the amount of staff time spent preparing bills and the amount of outstanding self-pay patient balances and increase the speed of revenue collection and the likelihood that the account will be paid off, thereby reducing bad debts expense (May 2004).

Providing healthcare services to patients is the core business of a hospital and the stage of the hospital revenue cycle during which revenue is generated. Under the prevalent reimbursement systems based on diagnosis-related groups, the patient's diagnosis determines the kind and extent of healthcare services provided and thus the

reimbursement the hospital can seek. Therefore, an important aspect of providing service is documenting all services provided in the patient's medical record, parts of which are used in the billing process and communicated to third-party payers to trigger appropriate payment (Cleverley and Cameron 2007). Whenever services are provided it is imperative that charges for those services be captured and entered into the hospital's information system because a service that is rendered, but not entered as a charge, will not be billed and thus will not produce patient revenue. Moreover, the length of time from point of service to charge entry is a critical factor in the effectiveness of hospital revenue cycle management, as lags in charge entry result in delays in billing and cash collection and reduce the speed of revenue collection (May 2004). As a final step, before a bill can be prepared, each case has to be assigned a diagnosis and a procedure code (Cleverley and Cameron 2007). Accurate and detailed medical documentation gives medical coders the opportunity to apply for the optimal level of reimbursement and thus maximize the amount of patient revenue (Berger 2008).

Back-end tasks, such as billing and collection, are the areas most readily identified with revenue cycle management (Wood 2007). Up-to-date, well-operated billing policies and procedures help prepare accurate and timely bills (Zelman et al. 2003). An important task in the billing process is claims editing, which aims to detect potential errors in claims before they are submitted to payers, thereby ensuring that the hospital receives the maximum payment for the services provided and shortening the time from claim submission to actual payment (Cleverley and Cameron 2007). When bills are not paid in a timely manner, follow-ups and denial management can help the hospital management increase the amount of patient revenue through a claims recovery process

whereby previously denied claims are corrected and resubmitted (Eldenburg, Schafer, and Zulauf 2004). At the same time, effective denials management can help decrease the time accounts receivable are outstanding. The hospital revenue cycle ends with the collection and posting of the cash received. Once the payment is received and posted, the patient's account is reconciled by recognizing (additional) contractual allowances, charity care services, or bad debt.

The effectiveness of revenue cycle management

As described in the previous section, some components of hospital revenue cycle management focus on increasing the speed of revenue collection and some focus on increasing the amount of net patient revenue. Hence, assessing the effectiveness of revenue cycle management depends on identifying ways to measure the amount and the speed of revenue collection. This section describes some key financial measures of effective hospital revenue cycle management. It then examines empirically the relationships among these key financial measures. We specifically seek to answer the question of whether hospitals with lower average collection periods are also able to perform well at maximizing the amount of net patient revenue they collect or whether there is a trade-off between the amount of patient revenue a hospital collects and its speed of revenue collection. This trade-off could arise if processes aimed at increasing the speed of collection reduce net patient revenues.

Measures

Hospital managers may use a number of key financial indicators to assess the overall effectiveness of the hospital's revenue cycle management activities as presented in Table 2.1. The most common measure of the speed of patient revenue collection is days in net accounts receivable, which is calculated as net accounts receivable times 365 days divided by net patient revenue (Berger 2008; Hammer 2005; May 2004; Prince and Ramachandran 1992; Quist and Robertson 2004). This financial ratio describes the number of days of net patient revenue that a hospital has due from patient billings after taking deductions for charity care, contractual allowances, and expected bad debts. Therefore, days in net accounts receivable indicates the average time a hospital's patient accounts receivable are outstanding or the average collection period on patient accounts. Median values for days in net accounts receivable have been decreasing steadily since 2000 for all U.S. hospitals from longer than 68 days to less than 55 days, a decrease that is likely caused by hospitals' devotion to better revenue cycle management (Solucient 2005).

Besides the speed of revenue collection, we argue that an equally important result of revenue cycle management is the amount of patient revenue a hospital collects, which is measured as net patient revenue per adjusted discharge (Solucient 2005). For the purpose of this study, net patient revenue is defined as the difference between gross patient revenue and the sum of contractual allowances, charity care, and bad debt. Net patient revenue per adjusted discharge contains three different adjustments to allow values to be compared across hospitals. First, wage index adjustments are made to control for differences in wages and, more generally, price levels across hospitals in different

locations. Second, case-mix index adjustments are made to account for differences in the severity of illness of the patients treated at different hospitals. Third, net patient revenue is adjusted for the amount of outpatient business of the hospital to take into account that hospitals with a greater proportion of outpatients, on average, earn lower net patient revenues per discharge.

According to generally accepted accounting principles, net patient revenue is the difference between gross patient revenue, that is, the price charged to patients and provisions for contractual allowances and charity care. Additional adjustments to net patient revenues are made in the form of bad debt expense to account for patients who are able but unwilling to pay. U.S. hospitals frequently collect less than half of their gross patient revenue. To gain a better understanding of the composition of the revenue deductions, that is, those parts of a hospital's gross patient revenues that are recorded but not collected (Griffith 1995), hospital managers frequently calculate contractual allowance, charity care, and bad debt percentages. The contractual allowance percentage indicates how much of a hospital's gross patient revenue is not collected by the hospital because of discounts granted to third-party payers. In this article, contractual allowances include allowances granted to Medicare, Medi-Cal (not taking into account disproportionate share payments), county programs for the indigent, and private insurers. The charity care percentage specifies how much of a hospital's gross patient revenue is not collected because of the provision of charity care. For the purpose of this study, charity care includes charity care provided under the Hill-Burton Act as well as other charity care. The bad debt percentage shows how much of gross patient revenue the hospital expects to be unable to collect because patients are able but not willing to pay.

Table 2.1: Financial Measures of the Effectiveness of Hospital Revenue Cycle Management

Financial Measure	Definition	Formula	Financial Benefit
Days in net accounts receivable	Number of days required to collect on charges for care provided to patients	(Net accounts receivable × 365) ÷ Net patient revenue	Speed
Net patient revenue per adjusted discharge	Average net patient revenue per discharge adjusted for wage index, case mix index, and the proportion of outpatient business of the hospital	(([Net patient revenue × 0.71 ÷ Wage index] + [Net patient revenue × 0.29]) ÷ Adjusted discharges) ÷ Case mix index Adjusted discharges = Total discharges × Gross patient revenue ÷ Gross inpatient revenue	Amount
Contractual allowance percentage	Percentage of gross patient revenue that is discounted to third-party payers	Contractual allowances ÷ Gross patient revenue	Amount
Charity care percentage	Percentage of gross patient revenue that is provided as charity care	Charity care ÷ Gross patient revenue	Amount
Bad debt percentage	Percentage of gross patient revenue that is written off as bad debt	Bad debt expense ÷ Gross patient revenue	Amount

Data and sample

The data used to analyze the relationships among the key financial indicators of effective hospital revenue cycle management were derived from the annual hospital financial disclosure reports submitted by California hospitals to the Office of Statewide Health Planning and Development (OSHPD). Financial data for California hospitals with fiscal years ending during calendar years 2004 to 2007 were examined. The sample used in this study contains 1,513 hospitals: 381 hospitals in 2004, 365 hospitals in 2005, 386 hospitals in 2006, and 381 hospitals in 2007, representing between 80 and 89 percent of

all California hospitals reporting financial information to the OSHPD for these four years. (Roughly ten to 20 percent of hospitals were excluded in each year mainly because of incomplete reporting of financial information to the OSHPD.)

Analysis

To test the relationships among the financial measures defined previously, nonparametric Spearman's rho correlation coefficients were calculated for each year between 2004 and 2007 as well as for the total sample of hospitals spanning the four-year study period from 2004 to 2007. Spearman's rho correlation coefficients were used in the analysis because they represent a nonparametric measure of correlation assessing how well an arbitrary monotonic function could describe the relationship between two variables, without making any assumptions about the frequency distribution of the variables. This analysis thus allowed us to determine whether there were any—not necessarily linear—relationships between any two of the five key financial measures of effective revenue cycle management that we were interested in studying.

Results

Sample characteristics

Between 2004 and 2007, median days in net accounts receivable in California hospitals increased by 2.64 days from 57.07 days to 59.71 days. Median net patient revenues per adjusted discharge increased by $1,068, or 13.7 percent, from $7,787 in 2004 to $8,855 in 2007. The proportion of gross patient revenue discounted to third-party payers increased

by two percentage points, from 65 percent in 2004 to 67 percent in 2007, and the proportion of gross patient revenue written off as bad debt expense decreased by 0.4 percentage points, from 1.9 percent in 2004 to 1.5 percent in 2007. The proportion of gross patient revenue provided as charity care remained relatively stable at around 0.5 percent of gross patient revenue over the four-year study period.

Relationships among measures of patient revenue

Table 2.2 provides an overview of the relationships between net patient revenue per adjusted discharge and the three types of revenue deductions—contractual allowances, charity care, and bad debt. As expected, all correlation coefficients are small but consistently negative and relatively stable across time. The correlation coefficients between net patient revenue per adjusted discharge and the contractual allowance percentage range from –0.17 to –0.32, those between net patient revenue per adjusted discharge and the charity care percentage range from –0.08 to –0.13, and those between net patient revenue per adjusted discharge and the bad debt percentage range from –0.18 to –0.24. For the four-year sample, the respective correlation coefficients are –0.24, –0.10, and –0.22, indicating that hospitals with fewer revenue deductions have on average higher net patient revenue per adjusted discharge.

Table 2.2: Relationship among Measures of the Amount of Patient Revenue
Net Patient Revenue per Adjusted Discharge

	2004	2005	2006	2007	2004–2007
Contractual allowance percentage	–0.2116 (.0001)	–0.3189 (.0000)	–0.3129 (.0000)	–0.1677 (.0010)	–0.2411 (.0000)
Charity care percentage	–0.0942 (.0746)	–0.1298 (.0148)	–0.1107 (.0320)	–0.0808 (.1154)	–0.0952 (.0003)
Bad debt percentage	–0.2401 (.0000)	–0.2080 (.0001)	–0.2412 (.0000)	–0.1812 (.0004)	–0.2243 (.0000)

Notes: Spearman's rho correlation coefficients and *p* values in parentheses.

Relationships among measures of the amount and the speed of patient revenue collection

Table 2.3 shows the relationships among measures of the amount and speed of patient revenue collection. The first row shows Spearman's rho correlation coefficients between days in net accounts receivable and net patient revenue per adjusted discharge, the two most important measures of effective hospital revenue cycle management in this study. The correlation coefficients are small but consistently negative with the exception of the year 2007. They range in magnitude from –0.13 to 0.05 with a correlation coefficient of –0.05 for the four-year sample.

Table 2.3: Relationships among Measures of the Amount and the Speed of Patient Revenue Collection

	Days in Net Accounts Receivable				
	2004	**2005**	**2006**	**2007**	**2004–2007**
Net patient revenue per adjusted discharge	–0.1250 (.0178)	–0.1112 (.0371)	–0.0627 (.2261)	0.0463 (.3671)	–0.0509 (.0515)
Contractual allowance Percentage	0.0287 (.5763)	0.0866 (.0986)	0.0672 (.1874)	0.1728 (.0005)	0.0954 (.0002)
Charity care percentage	–0.1322 (.0098)	–0.1100 (.0356)	–0.1224 (.0161)	–0.0275 (.5834)	–0.0925 (.0003)
Bad debt percentage	0.1153 (.0244)	0.0607 (.2472)	0.0379 (.4573)	0.0935 (.0616)	0.0755 (.0031)

Notes: Spearman's rho correlation coefficients and *p* values in parentheses.

The second to fourth rows in Table 2.3 shed light on how hospitals with lower average collection periods fare with respect to the revenue deductions they encounter compared with hospitals with higher average collection periods. The correlations between days in net accounts receivable and the contractual allowance percentage are small but consistently positive and fairly stable, ranging from 0.03 to 0.17. A similar pattern can be observed for the correlations between days in net accounts receivable and the bad debt percentage. Ranging from 0.04 to 0.12, the correlation coefficients are small but positive and relatively stable. None of the correlations for individual years, however, are statistically significant at the one percent confidence level (with the exception of the correlation coefficient between days in net accounts receivable and the contractual allowance percentage for the year 2007). Although the days in net accounts receivable measure is positively correlated with the contractual allowance percentage and the bad

debt percentage, it is negatively correlated with the charity care percentage; correlation coefficients range from –0.03 to –0.13 for the four individual years, all of which are significant at the 5 percent confidence level with the exception of the year 2007.

Discussion

Our discussion of the hospital revenue cycle demonstrated its complexity and the interrelations among many of its stages. Both our brief review of these processes and our empirical results suggest that activities to increase the amount of patient revenue and the speed with which the hospital collects its patient revenue often go hand in hand. It is reasonable to conclude that if a hospital has a comprehensive revenue cycle management program it can expect not only to increase its speed of revenue collection by reducing its average collection period but also to collect higher amounts of patient revenue per adjusted discharge. Therefore, our results do not support a view that there is a trade-off between the amount of patient revenue and the speed of revenue collection. For hospital revenue cycle managers and consultants working to improve the effectiveness of their hospitals' or clients' revenue cycle management activities, these results are good news. They provide seminal empirical evidence that hospitals wishing to improve their revenue cycle management activities do not appear to sacrifice revenues for shortened collection periods.

As expected, hospitals with higher net patient revenue per adjusted discharge are more likely to record lower revenue deductions. Perhaps as part of an aggressive revenue cycle management program, these hospitals typically grant fewer contractual allowances

to third-party payers, provide less charity care, and minimize their bad debt expenses. For the purpose of this study, contractual allowances, charity care, and bad debt are directly related to net patient revenue because net patient revenue is calculated as the difference between gross patient revenue and these revenue deductions. As a result, the findings for contractual allowances, charity care, and bad debt are consistent with what many researchers and practitioners would expect.

The relationship between revenue deductions and average collection periods is less clear. On the one hand, hospitals with shorter average collection periods have reduced contractual allowances and bad debt expenses, again suggesting that these results of effective revenue cycle management are complementary. The negative relationship between the average collection period and the bad debt percentage indicates that hospital financial managers do not appear to reduce the average collection period by writing off outstanding patient accounts more quickly. On the other hand, however, hospitals with shorter average collection periods also tend to provide slightly more charity care than hospitals with higher average collection periods. This result is the only bivariate result with inconsistent findings in terms of revenue cycle management outcomes. A fuller understanding of this result, as well as of all the bivariate results presented here, awaits multivariate analysis of a larger and more representative set of observations.

One set of factors meriting further scrutiny is changes in the patient population base that could be associated with a shift in payer mix or could permit increases in hospital-charged prices. Our analysis cannot rule out the possibility that the apparent complementary nature of the amount and speed of patient revenue collection is due more to other factors affecting gross or net revenues than to improved internal revenue cycle

management processes. Hospitals charging higher prices on their charge masters are likely able to increase their net patient revenue per adjusted discharge and, at the same time, reduce their average collection period. Although higher prices have an immediate effect on gross and net patient revenues, they also lead to lower days in net accounts receivable if the increase in prices, and thus gross and net patient revenues, is larger than the resulting increase in net accounts receivable. Similarly, a shift in the hospital's payer mix, that is, the percentage mix of public and private third-party payers, may result in higher net patient revenues per adjusted discharge as a result of reduced revenue deductions and, at the same time, reduced average collection periods if the increase in net patient revenue is larger than the increase in net accounts receivable.

Study limitations and future work

This research has a number of limitations that might affect the results of this study and limit their generalizability. First of all, the sample only includes California hospitals, which are unique in many respects but particularly in terms of property tax limitations, the mixture of not-for-profit and for-profit hospitals, and the types of geographic and socioeconomic market conditions they face (Clement, Smith, and Wheeler 1994). Thus, the precise results derived from this study of California hospitals might not be representative of U.S. hospitals in general. Second, the analysis is based on financial statement information from only four years, 2004 to 2007. Although these are the most recent years for which OSHPD financial data are available, it cannot be ruled out that the relationships found in this study are different during other time periods and thus not stable over longer periods. Third, the analysis is based exclusively on externally available

data from hospital financial statements. No internal data or indicators of the processes and effectiveness of hospital revenue cycle management have been used because of the limited availability of such data. Fourth, this analysis focuses on cross-sectional variation only and does not explore changes for individual hospitals over time. Additional correlation analysis of changes at the hospital level, however, confirmed the findings of the main analysis (see Appendix). Finally, as noted, the analyses performed in this study are purely descriptive, bivariate analyses of associations among various financial benefits of effective hospital revenue cycle management. Although Spearman's rho correlation coefficients do not assume a linear relationship between variables, its limitations are otherwise similar to those of the more frequently used Pearson correlation coefficient. In particular, bivariate correlation analyses limit the inferences that can be drawn about the independent relationships between key variables.

These caveats notwithstanding, this article is among the first to offer an expanded set of outcomes against which to measure the effectiveness of revenue cycle management. It also provides an early indication that these outcomes are complementary, suggesting that effective revenue cycle management achieves multiple positive results.

Appendix

In order to address one of the main limitations of this study, the cross-sectional analyses are replicated using year-over-year changes as well as changes over the four-year study period at the hospital level. As expected, the results of this reanalysis are similar to those of the cross-sectional analyses (Tables 2.4 and 2.5). The correlations between year-over-year changes in net patient revenue per adjusted discharge and in the contractual allowance percentage are small but consistently negative and statistically significant at the one percent confidence level. Similarly, the correlations between the year-over-year changes in net patient revenue per adjusted discharge and in the bad debt percentage are small but consistently negative. None of these, however, are statistically significant at conventional confidence levels. Finally, the correlations between the year-over-year changes in net patient revenue per adjusted discharge and in the charity care percentage are small and not significantly different from zero. For the four-year study period, the respective correlation coefficients are –0.08, 0.06, and –0.07 for the relationships between net patient revenue per adjusted discharge and contractual allowances, charity care, and bad debt, respectively.

Table 2.4: Relationships among Year-over-Year and Four-Year Changes in Measures of the Amount of Patient Revenue

	Net Patient Revenue per Adjusted Discharge			
	2004–2005	**2005–2006**	**2006–2007**	**2004–2007**
Contractual allowance percentage	–0.2183 (.0001)	–0.2008 (.0002)	–0.1379 (.0093)	–0.0757 (.1698)
Charity care percentage	0.0173 (.7770)	–0.0390 (.5214)	0.0507 (.3915)	0.0609 (.3182)
Bad debt percentage	–0.0894 (.1133)	–0.0611 (.2740)	–0.0493 (.3680)	–0.0663 (.2420)

Notes: Spearman's rho correlation coefficients and *p* values in parentheses.

The correlation coefficients for the relationships among year-over-year changes in the measures of amount and speed of patient revenue collection mirror the results of the cross-sectional analysis (see Table 2.5). The correlations between year-over-year changes in net patient revenue per adjusted discharge and days in net accounts receivable are small but consistently negative confirming the earlier finding that hospitals that collect their revenues faster tend to collect more revenue. With regard to the three types of revenue deductions, the correlations between year-over-year changes in days in net accounts receivable and both the contractual allowance percentage and the charity care percentage are small but almost always positive. The correlations between days in net accounts receivable and the charity care percentage, on the other hand, are small and consistently negative.

Table 2.5: Relationships among Year-over-Year and Four-Year Changes in Measures of the Amount and the Speed of Patient Revenue Collection

	Days in Net Accounts Receivable			
	2004–2005	**2005–2006**	**2006–2007**	**2004–2007**
Net patient revenue per adjusted discharge	–0.0718 (.1890)	–0.1482 (.0060)	–0.0512 (.3343)	–0.1963 (.0003)
Contractual allowance percentage	0.0921 (.0831)	0.1500 (.0046)	0.1127 (.0311)	0.0493 (.3567)
Charity care percentage	–0.0373 (.5330)	–0.0117 (.8451)	–0.0170 (.7708)	–0.0734 (.2202)
Bad debt percentage	0.0550 (.3152)	0.0491 (.3692)	–0.0058 (.9145)	0.1191 (.0303)

Notes: Spearman's rho correlation coefficients and *p* values in parentheses.

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Chapter 3

Hospital Revenue Cycle Management and Payer Mix: Do Government Payers Undermine Hospitals' Ability to Generate and Collect Patient Care Revenue?

Abstract

In recent years, budget pressures combined with the acceleration in the growth of hospital costs have drawn policymakers' attention to government payers of healthcare — in particular Medicare and Medicaid — and the ways in which these payers reimburse hospitals. Together, Medicare and Medicaid represent 55 percent of care provided by hospitals (American Hospital Association 2009a), yet little is known about how government payers affect hospitals' revenue cycle management performance. Using hospital financial information from Medicare cost reports for 2002 to 2007 and audited financial statements for 2000 to 2006, this study analyzes the relationship between hospitals' government payer mix, i.e., their proportions of Medicare and Medicaid patients, and their ability to generate and collect patient care revenue. Hospital-level fixed effects regression analysis finds that hospitals with higher Medicare payer mix collect somewhat more patient revenue while also collecting their revenue faster. Higher Medicaid payer mix, on the other hand, is associated with neither the amount nor the speed of patient revenue collection. To conclude, government payers do not appear to undermine hospitals' ability to generate and collect patient care revenue. Despite increases in government payer mix, hospital managers are frequently able to generate adequate amounts of patient revenue and collect it in a timely fashion.

Introduction

In recent years, budget pressures combined with the acceleration in the growth of hospital costs have drawn policymakers' attention to government payers of healthcare — in particular Medicare and Medicaid — and the ways in which these payers reimburse hospitals (American Hospital Association 2009a; Friedman et al. 2004). Medicare's and Medicaid's payment policies and practices affect both the volume of hospital care provided to publicly insured patients and its cost. As the proportion of health-related expenditures in the federal and many state budgets has increased, legislators have been forced to consider cuts to government payers' reimbursement rates as a means to contain health care costs and balance their budgets.

Medicare and Medicaid currently represent 55 percent of care provided by U.S. hospitals (American Hospital Association 2009a), yet little is known about how government payers affect hospitals' revenue cycle management performance, in particular their ability to generate and collect patient services revenue. The passage of Medicare and Medicaid in 1965 had a tremendous effect on hospitals (Berger 2008). The two programs were both expansive and expensive and enormously strengthened the financial position of hospitals (Starr 1982). The continued importance of government payers for hospitals' financial viability became clear after the introduction of Medicare's prospective payment system in 1983 and the passage of the Balanced Budget Act in 1997. Both implemented severe cuts to hospital reimbursement, which substantially reduced hospitals' patient revenues, suggesting that government payers' reimbursement policies and practices play an important role in hospitals' performance at managing the revenue cycle.

This study fills some of the gaps in the literature on hospital revenue cycle management and explores whether government payers undermine hospitals' ability to generate and collect patient revenue. In particular, it analyzes the relationship between hospitals' government payer mix, i.e., their proportions of Medicare and Medicaid patients, and the amount of patient revenue hospitals generate as well as the speed with which hospitals collect patient revenue. The findings of this study are not only of interest to hospital financial managers who aim to improve their management of the revenue cycle; the results can also inform federal and state policymakers as they consider the implications of potential changes to Medicare and Medicaid for the financial viability of hospitals and consequently access to hospital care for publicly insured patients.

Background and literature review

Empirical evidence on hospital revenue cycle management is rare and research on the relationship between hospital payer mix and revenue cycle management performance is virtually nonexistent. The overwhelming majority of publications are based on the insights and experiences of practitioners working in the field. As a result, most of the publications can be found in practitioners' journals presenting anecdotal evidence of potentially important factors of effective revenue cycle management and offering suggestions for improvements at other hospitals based on the experiences gained at the authors' institutions.

The empirical analysis of hospitals' revenue cycle management performance is complicated by the fact that it is largely driven by factors internal to the hospital, such as the organization of the patient registration process, the accuracy of medical

recordkeeping and coding, and the training and experience of the hospital's billing staff (for a detailed overview of the hospital revenue cycle, see Rauscher and Wheeler 2008). Since such internal information on hospitals' revenue cycle management policies and practices is generally not publicly available, the few existing empirical studies have focused on external factors thought to impact revenue cycle management performance. All of these studies have included indicators of hospital payer mix in one form or another as a key explanatory variable.

One of the earliest empirical studies of the relationship between payer mix and hospital revenue cycle management performance is a descriptive study by Prince and Ramanan (1992), which examines factors related to excess collection time. Excess collection time is measured as the difference between the actual collection time and the median collection time for one of six panels to which the hospital is assigned based on ownership and financial reporting practices. Using data for bond-issuing, not-for-profit hospitals for the years 1986 to 1988, the authors find that Medicare and Medicaid payer mix are negatively associated with excess collection time in three of the six panels, as is Blue Cross payer mix. Increases in Medicare, Medicaid, and Blue Cross payer mix are thus associated with decreases in hospitals' average collection periods.

In a study with a somewhat different focus, Rosko (2001) examines factors associated with hospitals' provision of uncompensated care. Uncompensated care represents one of the determinants of the amount of patient revenue a hospital generates and is thus an important aspect of revenue cycle management performance. Using data for all Pennsylvania hospitals for 1995, the author finds that uncompensated care, expressed in terms of revenues as a percentage of operating expenses, is positively

associated with the area unemployment rate, a proxy for those without health insurance and one aspect of hospital payer mix. The relationship between the area unemployment rate and the provision of uncompensated care, however, is not statistically significant at conventional confidence levels indicating that there is no relationship between a hospital's share of uninsured patients and its amount of patient revenue.

Likewise, Buckley (2004) finds no relationship between payer mix and hospitals' amount of patient revenue. As part of a study of the effects of payer mix on hospital nurse to patient ratios and hospital quality of care, the author explores the effect of payer mix on the amount of revenue hospitals collect per patient. Using an unbalanced panel of U.S. hospitals for the 1990s, the author finds small positive effects of Medicare and Medicaid payer mix on the amount of revenue per patient, none of which, however, is statistically significant at conventional confidence levels.

Conceptual framework

A hospital's ability to generate and collect patient care revenue is determined by its payer mix, i.e., its relative proportions of Medicare, Medicaid, privately insured, and uninsured patients. Payment policies and practices vary substantially across third-party payers and can be more or less generous with respect to how much and how fast hospitals are reimbursed for the services they provide (Friedman et al. 2004; Ladewig and Hecht 1993; May 2004).

The amount of patient revenue a hospital collects is a function of the prices the hospital achieves for its services and the volume of services provided. The composition

of a hospital's payer mix has a pervasive influence on both. Payer mix largely determines the average net revenue a hospital is able to generate for any given service (Cleverley and Cameron 2007). Unlike firms in most other industries, which use billed charges as the only type of payment, an average hospital may have several hundred different contractual relationships with third-party payers, all of which specify different rates of reimbursement for any given service. While Medicare and Medicaid pay hospitals according to pre-determined payment schedules – most frequently in the form of fixed per-episode payments based on diagnosis related groups — private third-party payers negotiate reimbursement rates individually with each hospital. On average, because of their market power, Medicare and Medicaid pay hospitals a substantially lower percentage of billed charges than private insurers and uninsured patients resulting in payment shortfalls for hospitals (American Hospital Association 2009a; Melnick and Fonkych 2008). Unless hospitals are able to offset some of the underpayments from Medicare and Medicaid by negotiating higher prices from private health insurers and charging the uninsured more, hospitals with higher Medicare and Medicaid payer mix likely collect reduced amounts of patient revenue.

A hospital's payer mix, however, not only influences the average price hospitals achieve for each service but also their volume of services. Before a patient can be admitted to the hospital, many third-party payers require pre-authorization of services; once a patient has been admitted, payers frequently influence the number of services and the intensity of care provided through case management and utilization review. Some payers, such as managed care organizations, manage the volume of services provided to their insured more than others in an effort to contain hospital costs (Robinson 1996). As a

result, hospitals with higher shares of managed care patients, including Medicare patients enrolled in Medicare Advantage plans and Medicaid patients enrolled in health maintenance organizations, may experience reductions in their volume of services and thus collect lower amounts of patient revenue when compared to hospitals with more patients covered under fee-for-service health insurance plans.

Equally importantly, but rarely discussed in the same context, a hospital's payer mix also influences its speed of revenue collection. Hospitals' average collection periods vary greatly by payer. While some third-party payers, such as Medicare and many managed care organizations, are bound by federal law or state prompt pay laws to reimburse providers within specified periods of time (Hammond 2002), other payers, such as private indemnity insurance companies, may take an inordinate amount of time to settle bills because of frequent disputes over coverage or reasonableness (Cleverley and Cameron 2007). Collections from indigent and self-pay patients often prove to be particularly difficult resulting in substantial payment delays (Solucient 2005). As a result, hospitals with higher shares of Medicare and managed care patients, including Medicaid patients in states where Medicaid is mainly administered through private health maintenance organizations, are often able to collect their patient revenue relatively fast while hospitals serving more patients with traditional fee-for-service insurance coverage as well as indigent and self-pay patients frequently experience payment delays.

Methods

Analytic model

Following previous empirical studies (Buckley 2004; Prince and Ramanan 1992; Rosko 2001) and the conceptual framework outlined above, I model hospital revenue cycle management performance, i.e., hospitals' ability to generate and collect patient revenue, as a function of payer mix and a set of control variables:

$$RCM_{it} = PayerMix_{it}\beta + X_{it}\gamma + \mu_i + \omega_{it}$$

Revenue cycle management performance, RCM_{it}, is measured using three key financial performance indicators in terms of increases in the amounts and the speeds of patient revenue collection. The independent variables of interest are indicators of hospitals' payer mix, $PayerMix_{it}$, in particular their shares of government payers, Medicare and Medicaid. In addition, a set of hospital-level characteristics, year and state dummy variables, represented as X_{it}, are included in the model. The subscripts i and t refer to hospital i in year t.

Because of the potential for hospital-level variation in the way hospitals manage the revenue cycle, I include a hospital-specific error term, μ_i, which represents the unobserved heterogeneity across hospitals (Cameron and Trivedi 2005; Greene 2008). Revenue cycle management policies and practices have been found to vary substantially across hospitals. While some hospitals have a highly integrated, well managed revenue cycle encompassing every step from patient registration to the collection and posting of cash, other hospitals are characterized by a silo structure of managing the revenue cycle with little integration of the functions of different departments (Eldenburg, Schafer, and Zulauf 2004) or are at a very early stage of establishing integrated revenue cycle

management policies and practices. In general, hospital-level heterogeneity can be modeled using either fixed or random effects. Hausman tests of the null hypothesis that the hospital-level effects are random indicated that fixed-effects regression was preferred over random effects. Heteroskedasticity robust White standard errors are calculated to account for the clustering of observations within hospitals over time.

Measures

Revenue cycle management performance

Hospital revenue cycle management performance, the dependent variable of interest in this study, is measured using three key financial indicators of hospitals' ability to generate and collect patient revenue. Hospitals' ability to generate patient revenue is measured using two measures of the amount of revenue, net patient revenue per adjusted discharge and net patient revenue per total assets. Hospitals' ability to collect patient revenue is measured using one measure of the speed of revenue collection, days in net accounts receivable (Table 3.1).

Table 3.1: Financial Measures of Hospital Revenue Cycle Management Performance

Financial Measure	Definition	Formula
Net patient revenue per adjusted discharge	Average wage index and case mix index adjusted net patient revenue per discharge where discharges are adjusted for the proportion of outpatient business of the hospital	{[(Net patient revenue × 0.71 ÷ CMS wage index) + (Net patient revenue × 0.29)] ÷ Adjusted discharges} ÷ Case mix index Adjusted discharges = Total acute care discharges × (Gross patient revenue ÷ Gross inpatient acute care revenue)
Net patient revenue per total assets	Average case mix index adjusted net patient revenue per dollar invested in total assets	(Net patient revenue ÷ Case mix index) ÷ Total assets
Days in net accounts receivable	Number of days required to collect on charges for care provided to patients	(Net accounts receivable × 365) ÷ Net patient revenue

The most frequently used indicator of hospital revenue cycle management performance is days in net accounts receivable, or the average collection period, a measure of the speed of patient revenue collection (Berger 2008; Hammer 2005; May 2004; Prince and Ramanan 1992; Quist and Robertson 2004; Solucient 2005). It is calculated as net accounts receivable times 365 days divided by net patient revenue and represents the number of days of net patient revenue that a hospital has due from patient billings after all revenue deductions. Unlike Prince and Ramanan (1992), I use days in net accounts receivable instead of excess collection time because the fixed-effects model I employ controls for hospital-level characteristics, such as ownership and financial reporting practices, which may affect hospitals' speed of revenue collection and were controlled for in Prince and Ramanan's measure of excess collection time.

Besides the speed of revenue collection, Rauscher and Wheeler (2008) have argued that an equally important indicator of revenue cycle management performance is a hospital's ability to generate patient revenue measured in terms of the amount of patient revenue. Unlike Buckley (2004), who defines the amount of revenue as revenue per patient, this study uses net patient revenue per adjusted discharge and net patient revenue per total assets. Net patient revenue per adjusted discharge is defined as wage and case mix index adjusted net patient revenue per discharge, where discharges are adjusted by the ratio of gross patient revenue to gross inpatient revenue. Adjusting net patient revenues per discharge for differences in case mix complexity, prevailing wage rates, and outpatient volumes facilitates the comparison of the amount of patient revenue across different types of hospitals and hospitals in different geographic locations, which the measure used by Buckley (2004) does not guarantee.

Net patient revenue per total assets is used as an alternative measure in those parts of the analysis where large numbers of missing data do not allow the calculation of net patient revenue per adjusted discharge without compromising sample size. Net patient revenue per total assets is defined as the ratio of case mix adjusted net patient revenue to a hospital's total assets. Scaling net patient revenue by the case mix index of a facility adjusts for differences in case mix complexity across hospitals. Expressing net patient revenue as a percentage of total assets adjusts for the size of a facility and thus to some extent for the volume of patient care provided, including both inpatient and outpatient care. Unlike net patient revenue per adjusted discharge, net patient revenue per total assets, however, does not adjust for differences in prevailing wage rates across hospitals.

Payer Mix Indicators

The independent variables of interest in this study are indicators of hospitals' government payer mix, i.e., their shares of Medicare and Medicaid patients. The reference group to which Medicare and Medicaid are compared consists of all private payers including commercial health insurers as well as uninsured and self-pay patients. In general, payer mix can be defined either in terms of revenues received from each payer or in terms of volume of services provided to patients covered by each payer, such as the number of admissions or patient days attributable to each payer. For the purpose of this study, three different measures of Medicare and Medicaid payer mix are employed in the analysis. Medicare and Medicaid payer mix are measured first in terms of revenues using gross patient services revenue and second in terms of volume using acute care admissions and acute care inpatient days (Table 3.2).

Measuring Medicare and Medicaid payer mix in terms of revenues, admissions, and patient days produces somewhat different estimates of the composition of each hospital's payer mix. Hospitals with large shares of Medicare patients likely boast high percentages on all three measures of payer mix. When measured in terms of acute care admissions, however, Medicare payer mix tends to understate the percentage of revenue that is derived from Medicare. This is due to the fact that Medicare patients have longer average lengths of stay allowing hospitals to generate more patient revenue (Solucient 2005). Likewise, hospitals with large shares of Medicaid patients likely record high percentages on all three measures of payer mix. When measured in terms of acute care admissions, however, Medicaid payer mix tends to overstate the percentage of revenue that is derived from Medicaid. This is due to the fact that reimbursement levels for

Medicaid patients are generally lower than those for Medicare and privately insured patients. The admission of a Medicaid patient does thus not allow the hospital to generate above average amounts of patient revenue (Solucient 2005).

Besides Medicare and Medicaid payer mix, I include one additional indicator of payer mix in parts of my analysis: the percentage of gross patient revenue derived from managed care payers. After government payers, managed health care organizations represent the next largest payer group for many hospitals (Berger 2008). The term managed care is a catch-all for a variety of health insurance plans that are designed to limit the cost of health care through a range of utilization management and cost containment techniques (Berger 2008). For the purpose of this study, managed care payer mix not only includes privately insured patients covered by managed care payers, such as health maintenance organizations (HMOs), preferred provider organizations (PPOs), and point-of-service (POS) plans, but also Medicare and Medicaid beneficiaries who receive their benefits through a managed care organization, such as Medicare beneficiaries enrolled in Medicare Advantage and certain Medicaid beneficiaries in states where Medicaid is administered through private HMOs.

Table 3.2: Measures of Hospital Payer Mix

Payer Mix Measure	Definition	Formula
Medicare payer mix		
Medicare gross patient service revenue	Percentage of gross patient service revenue received from Medicare	(Medicare gross patient service revenue ÷ Gross patient service revenue) × 100%
Medicare acute care admissions	Total Medicare acute care admissions divided by the total number of acute care patients admitted to a hospital, expressed as a percentage	(Medicare acute care admissions ÷ Total acute care admissions) × 100%
Medicare acute care days	Total number of Medicare acute care inpatient days at a hospital divided by the total number of acute care inpatient days at the hospital, expressed as a percentage	(Medicare acute care inpatient days ÷ Total acute care inpatient days) × 100%
Medicaid payer mix		
Medicaid gross patient service revenue	Percentage of gross patient service revenue received from Medicaid	(Medicaid gross patient service revenue ÷ Gross patient service revenue) × 100%
Medicaid acute care admissions	Total Medicaid acute care admissions divided by the total number of acute care patients admitted to a hospital, expressed as a percentage	(Medicaid acute care admissions ÷ Total acute care admissions) × 100%
Medicaid acute care days	Total number of Medicaid acute care inpatient days at a hospital divided by the total number of acute care inpatient days at the hospital, expressed as a percentage	(Medicaid acute care inpatient days ÷ Total acute care inpatient days) × 100%
Managed care payer mix		
Managed care gross patient service revenue	Percentage of gross patient service revenue received for patients insured in managed care health plans	(Gross patient service revenue from managed care payers ÷ Gross patient service revenue) × 100%

Control variables

Besides payer mix, a number of factors, both internal and external to the hospital, have been found to affect revenue cycle management performance (Buckley 2004; Prince and Ramanan 1992; Rosko 2001). One major limitation of the fixed effects regression model used in this study, however, is that coefficients on time-invariant covariates cannot be estimated but are absorbed in the individual-level constant term. Lack of identification is the price of the robustness of the specification to unmeasured correlation between the common effects and the exogenous variables (Greene 2008). For the purpose of this study, lack of identification is a minor issue since I am primarily interested in the relationship between payer mix, a time-variant variable, and revenue cycle management outcomes. Lack of identification, however, limits the number of control variables that can be included in the analysis (Table 3.3).

Table 3.3: Measures of Control Variables

Variable	**Definition/Formula**
Case mix index	Average diagnosis-related group (DRG) case weight for all of a hospital's Medicare patients using the Medicare DRG patient classification system
Average age of plant	Accumulated depreciation ÷ Depreciation expense
Year	Binary variable for each calendar year in the study
State trends	State × Year • State is a binary variable for each of the 50 U.S. states • Year is an ordinary variable whereby the first calendar year in the study is coded as 1, the second calendar year as 2, etc.

Case mix index is the average diagnosis-related group (DRG) case weight for all of a hospital's Medicare volume. Although it is specifically relevant to the Medicare patients at a given hospital, it is frequently considered a reasonable surrogate of the case mix complexity of all of a hospital's patients (Solucient 2005). Since case mix index is controlled for in both measures of the amount of patient revenue it is only included in the analysis of the speed of revenue collection. A higher case mix index may translate into payment delays for hospitals. More complex cases often prompt additional reviews by third-party payers in the processing of claims, which may result in hospitals having to wait longer before receiving payment. Prince and Ramanan (1992) included case mix index as an explanatory variable in their study of hospitals' collection performance. They found that case mix index was significantly negatively related to excess collection time in two out of six subgroups of hospitals analyzed providing empirical evidence that at least certain types of hospitals experience review delays in payment.

Average age of plant is calculated as accumulated depreciation on all of a hospital's buildings, fixtures, and major movable equipment divided by the depreciation expense of the period. It indicates the average accounting age in years of a hospital's capital assets. Average age of plant is only included as a control variable in the analysis of the amount of patient revenue measured in terms of net patient revenue per total assets. Hospitals may record higher net patient revenues per total assets because of more effective revenue cycle management. Hospitals may, however, also record higher net patient revenues per total assets because of changes in their asset base, such as changes in the book values of its property, plant, and equipment, which may be the result of an aging stock of their capital assets.

Finally, year and state dummy variables are included in the analysis. An indicator for the calendar year of the observation is included as a control variable to capture intertemporal changes in revenue cycle management performance common to all hospitals in the sample. Moreover, following Prince and Ramanan (1992) who found that the collection performance of hospitals varied by state, an indicator for the state in which each hospital operates is included as a control variable. However, since I use a fixed-effects regression model, simple state dummy variables cannot be included in the analysis. Instead, I include state trends, which are defined as interaction terms of state and year. The variable state consists of a binary variable for each of the 50 U.S. states. The variable year represents an ordinary variable whereby the first calendar year in the study is coded as 1, the second calendar year is coded as 2, and so on. State trends capture changes in revenue cycle management performance over time that are common to all hospitals in a state, such as changes in the reimbursement policies of a state's Medicaid program or changes in state-level insurance regulations affecting private health insurers including the passage of so-called prompt pay laws that require payers to pay with specified periods of time, typically ranging from 15 to 45 days (Hammond 2002).

Data and sample

Description of the data sources

A significant challenge to an analysis of the relationship between payer mix and revenue cycle management performance is the adequacy of the hospital financial data available. Hospitals' audited financial statements — the gold standard in hospital financial reporting — are not publicly available in many states and there is no national database of audited financial accounting information for not-for-profit U.S. hospitals (Kane and Magnus 2001). Health services researchers have thus come to rely upon five main data sources to analyze hospitals' financial status and performance: audited financial reports for subsets of U.S. hospitals, state hospital financial and statistical reports, Medicare Cost Reports, the American Hospital Association's Annual Survey, and Internal Revenue Service data (Needleman 2003). These data sources vary substantially in the accuracy and reliability of the financial information provided, the level of detail reported, and the representativeness of the hospitals included. With the exception of audited financial statements and some state hospital financial and statistical reports, all available data sources are unaudited and have been reported to contain many errors and inconsistencies (Burkhardt 1995; Kane and Magnus 2001; Magnus and Smith 2000; Needleman 2003). The limited availability of audited financial statements for not-for-profit hospitals, on the other hand, means that information from these reports generally does not allow researchers to draw conclusions that are representative for all not-for-profit U.S. hospitals.

This paper tries to overcome some of the existing data limitations by separately analyzing hospital financial information from two data sources and comparing the results:

First, I analyze financial data from the Medicare Cost Report collected and provided by Thomson Reuters.[1] Since almost all U.S. hospitals have a contract with Medicare to treat Medicare beneficiaries, the Thomson Reuters dataset represents close to the total population of U.S. hospitals. Second, I analyze audited hospital financial statement information for all bond-issuing, not-for-profit U.S. hospitals collected and provided by Merritt Research Services.[2] Analyzing both datasets allows me to compare and reinforce my results and generalize them to a larger subset of hospitals than the sole use of either one of the two datasets. Moreover, it allows me to use several different measures of both payer mix and revenue cycle management performance and thus determine the robustness of my results with respect to different specifications of the dependent and independent variables analyzed.

Thomson Reuters data

The data provided by Thomson Reuters contain financial data from the Medicare Cost Report for all hospitals that treated Medicare patients between 2002 and 2007. Of the 7,072 hospitals and 32,347 hospital year observations included in the dataset, I obtain financial information on 4,264 hospitals and 20,655 hospital year observations, which have complete data on the variables of interest. The final panel represents 60.3 percent of hospitals and 63.9 percent of hospital years in the database.

[1] Data for this publication were supplied by Thomson Reuters. Any analysis, interpretation, or conclusion based on these data is solely that of the authors, and Thomson Reuters disclaims responsibility for any such analysis, interpretation or conclusion.

[2] Audited financial statement information for bond-issuing, not-for-profit hospitals was supplied by Merritt Research Services, LLC of Cedar Rapids, Iowa. The software to construct the dataset used in this research was provided by InvestorTools, Inc. of Yorkville, Illinois.

Merritt Research Services data

The Merritt Research Services database contains audited financial statement information beginning in 1988 for all not-for-profit hospitals that have issued tax-exempt debt. The period of analysis is limited to 2000 to 2006. Of the 1,486 hospitals for which financial reports are available, I obtain financial information on 753 hospitals with complete data on the variables of interest. The final panel contains 2,761 hospital year observations, representing 50.7 percent of hospitals and 31.7 percent of hospital years in the database.

Derivation of the samples

Since data from two different sources is used in this study, the sample derivation process is applied twice. As described in detail below, both data sets have substantial missing data problems, which result in the final samples comprising only between 32 and 64 percent of all available hospital year observations. The nature of the missing data problems varies by data source. Thomson Reuters data is based on information from hospitals' Medicare Cost Reports and thus on unaudited financial statements, which are known to contain many errors (Kane and Magnus 2001). First, negative values are reported for several variables where it is impossible to have negative values. Neither assets nor liabilities should ever have negative values reported. Observations with negative values for assets and liabilities of interest for this study are consequently dropped from the sample. Moreover, implausibly large values are reported for several variables and observations with such values are also dropped. Merritt Research Services

data, on the other hand, represents financial statement information from audited financial statements. As a result, there are only very few missing or implausible values for most financial statement data elements. However, there is a substantial amount of missing information on hospitals' payer mix since hospitals are not obligated to provide information regarding payer mix in the notes to their financial statements. Observations with missing payer mix information are dropped from the sample.

Thomson Reuters data

The following steps were taken to derive the final sample of 4,264 hospitals and 20,655 hospital year observations (Table 3.4): 1,320 hospital year observations were excluded because of implausible values for days in net accounts receivable. Of these, 448 hospital year observations were excluded because of negative values and 872 hospital year observations were excluded because of extremely large values for days in net accounts receivable, defined as values that exceeded median days in net accounts receivable of 55.69 by twice the standard deviation of 91.27, or values greater than 238.23 days. Moreover, 10,310 hospital year observations were excluded due to extremely large values for net patient revenue per adjusted discharge, defined as values that exceeded median net patient revenues per adjusted discharge of $5,324.05 by twice the standard deviation of $137,410.80, or values greater than $280,145.65. Finally, one hospital year observation was excluded due to an implausible value for the percentage of Medicare acute care inpatient days, reported as 100.9 percent, and 61 observations were dropped due to missing values for Medicaid acute care admissions.

Merritt Research Services data

The following steps were taken to derive the final sample of 753 hospitals and 2,761 hospital year observations (Table 3.4): First, 49 hospital year observations were excluded because of missing values for days in net accounts receivable. Moreover, 4,181 hospital year observations were excluded due to missing values for Medicare payer mix, 71 hospital year observations were excluded due to missing values for Medicaid payer mix, and 1,602 hospital year observations were excluded due to missing values for managed care payer mix. Finally, 38 hospital year observations were excluded because of missing information on the hospital's case mix index and 13 observations were excluded due to missing values for average age of plant.

Table 3.4: Sample Derivation

	Thomson Reuters	**Merritt Research Services**
Number of hospital year observations in the initial data set	32,347	8,707
Observations excluded due to missing or implausible values for:		
Days in net accounts receivable	1,320	49
Net patient revenue per adjusted discharge	10,310	N/A
Net patient revenue per total assets	N/A	41
Medicare payer mix	1	4,181
Medicaid payer mix	61	71
Managed care payer mix	N/A	1,602
Case mix index	0	38
Average age of plant	N/A	13
Number of hospital year observations in the final sample (as a percentage of the initial data set)	20,655 (63.9%)	2,761 (31.7%)

The missing data problems encountered in both data sets raise the question in how far the final samples are representative of all hospitals in each data set. For this purpose, a set of organizational and financial characteristics of hospitals in the final samples is compared to those of all hospitals (Table 3.5). When compared to all hospitals in the Thomson Reuters data set, the final sample differs substantially on a number of organizational and financial indicators. Hospitals with complete data are generally larger, better performing, and not-for-profit hospitals. These findings are consistent with the observation by Burkhardt (1995) who found that hospitals with missing Medicare Cost Report data are generally smaller, poorer performing, and investor-owned hospitals. The hospitals in the final sample are also more likely to be teaching hospitals, which tend to serve more publicly insured and uninsured patients, and thus report higher ratios of revenue deductions to gross patient revenues.

Likewise, the final sample of Merritt hospitals differs from all hospitals in the Merritt Research Services database. While the hospitals with complete data are very similar in size and type of hospital to the hospitals with incomplete data, the two groups differ with respect to their operating and financial performance. Hospitals with complete data treat patients of somewhat higher case mix complexity and have higher occupancy rates. They also perform better financially — despite higher revenue deductions both their operating profit margin and their total profit margin are higher than those of hospitals with missing data.

Table 3.5: Representativeness of the Final Samples

	Thomson Reuters Hospitals		Merritt Research Services Hospitals	
	Final sample	All hospitals	Final sample	All hospitals
Hospital year observations included	20,655	32,347	2,761	8,707
Time period covered	2002 – 2007		2000 – 2006	
Size				
Number of hospital beds	175.8**	135.4	449	441
Gross patient revenues (in 000)	N/A	N/A	488,190	466,491
Net patient revenues (in 000)	133,000**	95,900	304,222*	342,446
Hospital ownership and type				
Not-for-profit hospitals	61%**	54%	N/A	N/A
Investor-owned hospitals	20%**	24%	N/A	N/A
Government-owned hospitals	19%**	23%	N/A	N/A
System affiliated hospitals	N/A	N/A	22%	22%
Teaching hospitals	31%**	23%	19%	18%
Operating performance				
Case mix index	1.32	1.32	1.33**	1.31
Occupancy rate	52%**	50%	63%**	62%
Average length of stay	4.1**	8.7	4.8	4.9
Financial performance				
Revenue deductions as a percentage of gross patient revenue	54%**	50%	50%**	48%
Operating profit margin	3.3	3.4	0.6*	0.4
Total profit margin	3.4	3.5	3.7**	3.4

Notes: Sample means are presented for all variables. Actual sample sizes for both final sample and all hospitals that were used in the calculations may be lower than the number of hospital year observations because of missing or implausible data elements that were excluded for the comparisons and t-tests reported above. * denotes difference in means between the final sample and all hospitals is statistically significant at the five percent confidence level. ** denotes difference in means between the final sample and all hospitals is statistically significant at the one percent confidence level.

Summary

To answer my research question, I estimate six different models of revenue cycle management performance, all of which represent variations of the general model described above (Table 3.6). First, I analyze the speed of revenue collection, the most frequently used measure of revenue cycle management performance, using days in net accounts receivable. I estimate three different versions of the above model. Models 1 and 2 employ Thomson Reuters hospital data. Model 1 defines Medicare and Medicaid payer mix, the main independent variables, in terms of acute care admissions. Model 2 defines Medicare and Medicaid payer mix in terms of acute care days. Model 3 uses hospital financial information from Merritt Research Services and defines Medicare and Medicaid payer mix in terms of gross patient services revenue received from these payers. It also includes managed care payer mix measured in terms of gross patient services revenue received from managed care payers as an additional control.

Second, I analyze the amount of patient revenue, again by estimating three different versions of my general model. Models 4 and 5 employ Thomson Reuters data and analyze net patient revenue per adjusted discharge as a function of payer mix. Model 4 defines Medicare and Medicaid payer mix in terms of acute care admissions while Model 5 defines Medicare and Medicaid payer mix in terms of acute care days. Model 6 employs financial information for Merritt Research Services hospitals and analyzes net patient revenue per total assets as a function of Medicare and Medicaid payer mix, whereby payer mix is measured in terms of gross patient services revenue.

Table 3.6: Overview of Model Specifications

Model	Data set used	Dependent variable analyzed	Medicare and Medicaid payer mix measured in terms of	Additional payer mix indicators included
1	Thomson Reuters	Days in net accounts receivable	Acute care admissions	None
2			Acute care days	None
3	Merritt		Gross patient service revenue	Managed care payer mix
4	Thomson Reuters	Net patient revenue per adjusted discharge	Acute care admissions	None
5			Acute care days	None
6	Merritt	Net patient revenue per total assets	Gross patient service revenue	Managed care payer mix

RESULTS

Descriptive results

Thomson Reuters hospitals

Revenue cycle management performance

On average, Thomson Reuters hospitals reported 57.2 days in net accounts receivable (Table 3.7). Between 2002 and 2007, the average collection period of the sample hospitals decreased by around seven days, from 61.5 days in 2002 to 54.4 days in 2007. Average collection periods varied substantially across hospitals, as indicated by the sample between group standard deviation of almost 21 days, but varied less within hospitals, as evidenced by the within group standard deviation of 12.3. Average net patient revenue per adjusted discharge equaled $5,806. As expected, average net patient revenue per adjusted discharge for the sample hospitals increased steadily over time, from $5,462 in 2002 to $6,321 in 2007. Like average collection periods, average net patient revenue per adjusted discharge varied considerably across hospitals but less within hospitals.

Payer mix indicators and control variables

Between 2002 and 2007, the percentages of acute care admissions and acute care inpatient days attributable to Medicare patients equaled 41.8 percent and 50.4 percent, respectively (Table 3.7). The difference of almost nine percentage point between these two measures can be explained by the fact that, once admitted, Medicare patients on average stay in the hospital longer than non-Medicare patients, mainly due to greater severity of illness and more comorbidities. For Medicaid patients, the percentages of

acute care admissions and acute care inpatient days equaled 15.3 percent and 12.6 percent, respectively. Unlike Medicare patients, most Medicaid patients stay in the hospital for a shorter period of time. As a result, Medicaid patients' share of inpatient days is smaller than their share of inpatient admissions. As expected, there was substantial variation in payer mix across hospitals while the changes in payer mix within hospitals over time were small. Payer mix is determined to a large extent by the socioeconomic environment that the hospital operates in and hospital managers may not be able to substantially change its composition. The average case mix index reported by the hospitals in the final sample was 1.32. Like payer mix, hospitals' case mix index varied substantially across hospitals but much less within hospitals over time.

Merritt Research Services hospitals

Revenue cycle management performance

On average, Merritt hospitals reported 59.7 days in net accounts receivable (Table 3.7). Between 2000 and 2006, days in net accounts receivable decreased by over 15 days, from 68.7 days in 2000 to 53.6 days in 2006. As expected, average collection periods varied considerably across hospitals as shown by the sample between group standard deviation of 15.4 days. Average collection periods varied less within hospitals as evidenced by the within group standard deviation of 9.4 days. Average case mix adjusted net patient revenue per total assets equaled 0.65, i.e., hospitals collected an average of 65 cents in case mix adjusted net patient revenues for each dollar invested in assets. Average case mix adjusted net patient revenue per total assets, however, varied substantially over time. In 2000, average net patient revenue per total assets was only 0.61 but subsequently

increased to 0.66 in 2006. Like average collection periods, average net patient revenue per total assets varied considerably across hospitals but less within hospitals.

Payer mix indicators and control variables

Between 2000 and 2006, the percentages of gross patient service revenues received from Medicare and Medicaid equaled 40.1 and 11.9, respectively (Table 3.7). While changes in hospitals' payer mix over time were small, there was substantial variation across hospitals: Medicare payer mix ranged from zero percent to 86 percent and Medicaid payer mix ranged from zero percent to 68 percent. Moreover, the average percentage of gross patient service revenue received from managed care payers was 27.8 percent. Again, changes in hospitals' managed care payer mix over time were small but considerable variation existed across hospitals: Managed care payer mix ranged from zero percent of gross patient service revenues to 97 percent. The average case mix index reported by the sample hospitals was 1.33 and the average age of plant was ten years.

Table 3.7: Descriptive Results

	Thomson Reuters				Merritt Research Services		
Variables	**Sample mean (SD)**	**Between group SD**	**Within group SD**		**Sample mean (SD)**	**Between group SD**	**Within group SD**
Revenue cycle management performance							
Days in net accounts receivable	57.16 (22.22)	20.66	12.29		59.74 (17.50)	15.35	9.43
Net patient revenue per adjusted discharge	5,806.46 (5,019.85)	8,066.98	1,317.52		N/A	N/A	N/A
Net patient revenue per total assets	N/A	N/A	N/A		0.65 (0.27)	0.25	0.076
Payer mix indicators							
Medicare gross patient service revenue	N/A	N/A	N/A		40.13 (11.93)	11.58	2.15
Medicare acute care admissions	41.77 (14.21)	14.73	3.81		N/A	N/A	N/A
Medicare acute care days	50.42 (14.91)	15.37	3.49		N/A	N/A	N/A
Medicaid gross patient service revenue	N/A	N/A	N/A		11.85 (9.45)	9.10	1.66
Medicaid acute care admissions	15.29 (11.46)	10.90	4.17		N/A	N/A	N/A
Medicaid acute care days	12.64 (9.88)	9.64	3.30		N/A	N/A	N/A
Managed care gross patient service revenue	N/A	N/A	N/A		27.85 (16.48)	16.03	4.12
Control variables							
Case mix index	1.32 (0.28)	0.29	0.045		1.33 (0.27)	0.27	0.046
Average age of plant	N/A	N/A	N/A		10.02 (2.71)	2.49	1.17

Hospital-level fixed effects regression results

Speed of revenue collection

Higher Medicare payer mix reduces hospitals' days in net accounts receivable, whereas higher Medicaid payer mix is not associated with changes in the average collection period (Table 3.8). All three hospital-level fixed effects regression models find negative coefficients on Medicare payer mix. An increase in Medicare payer mix of one percentage point is thus associated with a decrease in hospitals' average collection period by 0.08 to 0.14 days. Compared to private payers, Medicare pays hospitals faster. Medicaid, on the other hand, does not reimburse hospitals significantly faster than private payers. None of the three models finds any statistically significant relationship between Medicaid payer mix and days in net accounts receivable. Moreover, higher shares of managed care patients are associated with reductions in hospitals' average collection periods. Model 3, which is the only model that allows for the inclusion of managed care payer mix as a covariate, finds that a one percentage point increase in managed care payer mix is associated with a statistically significant decrease in hospitals' average collection periods of 0.13 days.

Table 3.8: Regression Analysis of Days in Net Accounts Receivable with Hospital-Level Fixed Effects

Variables	***Model 1***	***Model 2***	***Model 3***
Constant	54.91**	55.55**	87.01**
	(9.49)	(9.47)	(7.23)
Payer mix variables			
Medicare	–.076*	–.142**	–.121
	(.031)	(.040)	(.089)
Medicaid	–.018	–.021	–.26
	(.031)	(.045)	(.16)
Managed care payers	—	—	–.126*
			(.053)
Control variables			
Case mix index	–4.89	–4.67	–7.43
	(2.61)	(2.61)	(3.90)
Year dummies	5 included	5 included	6 included
State trends	50 included	50 included	48 included
Hospital fixed effects	4,264 included	4,264 included	752 included
Adjusted R^2	.016	.014	.056

Notes: Heteroskedasticity robust White standard errors are in parentheses. * Statistically significant at the 5 percent confidence level. ** Statistically significant at the 1 percent confidence level. Model 1 uses Thomson Reuters data and defines payer mix in terms of acute acre admissions. Model 2 uses Thomson Reuters data and defines payer mix in terms of acute care inpatient days. There were 4,264 hospitals and 20,655 hospital year observations in Models 1 and 2. Model 3 uses Merritt Research Services data and defines payer mix in terms of gross patient services revenue. There were 752 hospitals and 2,755 hospital year observations in Model 3.

Amount of patient revenue

Higher Medicare payer mix somewhat increases hospitals' net patient revenues whereas higher Medicaid payer mix is not associated with the average amount of patient revenue hospitals collect (Table 3.9). Two of the three hospital-level fixed effects regression models find positive coefficients on Medicare payer mix. When the amount of patient revenue is measured in terms of net patient revenue per adjusted discharge (as in Models 4 and 5), an increase in Medicare payer mix of one percentage point increases net patient revenue by between $21 and $80 per adjusted discharge. While statistically significant, these coefficients translate into relatively small increases of net patient revenue per adjusted discharge of between 0.3 and 1.4 percentage points. When the amount of patient revenue is measured in terms of net patient revenue per total assets (as in Model 6), however, higher Medicare payer mix is not associated with a statistically significant increase of the amount of patient revenue hospitals record.

The numerical difference between the coefficients in Models 4 and 5 can be explained by the fact that admissions, when used as a measure of Medicare payer mix, tend to underestimate both the percentage of patient days attributable to Medicare patients and the percentage of patient revenues derived from Medicare (Solucient 2005). Medicare patients tend to stay in the hospital longer and use more resources than most non-elderly patients. An increase in Medicare acute care admissions (Model 4) is thus associated with larger changes in the amount of patient revenues collected than an increase in Medicare acute care inpatient days (Model 5) or an increase in gross patient revenues derived from Medicare (Model 6).

The findings for Medicaid payer mix, on the other hand, are less clear. When measured in terms of acute care admissions (as in Model 4), an increase in Medicaid payer mix of one percentage point is associated with a statistically significant increase in net patient revenue of $7 per adjusted discharge. Likewise, when measured in terms of gross patient service revenue (as in Model 6), an increase in Medicaid payer mix is associated with a statistically significant increase in case mix adjusted net patient revenue per total assets of 0.003. Model 5, however, find no statistically significant relationships between higher Medicaid payer mix and net patient revenues.

Besides Medicaid payer mix, the only other statistically significant coefficient in Model 6 is the coefficient on average age of plant. An increase in the average age of plant by one year is associated with an increase in net patient revenue per total assets of 0.01. Given that a hospital's total assets are composed to a large extent of its property, plant, and equipment and thus depend on the average age of the property, plant, and equipment, this finding is not unexpected.

Table 3.9: Regression Analysis of Net Patient Revenue per Adjusted Discharge (Models 4 and 5) and Net Patient Revenue per Total Assets (Model 6) with Hospital-Level Fixed Effects

Variables	***Model 4***	***Model 5***	***Model 6***
Constant	6,948.67**	7,799.20**	.504**
	(269.73)	(240.79)	(.051)
Payer mix variables			
Medicare	79.77**	21.39*	–.0004
	(4.96)	(8.69)	(.0010)
Medicaid	7.42**	–1.998	.0030*
	(2.21)	(4.013)	(.0014)
Managed care payers	—	—	–.00045
			(.00043)
Control variables			
Average age of plant	— [(a)]	— [(a)]	.0100**
			(.0023)
Year dummies	5 included	5 included	5 included
State trends	50 included	50 included	48 included
Hospital fixed effects	4,264 included	4,264 included	753 included
Adjusted R^2	.0015	.0004	.10

Notes: Heteroskedasticity robust White standard errors are in parentheses. * Statistically significant at the 5 percent confidence level. ** Statistically significant at the 1 percent confidence level. Model 4 uses Thomson Reuters data and defines payer mix in terms of acute acre admissions. Model 5 uses Thomson Reuters data and defines payer mix in terms of acute care inpatient days. There were 4,264 hospitals and 20,655 hospital year observations in Models 4 and 5. Model 6 uses Merritt Research Services data and defines payer mix in terms of gross patient services revenue. There were 753 hospitals and 2,756 hospital year observations in Model 6. (a) Average age of plant is not included as a control variable because the dependent variable used does not depend on a hospital's total assets.

Discussion

Together, Medicare and Medicaid represent 55 percent of care provided by U.S. hospitals (American Hospital Association 2009a), yet little is known about how government payers affect hospitals' revenue cycle management performance, in particular their ability to generate and collect patient care revenue. I find that hospitals with a higher Medicare payer mix collect slightly higher average amounts of patient revenue while also collecting their patient revenue faster. Higher Medicaid payer mix, on the other hand, is associated with neither the amount nor the speed of patient revenue collection.

Hospitals with larger shares of Medicare patients report shorter average collection periods than hospitals with more privately insured and uninsured patients. This result is consistent with prior empirical evidence by Prince and Ramanan (1992) who also found that higher Medicare payer mix was associated with lower average collection times. Based on the speed of payment, Medicare is a good payer. By law, Medicare is required to pay hospitals within three to four weeks after a clean bill has been submitted electronically (Hobbs 2007; Newitt and Robertson 2007). Most private third-party payers and self-pay patients, on the other hand, take more time than Medicare to settle bills and pay hospitals. Private indemnity insurers in particular frequently delay payment because of disputes over coverage or reasonableness (Cleverley and Cameron 2007). The one exception are managed care payers, which tend to pay hospitals faster than other private payers. The more managed care contracts a hospital enters into, the more sophisticated the hospital has to be when negotiating, billing, and collecting patient revenues, all of which help reduce average collection times (Berger 2008).

Medicaid, on the other hand, does not appear to pay hospitals faster, on average, than most private health insurers. This result is not consistent with Prince and Ramanan (1992) who found that — at least during the late 1980s — higher Medicaid payer mix was associated with lower average collection times. One likely explanation for the differences in findings is that Medicaid represents a program operated and financed jointly by the federal government and the states. As a result, there exist 56 different Medicaid programs across the country whose payment policies and practices differ widely. While almost all states have enacted prompt pay laws, the average time payers may take to reimburse health care providers ranges from 15 to 45 days (Hammond 2002). Currently, some Medicaid programs pay hospitals as quickly as within 14 days, whereas others take up to three or four months to reimburse hospitals (Hobbs 2007). Given that the samples of hospitals analyzed in this study cover the years 2000 to 2007, the findings may reflect changes in Medicaid's average speed of reimbursement between the late 1980s and the early 2000s or, alternatively, point to a non-representative selection of hospitals and, potentially, states. Future work should look more closely at state-level differences in Medicaid's hospital reimbursement practices to determine whether increases in Medicaid payer mix add to hospitals' average collection times in states known for their slow Medicaid reimbursement while contributing to shorter average collection periods in states known for faster Medicaid reimbursement.

With respect to the amount of patient revenue, hospitals serving more publicly insured patients do not collect substantially more or less revenue than hospitals with more privately insured and uninsured patients. An increase in a hospital's government payer mix, in particular its share of Medicare patients, is even found to be associated with small

increases in the average amount of patient revenue the hospital records. This finding is consistent with prior empirical evidence by Buckley (2004) who also found small positive effects of both higher Medicare and Medicaid payer mix on the amount of patient revenue. Despite frequently voiced concerns about government payers' reimbursement rates (American Hospital Association 2009a), Medicare in particular appears to be a mid-range payer. Since their implementation in 1965, both Medicare and Medicaid have enormously strengthened the financial position of hospitals and as a result transformed the provision of hospital services into a profitable business. Despite substantial changes in reimbursement rates and terms during the past 25 years, such as the introduction of Medicare's prospective payment system in 1983 or the passage of the Balanced Budget Act in 1997, government payers continue to play an important role in hospitals' financial viability. Hospital managers' complaints about low reimbursement rates by government payers, in particular by Medicare, may thus be somewhat overstated.

Several other factors may, however, explain why hospitals serving more publicly insured patients do not necessarily collect reduced average amounts of patient revenue. First, when negotiating payment rates and terms, private third-party payers have historically taken into account the proportion of a hospital's Medicare and Medicaid patients and the payment rates for these patients. Private payers often consider the hospital a social enterprise in need of financial support to assure access to adequate care for their insured. Particularly since the introduction of Medicare's prospective payment system in 1983, which substantially reduced payment rates to hospitals, private third-party payers have been concerned about hospitals' financial viability. In Michigan, for instance, Blue Cross Blue Shield of Michigan has paid close attention to the total level of

revenue deductions hospitals incur —including contractual allowances granted to Medicare and Medicaid and bad debts from patients without health insurance. As a result, Blue Cross Blue Shield of Michigan, like many other private payers across the country, has often agreed to pay hospitals more than what is necessary to cover their cost. More recently, however, major purchasers of healthcare, such as the auto industry in Michigan, have raised concerns about the financial burden they incur when compensating hospitals for public payers' underpayments. While private payers' concerns about the financial viability of hospitals have for a long time been an important factor in the negotiation process, they likely constitute a less important explanation for why government payers do not appear to undermine hospitals' ability to generate adequate patient revenues in today's business environment.

In the current business environment, providers, i.e., hospitals themselves, have taken action to improve their revenue collections by initiating a variety of organizational and managerial changes. First, more effective revenue cycle management has enabled many hospitals to maintain their amounts of revenue per patient even as their payer mix has changed. Improvements in revenue cycle management that have been found to have positive effects on the amount of revenue include changes at the front end of the revenue cycle, such as requiring patients to pay upfront for the deductibles and co-payments they owe (Martinez 2008) and collecting information regarding any supplementary health insurance patients may have and that hospitals could bill for some of the care provided. At the back end of the revenue cycle, improved billing processes help increase the number of clean bills sent to government payers and their intermediaries and thus reduce the proportion of claims resubmissions and denials.

Second, cost shifting has allowed certain hospitals — in particular hospitals located in socioeconomically advantaged areas — to offset changes in payer mix. While increases in hospitals' shares of publicly insured patients may reduce patient revenue in the short-term, hospitals often look to the privately insured to make up the difference and remain financially viable in the long run. There is some empirical evidence that hospitals have traditionally been able to shift costs to private payers in order to counterbalance lower reimbursement rates by government payers. A study conducted by RAND, for instance, found that growing Medicare and Medicaid payment shortfalls accounted for 12 percent of the increase in rates paid to California hospitals by private insurers in the late 1990s (Zwanziger and Bamezai 2006). Likewise, Wu (2009) found that hospitals were able to transfer up 37 percent of the cuts in Medicare reimbursement rates implemented by the Balanced Budget Act in 1997 to private payers. In the early 2000s, coinciding with the managed care backlash and hospitals gaining market power, hospitals' payment-to-cost ratios for private payers continued to increase, from around 110 percent in 2000 to around 130 percent in 2007 (American Hospital Association 2009b), providing additional evidence that hospitals may be able to maintain average amounts of patient revenue by increasing their charge-to-cost ratios and charging the privately insured and the uninsured more (Melnick and Fonkych 2008).

Third, in order to offset revenue decreases associated with changes in payer mix, hospitals may decide to change their service mix (American Hospital Association 2009a, Berger 2008). Hospitals may reduce the provision of services that do not generate enough revenue to cover the costs associated with them even though these services may be the ones that underserved populations, such as the elderly or the poor, need most. At the

same time, hospitals may introduce new, more profitable services that do not necessarily address the greatest needs in the community. A recent example that received national attention was the announcement of the University of Chicago Medical Center in March of 2009 to reduce the number of inpatient beds available to emergency patients and to expand efforts to redirect to other hospitals and clinics those ER patients who do not need emergency care. The hospital, which serves a high percentage of Medicaid patients who often rely on care in the emergency room for non-emergent conditions, admitted that the changes were proposed to meet the hospital's financial challenges (Louden 2009).

Study limitations and future work

Non-random samples of U.S. hospitals

The hospitals analyzed in this study represent non-random samples of U.S. hospitals, which limits the generalizability of the findings. As discussed in detail in the section on data and sample selection, the final sample of Merritt Research Services hospitals includes only bond-issuing, not-for-profit U.S. hospitals. These hospitals are larger and better performing than the average U.S. hospital — they have higher occupancy rates, lower average lengths of stay, greater cash reserves, and stronger operating and total profit margins. Likewise, the final sample of Thomson Reuters hospitals does not represent a random sample of U.S. hospitals but includes disproportionately many larger, better performing, and not-for-profit hospitals. Given that I obtained similar results when separately analyzing both datasets, the findings of this study are likely generalizable to larger, better performing, and not-for-profit hospitals. The results, however, may not

apply to smaller, poorer performing hospitals and caution should thus be exercised when interpreting and generalizing the findings.

Revenue cycle management remains a black box

Using fixed effects, this study controls for hospital-level time-invariant factors that may mitigate the relationship between payer mix and revenue cycle management performance but revenue cycle management itself remains a black box. Because of data limitations, this study does not allow me to determine which elements of the revenue cycle hospital managers focus on when confronted with changes in payer mix and how specific improvements to the revenue cycle affect revenue cycle management outcomes. Future work should explore in more detail the changes in revenue cycle management that hospitals implement in response to changes in payer mix with the help of case studies, interviews, or surveys since detailed data on hospitals' internal revenue cycle management policies and practices is generally not publicly available.

Potential endogeneity of payer mix

The study design does not allow me to determine whether payer mix is endogenous, which may violate the assumptions of the linear regression model and lead to biased and inconsistent parameter estimates. Payer mix may be endogenous to revenue cycle management performance because payer mix not only affects a hospital's revenue cycle management performance, but revenue cycle management may also include policies and practices aimed at changing payer mix. As discussed above, reimbursement rates and

terms vary substantially across payers and payer mix thus represents an important determinant of revenue cycle management performance. Revenue cycle managers, on the other hand, are not completely at the mercy of the hospital's payers. Some managers engage in more revenue-cycle friendly contracting than others and are able to negotiate more favorable payment rates and terms (Berger 2008; May 2004). Moreover, as part of their revenue cycle management, hospitals increasingly focus on uninsured and self-pay patients.[3] During patient registration, many hospitals now routinely offer financial counseling to help patients without health insurance find coverage or enroll in a payment plan. Some uninsured patients, for instance, are eligible for Medicaid or SCHIP but may require assistance with the enrollment process. Others may be eligible for COBRA coverage through a former employer but may need help paying for the premiums. While effective revenue cycle management may allow hospitals to somewhat change their payer mix, the overall effect is likely small. A hospital's payer mix depends to a large extent on the demographic and socioeconomic characteristics of the populations served, which do not change much in the short run. Hospitals in areas with an above-average proportion of elderly residents, for instance, receive higher shares of patient revenue from Medicare whereas hospitals in areas with an above-average proportion of low-income residents receive higher shares of patient revenue from Medicaid and self-pay patients. The exogeneity of hospital payer mix is also empirically supported by the relatively small within group standard deviations of all hospital payer mix variables included in this analysis (Table 3.7).

[3] Interview with Chris Evans of Accretive Health in September 2008.

No consideration of major changes in reimbursement by government payers

Caution should be exercised when extrapolating the findings of this study to major changes in government reimbursement rates and terms as proposed, for instance, as a result of the recent economic downturn or the health reform bill passed in March 2010. This study relies on hospital financial information for the years 2000 to 2007, the most recent years for which data is available. While budget pressures combined with the acceleration of hospital cost growth have forced government payers to consider cutting payment rates for the publicly insured (Friedman et al. 2004), no major changes to how government payers reimburse hospitals were made during this period of time.

Continued fiscal stress related to the recent economic downturn, however, has increased states' budget shortfalls and forced many of them to cut Medicaid enrollment, benefits, and provider reimbursement rates (Kaiser Commission on Medicaid and the Uninsured 2010). So far, funds from the American Recovery and Reinvestment Act (ARRA) have helped states to avoid more severe cuts in provider reimbursement rates. Since increases in states' Medicaid budgets as a result of ARRA funds, however, are currently set to expire at the end of 2010, most states have already announced that they are planning on reducing provider rates in the near future to help balance their budgets. As a result, hospitals serving large and growing numbers of Medicaid patients may experience reductions in patient revenues. Moreover, substantial changes in the health care system as a result of the passage of health reform, such as the requirement that most U.S. citizens and legal residents purchase health insurance coverage starting in 2014 (Kaiser Family Foundation 2010), may significantly alter the findings of this study.

Hospitals will likely benefit from an individual insurance mandate since it will reduce the number of uninsured and other self-pay patients and thus bolster hospitals' revenues.

No focus on costs and profitability by payer group

Finally, my analysis of payer mix focuses on patient revenues and does not allow me to draw any conclusions about the relationship between payer mix and costs or payer mix and profitability. Recent research underscores the importance of effective revenue cycle management for highly profitable hospitals alongside traditional cost containment efforts. An analysis using 2008 hospital financial data conducted by Thomson Reuters (2009), for instance, showed that the difference in net operating revenues per adjusted discharge between the most and the least profitable hospitals was $854 whereas the difference in operating expenses per adjusted discharge was only $316. Nonetheless, revenue is only one factor in the determination of hospitals' profitability. The cost of providing care represents the second component in this calculation. Costs of treatment may be lower for Medicare and Medicaid patients if hospitals provide fewer services to these patients in order to avoid or at least reduce losses. Empirical studies have found that the provision of hospital services varies with patients' insurance coverage and that privately insured patients tend to receive more services than publicly insured patients (see, for instance, Braveman et al. 1991). The overall cost of treating publicly insured patients may, on the other hand, be higher given that the health status of many Medicare and Medicaid patients is worse than that of most privately insured patients and their need for services thus greater. There is, for instance, evidence that patients of lower socioeconomic status, such as most Medicaid patients, have longer average lengths of stay, which may require

hospitals to spend more resources when treating these patients (see, for instance, Epstein et al. 1990).

Conclusion

This study finds no evidence that government payers undermine hospitals' ability to generate and collect patient care revenue. Even though Medicare and Medicaid are known to pay hospitals less than private payers, hospitals with more publicly insured patients do not collect substantially lower average patient revenues. Moreover, Medicare pays hospitals faster than most private payers, which benefits hospitals as it reduces their average collection periods. For hospital managers, these findings may represent good news. They show that, despite increases in the number of publicly insured patients served, managers are frequently able to generate adequate amounts of patient revenue and collect it in a timely fashion. Policymakers, however, should exercise caution when interpreting these findings and considering changes in government payers' reimbursement of hospitals. The results of this study do not necessarily suggest that the reimbursement rates and terms set by government payers are adequate to ensure hospitals' financial viability and thus guarantee access to needed hospital services for the publicly insured. While hospitals serving large numbers of Medicare and Medicaid patients may be able to maintain average amounts of patient revenue through effective revenue cycle management and continued cost containment, these hospitals may also be forced to shift more of the costs of care to privately insured and uninsured patients, reduce the provision of services to Medicare and Medicaid patients, postpone needed capital replacements or expansions, or even close their doors (Berger 2008).

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Chapter 4

Short-Term Financial Management and Long-Term Financial Performance: What is the Link between Revenue Cycle Management, Profitability, and Not-for-Profit Hospitals' Ability to Grow Equity?

Abstract

Hospitals' profitability and ability to grow equity represent key factors in their efforts to maintain the up-to-date facilities and equipment needed to attract well-trained health care professionals and provide high-quality patient care. Unlike for-profit hospitals, which can raise equity by issuing shares, not-for-profit hospitals rely mainly on retained earnings from both operating and non-operating activities to build their equity capital. Hospitals' core operating activity is the provision of patient care. Hence, managing the flow of patients through the hospital, from appointment scheduling and patient registration at the front end of the revenue cycle to discharge and billing at the back end, has the potential to boost hospitals' profitability and strengthen their ability to grow equity capital.

Using panel data from audited financial statements for bond-issuing, not-for-profit hospitals for the years 2000 to 2007, this study finds that effective revenue cycle management is indeed positively associated with not-for-profit hospitals' profitability and ability to grow equity. This link is found to be particularly strong for measures of hospitals' operating performance, indicating that the pathway through which revenue cycle management improves hospitals' long-term financial performance focuses on operations. Hospital revenue cycle managers and consultants may view these findings

positively. Efforts aimed at managing the revenue cycle more effectively may frequently be worthwhile investments that have the potential to strengthen the financial viability of an organization in the long term.

Introduction

Hospitals' profitability and ability to grow equity represent key factors in their efforts to maintain the up-to-date facilities and equipment needed to attract well-trained health care professionals and provide high-quality patient care. Profitable hospitals are able to retain and reinvest more of their earnings, which translates into higher growth in equity capital. For not-for-profit hospitals in particular, retained earnings represent the most important source of equity. Unlike their for-profit counterparts, not-for-profit hospitals cannot raise equity externally by issuing shares (Rivenson et al. 2000). Managers of not-for-profit hospitals thus have to focus their efforts to build equity on their organizations' internal operations and supplement these efforts with profitable non-operating activities, including raising capital through donations and gifts and managing their often substantial endowments and financial investments. In the current business environment, however, in which many hospitals have lost substantial parts of their endowments and are experiencing shrinking donation and gift receipts, boosting the profitability of operating activities has gained in importance for the purpose of building equity capital.

Hospitals' core operating activity is the provision of patient care. Hence, managing the flow of patients through the hospital, from appointment scheduling and patient registration at the front end of the revenue cycle to discharge and billing at the

back end, is of crucial importance. Aimed at generating higher patient revenues and reducing average collection periods, the effective management of the revenue cycle has the potential not only to boost hospitals' operating performance but also to improve their total profitability and thus strengthen their ability to grow equity. Despite practitioners' continued interest in revenue cycle management (Danielson and Fuller 2007; Hammer 2005; Ladewig and Hecht 1993; May 2004), to this date, however, no empirical study has examined its association with hospitals' profitability and ability to build equity.

This research attempts to fill some of the gaps in the literature and explores whether effective revenue cycle management can help managers of not-for-profit hospitals improve their organizations' profitability, strengthen their ability to grow equity capital, and thus remain financially viable in the long term. More specifically, this study analyzes the relationship between two measures of revenue cycle management performance, the amount of patient revenue a hospital generates and the speed with which a hospital collects its patient revenue, and several measures of hospitals' profitability and equity value. It attempts to answer the following research questions: What is the link between revenue cycle management performance and not-for-profit hospitals' operating and total profit margins? What is the relationship between revenue cycle management performance and not-for-profit hospitals' free cash flow? And, finally, does effective revenue cycle management translate into higher values of equity capital for not-for-profit hospitals? Besides contributing to the small but growing literature on the relationship between elements of firms' short-term financial management — including revenue cycle management —and their long-term financial performance, the answers to these questions are of particular interest to hospital financial managers and consultants as

they seek to improve their organizations' long-term financial viability by investing in more effective revenue cycle management policies and practices.

Background and literature review

Historically, short-term financial management, or working capital management as accounting scholars sometimes refer to it, has not received much attention in the corporate finance literature (Sartoris and Hill 1983; Smith 1973). The main reason for this historic neglect was the predominant academic focus on market efficiency, which formed the basis for the development of corporate finance theory (Cohn and Pringle 1980; Sartoris and Hill 1983). Under the assumption of perfectly efficient financial markets, short-term financial management is irrelevant since it cannot be used to increase firm value (Lewellen, McConnell, and Scott 1980) and firms thus have no incentive to hold short-term financial assets of any kind (Cohn and Pringle 1980).

Using the management of accounts receivable as an example, Lewellen, McConnell, and Scott (1980) demonstrate that in perfectly competitive markets the availability of trade credit affects neither sales volumes nor firm values. In such a situation, there can only be one effective price for a commodity because the firms producing and selling the commodity all seek to maximize their value to the point where marginal revenue equals marginal cost. All credit terms that are acceptable to both sellers and buyers are the present value equivalent of cash terms and thus perfect substitutes from a valuation standpoint. Rather than holding short-term financial assets that promise no excess returns firms simply borrow as the need arises (Cohn and Pringle 1980).

In the conclusion of their paper, however, Lewellen, McConnell, and Scott (1980, p. 112) acknowledge that there are financial market imperfections "that might impact the trade credit decision and allow an opportunity for the ingenious design of credit policy to affect firm value". Market imperfections that may allow managers to use short-term financial management strategies to affect firm value include taxes (Brick and Fung 1984), illiquidity and bankruptcy costs (Emery 1984), transaction costs (Ferris 1981; Schwartz 1974), asymmetric information (Smith 1987), and legal restrictions, such as the ban on direct price discrimination (Mian and Smith 1992; Petersen and Rajan 1997). In reality, where financial market imperfections are ubiquitous, short-term financial management may thus play an important role in firms' long-term financial viability. Holding short-term financial assets, such as cash, marketable securities, and accounts receivable, may yield excess returns and thus allow managers to boost their organizations' profitability and grow their equity capital (Cohn and Pringle 1980). The management of short-term assets and liabilities as well as the relationship between short-term financial management and firms' long-term financial performance thus warrant the careful investigation by both corporate finance researchers and financial managers.

Empirical research on the relationship between firms' short-term financial management and their long-term financial performance started in the early 1990s with studies conducted for a variety of industries in several different countries over different periods of time. With his examination of 2,000 U.S. firms in 20 different industries between 1970 and 1989, Soenen (1993) was among the first to show that effective short-term financial management, measured in terms of the length of the cash conversion cycle (defined as days in accounts receivable plus days in inventory minus days in accounts

payable), was associated with higher profitability. This relationship, however, depended on the industry under study and was generally not very strong. Using similar data for 2,718 U.S. firms for 1974 to 1993, Jose, Lancaster, and Stevens (1996) were able to replicate the results by Soenen (1993). They found that shorter cash conversion cycles were associated with both improved return on assets and return on equity thus offering strong evidence that for most firms and most industries, aggressive working capital management policies enhance financial performance.

Besides providing additional empirical evidence for the negative relationship between the length of firms' cash conversion cycle and their profitability, Shin and Soenen (1998) showed that the length of the cash conversion cycle was also significantly negatively correlated with firms' stock returns. Reducing the cash conversion cycle to a reasonable minimum may allow managers not only to improve their firms' profitability but also to create shareholder value, a hypothesis that has not yet been tested empirically but will be explored in this study.

More recently, Deloof (2003) and Lazaridis and Tryfonidis (2006) investigated the relationship between the length of the cash conversion cycle and firm profitability using firm-level fixed effects regressions rather than the simple correlation and ordinary least squares regression analyses employed in prior empirical work. Using data for publicly traded firms in Belgium and Greece, respectively, both studies found negative associations between the length of the cash conversion cycle and firms' profitability thus confirming prior empirical evidence. More importantly, however, when separately analyzing the link between each of the three components of the cash conversion cycle and firms' profitability both studies found that decreases in the number of days held in

inventory and accounts receivable were associated with increases in profitability as were decreases in the number of days held in accounts payable.

To date, no empirical study has explicitly focused on exploring the relationship between elements of not-for-profit hospitals' short-term financial management — in particular their management of the revenue cycle — and their long-term financial performance. Not-for-profit hospitals clearly do not face efficient capital markets (Reiter 2004) and effective revenue cycle management may thus allow hospital managers to boost their organizations' profitability and strengthen their ability to grow equity capital. Descriptive research has supported the idea that high-performing hospitals manage the revenue cycle more effectively than low-performing hospitals (Cleverley 1990; Danielson and Fuller 2007; Eldenburg, Schaffer, and Zulauf 2004). Financially well off hospitals have been found to record both higher amounts of patient revenue as a result of higher gross charges and lower revenue deductions and write-offs as well as lower average collection periods as a result of lower investments in accounts receivable (Cleverley 1990; Solucient 2005). Moreover, empirical studies of the factors associated with hospital profitability have shown that short-term financial management in general, and the management of patient revenues and patient receivables in particular, matters (Cody, Friss, and Hawkinson 1995; Gapenski and Vogel 1993). None of these studies, however, has used a comprehensive definition of hospital revenue cycle management performance in terms of both the amount and the speed of patient revenue collection nor has any of these studies extended the analysis to indicators of hospitals' long-term financial performance besides accounting measures of profitability.

Conceptual framework

Aimed at increasing the amount and the speed of patient revenue collection, the effective management of the revenue cycle has important implications for hospitals' profitability and ability to grow their equity capital. The following discussion will first focus on the relationship between revenue cycle management and hospital profitability before examining the relationship between revenue cycle management and hospitals' equity values.

Revenue cycle management and hospital profitability

Generating higher amounts of patient revenue as a result of more effective revenue cycle management has a direct effect on hospital profitability. As part of their management of the revenue cycle, hospital managers may pursue more aggressive pricing and attempt to reduce revenue deductions, in particular contractual allowances granted to third-party payers and charity care, resulting in higher net patient revenues. In addition, more effective revenue cycle management may reduce the number of uninsured and self-pay patients a hospital serves and, consequently, bad debt expenses and operating expenses. Higher patient revenue and lower operating expenses result in higher operating income, net income, and operating cash flows, all of which improve a hospital's profitability. Stockamp, a well-known revenue cycle management consultancy, provides examples of improved hospital profitability due to more effective revenue cycle management. Dallas based Baylor Health Care System, for instance, was able to record over $20 million of annually recurring income statement benefits as a result of improving its revenue cycle

management processes, and Inova Health System in Falls Church, VA, another Stockamp client, reported annually recurring income statement benefits of $45 million.[4]

The second financial benefit of effective revenue cycle management, collecting patient revenue faster, has an indirect effect on not-for-profit hospitals' profitability. Higher speed of revenue collection lowers the balances of accounts receivable on a hospital's balance sheet, which minimizes the need for short-term borrowing and reduces interest expenses (Soenen 1993). Lower interest expenses reduce operating expenses and consequently increase a hospital's operating and net income. Again, referring to the examples provided by Stockamp, Baylor Health Care System benefited from $18 million in balance sheet improvements as a result of managing its revenue cycle more effectively. Likewise, Inova Health System was able to increase its patient cash collection by twelve percent, decrease its days in accounts receivable by eleven percent, and as a result record a balance sheet benefit of $24 million.[5]

Besides reducing short-term liabilities and interest expenses, shorter collection periods may also generate surplus cash that can be invested in short-term financial securities (Soenen 1993). Unlike their for-profit counterparts, which can return excess cash to shareholders in the form of dividends and stock repurchases, not-for-profit hospitals, which do not have this option, tend to hoard excess cash. As a result, not-for-profit hospitals typically maintain substantial financial investments whose earnings represent non-operating revenue and improve profitability through higher net income.

[4] Examples from Stockamp website available at http://stockamp.com/index.jsp?pageID=casestudies.
[5] Examples from Stockamp website available at http://stockamp.com/index.jsp?pageID=casestudies.

Revenue cycle management and hospital equity values

Effective revenue cycle management increases not only a hospital's profitability but also its equity value since fundamentally, a firm's equity value is driven by profitability and growth (Lundholm and Sloan 2004). By expressing equity value as a function of these two drivers, the residual income valuation model exploits this intuition. Residual income is commonly defined as the amount that accounting earnings exceed the capital charge on the book value of equity invested in the firm. Notationally:

$$RI_t = NI_t - (r_E \times B_{t-1})$$

where RI_t is the residual income in year t, NI_t is the net income in year t, r_e is the cost of equity capital, and B_{t-1} is the book value of equity at the end of year t–1. Residual income can also be expressed in terms of return on equity, a commonly used measure of profitability, as can be seen in the following equation:

$$RI_t = NI_t - (r_E \times B_{t-1}) = \left(\frac{NI_t}{B_{t-1}} - r_E\right) \times B_{t-1} = (ROE_t - r_E) \times B_{t-1}$$

where ROE_t is the return on equity for year t, and RI_t , NI_t, r_e, and B_{t-1} are defined as above. The residual income model then computes the equity value of the firm as the sum of its initial equity book value plus the present value of future residual income flows (Lundholm and Sloan 2004). The estimated equity value V_0 at time 0, i.e., at the time of the valuation of the firm, can be written as:

$$V_0 = B_0 + \sum_{t=1}^{T} \frac{RI_t}{(1 + r_E)^t}$$

where B_0 is the equity book value at time 0 and RI_t and r_e are defined as above. If a firm earns future accounting income at a rate exactly equal to its cost of equity capital, then the present value of its future residual income is zero, and V_0 equals B_0. Firms that neither create nor destroy wealth are worth only their current equity book value. However, firms whose ROEs are higher than r_e have equity values greater than their book values and vice versa (Frankel and Lee 1998). The immediate relationship between profitability and equity value can be seen when firm value is rewritten as:

$$V_0 = B_0 + \sum_{t=1}^{T} \frac{RI_t}{(1+r_E)^t} = B_0 + \sum_{t=1}^{T} \frac{(ROE_t - r_E) \times B_{t-1}}{(1+r_E)^t}$$

As described in detail above, effective revenue cycle management increases a hospital's operating and non-operating revenue and decreases its operating expenses. Consequently, a hospital's net income and return on equity, commonly defined as the ratio of net income to equity, go up. At the same time, effective revenue cycle management reduces some of the uncertainty associated with generating and collecting patient revenues by establishing policies and practices that enable the hospital to record all necessary demographic, clinical, and insurance information before and during the provision of care and thus improve its coding, billing, and cash collections. Since the provision of patient care is the core business of most hospitals better revenue cycle management reduces a hospital's collection risk and thus its business risk. Lower business risk, on the other hand, reduces the costs of equity capital. As a result, both hospitals' residual income and their residual income based equity value increase.

Effective revenue cycle management, however, not only increases a hospital's operating and total profit margins but also its free cash flow. Discounted cash flow valuation thus provides an alternative framework for how effective revenue cycle management may help a firm strengthen the value of its equity capital. The classic discounted cash flow valuation model defines a firm's equity value as a function of its free cash flow and its weighted average cost of capital plus excess cash and investments minus long-term debt (Brealey, Myers, and Allen 2007; Grant 1989). Notationally:

$$V_0 = \sum_{t=1}^{T-1} \frac{FCF_t}{(1+WACC)^t} + \frac{FCF_T}{(1+WACC)^T} + ExcessCasInv_0 - LTDebt_0$$

whereby FCF_t is the projected free cash flow in period t, WACC is the weighted average cost of capital, and $ExcessCasInv_0$ and $LTDebt_0$ are the excess cash and investments and the long-term debt a hospital holds at the time of the valuation, respectively.

As described in detail above, effective revenue cycle management increases a hospital's operating and non-operating revenue and decreases its operating expenses resulting in higher net income and operating cash flow. Effective revenue cycle management also reduces a hospital's balance in accounts receivable and thus its net working capital. Both the increase in net income and the decrease in net working capital increase a hospital's free cash flow. Moreover, effective revenue cycle management reduces a hospital's weighted average cost of capital by reducing some of the uncertainty associated with generating and collecting patient revenue and thus the business risk of the hospital. Lower business risk decreases a hospital's cost of equity capital, which is a crucial component of its weighted average costs of capital. As a result of its positive

effects on both free cash flows and the weighted average cost of capital, effective revenue cycle management increases the value of the hospital's equity capital.

Methods

Analytic model

Based on previous empirical studies (Deloof 2003; Lazaridis and Tryfonidis 2006) and the conceptual framework outlined above, I analyze the relationship between revenue cycle management and not-for-profit hospitals' financial performance using ordinary least squares regressions with hospital-level fixed or random effects, whenever appropriate. I estimate two models:

$$P_{it} = \beta_1 RCM_{it} + X_{it}\beta + \mu_i + u_{it}$$

$$V_{it} = \gamma_1 RCM_{it} + Y_{it}\gamma + \mu_i + v_{it}$$

The dependent variables analyzed in the first model are measures of hospital profitability, P_{it}, and the dependent variables analyzed in the second model are measures of hospital equity value, V_{it}. The independent variables of interest for both models are indicators of a hospital's performance at managing the revenue cycle, RCM_{it}. A set of control variables, X_{it} and Y_{it}, is included in each model containing hospital-level organizational and financial characteristics as well as state and year dummy variables. The subscripts i and t refer to hospital i in year t. In all regressions, standard errors are calculated using White's correction for heteroskedasticity.

Because of the potential for hospital-level variation in profitability and firm value, I include hospital-specific error terms, μ_i, which control for unobserved, time-invariant

heterogeneity across facilities, whenever appropriate (Cameron and Trivedi 2005; Greene 2008). Profitability and firm value vary substantially across hospitals. Part of this variation is explained by externally observable hospital characteristics, such as size, ownership, and location. Another part of the variation, however, may be due to time-invariant hospital characteristics that cannot be observed externally, such as internal managerial policies and practices or the quality of the managerial staff (Cody, Friss, and Hawkinson 1995; Gapenski, Vogel, and Langland-Orban 1993). In general, hospital-specific characteristics can be modeled with hospital-level variables, with fixed effects, or with random effects. To determine whether fixed or random effects were preferred over ordinary least squares regression Breusch-Pagan tests were conducted. In all but two cases (residual income based equity values and residual income based equity values based solely on a hospital's operations), Breusch-Pagan tests rejected the null hypothesis that the variance of the random effects was zero implying that either fixed or random effects were preferred to ignoring hospital-specific effects altogether. Then, in a second step, Hausman tests of the null hypothesis that the hospital-level effects were random were conducted to decide whether to include fixed or random effects. In two cases (operating profit margin and free cash flow), Hausman tests indicated that random effects were preferred over fixed effects while in the other two cases (total profit margin and discounted cash flow based equity values), Hausman tests indicated that fixed effects were preferred over random effects.

Measures

Dependent variables

Following the conceptual framework, the dependent variables used in this study consist of six measures of hospital financial performance: In the first model, three measures of hospital profitability — total profit margin, operating profit margin, and free cash flow — are analyzed; in the second model, three measures of hospitals' equity values — two estimates of equity value based on residual income valuation and one estimate based on discounted cash flow valuation — are examined.

Hospital profitability

In general, a hospital's profitability can be measured in terms of either accounting profits or cash flows (Ehreth 1994; Gapenski, Vogel, and Langland-Orban 1993; Phillips 2003). Accounting indicators, such as total and operating profit margins, are commonly used to assess hospitals' financial performance and have great acceptance among practitioners (Cleverley 1990, Solucient 2005). Accountants prefer accounting earnings because they rely on accrual accounting and thus provide a more accurate estimate of the economic value added during a given time period. Finance scholars, on the other hand, have argued that a hospital's true financial condition is more closely related to the cash flow it generates than to its reported income, which can be subject to managerial manipulation (Gapenski, Vogel, and Langland-Orban 1993). Not-for-profit hospitals in particular have been found to engage in managerial earnings management relying on judgment in the use of discretionary accounting accruals, such as the allowance for bad debt expense, to meet earnings objectives (Leone and Van Horn 2005). Accounting profits — and hospital

equity values calculated based on accounting profits — may thus provide inadequate and at times misleading information about the financial health of not-for-profit hospitals (Kane 1991).

Despite these concerns, total profit margin remains one of the most popular indicators of hospital profitability (Clement, D'Aunno, and Poyzer 1993; Cleverley 1990; Ehreth 1994; Solucient 2005). Total profit margin is calculated as the difference between a hospital's total revenue and its total expenses (i.e., its excess of revenue over expenses, or net income) divided by total revenue. It represents the overall profitability of the firm per dollar of revenue earned. A second commonly used measure of hospital profitability is operating profit margin, which measures profitability solely with respect to patient care services and other operating activities (Cleverley 1990; Solucient 2005). Operating profit margin is calculated as the difference between a hospital's operating revenue and its operating expenses (i.e., its operating income) divided by operating revenue. It represents the percentage of operating revenues converted into operating income.

Moreover, in response to the above mentioned concerns regarding accounting measures of profitability, the concept of free cash flow has gained in importance as a measure of hospital profitability, mainly because free cash flow is less vulnerable to managerial earnings management and thus more objective (Horngren et al. 2006; Kane 1991). Hence, for the purpose of this research, free cash flow is analyzed as an additional measure of not-for-profit hospitals' profitability. Free cash flow is calculated as the change in net assets plus interest and noncash expenses minus investments in fixed assets and net working capital (Grant 1989). It represents the amount of cash left over after

undertaking the firm's operations and making all investments necessary to ensure its continued operation (Horngren et al. 2006; Phillips 2003).

Hospital equity values

Unlike profitability, measuring equity values is challenging, particularly for not-for-profit hospitals (Long 1976; McCue, McCue, and Wheeler 1988; Phillips 2003). While the market value of for-profit hospitals' equity can easily be calculated as the product of share price and the number of shares outstanding, the corresponding equity value for not-for-profit hospitals involves forecasting their future financial performance either in terms of cash flows or accounting profits and deriving an estimate of their equity value by discounting these forecasts (Long 1976; Phillips 2003). Two commonly used valuation methods are based on this principle: discounted cash flow valuation, the gold standard in corporate finance, and residual income valuation, a technique advocated for and used by accounting scholars. Finance scholars have long recommended the use of discounted cash flow valuation techniques for purposes of valuing not-for-profit organizations including hospitals (Grant 1989; Long 1976; Phillips 2003). Residual income valuation techniques, on the other hand, have not yet been employed for this purpose. Focusing on earnings rather than dividends, and thus on wealth creation rather than wealth distribution, residual income valuation may, however, be particularly suitable for valuing firms that do not pay dividends, such as not-for-profit organizations (Stowe et al. 2007). Hence, for the purpose of this research, both discounted cash flow and residual income valuation models are used to derive estimates of the value of not-for-profit hospitals' equity capital.

Focusing on equity book values and earnings, residual income valuation provides a simple model that allows users to quickly estimate a firm's equity value (Lee 1996) and existing empirical research has generally provided enthusiastic support for this technique (Dechow, Hutton, and Sloan 1999). For the purpose of this research, residual income based estimates of hospitals' equity values are obtained using a discounted residual income approach sometimes referred to as the Edwards-Bell-Ohlson valuation technique. Following Frankel and Lee (1998) and Stowe and colleagues (2007), I estimate equity value at time t, V_t, using the following simple approach of a short-horizon earnings forecast for one year:

$$V_t = B_t + \frac{(FROE_t - r_E)}{(r_E - g)} \times B_t$$

where B_t is the equity book value at time t, $FROE_t$ is the forecasted return on equity for the period t, r_e is the cost of equity capital, and g is the long-term growth rate. In theory, the forecast horizon should be set large enough for firms to reach their competitive equilibrium (Frankel and Lee 1998). In practice, however, the ability to forecast returns on equity diminishes quickly over time, and forecasting errors are compounded in longer expansions. As a result, I use a forecast horizon of one year only.

The four parameters needed for the estimation are the equity book value (B_t), the return on equity forecasts ($FROE_t$), the cost of equity capital (r_e), and the long-term growth rate (g). First, equity book values are obtained from the hospital's balance sheet. For the purpose of this study, I use a hospital's total net assets as the measure of its equity book value. Unlike their for-profit counterparts, not-for-profit hospitals separate their equity into restricted and unrestricted net assets. While the use of restricted net assets is limited by external donors and grant agencies to specific activities including charity care,

research and teaching, and plant replacements, unrestricted net assets have no such restrictions attached to them and hospital managers thus have considerable discretion over how to use these funds. Both restricted and unrestricted net assets, however, represent equity capital and hospital managers do not care particularly about accounting classifications when attempting to grow the equity of their organization. Moreover, there are several interrelations between restricted and unrestricted net assets and funds categorized as restricted may become unrestricted over time. A donation restricted for the purchase of medical equipment, for instance, is recorded as a temporarily restricted net asset upon receipt of the donation. Once the medical equipment is purchased, however, the temporarily restricted net asset is released from restrictions and becomes part of the hospital's unrestricted net assets. A contribution to an endowment fund, on the other hand, always remains permanently restricted. Any income earned on the endowment fund, however, is recorded as investment income in the hospital's statement of operations and, consequently, increases its unrestricted net assets.

Second, to estimate a hospital's residual income based equity value I calculate the cost of equity capital as the simple average of a hospital's return on equity over the past five years whereby — following the definition of equity book value in terms of total net assets and adjusting the income statement to reflect a clean surplus (Stowe et al. 2007) — return on equity is defined as the change in net assets divided by total net assets. In theory, the cost of a firm's equity capital should reflect the premium demanded by equity investors to invest in a firm or project with comparable risk, which is given by the stock market (Frankel and Lee 1998; Wheeler and Smith 1988). In the absence of a residual claimant, however, the cost of equity financing for not-for-profit hospitals can be difficult

to determine and the hospital's board of directors must usually provide guidance on the return required by the community for capital investments (Wheeler and Smith 1988). The rate of return on a hospital's equity should thus be derived from its long-range financial plan, which indicates the rate of growth necessary to achieve the institution's goals (Conrad 1984; Wheeler and Clement 1990). Hence, one common approach to determining the required return on equity for not-for-profit organizations is to calculate the actual return on equity over the past few years, which can then serve as a starting point in establishing future target growth rates (Wheeler and Smith 1988).

Third, I use a hospital's current return on equity — defined as the change in net assets divided by total net assets — to proxy for its future return on equity (Frankel and Lee 1998). Forecasting future returns on equity represents the most important and difficult task in the residual income valuation exercise. In general, there are two alternative methods to forecast future returns on equity: analysts' earnings forecasts or prior period returns. Since analysts' earnings forecasts are not available for not-for-profit hospitals, the latter alternative is employed in this study.

Finally, since the single-stage residual income model used in this study implies that a hospital has a constant return on equity and a constant earnings growth rate in perpetuity, I assume a long-term growth rate of one percent, which may, however, be a rather conservative estimate of hospitals' growth potentials. In the past two decades, health expenditures have grown at average annual rates of around seven percent (American Hospital Association 2009). The main reason for assuming a much lower growth rate for purposes of this research is that while hospitals' earnings may be growing at rates greater than one percent in the next several years the hospital industry is predicted

to reach a steady state in the near future. Major third-party payers are currently starting to reduce reimbursement rate increases and health policy makers are searching for ways to reform the U.S. health care system to contain costs and thus make the system more sustainable.[6]

Besides estimating residual income based equity values based on a hospital's total profitability, I also estimate hypothetical equity values based solely on a hospital's operating performance. As discussed above, revenue cycle management focuses on generating and collecting revenue from the provision of patient care, which represents the main line of business for hospitals. Effective revenue cycle management thus increases hospitals' operating revenue, reduces their operating expenses, and improves their operating profitability. Effective revenue cycle management does not, however, change the way not-for-profit hospitals manage their often substantial endowments and financial investments with the exception of generating limited surplus funds that may be used for investment purposes. Similar to the analysis of operating margin, the analysis of hospitals' hypothetical equity values based solely on operations may thus shed light on whether revenue cycle management is indeed more strongly related with hospitals' operating performance than with their overall performance.

To estimate hypothetical equity values based solely on operating performance, I redefine return on equity to reflect only the hospital's operating activities. This redefined return on equity is calculated as the ratio of the hospital's change in net assets adjusted for non-operating income to the hospital's total net assets adjusted for assets not used in operations. More specifically, I calculate the adjusted change in net assets, the numerator,

[6] Talk given by Tom Weil, PhD in the Department of Health Management and Policy on February 9, 2010

as the change in net assets multiplied by the ratio of operating income to net income. The denominator, adjusted net assets, is calculated as total net assets multiplied by the ratio of non-financial assets to total assets. Non-financial assets include all of a hospital's assets with the exception of long-term investments and assets limited as to use, both of which consist of cash and investments that are not used in day-to-day operations but are mainly held to generate investment income. The cost of equity capital is then estimated as the average of the hospital's redefined return on equity over the past five years and the redefined return on equity for the current period is used to proxy for its future return on equity. While the so-calculated equity values based solely on operating performance cannot be interpreted as actual equity values they are intended to provide an estimate of the hypothetical equity value of a hospital if the hospital provided only patient care and other operating services, such as research and teaching, using all its assets for this purpose and did not engage in non-operating activities including managing endowments and other financial investments.

Finally, besides accounting based estimates of a hospital's equity value, a third estimate is obtained using discounted cash flow valuation, which defines a firm's equity value as a function of its free cash flow and its weighted average cost of capital (Brealey, Myers, and Allen 2007; Grant 1989). Notationally:

$$V_0 = \sum_{t=1}^{T-1} \frac{FCF_t}{(1+WACC)^t} + \frac{FCF_T}{(1+WACC)^T} + ExcessCasInv_0 - LTDebt_0$$

whereby FCF_t is the projected free cash flow in period t, WACC is the weighted average cost of capital, and $ExcessCasInv_0$ and $LTDebt_0$ are the excess cash and investments and the long-term debt a hospital holds at the time of the valuation, respectively.

First, not-for-profit hospitals' free cash flow is defined as the change in net assets plus interest and noncash expenses minus investments in fixed assets and net working capital (Grant 1989). In practice, the valuation of a hospital requires projecting future free cash flows based on forecasted financial statements. In empirical research studies, however, the use of pro-forma information is not feasible because of the subjective nature of such information and the large number of hospitals for which detailed pro-forma financial statements would have to be developed (Phillips 2003). Consequently, future free cash flows are estimated using the simple average of the free cash flow of the current and two prior periods multiplied by an adjusted annual growth rate. For each hospital year observation in the dataset, five years of future free cash flow are calculated (Grant 1989; Phillips 2003). The annual growth rate is defined as the average annual nominal growth rate in national health expenditures of 7.3 percent from 1990 to 2005 (American Hospital Association 2009) adjusted for differences in a hospital's quality of earnings defined as net income divided by free operating cash flows (Phillips 2003). To adjust a hospital's growth rate I standardize the distribution of the quality of earnings indicator so that hospitals with average earnings quality are assigned the average growth rate of 7.3 percent. Hospitals with below-average earnings quality are assigned lower adjusted growth rates and hospitals with above-average earnings quality are assigned higher adjusted growth rates whereby adjusted growth rates range from 5.1 to 9.5 percent.

Second, not-for-profit hospitals' weighted average cost of capital is calculated as

$$WACC = r_D \times \frac{D}{D+E} + r_E \times \frac{E}{D+E}$$

whereby D is the value of the hospital's debt, E is the value of the hospital's equity, r_D is the cost of debt financing, and r_E is the cost of equity financing (Wheeler and Smith 1988). For purposes of this research, D is defined in terms of a hospital's book value of total liabilities and E is defined in terms of a hospital's book value of total net assets since market values of debt and equity are not easily available for not-for-profit hospitals. Following Wheeler and Smith (1988), the cost of debt financing, r_D, is calculated as net interest expense divided by a hospital's long-term liabilities and the cost of equity financing, r_E, is defined as the simple average of the hospital's return on equity over the past five years as discussed above.

The present value of a hospital's free cash flows is then calculated as the forecasted free cash flows for the first five years discounted at the weighted average cost of capital plus the horizon value plus any excess cash and investments minus long-term debt. The horizon value is calculated using the forecasted free cash flow for year six in perpetuity discounted at the weighted average cost of capital. This calculation of the horizon value implies a growth rate of zero, which may, however, be a rather conservative estimate. As discussed above, the hospital industry is predicted to reach a steady state in the near future as both third-party payers and policy makers are starting to reduce reimbursement rate increases to contain ever increasing health care costs and thus make the system more sustainable.[7]

[7] Talk given by Tom Weil, PhD in the Department of Health Management and Policy on February 9, 2010

Independent variables

Hospital revenue cycle management performance, the independent variable of interest in this study, is measured using two financial indicators of hospitals' ability to generate and collect patient revenue, net patient revenue per total assets as a measure of the amount of patient revenue and days in net accounts receivable as a measure of the speed with which patient revenue is collected. For the purpose of this research, both independent variables were lagged in the analyses to mitigate the problem of reverse causality.

Days in net accounts receivable, also known as the average collection period, represents the most important financial measure of hospitals' performance at revenue cycle management (Berger 2008; Hammer 2005; May 2004; Prince and Ramanan 1992; Quist and Robertson 2004; Solucient 2005). Calculated as net patient accounts receivable times 365 days divided by net patient revenue, the average collection period describes the number of days of net patient revenue that a hospital has due from patient billings after all revenue deductions.

Besides the speed of revenue collection, Rauscher and Wheeler (2008) have argued that an equally important indicator of revenue cycle management performance is a hospital's ability to generate patient revenue by reducing revenue deductions and write-offs. This study measures the amount of revenue generated in terms of net patient revenue per total assets, which is defined as the ratio of a hospital's case mix adjusted net patient revenues to total assets. Scaling net patient revenues by case mix index adjusts for differences in patients' severity of illness across hospitals. Expressing net patient revenues as a percentage of total assets adjusts for differences in size across hospitals and thus differences in the volume of both inpatient and outpatient care provided.

Control variables

Besides revenue cycle management, a number of factors, both internal and external to hospitals, have been found to be associated with their ability to perform well financially and grow their equity capital. One major limitation of fixed and random effects regression models, however, is that coefficients on time-invariant covariates cannot be estimated but are absorbed in the individual-level constant term. Lack of identification is the price of the robustness of the specification to unmeasured correlation between the common effects and the exogenous variables (Greene 2008). For the purpose of this study, lack of identification is a minor issue since I am only interested in the coefficients on the indicators of revenue cycle management performance, which varies within hospitals over time. Lack of identification, however, limits the number of control variables that can be included in analyses in which fixed or random effects are used to the ones described in the following.

First, because of the interrelations between different aspects of short-term financial management, this study not only includes days in net accounts receivable but also controls for a second aspect of hospitals' short-term financial management, the effectiveness of their management of short-term liabilities, measured in terms of days in accounts payable (Deloof 2003; Jose, Lancaster, and Stevens 1996; Lazaridis and Tryfonidis 2006; Shin and Soenen 2000; Soenen 1993). Days in accounts payable is defined as accounts payable times 365 days divided by net patient revenues. Improved long-term financial performance may not only be due to better revenue cycle management but also the result of changes in payment periods. Hospitals may, for instance, choose to lengthen their payment periods to reduce the need for short-term

borrowing and, consequently, their interest expenses, resulting in higher operating and total profit margins, reduced working capital requirements, and thus higher equity values.

Moreover, besides effective working capital management many not-for-profit hospitals rely on non-operating income from endowments and other financial investments to improve their long-term financial performance (Gapenski, Vogel, and Langland-Orban 1993). For the purpose of this study, the extent of a hospital's financial assets is controlled for using the financial asset ratio. The financial asset ratio is calculated as the sum of a hospital's long-term investments and limited use assets divided by its total assets. Hospitals with large endowments and financial investments earn considerable amounts of non-operating income, which increases their net income and total profit margin. Larger proportions of assets held in endowments and financial investments also generate additional cash inflows, all of which increase hospitals' equity values.

Besides financial assets, the condition of a hospital's plant assets, measured in terms of their average accounting age, represents an important factor for hospitals' profitability and their ability to build equity (McCue, McCue, and Wheeler 1988; Phillips 2003). The average age of a hospital's property, plant, and equipment is defined as accumulated depreciation divided by the current year's depreciation expense. The impact of aging facilities on a hospital's profitability and residual income based measures of equity value depends largely on which method the hospital has chosen to depreciate its fixed assets. Higher average age of property, plant, and equipment, however, increases the need to replace aging facilities and equipment resulting in increased cash outflows and, consequently, reduced free cash flows and lower discounted cash flow based equity values (McCue, McCue, and Wheeler 1988).

In addition to the composition of a hospital's assets, long-term financial performance depends on the capital structure of the organization (Deloof 2003; Gapenski, Vogel, and Langland-Orban 1993; Lazaridis and Tryfonidis 2006; Shin and Soenen 2000). Capital structure is controlled for using the debt financing ratio, which is defined as the ratio of total liabilities to total assets. Hospitals with greater debt financing ratios incur higher interest expenses resulting in lower operating income and thus lower operating and total profit margins. Higher proportions of assets financed with debt also result in additional cash outflows required to service the debt and thus reduced free cash flows potentially reducing a hospital's equity value.

Focusing now on operations, the association between a hospital's revenue cycle management policies and practices and its long-term financial performance also depends on the volume of care provided. While previous research has suggested a range of volume measures including admissions, discharges, patient days, and occupancy rates (Long 1976; McCue, McCue, and Wheeler 1988), for the purpose of this research, the volume of patient care provided is controlled for using the total number of patient days since the hospitals analyzed in this study have the fewest missing observations for this variable. In general, revenues are defined as price multiplied by quantity. Besides price effects as a result of more effective revenue cycle management, higher patient revenues may also be due to volume effects. Greater volumes of services provided translate into higher operating and total profit margins as well as increased free cash flow and thus have the potential to increase hospitals' equity capital.

Moreover, the association between revenue cycle management and long-term financial performance depends on how fast a hospital's revenues are growing. Revenue

growth is measured in terms of the ratio of the difference between net patient revenues of the current and the previous period and net patient revenues of the previous period. Hospitals that experience substantial revenue growth may be able to increase current period earnings by recognizing revenues more quickly, for instance by recognizing reduced revenue deductions. Hospitals that experience substantial revenue growth may also record higher free cash flows if the increase in cash flow from operations exceeds the required increase in working capital, including potential increases in accounts receivable, all of which may translate into higher equity values.

As discussed above, lack of identification constitutes a problem in fixed and random effects regression analyses. Ordinary least squares regression analysis without hospital-level fixed or random effects, on the other hand, not only allows for but frequently requires the inclusion of additional hospital-specific controls, such as indicators of size, ownership, and type, to mitigate omitted variable bias. Hence, all ordinary least squares regression analyses include three additional control variables: First, in order to control for differences in size across hospitals, the number of licensed beds is included as a control variable. While descriptive evidence suggests that larger hospitals are more profitable and record higher cash flows (Solucient 2005) empirical evidence on the relationship between hospitals' size and their long-term financial performance is inconclusive (Cody, Friss, and Hawkinson 1995; Gapenski, Vogel, and Langland-Orban 1993). Some authors have argued that larger hospitals may be more profitable due to the flexibility of beds used and economies of scale (Cody, Friss, and Hawkinson 1995) while others have made the opposite argument claiming that larger hospitals may actually experience diseconomies of scale (Gapenski, Vogel, and Langland-Orban 1993).

Second, in order to control for differences in ownership, a binary variable indicating whether or not a hospital is affiliated with a hospital or health system is included as a control variable. Descriptive evidence suggests that system affiliated hospitals perform better financially than free-standing facilities (Solucient 2005). Empirical studies, however, do not support this claim but find that, controlling for other hospital and market characteristics, system affiliation is frequently not associated with hospitals' long-term financial performance (Cody, Friss, and Hawkinson 1995; Gapenski, Vogel, and Langland-Orban 1993).

Third, in order to account for differences between teaching and non-teaching hospitals, a binary variable indicating a hospital's teaching status is included as a control variable. While descriptive evidence points to the fact that teaching hospitals are somewhat more profitable and record higher cash flows than non-teaching institutions (Solucient 2005) empirical studies conclude that teaching hospitals tend to perform worse, a finding that is consistent with the notion that the costs of supporting teaching programs are frequently not offset by the incremental revenues and subsidies generated by such programs (Gapenski, Vogel, and Langland-Orban 1993).

Finally, besides hospital operational and financial characteristics, year and state dummy variables are included as controls. A binary variable for the calendar year of each hospital is included in all analyses to capture intertemporal changes in profitability and equity values that are common to all hospitals in the sample. Moreover, binary variables for each of the 50 U.S. states are included in all ordinary least squares regression analyses to account for differences in hospitals' financial performance across states that are due to

differences in location, such as differences in Medicaid reimbursement rates and policies or state-level insurance regulations.

Data and sample

Description of the data

For the purpose of this study, I analyze audited financial statement information for all bond-issuing, not-for-profit U.S. hospitals collected and provided by Merritt Research Services.[8] The analysis is limited to the years 2000 to 2007. The derivation of some of the variables, however, requires data from up to four prior years, i.e., hospital financial statement information for the years 1996 to 2007 is used in this study.

Derivation of the samples

In order to preserve the sample size as much as possible separate samples are derived for the analyses of hospital profitability, residual income based hospital equity values, and discounted cash flow based hospital equity values (Table 4.1).

Analysis of hospital profitability

The following steps were taken to derive the final sample of 1,170 hospitals and 6,062 hospital year observations (Table 4.1): First, 294 hospital year observations were excluded because of missing or implausible values for operating profit margin, whereby implausible values were defined as those smaller than –20 percent and greater than 20 percent. Second, 34 observations were excluded due to implausible values for total profit

[8] Audited financial statement information for bond-issuing, not-for-profit hospitals was supplied by Merritt Research Services, LLC of Cedar Rapids, Iowa. The software to construct the dataset used in this research was provided by InvestorTools, Inc. of Yorkville, Illinois.

margin, whereby implausible values were again defined as those smaller than –20 percent and greater than 20 percent. Third, seven observations were dropped due to missing values for free cash flow. Fourth, with respect to the independent variables, 177 observations were excluded due to missing values for days in net accounts receivable and 120 observations were dropped due to missing values for net patient revenue per total assets. Finally, with respect to the control variables, 91 observations were excluded due to missing values for days in accounts payable, 32 observations were excluded due to missing values for average age of property, plant, and equipment, 141 observations were dropped due to implausible values for the debt financing ratio whereby implausible values were those smaller than zero and greater than one, 22 observations were excluded due to missing values for the financial asset ratio, and 2,691 observations were dropped because of missing values for patient days. The final sample represents 77.9 percent of all hospitals and 61.4 percent of all hospital year observations in the initial data set.

Analysis of hospital residual income based equity values

The following steps were taken to derive the final sample of 1,005 hospitals and 4,664 hospital year observations (Table 4.1): First, 2,638 hospital year observations were excluded because of missing or implausible values for hospitals' residual income based equity value. Among these were all observations for which the estimated cost of equity capital was negative as this cannot be the case in practice. Second, 25 observations were excluded due to missing or implausibly large values for days in net accounts receivable defined as values greater than 365 days. Third, 49 observations were excluded due to missing values for net patient revenue per total assets. Finally, 114 observations were

dropped due to missing values for days in accounts payable, 27 observations were excluded due to missing values for average age of property, plant, and equipment, and 2,354 observations were excluded due to missing values for patient days. The final sample represents 66.9 percent of all hospitals and 47.2 percent of all hospital year observations in the initial data set.

Analysis of hospital residual income based equity values based on operations

The following steps were taken to derive the final sample of 885 hospitals and 3,732 hospital year observations (Table 4.1): First, 3,570 hospital year observations were excluded because of missing or implausible values for hospitals' residual income based equity value whereby again a substantial number of observations had to be dropped because of negative estimates of the cost of equity capital. Second, 25 observations were excluded due to missing or implausibly large values for days in net accounts receivable defined as values greater than 365 days. Third, 49 observations were excluded due to missing values for net patient revenue per total assets. Finally, 114 observations were dropped due to missing values for days in accounts payable, 27 observations were excluded due to missing values for average age of property, plant, and equipment, and 2,354 observations were excluded due to missing values for patient days. The final sample represents 58.9 percent of all hospitals and 37.8 percent of all hospital year observations in the initial data set.

Analysis of hospital discounted cash flow based equity values

The following steps were taken to derive the final sample of 879 hospitals and 3,310 hospital year observations (Table 4.1): First, 5,174 hospital year observations were excluded because of missing values for hospitals' discounted cash flow based equity values. More specifically, 1,981 observations were excluded because their forecasted free cash flow was missing or negative, which prevented the use of the simplified discounted cash flow valuation model developed above and would have required more detailed analysis and valuation on a case by case basis; 35 observations were dropped because earnings quality could not be assessed and no reliable estimate of the growth rate of the free cash flows could thus be calculated; 3,088 observations were excluded because the estimated return on equity was missing or negative; 71 observations were dropped because the weighted average cost of capital was missing or negative; and nine observations were excluded because information on long-term investments was missing. Moreover, nine observations were excluded because of missing values for days in net accounts receivable, 25 observations were excluded because of missing values for net patient revenues per total assets, 27 observations were excluded due to missing values for days in accounts payable, six observations were excluded due to missing values for average age of property, plant, and equipment, and 1,320 observations were dropped due to missing values for patient days. The final sample represents 58.5 percent of all hospitals and 33.5 percent of all hospital year observations in the initial data set.

Table 4.1: Sample Derivation

	Profitability	**Residual income based equity value**	**Residual income based equity value based on operations**	**Discounted cash flow based equity value**
Number of hospital year observations in the initial data set	9,871	9,871	9,871	9,871
Observations excluded due to missing or implausible values for:				
Operating profit margin	294	N/A	N/A	N/A
Total profit margin	34	N/A	N/A	N/A
Free cash flow	7	N/A	N/A	N/A
Residual income based equity value	N/A	2,638	3,570	N/A
Discounted cash flow based equity value	N/A	N/A	N/A	5,174
Days in net accounts receivable	377	25	25	9
Net patient revenue per total assets	120	49	49	25
Days in accounts payable	91	114	114	27
Average age of property, plant, and equipment	32	27	27	6
Debt financing ratio	141	0	0	0
Financial asset ratio	22	0	0	0
Patient days	2,691	2,354	2,354	1,320
Revenue growth	0	0	0	0
Number of hospital year observations in the final sample (as a percentage of the initial data set)	6,062 (61.4%)	4,664 (47.2%)	3,732 (37.8%)	3,310 (33.5%)

Representativeness of the final samples

The missing data problems encountered in the process of deriving the samples raise the question of the extent to which the final samples are representative of all bond-issuing, not-for-profit U.S. hospitals. To provide an assessment of representativeness, a set of organizational and financial characteristics of the hospitals in the four final samples was compared to those of all hospitals (Table 4.2). The hospitals in the four final samples were found to be relatively similar to all bond-issuing, not-for-profit hospitals with the exception of financial performance. Hospitals in all four samples tended to recorded substantially higher operating and total profit margins than all bond-issuing, not-for-profit hospitals. Hospitals in the final samples used to analyze both residual income and discounted cash flow based equity values, however, recorded the highest operating and total profit margins. This result is likely due to the fact that hospitals that did not perform well financially during all or parts of the study period, e.g. hospitals with negative forecasted free cash flows or negative estimated costs of equity capital, were excluded from the samples to allow the calculation of reasonable equity value estimates. Furthermore, hospitals for which discounted cash flow based equity values could be calculated were more likely to be part of a hospital system. This result is consistent with prior empirical evidence indicating that hospital systems frequently perform better financially than free-standing facilities as shown above (Solucient 2005).

Table 4.2: Representativeness of the Final Samples

	Profitability	**Residual income based equity value**	**Residual income based equity value based on operations**	**Discounted cash flow based equity value**	**All hospitals**
Hospital year observations included	6,062	4,664	3,732	3,310	9,871
Size					
Number of hospital beds	426	445	436	460	441
Net patient revenues (in 000)	332,680	356,919	360,888	373,010	358,749
Hospital ownership and type					
System affiliated hospitals	21.6%	21.5%	22.1%	23.9%**	21.7%
Teaching hospitals	18.1%	18.7%	17.4%	17.9%	17.6%
Operating performance					
Case mix index	1.32**	1.33**	1.33**	1.32**	1.31
Occupancy rate	62.1%	62.5%*	62.1%	62.5%	61.8%
Average length of stay	4.8	4.8	4.7	4.8	4.9
Financial performance					
Operating profit margin	1.2**	1.7**	2.6**	2.5**	0.8
Total profit margin	3.9**	4.6**	5.0**	5.2**	3.5

Notes: Sample means are presented for all variables. Actual sample sizes for the final samples and all hospitals that were used in the calculations may be lower than the number of hospital year observations because of missing or implausible data elements that were excluded for the comparisons and t-tests reported above. * denotes difference in means between the respective final sample and all hospitals is statistically significant at the five percent confidence level. ** denotes difference in means between the respective final sample and all hospitals is statistically significant at the one percent confidence level.

Results

Descriptive results

Hospital profitability

On average, hospitals reported total profit margins of 3.9 percent and operating profit margins of 1.2 percent (Table 4.3). Median total and operating profit margins were 3.9 percent and 1.6 percent, respectively. Both total and operating profit margins varied considerably across hospitals as shown by the between group standard deviations of 3.8 and 4.3, respectively. They also varied within hospitals but to a smaller extent, as shown by the within group standard deviations of 2.8 and 2.6, respectively. The median hospital reported free cash flows of $3,544,500 while the average free cash flow was $7,295,772. Unlike operating and total profit margins, free cash flows varied more within than across hospitals as evidenced by the within and between group standard deviations of $29,318,990 and $24,421,640, respectively.

Hospital residual income based equity values

As described above, the calculation of a hospital's residual income based equity value is a function of the book value of its net assets, its cost of equity capital, its forecasted return on equity, and its long-term growth rate. Between 2000 and 2007, hospitals reported median net assets of $122,019,000. Their median cost of equity capital and forecasted return on equity were 6.8 percent and 7.4 percent, respectively, while their average cost of equity capital and forecasted return on equity were 7.4 percent and 7.3 percent, respectively. For almost 50 percent of hospitals the forecasted future return on equity was thus smaller than the cost of equity capital resulting in negative estimated

equity values. As a result, hospitals recorded median residual income based equity values of $105,008,500 but average residual income based equity values of –$1,175,310,000 (Table 4.3). Residual income based equity values varied substantially both across and within hospitals as evidenced by the between and within group standard deviations of $38,300,000,000 and $84,400,000,000.

Hospital residual income based equity values based on operations

The calculation of a hospital's equity value based solely on operations requires adjusting its cost of equity capital and its forecasted return on equity on the basis of its operating performance. Between 2000 and 2007, the median hospital reported adjusted costs of equity capital and adjusted forecasted returns on equity of 6.6 percent and 6.0 percent, respectively, while average costs of equity capital and adjusted forecasted returns on equity were 8.6 percent and 6.9 percent, respectively. The finding that both median and average forecasted return on equity were less than median and average cost of equity capital mirrors the trend of hospitals' declining operating performance during the late 1990s and early 2000s (American Hospital Association 2009). During this time, the proportion of hospitals with negative operating margins increased to almost 40 percent before declining to around 30 percent in the mid-2000s. As a result, median residual income based equity values based on operations only were $74,218,770, which is substantially lower than hospitals' median net assets of $120,450,000 (Table 4.3). Average equity values were $1,236,656,000 despite a substantial proportion of hospitals for which the forecasted future return on equity was smaller than the cost of equity capital. Again, equity values varied substantially both across and within hospitals as

evidenced by the between and within group standard deviations of $16,000,000,000 and $32,500,000,000, respectively.

Hospital discounted cash flow based equity values

As described above, equity values based on discounted cash flow valuation are a function of a hospital's free cash flows and its weighted average cost of capital. The hospitals in the sample reported median forecasted free cash flows of $6,233,833 per year, which, discounted at the median weighted average cost of capital of 5.2 percent, translated into a median present value of the projected free cash flows for the first five years of $32,973,200. The median present value of the horizon was $142,487,700 and the resulting median discounted cash flow based equity value was $144,763,600 (Table 4.3). Average discounted cash flow based equity values were $390,939,600 and varied substantially across hospitals as evidenced by the between group standard deviation of $783,358,800 but less within hospitals as evidenced by the within group standard deviation of $557,600,900.

Comparison of residual income and discounted cash flow based equity values

For the smallest of the four final samples, the sample of 3,310 hospital observations for which I was able to estimate discounted cash flow based equity values, the median residual income based equity value was $122,272,600 and the median residual income based equity value based on operations only was $79,288,590, compared to median discounted cash flow based equity values of $144,763,600. This translated into median equity values per bed of $484,982, $345,072, and $581,835, respectively. These estimates

are somewhat higher than the estimates reported in prior empirical studies. McCue, McCue, and Wheeler (1988), for instance, report an average price of $68,917 paid per bed in hospital mergers and acquisitions between 1978 and 1984. They also note, however, that the standard deviation of $50,547 for price per bed is very high, which suggests a great deal of variation in the actual prices paid per bed. A more recent study by Phillips (2003) finds that for 30 hospital mergers and acquisitions between 1992 and 1996 the average price paid per bed was $322,456 with a standard deviation of $205,302. Finally, McCue and Kim (2005) report median prices per bed of between $110,416 and $316,335 for 67 hospital mergers and acquisitions between 1999 and 2001. Given that neither the estimates of price per bed published in the literature nor the estimates calculated in this study are adjusted for inflation and given that the hospitals analyzed in this study tend to be larger, better performing hospitals than both the average U.S. hospital and any hospital likely to be acquired in a merger or acquisition, the equity values derived in this study appear to produce reasonable estimates of hospitals' market value of equity.

As expected, residual income and discounted cash flow based equity values for each of the 3,310 hospital year observations were not numerically identical but positively correlated as shown by a correlation coefficient of 0.21 (p-value < 0.001). In theory, under the same set of assumptions, residual income and discounted cash flow valuation are expected to result in identical estimates of firms' equity values (see Appendix B). In practical applications, however, equity values calculated using residual income valuation differ from equity values calculated using discounted cash flow valuation due to the simplifications in the valuation models used and the differences in the assumptions made.

Both residual income and discounted cash flow based equity values, on the other hand, were only weakly associated with residual income based operating equity values. The correlation coefficient between the two residual income based equity values was 0.03 (p-value = 0.14) and the correlation coefficient between discounted cash flow based equity values and residual income based equity values based on operations was 0.06 (p-value = 0.002). These results were not unexpected. Hospitals that perform well financially and are able to grow their equity capital with the help of endowments and financial investments do not necessarily earn most of their income from the provision of patient care. Indeed, given that almost 40 percent of U.S. hospitals currently have negative patient margins (American Hospital Association 2009) these hospitals may have to rely more extensively on non-operating revenues in order to remain profitable and build equity, partially because of their comparatively poor operating performance.

Revenue cycle management performance

Hospitals in the largest of the four samples analyzed in this study (the sample used to analyze hospitals' profitability) recorded a median of 59.1 days and an average of 60.8 days in net accounts receivable during 2000 to 2007 (Table 4.3). Average collection periods varied considerably across hospitals as shown by the sample between group standard deviations of 14.4 days. Average collection periods varied somewhat less within hospitals as evidenced by the within group standard deviation of 9.9 days. Average case mix adjusted net patient revenue per total assets equaled 0.64, i.e., hospitals collected an average of 64 cents in case mix adjusted net patient revenue for each dollar invested in assets. Median net patient revenue per total assets was 0.61. Like average collection

periods, average net patient revenue per total assets varied considerably across hospitals (as shown by the between group standard deviation of 0.25) but less within hospitals (as shown by the within group standard deviation of 0.08). These results did not differ substantially from the descriptive results for the independent variables in the samples used to analyze residual income and discounted cash flow based equity values, which were therefore omitted in Table 4.3.

Control variables

Between 2000 and 2007, the sample hospitals provided an average of 97,950 days of patient care per year and their net patient revenues grew at an average annual rate of 8.6 percent (Table 4.3). They reported an average of 19.1 days in days in accounts payable. Their average age of their property, plant, and equipment was 9.9 years. 27 percent of hospitals' assets represented financial assets and 48 percent of all assets were financed with debt. Again, these descriptive results did not differ much from the descriptive results for hospital in the samples used to analyze residual income and discounted cash flow based equity values, which were therefore not included in Table 4.3. Moreover, as shown in Table 4.2, the average number of licensed beds was 426. An average of 21.6 percent of hospitals was affiliated with a hospital or health system and 18.1 percent were teaching hospitals.

Table 4.3: Descriptive Results

Variables	Median	Mean (standard deviation)	Between group standard deviation	Within group standard deviation
Hospital profitability				
Total profit margin	3.88	3.93 (4.35)	3.79	2.82
Operating profit margin	1.63	1.18 (4.58)	4.35	2.60
Free cash flow	$3,544,500	$7,295,772 ($37,212,600)	$24,421,640	$29,318,990
Hospital equity values (in 000s)				
Residual income based equity value	$105,009	–$1,175,310 ($93,100,000)	$38,300,000	$84,400,000
Residual income based equity value based on operations	$74,219	$1,236,656 ($36,300,000)	$16,000,000	$32,500,000
Discounted cash flow based equity value	$144,764	$390,940 ($968,127)	$782,359	$557,601
Revenue cycle management performance				
Days in net accounts receivable	59.12	60.76 (16.85)	14.40	9.94
Net patient revenue per total assets	0.61	0.64 (0.25)	0.25	0.078
Control variables				
Days in accounts payable	15.9	19.10 (11.61)	11.62	4.63
Average age of property, plant, and equipment	9.6	9.93 (2.70)	2.58	1.21
Financial asset ratio	0.27	0.27 (0.15)	0.14	0.056
Debt financing ratio	0.48	0.48 (0.16)	0.16	0.052
Patient days	53,764	97,950 (172,584)	164,960	15,484
Revenue growth	0.080	0.086 (0.083)	0.062	0.069

Notes: Summary statistics for the independent and control variables are calculated for the largest of the three samples, the sample derived for the analysis of hospital profitability, which included 6,062 hospital year observations. Descriptive results for the independent and control variables for the sample used to analyze both residual income and discounted cash flow based equity values are very similar to the results presented above and are thus not presented in Table 4.3. Summary statistics for the number of licensed beds, system affiliation, and teaching status are presented in Table 4.2 and thus omitted in Table 4.3.

Multivariate regression results

Hospital profitability

Effective revenue cycle management is associated with improved hospital profitability (Table 4.4). As expected, all three regressions find negative coefficients on days in net accounts receivable and positive coefficients on net patient revenue per total assets. A decrease in the average collection period by one day was associated with increases in total and operating profit margins of 0.068 and 0.065 percentage points, respectively, as well as an increase in free cash flows of $50,830. These findings are consistent with prior empirical evidence for for-profit firms in various industries besides health care (Deloof 2003; Lazaridis and Tryfonidis 2006; Shin and Soenen 1998; Soenen 1993; Wang 2002) and provide statistical evidence that the positive relationship between the effective management of accounts receivable and profitability also applies to not-for profit hospitals.

Moreover, an increase in net patient revenue per total assets of one percentage point was associated with an increase in total profit margin of 0.02, an increase in operating profit margin of 0.03, and an increase in free cash flow of $12,971 providing seminal empirical evidence that, besides accounts receivable management, managing the amount of patient revenue plays an important role for not-for-profit hospitals' profitability.

Almost all coefficients on the control variables included in the model were of the expected sign and highly significant (Table 4.4). As expected, both total and operating profit margins increased with increases in the growth in patient revenues and the proportion of assets held in financial assets. Both profit margins decreased with increases

in the proportion of assets financed with debt and the average payment period. However, while total profit margin increased with increases in the average age of property, plant, and equipment operating profit margins decreased slightly as the hospital's fixed assets got older. Furthermore, free cash flows increased with the volume of care provided and the proportion of assets held in financial assets and decreased with the number of days held in accounts payable and the average age of property, plant, and equipment.

Table 4.4: Regression Analysis of Hospital Profitability

Variables	***Total Profit Margin***	***Operating Profit Margin***	***Free Cash Flow (in 000s)***
Constant	8.37**	6.08**	–8,330.50*
	(.77)	(.59)	(3,274.25)
Revenue cycle management performance			
Days in net accounts receivable	–.0677**	–.0649**	–50.83*
	(.0056)	(.0049)	(24.70)
Net patient revenue per total assets	1.77**	3.34**	12,970.55**
	(.53)	(.38)	(2,245.39)
Control variables			
Days in accounts payable	–.0318**	–.0536**	–184.12**
	(.0094)	(.0071)	(52.70)
Average age of PPE	.223**	–.008**	–336.22*
	(0.039)	(.031)	(157.78)
Debt financing ratio	–10.52**	–7.66**	N/A
	(.82)	(.57)	
Financial asset ratio	7.21**	3.27**	9,594.87**
	(.75)	(.58)	(3,262.93)
Patient days (in 000s)	.0025	.0084	.083**
	(.0016)	(.0061)	(.017)
Revenue growth	7.88**	10.17**	–926.66
	(.90)	(1.13)	(5,609.04)
Year dummies	7 included	7 included	7 included
Hospital fixed or random effects	1,170 fixed effects included	1,170 random effects included	1,170 random effects included
Adjusted R^2	.21	.17	.15

Notes: Heteroskedasticity robust White standard errors are in parentheses. * Statistically significant at the 5 percent confidence level. ** Statistically significant at the 1 percent confidence level. Independent variables were lagged in all analyses.

Hospital equity value

Effective revenue cycle management is associated not only with improved profitability but also with higher equity values (Table 4.5). While all three regressions found negative coefficients on days in net accounts receivable, only the one in the analysis of discounted cash flow based equity values was statistically significant. A decrease in days in net accounts receivable by one day was found to be associated with an increase in discounted cash flow based equity values of $4,009,301. Moreover, all three regressions found positive coefficients on net patient revenue per total assets. Again, only the coefficient in the analysis of discounted cash flow based equity values was statistically significant indicating that an increase in net patient revenues per total assets by one percentage point was associated with an increase in discounted cash flow based equity values of $9,110,706.

The coefficients on the control variables included in the model were, for the most part, not statistically significant with the exception of the analysis of discounted cash flow based equity values (Table 4.5). Besides the amount and the speed of revenue collection the two other factors that explained changes in discounted cash flow based equity values were a hospital's debt financing ratio and its proportion of assets invested in financial assets. Discounted cash flow based equity values increased with increases in both debt financing ratio and financial asset ratio.

Table 4.5: Regression Analysis of Hospital Equity Values (in 000s)

Variables	***Residual income based equity value***	***Residual income based equity value based on operations***	***Discounted cash flow based equity value***
Constant	13,600,000 (10,600,000)	–2,689,495 (5,071,391)	–847,814 (491,161)
Revenue cycle management performance			
Days in net accounts receivable	–19,719.89 (70,855.38)	–39,100.32 (23,815.46)	–4,009.30** (1,426.33)
Net patient revenue per total assets	3,283,804.00 (4,522,106.00)	4,181,330.00 (2,599,206.00)	911,070.60** (157,983.80)
Control variables			
Days in accounts payable	4,767.81 (16,330.44)	76,807.76 (56,075.53)	–4,335.95 (2,595.65)
Average age of PPE	–567,593.30 (595,644.50)	–395,933.20* (197,533.20)	–699.24 (11,797.91)
Debt financing ratio	–11,100,000 (11,800,000)	–266,729 (1,465,720)	518,754.60* (217,767.70)
Financial asset ratio	–6,139,638 (8,001,178)	9,982,299 (7,052,621)	696,743.00** (207,897.90)
Patient days (in 000s)	11,687.31 (6,513.07)	7,413.31 (4,344.10)	4,090.35 (3,762.15)
Revenue growth	–22,700,000 (28,800,000)	4,653,631 (6,032,652)	324,122.90 (184,681.10)
Licensed beds	–5,513.80 (4,605.00)	–2,928.49 (2,787.12)	N/A
Teaching status	4,674,830 (3,393,838)	5,745,481 (4,233,651)	N/A
System affiliation	4,312,127 (3,202,288)	–1,620,752 (991,434.80)	N/A
Year dummies	7 included	7 included	7 included
State dummies	49 included	48 included	N/A
Hospital fixed or random effects	N/A	N/A	879 fixed effects included
Adjusted R^2	.0067	.021	.33

Notes: Heteroskedasticity robust White standard errors are in parentheses. * Statistically significant at the 5 percent confidence level. ** Statistically significant at the 1 percent confidence level. Independent variables were lagged in all analyses.

Sensitivity analyses

Sensitivity analyses were conducted to determine whether the results for hospitals' equity values were robust to the use of different subsamples of bond-issuing, not-for-profit hospitals and to variations in some of the key assumptions made in the calculation of hospitals' equity values. First, due to different data requirements, three separate samples were derived to calculate and analyze hospitals' equity values. While the hospitals in these three samples did not differ substantially from all bond-issuing, not-for-profit hospitals in terms of their organizational characteristics their financial performance was notably better (Table 4.2) and hospitals for which discounted cash flows could be calculated reported the strongest financial performance. The above finding of a lack of statistically significant relationships between revenue cycle management performance and not-for-profit hospitals' residual income based equity values may thus be the result of using samples that include broader ranges of hospitals whose financial performance is, on average, somewhat weaker and may not be robust to using a sample that includes only the most profitable hospitals. Additional analyses of the relationship between revenue cycle management performance and residual income based equity values for the subset of highly profitable hospitals for which both residual income and discounted cash flow based equity values were available, however, provided little evidence for this explanation. With the exception of the coefficient on net patient revenue per total assets in the analysis of residual income based equity values, which remained positive but became statistically significant, none of the results changed. The above findings thus appear to be relatively robust to small differences in financial performance across hospitals.

Moreover, the calculation of both residual income and discounted cash flow based equity values requires a number of assumptions and the results obtained may be an artifact of the specific set of assumptions made. Sensitivity analyses, however, showed that the findings for both residual income and discounted cash flow based equity values were relatively robust to changes in several of the key assumptions. In the calculation of residual income based equity values, for instance, assuming long-term growth rates of zero or three percent rather than one percent did not affect the results. Likewise, redefining a hospital's forecasted return on equity as the weighted average of its return on equity over the past three years did not change the findings. Moreover, excluding observations with negative residual income based equity values or, alternatively, replacing the estimated equity value with the book value in those cases in which residual income based equity values were smaller than equity book values did not produce substantially different findings.

Likewise, the findings for discounted cash flow based equity values were relatively robust to variations in their calculation including redefining the forecasted free cash flow as the simple average of the free cash flows over the past five rather than three years and using a lower average growth rate of three percent, which mirrors the average annual GDP growth during the study period, rather than using an average annual growth rate of 7.3 percent. Furthermore, excluding observations with negative equity values or, alternatively, replacing estimated equity values with equity book values in those cases in which discounted cash flows based equity values were smaller than equity book values did not affect the findings of this study.

Discussion

One of the most important findings of this study is that not-for-profit hospitals' profitability is clearly linked to their performance at managing the revenue cycle. This research thus provides seminal empirical evidence that successful revenue cycle management is not only associated with improved profitability of for-profit firms but also plays an important role in the financial performance of not-for-profit hospitals. As expected, greater amounts of patient revenue and faster collection periods are associated with improved operating and, to a somewhat smaller degree, total profit margins. As hospitals adopt more aggressive pricing policies and reduce revenue deductions and write-offs, their operating revenue increases, which results in higher operating income and, consequently, operating margins (Cody, Friss, and Hawkinson 1995). Higher patient revenue also has a positive, albeit smaller, effect on total margins. While operating income represents an important element of net income, the latter also depends on non-operating activities, in particular the efficient management of endowments and financial investments (Solucient 2005). Especially larger, well performing, not-for-profit hospitals, such as the ones analyzed in this study, have been found to generate substantial amounts of non-operating income (Cleverley 1990), which may be the most important reason for why net patient revenue per total assets displays a stronger link with operating rather than total profit margins.

Besides the amount of patient revenue, the speed with which hospitals collect their revenue plays an important role for their profitability. Shorter collection periods are associated with improvements in both operating and total profit margins. Collecting patient revenues faster reduces a hospital's balance in accounts receivable and,

consequently, its need for short-term financing and thus its interest expenses. Reduced interest expenses translate into higher operating and net income and improved profit margins. Unlike net patient revenue per total assets, which is more strongly associated with a hospital's operating performance, days in net accounts receivable displays an almost equally strong link with both operating and total profitability. Given that — similar to increases in net patient revenue — reductions in interest expenses have a direct effect on a hospital's operating performance but only an indirect effect on its total profitability, this finding may indicate that hospital managers use surplus cash as a result of shorter collection periods not only to reduce their organizations' short-term liabilities but also to invest in short-term securities, which produce additional investment income and, consequently, increase non-operating income.

Furthermore, as expected, greater amounts of patient revenue and shorter collection periods are associated with higher free cash flows. Generating more patient revenue results in additional cash inflows from patients and third-party payers, which boosts a hospital's cash flow from operations, one of the major components of its free cash flow. Likewise, each reduction in accounts receivable results in a one-time cash inflow as it reduces a hospital's investment in working capital and thus increases its free cash flow. While previous research has suggested that there may be a link between effective working capital management and firms' free cash flow (Jose, Lancaster, and Stevens 1996; Soenen 1993), no empirical studies have tested this hypothesis. This research thus provides seminal empirical evidence that there is indeed a positive relationship between the effectiveness of one aspect of an organization's short-term

financial management — its management of the revenue cycle — and its free cash flow, at least in the case of not-for-profit hospitals.

A second important finding of this study is that improved revenue cycle management performance is associated with not-for-profit hospitals' abilities to grow their equity capital. The strength of this relationship, however, depends on the valuation technique used. The link between revenue cycle management performance and hospitals' ability to grow equity is particularly strong for equity value estimates based on discounted cash flow valuation. As shown in the analysis of hospital profitability, effective revenue cycle management is strongly and positively associated with free cash flow, one of the main elements of discounted cash flow valuation. Not surprisingly, greater amounts of patient revenue and shorter collection periods are thus also associated with higher discounted cash flow based equity values. Given that corporate finance theory has long considered short-term financial management to be irrelevant for the value of the firm (Lewellen, McConnell, and Scott 1980) this study of not-for-profit hospitals provides empirical evidence that, in practice, market imperfections may allow managers to use short-term financial management strategies, such as revenue cycle management, to grow their organizations' equity.

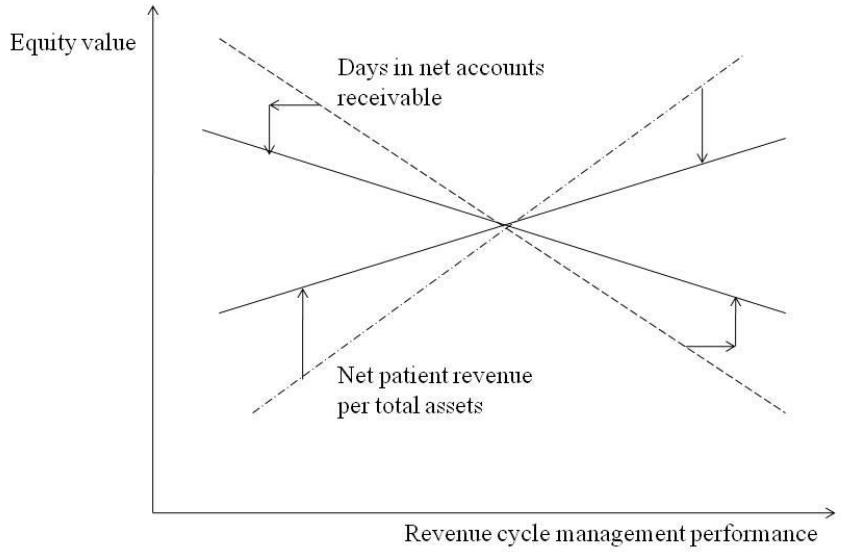
The link between revenue cycle management performance and hospitals' ability to grow equity, however, is weaker when hospitals' equity values are estimated using residual income valuation. As described above residual income valuation defines a hospital's equity value based on its reported accounting earnings, in particular its net income, a measure of its total profitability. Hence, the relationship between revenue cycle management performance and hospitals' equity values mirrors the relationship between

revenue cycle management performance and hospitals' total margins. As expected and consistent with the findings for total margins, the amount of a hospital's patient revenues is positively and the length of its collection period is negatively associated with residual income based equity values. Unlike in the analysis of total profit margins, however, the coefficients on net patient revenue per total assets and days in net accounts receivable are not statistically significant, which may partially be the result of attenuation bias due to the fact that accounting values were used in the calculations, which tend to be vulnerable to managerial earnings management.

Like many for-profit firms, not-for-profit hospitals have been found to engage in substantial manipulations of earnings (Burgstahler and Dichev 1997; Leone and Van Horn 2005). Empirical evidence suggests that not-for-profit hospitals have an incentive to manage earnings to a range just above zero both by adjusting discretionary spending (Hoerger 1991) and by taking advantage of the subjective nature of certain accounting accruals, such as the allowance for bad debt expenses (Berger 2008). Accounting manipulations may thus reduce the variance in hospitals' reported earnings and residual income based equity values while also changing hospitals' indicators of revenue cycle management performance. Manipulations of the allowance for bad debt expenses, for instance, not only result in misrepresentations of a hospital's earnings but also affect its accounts receivable. Hospitals with high positive earnings may increase their allowance for bad debt expenses to reduce their reported earnings. This manipulation, however, also translates into lower balances in accounts receivable and thus shorter collection periods. Hospitals with low negative earnings, on the other hand, may have an incentive to decrease their allowance for doubtful accounts to increase their reported earnings, which

leads to higher balances in accounts receivable and longer collection periods. As a result, both days in net accounts receivable and equity values calculated based on reported earnings decrease for well performing hospitals and increase for poorly performing hospitals biasing the slope coefficient on days in net accounts receivable toward zero (Figure 4.1).

Figure 4.1: Effect of Managerial Earnings Management on the Relationship between Revenue Cycle Management Performance and Equity Values



A final important finding of this study is that the pathway through which effective revenue cycle management contributes to a hospital's long-term financial performance relies on improvements to its day-to-day operations, thus strengthening its operating performance. Effective revenue cycle management displays a stronger relationship with

hospitals' operating rather than total profit margins and the findings for hospitals' hypothetical equity values calculated under the assumption that all its equity is used in operations compared to the findings for hospitals' total residual income based equity values provide some, albeit weak, additional evidence for this link. Analogous to the findings for hospitals' operating margins, in the analysis of hospitals' hypothetical equity values based solely on their operating performance, the coefficient on days in accounts receivable is positive and the coefficient on net patient revenue per total assets is negative. This result suggests that, in the hypothetical case in which hospitals used all their equity for the provision of patient care and were able to maintain their current operating performance, they would benefit more strongly from improved revenue cycle management performance compared to the status quo, in which they use only parts of their equity capital in operations.

While in the expected direction, both regression coefficients, however, are only borderline statistically significant (p-values of 0.10 on days in net accounts receivable and 0.11 on net patient revenue per total assets). This finding may again be partially attributable to attenuation bias as a result of managerial earnings management. Continuing the discussion above, managerial earnings management may not only affect hospitals' residual income based equity values but may also result in biased estimates of their hypothetical equity values based solely on operations. Manipulations of the allowance for bad debt expense, for instance, may not only lead to misrepresentations of a hospital's net income but also of its operating income. As a result, the variance in both hospitals' adjusted return on equity and their so-derived residual income based equity values decreases. Moreover, while the variance in hospitals' days in net accounts

receivable increases as a result of manipulations of the allowance for doubtful accounts net patient revenue per total asset remains unchanged resulting in regression coefficients that are biased toward zero (Figure 4.1).

Study limitations and future work

Non-random samples of U.S. hospitals

The hospitals analyzed in this study do not represent random samples of U.S. hospitals, which limits the generalizability of the findings. The Merritt Research Services database includes only bond-issuing, not-for-profit U.S. hospitals. These hospitals are generally larger and better performing than the average U.S. hospital — they have higher occupancy rates, lower average lengths of stay, greater cash reserves, and stronger operating and total profit margins. The subsets of hospitals analyzed for the purpose of this research are very similar to all bond-issuing, not-for-profit hospitals with the exception of financial performance where the former report even stronger results. The findings of this study thus likely hold true for larger, financially well-off, not-for-profit hospitals but may not be generalizable to smaller, poorer performing hospitals and caution should therefore be exercised when interpreting the findings.

Moreover, the results may not generalize to for-profit hospitals, which have been found to differ from not-for-profit hospitals on a number of organizational and financial characteristics and which can grow equity not only by retaining and reinvesting earnings but also by issuing shares. A more complete picture of the relationship between revenue cycle management performance and both for-profit and not-for-profit hospitals'

profitability and ability to grow equity thus awaits the analysis of a larger, more representative sample of U.S. hospitals.

Measurement of the amount of patient revenue

Measuring changes in the amount of revenue a hospital generates due to improved revenue cycle management in terms of net patient revenue per total assets has several limitations, which may affect the findings of this research as well as their interpretation. First, as discussed above, any increases in net patient revenue per total assets may be the result of both price and volume effects. Revenue cycle managers, however, focus most of their attention on increasing price by reducing revenue deductions and other write-offs and not on increasing patient volume. This study controls for the effect of changes in patient volumes by including the number of patient days as a control variable. Patient days, however, only reflect a hospital's volume of inpatient care and do not take into account any outpatient care provided, which represents an increasingly important part of most hospitals' business (American Hospital Association 2009).

Moreover, increases in net patient revenue per total assets may also be due to changes in a hospital's asset base rather than improved revenue cycle management. To control for changes in total assets, hospitals' average age of property, plant, and equipment is included in the analysis. This variable, however, only takes into account changes in hospitals' fixed assets and does not control for changes in current assets. Future work should thus employ alternative measures of hospitals' ability to generate patient revenues, such as net patient revenue per adjusted discharge or net patient revenue

expressed as a proportion of gross patient revenue, to determine the robustness of the findings in this study.

Estimation of not-for-profit hospitals' equity values

Since all the hospitals in this study are not-for-profit hospitals, market values of their equity capital are not available but had to be estimated with the help of residual income and discounted cash flow valuation techniques. In theory, under the same set of assumptions, both valuation models result in equal estimates of a firm's equity value (for a mathematical proof, see Appendix B). My implementation of these models, however, relies on a number of simplifying assumptions and leaves much room for improvement. Both models employed in this study, for instance, rely solely on information about a hospital's past performance and do not take into account information about current and future developments that may change historical earnings and cash flow trends. Analysts' earnings forecasts, however, have been shown to contain more value-relevant information than historical accounting information alone (Dechow, Hutton, and Sloan 1999; Frankel and Lee 1998). The sole use of historical information may thus focus too much on the status quo and either overstated or understated hospital equity values, particularly for hospitals with extremely volatile earnings. Future work may be able to improve the estimation procedure by including analysts' or managers' earnings forecasts to take into account future developments that are not reflected in a hospital's past performance.

Potential endogeneity of revenue cycle management

The research design of this study does not allow me to determine whether revenue cycle management is endogenous, which may violate the assumptions of the linear regression model and lead to biased and inconsistent parameter estimates. Revenue cycle management may be endogenous to hospitals' profitability and ability to grow equity since revenue cycle management not only affects financial results but superior financial performance may also provide hospitals with the resources necessary to improve their management of the revenue cycle. This study discusses in great detail the pathways through which improved revenue cycle management is hypothesized to improve not-for-profit hospitals' profitability and free cash flow and strengthen their ability to build equity capital. Strong financial performance, however, may also enable hospital managers to focus more of their time and resources on managing the revenue cycle, both of which may be more readily available in organizations that perform well rather than in organizations that are struggling to remain in business. Financially well off hospitals may, for instance, have the resources to implement a more sophisticated billing and denials management system and thus reduce their outstanding accounts receivable and shorten their average collection periods.

Endogeneity concerns may, however, be mitigated by empirical evidence that indicates that over the past decade not only the most profitable hospitals but hospitals across the board achieved substantial improvements in their revenue cycle management performance. Hospitals were able to not only boost their net patient revenue by continuing the aggressive pricing policy many of them had begun to adopt but also collect their patient revenue faster (Solucient 2005). While certain investments in revenue

cycle management are indeed difficult and costly to introduce, such as the implementation of an electronic health record system that collects and connects all of a patient's clinical and administrative data (Eldenburg, Schafer, and Zulauf 2004), others can be implemented by simply reorganizing and streamlining small but key aspects of the revenue cycle, such as standardizing the process of collecting patient information during registration through education and training sessions for the staff members involved (May 2004). Future work will be needed to more fully address potential endogeneity problems in this research. One promising way to do so might be the use of instrumental variables. Instrumenting for revenue cycle management performance has the potential to address the issue of reverse causality and obtain consistent parameter estimates, at least in large samples.

Conclusion

Successful management of the revenue cycle plays an important role in not-for-profit hospitals' efforts to boost profitability, build equity capital, and thus remain financially viable in the long term. This link is found to be particularly strong for measures of hospitals' operating performance indicating that the pathway through which revenue cycle management is associated with hospitals' long-term financial performance focuses on operations. Hospital revenue cycle managers and consultants may view these findings positively. Managerial efforts aimed at increasing both the amount and the speed of patient revenue collection may be worthwhile investments that have the potential to make a difference in the organization's long-term financial performance. Being able to grow equity not only supplies managers with additional internal financing resources but also

increases their access to debt financing, both of which represent key factors when it comes to maintaining the up-to-date facilities and equipment needed to attract well-trained health care professionals and provide high-quality patient care.

Appendix A: Accounting errors and distortions and the residual income valuation model

The following example developed by Lundholm and Sloan (2004) demonstrates that the residual income valuation model is relatively resilient to accounting errors and distortions if the forecasts anticipate the unraveling of any accounting errors or distortions in future accounting periods. Let the sequence of forecasted equity book values and net income be B_0, NI_1, B_1, NI_2, B_2, NI_3, B_3, etc until infinity. Then the residual income valuation model defines the value of the firm's equity as:

$$V_0 = B_0 + \frac{NI_1 - r_E \times B_0}{1 + r_E} + \frac{NI_2 - r_E \times B_1}{(1 + r_E)^2} + \frac{NI_3 - r_E \times B_2}{(1 + r_E)^3} + \cdots$$

Let there be an accounting distortion in the form that \$K is missing from B_0, for instance because of an investment in research and development that cannot be capitalized but is forecasted to pay off in year 1. Correcting this distortion in the residual income model by adding K to the book value of equity in year 0 and subtracting it from net income in year 1 would result in the following equity value of the firm:

$$V_0 = (B_0 + K) + \frac{NI_1 - K - r_E \times (B_0 + K)}{1 + r_E} + \frac{NI_2 - r_E \times B_1}{(1 + r_E)^2} + \frac{NI_3 - r_E \times B_2}{(1 + r_E)^3} + \cdots$$

$$V_0 = (B_0 + K) + \frac{-K \times (1 + r_E)}{1 + r_E} + \frac{NI_1 - r_E \times B_0}{1 + r_E} + \frac{NI_2 - r_E \times B_1}{(1 + r_E)^2} + \frac{NI_3 - r_E \times B_2}{(1 + r_E)^3} + \cdots$$

$$V_0 = (B_0 + K) - K + \frac{NI_1 - r_E \times B_0}{1 + r_E} + \frac{NI_2 - r_E \times B_1}{(1 + r_E)^2} + \frac{NI_3 - r_E \times B_2}{(1 + r_E)^3} + \cdots$$

$$V_0 = B_0 + \frac{NI_1 - r_E \times B_0}{1 + r_E} + \frac{NI_2 - r_E \times B_1}{(1 + r_E)^2} + \frac{NI_3 - r_E \times B_2}{(1 + r_E)^3} + \cdots$$

Similarly, if the additional value materializes in year 2 (or in any other year), the residual income based equity value of the firm remains unchanged.

Appendix B: Derivation of the residual income valuation model from the discounted dividend model

In corporate finance, the value of the firm has traditionally been defined as the present value of its expected future dividends (Frankel and Lee 1998). Not-for-profit firms, however, do not pay dividends and discounted dividend models can thus not be used to estimate the value of these organizations. There are, however, two alternative valuation models that are suitable for valuing not-for-profit organizations, discounted cash flow valuation and residual income valuation. While discounted cash flow valuation models focus on free cash flows, residual income valuation models express value in terms of accounting residual income flows (Lundholm and Sloan 2004). Free cash flows can either be obtained directly or, under the assumption of the clean surplus relation, which states that a firm's book value of equity can only be changed by dividends or earnings (Ohlson 1995; Stowe et al. 2007), free cash flows can be computed based on net income and the change in common equity as shown in an example developed by Lundholm and Sloan (2004). That is,

$$B_t = B_{t-1} + NI_t - D_t$$

where B_t and B_{t-1} represent the book value of equity in period t and t–1, respectively, NI_t represents the net income of period t, and D_t represents dividends paid in period t, implies that

$$D_t = NI_t - (B_t - B_{t-1})$$

Discounting these cash flows at the cost of equity capital renders the building block of all valuation models, the discounted divided model, shown formally as:

$$V_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1 + r_E)^t}$$

The residual income valuation model can be derived from this model starting with the discounted dividend model and writing dividends as:

$$D_t = NI_t - (B_t - B_{t-1})$$

For each future period, $RI_t + r_E * B_{t-1}$ is substituted for NI_t, where RI_t represents the residual income of period t, r_e represents the cost of equity capital and B_{t-1} and NI_t are defined as before. The first term in the calculation of V_0 (when t = 1) can then be written as:

$$\frac{(RI_1 + r_E \times B_0) - (B_1 - B_0)}{1 + r_E}$$

Analogously, the second term in the calculation of V_0 (when t = 2) can be written as:

$$\frac{(RI_2 + r_E \times B_1) - (B_2 - B_1)}{(1 + r_E)^2}$$

Adding these two terms together results in:

$$B_0 + \frac{RI_1}{1 + r_E} + \frac{RI_2}{(1 + r_E)^2} - \frac{B_2}{(1 + r_E)^2}$$

The residual income model can thus be built term by term. Every time another term is added the appropriately discounted RI_t term is added and the last term in the previous sum is cancelled. We can thus write:

$$V_0 = B_0 + \frac{RI_1}{1 + r_E} + \frac{RI_2}{(1 + r_E)^2} + \frac{RI_3}{(1 + r_E)^3} + \ \ldots + \frac{RI_\infty}{(1 + r_E)^\infty} - \frac{B_\infty}{(1 + r_E)^\infty}$$

Since the summation is indefinite, the last term is pushed out indefinitely far into the future, and hence has a present value of zero. So, we can summarize and write V_0 as

$$V_0 = B_0 + \sum_{t=1}^{T} \frac{RI_t}{(1 + r_E)^t}$$

which is the algebraic statement of the residual income valuation model.

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Chapter 5

Conclusion

This dissertation research examined several questions surrounding the financial benefits of effective revenue cycle management from the perspective of hospitals. Specifically:

1. What are the financial benefits of effective hospital revenue cycle management? Is there a trade-off between the amount of patient revenue hospitals earn and the speed with which they collect patient revenue?
2. What are the determinants of hospital revenue cycle management performance? How does payer mix, in particular the proportion of publicly insured patients, affect hospitals' revenue cycle management performance? Do government payers indeed undermine hospitals' ability to generate and collect patient revenue as is frequently claimed by hospital practitioners?
3. What is the link between revenue cycle management performance and hospitals' long-term financial viability? Does effective revenue cycle management improve hospitals' profitability? Does effective revenue cycle management strengthen hospitals' ability to grow equity capital?

What prompted this research was a desire to define and explore the financial benefits that hospitals derive from effective revenue cycle management in today's business environment, in which many hospitals are confronted with stricter regulations

and billing requirements, more thorough preauthorization and precertification, underpayments, and greater delays in payments. Despite the continued interest of hospital practitioners and numerous publications on revenue cycle management in the practitioner literature (Danielson and Fuller 2007; D'Cruz and Welter 2008; May 2004), revenue cycle management has not received much attention in health care finance research. This dissertation sought to complement existing anecdotal evidence and fill some of the gaps in the revenue cycle management literature.

Starting with a brief description of current hospital revenue cycle management practices, Chapter 2 provided the background and foundation for all three studies that comprise this dissertation. Then, Chapter 2 proposed several measures of the financial benefits of effective revenue cycle management in terms of increases in the amount and the speed of patient revenue collection. Given the complexity of the revenue cycle, hospital managers frequently use a wide range of internal performance measures to assess the performance of each component of the revenue cycle (May 2004). Most of these performance indicators are neither standardized and comparable across institutions nor publicly available. By suggesting aggregate performance measures based on externally available financial statement information, Chapter 2 provided researchers and other external stakeholders with a framework to assess hospitals' performance at managing the revenue cycle.

Chapter 2 also provided empirical evidence on the relationships among these aggregate financial indicators of effective revenue cycle management. Using financial statement data for California hospitals for 2004 to 2007, correlation analysis showed that there was no trade-off between indicators of the amount of patient revenue hospitals

generated and the speed with which they collected their revenues but that these financial benefits often went hand in hand. Chapter 2 thus provided early indication that effective revenue cycle management achieves multiple positive results. Additional analyses of Medicare Cost Report data for all U.S. hospitals as well as audited financial statement data for bond-issuing, not-for-profit hospitals confirmed these findings indicating that they appear to be representative not only of California hospitals but of a majority of U.S. hospitals (Table 5.1).

Table 5.1: Relationships among Measures of the Amount and the Speed of Patient Revenue Collection

Data set	**Time period**	**Spearman's rho correlation coefficient (*p*-value in parentheses)**
Financial statement information for California hospitals provided by the Office of Statewide Health Planning and Development	2004 – 2007	–0.0509 (0.052)
Medicare Cost Report information for all U.S. hospitals provided by Thomson Reuters	2002 – 2007	–0.0731 (p<0.001)
Financial statement information for bond-issuing, not-for-profit hospitals provided by Merritt Research Services	2000 – 2007	–0.1049 (p<0.001)

The development of aggregate indicators of the financial benefits of effective revenue cycle management provided the basis for the empirical analyses in Chapters 3 and 4. More specifically, once hospitals that perform well at managing the revenue cycle could be identified and distinguished from those that perform poorly, two interesting research questions ensued: First, what factors determine whether hospitals perform well at revenue cycle management? And, second, does the effective management of the revenue cycle allow hospitals to strengthen their long-term financial viability? Chapter 3 focused on the first question while Chapter 4 addressed the second question.

Chapter 3 explored the determinants of hospitals' performance at managing the revenue cycle with a particular focus on payer mix. Given the idiosyncrasies of the third-party payer system, in which the prices a hospital charges do not equal the revenues it collects and the extension of credit is a business necessity rather than a managerial choice, the composition of a hospital's payer mix is paramount to its ability to effectively manage the revenue cycle. Government payers in particular are under substantial pressure to contain ever increasing health care costs and hospital managers thus frequently claim that serving increasing numbers of publicly insured patients undermines their ability to generate adequate amounts of patient revenue and collect revenue in a timely fashion.

Chapter 3, however, found no empirical evidence for this hypothesis. Using hospital financial information from the Medicare Cost Report for 2002 to 2007 and audited financial statements for bond-issuing, not-for-profit hospitals for 2000 to 2006, hospital-level fixed effects regression analysis found that hospitals with higher Medicare payer mix even collected somewhat more patient revenue while also collecting their revenue faster. Higher Medicaid payer mix, on the other hand, was associated with

neither the amount nor the speed of patient revenue collection. Hence, government payers did not appear to undermine hospitals' ability to generate and collect patient revenue, a finding that may represent good news for many hospital practitioners. Rather than being driven mainly by external payment system forces, hospitals' performance at revenue cycle management is likely the result of effective internal managerial practices.

Chapter 4 built on Chapter 3 by exploring the link between effective revenue cycle management and not-for-profit hospitals' long-term financial performance. Corporate finance theory posits that in perfectly efficient financial markets, short-term financial management, such as revenue cycle management, affects neither the profitability nor the market value of a firm since investing in short-term assets does not generate any excess returns (Cohn and Pringle 1980; Lewellen, McConnell, and Scott 1980). Not-for-profit hospitals, however, do not face perfect capital markets (Reiter 2004). Hence, in practice, revenue cycle management, one of the most important elements of hospitals' short-term financial management, may allow hospital managers to boost their organizations' profitability and strengthen their ability to grow equity capital.

The results of Chapter 4 confirmed this hypothesis. Hospital-level regressions of audited financial statement data for bond-issuing, not-for-profit hospitals for 2000 to 2007 found positive relationships between revenue cycle management performance and both profitability and not-for-profit hospitals' ability to grow equity. Higher amounts and greater speed of patient revenue collection were positively associated with several indicators of hospitals' profitability, including operating and total profit margins and free cash flow, and their ability to grow equity, including both residual income and discounted cash flow based equity values. This link was particularly strong for measures of

hospitals' operating performance providing early indication that the pathway through which revenue cycle management improves hospitals' long-term financial performance focuses on operations.

Together, the three studies that comprise this dissertation showed that, despite potentially unfavorable external market factors, such as high proportions of publicly insured patients, effective hospital revenue cycle management achieves multiple financial benefits in terms of both improved amounts and speeds of patient revenue collection and thus has the potential to boost hospitals' profitability and strengthen their ability to grow equity capital, mainly through improvements to operating performance.

Future work

While the results of this dissertation are informative, substantial opportunities exist for extending the research on hospital revenue cycle management. Five areas of future work will be discussed in the following. First, while this dissertation defined and analyzed several aggregate financial measures of effective revenue cycle management, the analysis was based exclusively on indicators that could be derived from externally available hospital financial statements. Since detailed data on hospitals' revenue cycle management policies and practices are generally not publicly available, this dissertation did not allow me to analyze internally used measures of revenue cycle management performance and determine which elements of the revenue cycle hospital managers focus on when attempting to improve its performance. Nor did this research allow me to analyze how specific improvements to various components of the revenue cycle affect hospitals'

performance at revenue cycle management. Hence, the way practitioners manage the revenue cycle remains a black box.

Future work should explore in more detail any internal changes practitioners implement to improve their management of the revenue cycle. This would allow both researchers and practitioners to understand which components of the revenue cycle are paramount to its effective management. Due to data limitations, however, pursuing this line of research would require the collection of primary data. Qualitative or mixed-methods research including case studies, interviews, and surveys may all provide avenues to shed light on the black box of revenue cycle management. Moreover, the use of qualitative research methods would allow researchers to extend their focus beyond financial benefits of effective revenue cycle management to include indicators of patient and employee satisfaction, two important but frequently neglected aspects of hospitals' performance at managing the revenue cycle (Berger 2008).

A second way this dissertation, in particular Chapter 3, may be extended is by exploring the effects of consumer driven health plans on hospitals' performance at managing the revenue cycle (D'Cruz and Welter 2008). In recent years, consumer driven health has experienced rapid growth, which is reflected in an increasing number of Americans enrolled in high-deductible health insurance plans. The core feature of these plans is that the patient is responsible for paying a substantial deductible out of pocket before the health plan assumes any financial responsibility. In theory, consumer driven health thus places more financial responsibility on the patient and encourages patients to change their behaviors to contribute to better health and, in the case of illness, seek more cost-effective care.

For providers, however, the rapid growth of high-deductible health plans has resulted in shifts in payment flows by introducing new parties into the revenue cycle. Under the traditional third-party payer system, insured patients have only limited financial contact with providers besides being responsible for generally small deductibles and co-payments. Consumer driven health plans, however, place the patient at the forefront of the revenue cycle. As financial responsibility shifts to the patient health care providers are seeing an increase in denials from third-party payers as claims below the deductible are returned as zero payments. As a result, improvements to the front end of the revenue cycle, in particular insurance verification and patient financial counseling, have become paramount to hospitals' efforts to reduce revenue deductions and write-offs and increase patient revenue. Another significant challenge in the consumer driven health environment is the timely collection of patient revenues. Billings and collections from patients rather than third-party payers frequently result in delays in payments since the automated, computer-based claims transmission systems used to submit claims to third-party payers cannot be used to bill individual patients. As hospital managers look to improve on the inefficiencies of revenue cycle management, these new industry dynamics are thus creating additional challenges to an already complex process.

Future work should first explore in how far the percentage of patients enrolled in high-deductible health plans affects hospitals' performance at managing the revenue cycle in terms of both the amount of patient revenue and the speed of revenue collection. Second, and maybe more importantly, research will be needed to explore how hospitals may adapt their management of the revenue cycle to maintain adequate amounts of patient revenue and collect it in a timely fashion despite increases in the number of

patients in high-deductible health plans. Besides financial aspects, patient satisfaction with hospitals' management of the revenue cycle will gain in importance in this environment since patient dissatisfaction may not only result in patients not paying promptly and fully but may also jeopardize hospitals' future revenue opportunities. As discussed above, indicators of patient satisfaction should thus be included in future research.

Third, future work should extend this research, in particular Chapter 4, to include not only revenue cycle management but also other elements of hospitals' short-term financial management. In the current third-party payer environment, the generation and collection of patient revenue represent some of the most important aspects of hospitals' working capital management. Besides managing the revenue cycle, however, the effectiveness of a hospital's short-term financial management depends on its management of inventories and accounts payable. Like most service organizations, hospitals today have little investment in inventory (Smith 1980), which may therefore play only a minor role in their short-term financial management. Accounts payable, on the other hand, represent an important short-term liability as hospital managers may be able to extend payment periods to fund investments in short-term assets including patient receivables. Consequently, one aggregate measure to assess hospitals' performance at short-term financial management is the difference between the number of days in accounts receivable and the number of days in accounts payable. This simplified version of the length of the cash conversion cycle measures the average number of days between the purchase of supplies necessary for the provision of patient care and the collection on

patient accounts after services have been provided indicating the efficiency with which cash flows through the organization.

Future work should explore the link between the length of the cash conversion cycle and hospitals' long-term financial viability to provide a more complete picture of how hospitals' short-term financial management is associated with their long-term financial health. Finance theory posits that highly profitable firms may improve their short-term financial management performance by reducing their collection periods while simultaneously increasing their payment periods. Empirical studies, however, have found that highly profitable firms tend to have both shorter collection and shorter payment periods (Deloof 2003; Lazaridis and Tryfonidis 2006). The statistically significant negative coefficient on days in accounts payable, which was included as a control variable in the analysis of hospital profitability in Chapter 4, provided seminal empirical evidence that this relationship may also hold for not-for-profit hospitals. Additional research, however, will be needed to more fully understand the relationship between hospitals' performance at managing all elements of their working capital and their profitability as well as their ability to grow equity capital.

Fourth, this dissertation has examined the financial benefits of effective revenue cycle management from the perspective of health care providers but has largely ignored the payer side. As discussed in Chapter 2, the many components of a hospital's revenue cycle provide practitioners with numerous opportunities to improve its management by, among other things, reducing existing administrative inefficiencies. Nonetheless, health care providers still spend enormous time and money trying to determine whether a patient has coverage or why a claim was denied resulting in tens of billions of dollars each year

that are wasted (Abelson 2010). To further reduce administrative inefficiencies, regulators and third-party payers will need to step up their efforts and partner with health care providers to help them improve their revenue cycle management. A first important step in this direction was the passage of the Health Insurance Portability and Accountability Act of 1996, which promoted uniform billing and claims transmission standards. With these mandates in place, software development, uniform standards of practice, and clarity of coding and transmission requirements have all positively affected providers' cash collections (Rauscher and Wheeler 2008).

Besides regulatory action, however, as part of the recent discussion over how best to overhaul the U.S. health care system, payers have promised to do their part to contain costs by tackling the burdensome paperwork involved in submitting and paying medical claims (Abelson 2010). In early February 2010, several insurers including Aetna, Cigna, Blue Cross Blue Shield, and United Health Care announced a pilot program in the state of New Jersey that offers health care providers the ability to use a new web portal to check a patient's coverage and track claims, regardless of which of the participating health plans the patient is enrolled in. A similar system implemented in Ohio in late 2009 was well received by participating providers. Nonetheless, many participating providers have indicated that additional efforts are needed to standardize and streamline the processes between payers and providers to further streamline the revenue cycle.

Future work should evaluate these and other pilot projects to determine in how far they are able to make a difference in health care providers' management of the revenue cycle. Moreover, it would be interesting to explore whether there are incentives for providers and payers to jointly implement such systems and share the associated costs

and benefits. In the health care management literature, a number of studies have used the concept of the business case for quality to evaluate whether investments in improvements of clinical care are able to generate financial win-win situations for both providers and payers, which would make their adoption more likely (Leatherman et al. 2003; Wheeler et al. 2007). I would be interested in extending the concept of the business case for quality beyond aspects of the quality of clinical care to include the quality of administering health care. The question I want to explore is whether the elimination of administrative inefficiencies in the process of paying for medical care can reduce costs for both providers and payers and thus result in a win-win situation. The existence of a positive business case for quality may then provide an incentive for both providers and payers to jointly implement systems that streamline health insurance paperwork and allow providers to improve their management of the revenue cycle.

Finally, this dissertation relied on hospital financial information for some or all of the years from 2000 to 2007, the most recent years for which data was available. The findings of this research, however, may differ for different periods of time. With the passage of the health reform bill in March 2010, the U.S. health care system is set to undergo substantial transformations in the years to come. One of the most important changes will be the extension of health insurance coverage to more than 32 million currently uninsured Americans by 2014 (Kaiser Family Foundation 2010). This provision clearly benefits hospitals as it increases their numbers of paying customers. Currently, uninsured and other self-pay patients are often unable or unwilling to pay their medical bills resulting in the loss of patient revenues for hospitals. Moreover, collections from uninsured and self-pay patients tend to take time since they often involve patients paying

their bills in installments over many months or even years, thus lengthening hospitals' collection periods. Requiring almost all Americans to purchase health insurance coverage starting in 2014 will thus likely a have substantial impact on hospitals' revenue cycle management performance. Near universal health insurance coverage not only reduces the number of unpaid medical bills and thus hospitals' bad debt expenses but may also shorten the time that medical bills are outstanding.

Future work should replicate some the analyses in this dissertation to explore how hospitals' performance at managing the revenue cycle changes over time. Particularly during the coming decade, during which the U.S. will see major changes in the provision and financing of health care as a result of the passage of the health reform bill, hospitals' revenue cycle management performance can be expected to improve substantially. Reexamining both the determinants and the financial benefits of effective revenue cycle management in this substantially different business environment has the potential to further improve our understanding of hospital revenue cycle management.

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