Understanding the Health Care Business Model

The financial analyst's point of view

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From the Editor—About This Issue

Once again, this issue of the *Journal of Health Care Finance* is illustrative of the breadth of topics we cover. We are always interested in new article ideas that directly or indirectly relate to health care finance. To submit ideas or articles, please send an email to: *HealthFinanceJournal@yahoo.com.*

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Health Care Reform and Connecticut's Non-Profit Hospitals

Jeffrey P. Cohen, William Gerrish, and J. Robert Galvin

The recent federal Health Care Reform Act signed into law by President Obama is expected to lead to greater patient volumes at non-profit hospitals in Connecticut (and throughout the country). The financial implications for these hospitals depend on how the costs per patient are expected to change in response to the anticipated higher patient volumes. Using a regression analysis of costs with annual data on 30 Connecticut hospitals over the period 2006 to 2008, we find that there are considerable differences between outpatient and inpatient unit cost structures at these hospitals. Based on the results of our analysis, and assuming health care reform leads to an overall increase in the number of outpatients, we would expect Connecticut hospitals to experience lower costs per outpatient treated (economies of scale). On the other hand, an influx of additional inpatients would be expected to raise unit costs (diseconomies of scale). After controlling for other cost determinants, we find that the marginal cost of an inpatient is about $8,000 while the marginal cost of an outpatient is about $44. This disparity may provide an explanation for our finding that the effect of additional patient volumes overall (combining inpatient and outpatient) is an increase in hospitals' unit costs. Key words: *health care reform, unit costs, hospital cost structure, economies of scale, cost* elasticities.

The recent historic health care bill passed by the US Congress and signed by President Barack Obama is expected to have broad-reaching implications for many aspects of health care in the United States. We examine one specific aspect in one geographic location—the potential implications of higher patient volumes that are expected to accompany federal health care reform on the financial performance of Connecticut's not-for-profit hospitals.

Virtually all hospitals in Connecticut are non-profits. These hospitals operate via revenues from several sources including Medicare, Medicaid, uncompensated care, and non-governmental payers (*e.g.*, private insurance). These revenue streams result in a complex payer mix, allowing hospitals to "cost shift" from the typically lower paying public payers (which often pay below cost), to the higher paying private payers. That is, hospitals utilize the occupancy of private pay patients to offset operating losses due to below cost public pay reimbursements and to maximize overall margins.

On March 23, 2010, President Obama signed into law the comprehensive health reform legislation, the Patient Protection and Affordable Care Act. The law makes broad changes to the way health insurance will be provided and paid for in the United States. Starting in 2014, the law will require most US citizens to have health insurance, and calls for the establishment of state-based "exchanges" through which individuals can purchase health insurance if they do not have access to affordable employer coverage.[1] In

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Connecticut, about 10 percent of the total population (approximately 335,000 individuals) are uninsured. Under the new law, by 2014, most of Connecticut's uninsured will become eligible for health benefits.[2]

Increased access to health care may result in positive implications for hospitals. Moody's Investor Service recently projected a positive impact for both not-for-profit and for-profit hospitals as a result of health care reform, due to increased volumes of insured patients and reductions in unreimbursed care.[3] Other benefits may result from fewer emergency department visits and a reduction in recurring hospitalizations due to better (and possibly less costly) outpatient follow-up care.

On the other hand, reform may create economic pressures for some hospitals. Increased patient volume may result in a "slow surge" of patients that strains the bed capacity of hospitals that are already stretched, due to physical, operating, and/or staff limitations. While comprised of more insured patients, this surge may result in negative operating margins if reimbursements are insufficient to cover overall costs.

Since it is apparent that health care reform will lead to increased volumes of hospital patients (both inpatient and outpatient) in Connecticut (as well as in other states), the hypothesis we test is: *Hospitals face decreasing unit costs when they treat more patients.*

To empirically test this hypothesis for hospitals in Connecticut, and to determine how hospitals in the state might be impacted by reform, we conduct a statistical analysis to estimate cost function models, using hospital-level data covering the years 2006 to 2008. We test the above hypothesis separately for inpatient days, outpatient visits, and for both, across all 30 hospitals in the state.

One objective of this study is to examine the current cost structure of Connecticut hospitals, with the goal of generating information that can be useful in anticipating the cost impacts on hospitals of health care reform.

Given the results of our statistical analysis, we can explain how recent variation in the numbers of outpatients and inpatients in Connecticut hospitals affect unit costs, and thus how treatment unit costs may be expected to be impacted immediately following health care reform if patient volumes rise as expected. One possible result is that additional inpatients and/or outpatients would lead to lower unit costs, possibly due to current under-utilization of expensive equipment or fluctuations in general capacity utilization. Such a scenario is referred to by economists as "economies of scale."

Another potential outcome is that greater patient volumes might increase unit costs ("diseconomies of scale"), perhaps because of the lack of flexibility to expand capacity in the short-run, or because of additional costs associated with recruiting qualified staff.

The third possibility is that hospitals may already be operating close to their efficient scale, so that a change in patient volumes might have no statistically significant effect on unit costs of treatment. Also, it is possible that some hospitals in the state may be facing economies of scale, while others may be operating with diseconomies of scale or at the efficient scale.

Since some hospitals may see more (or less) of a rise in outpatient visits than inpatient days, and outpatient/inpatient cost structures may be different, we include separate control variables for inpatient days and outpatient visits at each hospital.

Review of Literature

Our study differs from previous research on hospitals' economies of scale since we use sophisticated regression techniques that are well grounded in economic theory, and recent hospital-level data across the state of Connecticut. The use of data from hospitals across the state is important because of variation in hospital characteristics across the state (such as Medicare and Medicaid patient volumes).

Other studies have estimated scale economies for general hospital costs. Early studies in the general literature on hospital cost estimation ran regressions of costs on a group of variables.[4] These early studies did not recognize the theoretical conditions the cost function needs to satisfy. Some later studies began to accommodate regularity conditions for output(s) but not for input prices.[5] This omission precludes appropriate scale economies measurement.

More recent studies have used more general cost functions that allow for interactions between output(s) and input(s).[6] These studies show the importance of flexible functional forms, such as a generalized Leontief form, for evaluating cost efficiency and scale economies. However, Cohen and Morrison Paul[7] and Li and Rosenman[8] focus on hospitals in Washington State, and both find significant economies of scale for outpatient and inpatient treatment. Their analyses also cover much older data—for instance, the most recent time period covered by either of these studies was 2002 by the former—and now an updated analysis for another state in a different part of the country may be expected to yield different insights in light of the passage of so much time.

In other words, valid inferences about the impact of increased volumes of patients in Connecticut in 2010 cannot be made based on the magnitude and direction of hospitals' economies of scale estimates in one other particular state (WA) found for the year 2002. Thus, our research is a contribution because it addresses these issues in a current, comprehensive and rigorous manner in order to explain how health care reform might affect hospital costs in Connecticut.

Data

We acquired financial data from the State of Connecticut Department of Public Health's Office of Health Care Access (OHCA) on 30 hospitals over the period 2006 to 2008. These data include information on:

- Value of property, plant, and equipment (which we use for capital stocks);
- Total salaries and benefits and full-time equivalents (we divide salaries by full-time equivalents to obtain a "labor price");
- "Other" spending (excluding employees and capital);
- Inpatient days and outpatient visits (each of which we use as separate "output" control variables);
- Medicare and Medicaid visits and discharges (separate shift variable); and
- Whether the hospital is in an urban or rural area (a shift variable).

We also obtained data on the Case-Mix index for each hospital (which is a shift variable) from OHCA.

Approach

The research methodology to estimate economies of scale is based on the statistical techniques of regression analysis. We

estimate a regression on a cost function for Connecticut hospitals. Microeconomic foundations support the use of such a cost function as a representation of the underlying hospital "production technology," as long as the data satisfy standard regularity conditions.[9] These conditions ensure that the cost function is consistent with "real world" conditions such as higher costs for greater output or input levels (assuming costs are being minimized). Such a specification allows for a detailed representation of hospital costs.

Such a cost function is dependent on the outputs, consisting of the quantities of outpatient visits and inpatient days; the average prices of the "variable" inputs (*e.g.*, average salaries and benefits of the "full time equivalent" staff and "other" expenditures); the quantities of "fixed" inputs (*e.g.*, owned capital stocks for physical facilities and equipment); and other factors that may "shift" the cost function as described above. The short-run cost function model for each hospital, i, at any point in time, t, can be written as: $TC_{it} = VC_{it}(P_{it}, Y_{it}, R_{it}, K_{it}) + P_{kit}K_{it}$, where K_{it} is a vector of capital stocks (consisting of the value of plant, property and equipment), with corresponding price P_{kit}; P_{it} is a vector of input "prices" (consisting of two elements: average wages/benefits and "other" spending); TC_{it} are total costs; VC_{it} are variable costs (total spending on wages/benefits plus "other" spending), and includes the stock of capital as a fixed factor and omits capital price; and R consists of the "shift" variables.

We use the generalized Leontief (GL) variable cost function, as opposed to the translog that has been used by some researchers. Hospitals treating only either inpatients or outpatients will have a "0" for the other output type. This is problematic for the translog since log(0) is undefined. The GL avoids this issue. The GL functional form is:

$$VC_{it}(P_{it}, Y_{it}, R_{it,} K_{it}) \equiv [\Sigma_n \alpha_n P_{nit} + \Sigma_n \Sigma_l \delta_{ln} P_{nit} Y_{lit} + \Sigma_n \Sigma_k \delta_{kn} P_{nit} K_{kit} + (\Sigma_n P_{nit})(\Sigma_l \delta_{ll} Y_{lit}^2 + \delta_{kk} K_{kit}^2 + \Sigma_l \Sigma_m \delta_{lm} Y_{lit} Y_{mit} + \Sigma_m \delta_{km} K_{kit} Y_{mit}) + \Sigma_r \delta_{rr} R_{rit}] + u_{it},$$

where VC is hospital i's total variable costs; Y represents the "outputs" (inpatient days and outpatient visits); K is private capital stock; the P_{nit} are the variable input prices (employee wages/benefits; and total "other" spending); R represents "shift" factors (an indicator variable for "urban"; a hospital case-mix index; and Medicare/Medicaid inpatient days and outpatient visits); and u_{it} is a random error term assumed to have a normal distribution with mean zero and constant variance. The α and δ (with subscripts as above) are regression parameters.

After we estimate the cost function model, we can obtain estimates for elasticities of scale for hospitals in each state, as averages of the elasticity for all hospitals. The elasticity of variable costs with respect to each output type, which is often referred to as an "elasticity of scale," can be written as the ratio of marginal costs to average costs.

If the combined output elasticity is statistically significantly less than one, this provides evidence of economies of scale; that is, average costs would be greater than marginal costs, so average costs are decreasing with additional output. This trend implies that if hospitals treat more patients, the unit cost of treating these patients is lower. The opposite is true if this elasticity is statistically significantly greater than one. When marginal costs are equal to average costs, or their ratio

is insignificantly different from one, this scenario is described as the efficient scale.

One potential explanation for economies of scale is indivisible inputs. For instance, when a hospital builds physical space but is not using it to full capacity, the unit costs of treatment would be higher than when the facility is filled to capacity.

Economies of scale when there are multiple outputs (which here is for hospitals treating both inpatients and outpatients) are typically measured as the sum of the cost elasticities with respect to the outputs:[10] $\varepsilon_{TC,Y} = \varepsilon_{VC,Y} = \Sigma_m \partial VC/\partial Y_m \bullet (Y_m/VC) = \Sigma_m \partial \log VC/\partial \log Y_m$, where m represents individual outputs (inpatient days, outpatient visits) and "log" is the natural (base e) logarithm.

When there is only one output or when it is desirable to examine economies of scale together for inpatient and outpatient treatments, scale economies are given by $\varepsilon_{TC,Y} = \varepsilon_{VC,Y} = \partial VC/\partial Y \bullet (Y/VC) = \partial \log VC/\partial \log Y$ = (% change VC)/(% change Y). If costs increase less (or more) than proportionally with a one percent increase in output levels, *i.e.*, if $\varepsilon_{VC,Y}<1$ (or $\varepsilon_{VC,Y}>1$), economies (or diseconomies) of scale prevail. If a one percent increase in output levels leads to exactly a one percent increase in costs (*i.e.*, $\varepsilon_{VC,Y}=1$), then hospitals are at their efficient scale, and changes in patient volume would not have any significant impact on unit costs.

Results

Descriptive statistics of the data for the 30 hospitals in our sample over the years 2006 to 2008 are presented in Figure 1. The average hospital in the sample faced total costs of about $250 million, employed about 1,640 workers (full-time equivalents), and paid those workers an average salary of about $81,000. The range of average salary across hospitals was between $59,000 and about $101,000. The smallest hospital employed 283 full time equivalents, while the largest hospital employed over 6,000 full time equivalents. An average of 69,200 inpatient

Figure 1. Descriptive Statistics Number of Observations: 90 (Annual Data on 30 hospitals, Covering the Years 2006–2008)

	Mean	Std Dev	Minimum	Maximum
TCOST	2.47610D+08	1.99370D+08	4.72522D+07	1.05791D+09
KSTOCK	9.73537D+07	7.30748D+07	1.84713D+07	2.93794D+08
TOTFTE	1640.48	1282.32	283	6343.8999
WAGE_RATE	81282.56502	7797.94	59314.69531	101886.0234
IPDAYS	69200.5	58843.99694	11268	272757
OUTPAT_TOTAL	216712.3667	142666.7386	37047	659127
MCARE_DAY	33596.4	25469.64896	58	99749
MCAID_DAY	10449.91111	12253.04931	303	62488
NONWAGE_EXP	1.13670D+08	9.74098D+07	2.08518D+07	5.32018D+08
CMI	1.340	0.232	0.888	2.223

days and 216,000 outpatients were treated at each hospital.

After estimating the statistical model described above using least squares regression techniques, we obtain parameter estimates for all of the α and δ parameters. These parameters are used to obtain the elasticity estimates that we present in Figure 2. While we do not present the results for the individual regression parameter estimates here, they are available from the authors upon request.

First, it is noteworthy to mention that after controlling for all other cost determinants, the marginal cost of an outpatient is about $44, while the marginal cost of an inpatient is about $8,000. These marginal costs are tied to the elasticities of costs with respect to outpatients and inpatients (note that the respective t-statistics are the same). This is because the elasticity of scale for each type of patient treatment is the marginal cost divided by the average cost. The elasticity of costs with respect to outpatients is 0.038, which is statistically significantly greater than zero at the one-tailed, 5 percent level (P-value=0.058). It is also statistically significantly less than one, implying that additional outpatients would be expected to lead to lower unit costs of outpatients.

The picture is somewhat different for inpatients. The elasticity of costs with respect to inpatients is 2.28, which is statistically significantly greater than zero at all levels of significance (P-value=0.000). Moreover, this elasticity is statistically significantly greater than one, which implies that additional inpatients would be expected to result in higher unit costs of inpatients. This may be because many Connecticut hospitals are stretched in terms of available beds, so additional patients at the margin would make it more costly to treat each existing patient.

When we assess the elasticity of scale with respect to both inpatients and outpatients together, we find strong evidence of diseconomies of scale. In other words, increasing total patients (due to increases in either inpatients and/or outpatients) leads to higher overall unit costs.

It is also noteworthy to mention that hospital costs have been increasing over time, after controlling for all other determinants of hospital costs. The elasticity of costs with respect to time is 0.04 and statistically significant (P-value = 0.013), implying that costs

Figure 2. Elasticity Estimates

Elasticity	Estimate	Std. Error	t-statistic	P-value
eTC, outpat	0.038458	0.020326	1.89204	[.058]
eTC, inpat	2.23235	0.17758	12.571	[.000]
eTC, both	2.27081	0.174912	12.9826	[.000]
MCinpat	7987.69	635.408	12.571	[.000]
MCoutpat	43.9412	23.2243	1.89204	[.058]
eTC,t	0.044141	0.017749	2.48691	[.013]
eTC,K	-0.04023	0.037082	-1.08478	[.278]

increased by about 4 percent annually over the period of the sample (2006 to 2008).

Conclusions

Federal health care reform is expected to lead to additional people seeking health care treatment. Some of these additional patient volumes will be absorbed by hospitals. In Connecticut, our analysis shows that additional outpatients should lower unit costs of treatment, while additional inpatients should lead to significantly higher unit treatment costs. Also, when assessing the situation overall without distinguishing between inpatients and outpatients, greater patient volumes in Connecticut hospitals should lead to significantly higher unit costs.

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Understanding the Health Care Business Model: The Financial Analysts' Point of View

Per Nikolaj Bukh and Christian Nielsen

This study focuses on how financial analysts understand the strategy of a health care company and which elements, from such a strategy perspective, they perceive as constituting the cornerstone of a health care company's business model. The empirical part of this study is based on semi-structured interviews with analysts following a large health care company listed on the Copenhagen Stock Exchange. The authors analyse how the financial analysts view strategy and value creation within the framework of a business model. Further, the authors analyze whether the characteristics emerging from a comprehensive literature review are reflected in the financial analysts' perceptions of which information is decision-relevant and important to communicate to the financial markets. Among the conclusions of the study is the importance of distinguishing between the health care companies' business model and the model by which the payment of revenues are allocated between end users and reimbursing organizations. Key Words: *Strategy, business models, disclosure, financial analysts, revenue streams.*

For the health care sector in general, the customer base is growing steadily. In developed countries the demographic changes will in the coming decades increase the percentage of elderly considerably, because of the post-World War II baby boom as well as the fact that our lifespan also is increasing. In the developing countries, *e.g*., the so-called BRIC countries (Brazil, Russia, India, and China), higher living standards will give rise to the creation of large health care sectors. However, this does not imply that health care companies will be greeting times of unwarranted prosperity. As globalization creates greater demands for health care services, globalization too will create greater competition for health care companies. Therefore, explaining and communicating uniqueness, profitability, and strategy, *i.e*., the business model, will play a vital role in attracting capital. This article thus studies the constituents of a health care company's business model through the eyes of the analysts following it.

The capital market plays an important role in our present day society as it facilitates the distribution of capital between investors and companies. Within the realm of the capital market, information plays a central role because of, for example, agency costs[1] and the fact that there is information asymmetry[2] between company management and

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investors. Recent research in relation to IPOs in the health care industry[3] suggests that new companies entering the market represent great peril to the investment community because a mere financial analysis of the company is insufficient to understand future profitability in this sector.

By means of the annual report, Web pages, investor meetings, conference calls, as well as private meetings, publicly listed health care companies provide information to the capital market, *i.e*., investors and financial analysts, in order to minimize such information asymmetry. In principle, the disclosure of additional relevant non-financial information, for example, relating to the pipeline and relevant partnerships across the pharmaceutical industry, is expected to lower the cost of equity capital[4] because increased disclosure reduces information asymmetry and lowers investor uncertainty about the future prospects of the company, thus facilitating a more precise valuation of the company, as discussed by Botosan.[5] It is, however, not sufficient that credible, reliable, and neutral information is conveyed to the capital market. The information should also be relevant in relation to assessing aspects of the company's current and future performance, and, more importantly, the investors and analysts should be able to comprehend this information.

Most literature concerning supplementary reporting models[6] and voluntary disclosure in general[7] suggests that information on the strategy of the company, in the form of key value drivers, should form the basis for disclosure of information and therefore also for the dialogue with financial analysts. From a strategy perspective, such a reporting model or framework for disclosure is offered by the concept of a *business model* and Lev[8] has previously argued that the existing problem of lacking transparency in corporate reporting can be overcome by basing disclosure on the company's business model. Business models have earlier been intimately connected with e-business;[9] however, the concept as such has a much broader meaning in recent management literature.

The aim of this study is to identify which elements a health care business model could consist of in order to form the basis for the communication between management and financial analysts. Previous literature on business models has mostly been based on theoretically anchored models of, for example, value creation—relationships between resources or growth drivers where one or sometimes a few companies have been used as cases or illustrations of the models. This article, however, does not attempt to verify the usefulness of a specific perspective on business models. Rather, we take financial analysts' understandings of strategy and strategy related elements as a starting point, and then analyse the business model of a health care company, in turn identifying the elements that financial analysts mobilise when they understand, analyse, describe, and rationalise strategy.

Thus, the main contribution of this study is the identification of the elements that constitute financial analysts' concrete understanding of the health care business model since a more general formulation of a business model should comprehend building blocks that can facilitate the communication of these elements.

The empirical part of this article is based on interviews with 12 financial analysts from European investment banks about the business model of a large health care company listed on the Copenhagen Stock Exchange.

Our focus when conducting the interviews was on identifying the general elements that constitute a business model from the analysts' point of view. In this article the interviews are analyzed using a coding approach where codes determined from a comprehensive survey of the literature on business models are taken as a starting point.

The remainder of this article is structured as follows: After an introduction to the information needs of analysts, we introduce the concept of a business model. Then we review the literature on business models focusing on the identification of specific characteristics, followed by an introduction of the research methodology and the interview data, and the empirical analysis of the health care case-company structured around the business model characteristics, respectively. Finally, we offer conclusions on the study and further avenues of research.

Analysts' Information Needs

Both from the perspective of the financial markets and accounting organizations, a growing frustration with traditional financial reporting has been evident in the last two decades. Such frustrations have been expressed in the 'Jenkins Report,'[10] the work of the former commissioner of the Securities and Exchange Commission (SEC), Steven Wallman[11] and, more recently by the Accounting Standard Board[12] and The Canadian Institute of Chartered Accountants.[13]

Various studies of investors' and analysts' information demands[14] indicate a substantial difference between the types of information found in companies' annual reports and the types of information demanded by the capital market.[15] This information gap is partly due to an increased demand for non-financial information, *i.e.*, concerning the company's strategy and competencies, and its ability to motivate the staff, increase customer satisfaction, etc. However, this information gap may also be due to a lack of understanding of business models and of proper communication between company management and the capital market.[16] In this respect, Nilsson *et al.*[17]suggest that the main objective of applying a business model approach is to bridge the communication gap between management and external stakeholders, as shared models become a platform for creating common understanding.

From the financial analysts' point of view, information disclosed in the annual report or in a supplementary report only constitutes one part, maybe even an inferior part, of the information set needed to make recommendations to clients. This is because financial analysts are in a privileged position to "get more information—and sooner—than all [other information users] except the very largest investors."[18] Thus it might be the case that information provided in the annual report has value relevance, but the analysts have already a much more detailed understanding about, for example, the research and development activities than what could be gained from reading about the aggregated research and development expenses.

The Business Model as Basis for Corporate Communication

Changes in the nature of value creation have inevitably called for new reporting metrics and frameworks. Blair and Wallman[19] argue for instance that a model for business reporting reflects the dynamics of wealth creation. Business reporting should essentially constitute a representation of the company's business model "by describing

the relationships among the various input measures and outcome measures, and to link the primary inputs to intermediate inputs and, ultimately, to financial performance and other measures of total value creation."[20]

Competition now increasingly stands between competing business concepts as Hamel[21] argues and not only between constellations of companies linked together in linear value chains, as was the underlying notion in the original strategy framework by Porter.[22] If companies within the same industry operate on the basis of different business models, different competencies and knowledge resources are utilized in the value creation processes, and the mere benchmarking of financial or non-financial indicators will not provide insight in the profit or growth potential of the company. Comparisons of the specific company with its peer group require interpretation within an understanding of differences in business models.

The business model concept has intimate connections to corporate disclosure and the ongoing debate about transparency. Since forward-looking information can be difficult to comprehend if it is not mobilized within the relevant context, supplementary disclosures must be linked to value creation.[23]

There exists a substantial amount of literature on business models. However, there is no generally accepted definition of what a business model is and the theoretical grounding of most business model definitions is rather fragile. Nielsen[24] offers a definition along the lines of: "A company's business model describes its collaborative portfolio of strategy choices put in place for the handling of the processes and relationships that drive value creation on operational, tactical and executive levels." Furthermore, business model definitions vary significantly as they are derived from a number of different perspectives. In this study we are interested in how business models can form the basis for communication between management and financial analysts.

Thus, we perceive the business model as a management technology that helps management communicate and share its understanding of the business logic to external stakeholders,[25] in our case primarily analysts and investors. The notion here is that management must explain the company's unique value proposition to external parties, as Sandberg[26] states: "Spell out how your business is different from all the others." Finally, the mere process of modelling the business helps management in identifying and understanding the relevant elements of its business,[27] such as, for example, value drivers and other causal relationships.

Characteristics of the Business Model

It is not possible to cover all literature on business models within the scope of this article, but in this section we review those parts of the literature that we have found representative or most relevant in developing a business model framework useful in corporate communication. We have as shown in Figure 1 chosen to structure our review around nine topics that are typically discussed in the literature on business models. These areas, which are termed 'characteristics of business models' are in this article grouped in three overall categories covering the areas that are most often included as part of a business model:

- The overall criteria that determine long-term performance;

Figure 1. Overview of Business Model Characteristics

1. Criteria for Long-Term Performance	• Sustainable development • Strategy • Improving the business and innovation
2. Points of Departure for Creating Products and Services	• Resource base • Value chain • Value proposition
3. Interconnections That Drive Value	• Value drivers • Value creation • Causal relationships

- The point(s) of departure for creating products and services; and
- The key interconnections that drive the value generation of the company.

Criteria for Long-Term Performance

While the ultimate goal from an extreme shareholder perspective could be said to increase the stock price by creating profit, business models sometimes address broader criteria such as *sustainable development*, which implies that focus is shifted from mere profit orientation towards sustainable enterprises and an economic reality that connects industry, society, and the environment.[28] This need for linking sustainable development to business strategy is for instance acknowledged by Funk,[29] who characterizes the sustainable organization as "one whose characteristics and actions are designed to lead to a 'desirable future state' for *all* stakeholders," and by Afuah and Tucci[30] who argue that the business model concerns sustainable development through the company's unique value configuration.

In using the notion of a business model as our key concept in this study we have implicitly assumed that it comprehends something more than *strategy* or at least is a concept different from strategy. In this sense Magretta[31] is clear when she states that "business models describe, as a system, how the pieces of a business fit together. But they don't factor in one critical dimension: competition," which implies that she finds companies' competitive basis to be completely outside the business model.

Another perspective is offered by Czuchry and Yasin[32] who argue that a business model is not necessarily successful by itself because companies must integrate and align strategic and operational efforts, activities, resources, and decisions into a systematic organizational strategy, thus indicating that strategy is an integrated component of a business model. Departing from this discussion, Chesbrough and Rosenbloom[33] argue that while business models are more oriented towards value creation and sustainable development from a bounded rationality perspective, strategy theory is more apt to consider value creation from a shareholder perspective, and suppose full analytical rationality of decision-makers.

Finally, business models have also been associated with company's efforts to *improve the business and innovate*. Much early literature[34] departed in how new technology, most notably the Internet, revolutionized certain industries and changed the feasibility of existing business models. This was for instance illustrated by Gallaugher[35] who showed how e-commerce enabled the emergence of new business models.

Also from an innovation perspective Kartseva *et al.*[36] suggest the business model as a basis for strategic analysis since it offers the possibility for mapping new business ideas graphically in a clear and communicable fashion. In this way business models facilitate change because of their building-block-like approach to formulating the business logic of a company.

Points of Departure for Creating Products and Services

In this section we take a closer look at how business models describe elements of the organization that are a part of the company's performance. Performance-related elements are elements that relate to the actual structure of the company. We distinguish between three characteristics:

1. Resource base;
2. Value chain; and
3. Value proposition.

The company's resource base is important, as there has been a lot of focus on which resources actually drive company value creation. For example, in the knowledge society it is stated that primarily knowledge drives value creation. Along these lines, Miller *et al.*[37] argue that capabilities are the backbone of a company's competitive advantage because resources are a more stable element on which to base sustainable development than competitive strategy in a highly volatile business environment. Klaila[38] explains how the business model helps to identify the critical behaviours, competencies, and market conditions and account for the company's resources of intellectual capital. From the resource-based perspective we must perceive resources in the sense of being assets[39] and inputs to the value creation process of the company. As it is difficult for organizations to understand the role of knowledge resources in their value creation,[40] the business model approach becomes advantageous by visualizing the company's capability configurations, which are the cohesive combination of resources and capabilities embedded within its infrastructure, and which generate value.[41]

Porter defines the value chain as a basic tool for analyzing the sources of competitive advantage of the company, by enabling systematic examination of all the activities a company performs and how these activities interact.[42] Every company is essentially a collection of interdependent activities that are performed to create value. The value chain can also be perceived as, according to Shank and Govindarajan,[43] a generic concept for organizing our thinking about strategic positioning. They define the value chain as "the linked set of value-creating activities all the way from basic raw materials to the ultimate end-use product delivered into the final consumers' hands."[44] Within the notions of business models, the value chain comprises the company's activities and organization[45] and the structure of the company.[46] In Bell *et al.*'s[47] framework, core business processes and activities, and the analysis hereof, are viewed in the light of a value chain perspective. Likewise, Chesbrough and

Rosenbloom[48] imply that the value chain perspective leads to identification of the activities and assets (inputs) that are necessary to deliver the company's value proposition (outputs).

However, there exist other value configuration models than the value chain. Stabell and Fjeldstad[49] suggest that the value chain is but one of three generic value configuration models. Stabell and Fjeldstad[50] distinguish between three generic value configuration models:

1. The value chain;
2. The value shop; and
3. The value network.

They argue that such a distinction is required in order to create an understanding and ultimately facilitate the analysis of company-level value creation across a broad range of industries and companies. According to Giertz,[51] each type of business is based on this kind of unique value creation logic. Understanding and managing companies, he argues, thus requires a simulation that will test the business model and its strategy. Sweet[52] argues for the necessity of understanding how the business model and its value creating elements work, as a prerequisite for managing the company. Ramirez[53] too, offers an alternative view to that associated with value creation in industrial production, arguing that technical breakthroughs and social innovations in actual value creation render the alternative, a so-called value co-production framework.

The value proposition or offering of the company depicts which value it intends to deliver to its customers. "A 'business model' is … a precise definition of who customers are, and how the company intends to satisfy their needs both today and tomorrow."[54] Morris's definition, departing in the value of the companies offering to the end users, is very close to the definition of the knowledge narrative from the Danish guideline for intellectual capital statements. The knowledge narrative "expresses the company's ambition to increase the value a user receives from a company's goods or services."[55] Chesbrough and Rosenbloom[56] similarly define the value proposition as the value created for the user of the company's offering. According to Webb and Gile,[57] departing from the notion of customer needs is the only true strategic approach to take, thereby arguing against the previous literature stating that the company's resources ought to be the starting point for strategy formulation. For Hedman and Kalling[58] the company's value proposition is equivalent to the generic strategy of the company. In a likewise manner, Alt and Zimmermann[59] define the value proposition as a part of the company's mission statement together with its vision and strategic goals.

Each type of business has its unique value proposition logic[60] as the value proposition is closely linked to the products and services delivered.

Interconnections That Drive Value

The final category of business model characteristics concerns descriptions of internal linkages in the company related to performance and creating value. By performance-related linkages we mean elements such as value drivers, value creation processes, and causality between, for example, activities, resources, and processes. These three categories regard the internal aspects of a company's business model because they all are concerned with *how* value is created. Bray[61] perceives value drivers as the link between

key performance indicators and business objectives, at the same time underlining that value drivers are not outcome-oriented key performance indicators; rather they are forward-oriented performance measures. As value drivers imply causal relationships, they are more clearly visualized in a business model.

As Bray depicted above, key performance indicators are linked to business objectives via identification of the key drivers of value, which in turn can be interpreted as key success factors.[62] Value drivers are not static performance measures. Rather they will vary over time, both within a business cycle and from business cycle to business cycle.[63] Eventually the company's present value-drivers will be replaced. This may be a result of the company changing its strategy or business model, which must have an effect on the drivers involved in the value chain and value creation process, or it could be an effect of the changing external environment.

A business model is inevitably a representation of how the company creates value, and *value creation*, therefore, is a cornerstone of the business model concept. The external prerequisite, the value proposition, is a central notion when referring to the internal prerequisite value creation, as the company's offering affects which value it must create and deliver to its customers and the users of its products or services. According to Linder and Cantrell,[64] "a real business model is the organization's core logic for creating value." Alt and Zimmermann[65] also link the business model to value creation, by stating that it describes the logic that lies behind the actual processes of a 'business system' for creating value.

The ability of establishing precise connections and causal links and relationships between knowledge resources, competences, intellectual capital, etc., and the value creation of an organization, has been in the interest of the business and academic communities for a long time. Via a business model approach it is possible to identify causal loops that depict linkages between key performance measures and financial results[66] and that link combinations of assets to value creation.[67]

Data and Research Methodology

In the empirical part of this article, we examine the financial analyst's way of thinking about strategy and business models in terms of the techniques, methodologies, procedures, systems, presentations, frameworks, etc., that are used when they articulate their understandings of the strategy of a specific Danish case company, Coloplast.

In addressing this issue a qualitative research approach will be used. Financial analysts that regularly analyze the company, participate in corporate presentations, etc., and thus have a detailed knowledge about the company, its strategy and the industry, have been interviewed and the interviews are analyzed where the nine characteristics of the business model have been used as a starting point for the analysis of the data.

The Case Company, Coloplast

The case company, Coloplast (*www.coloplast.com*), founded in 1957, is a worldwide provider of high quality and innovative health care products and services, and is represented in 30 countries. In the fiscal year 2006/07, its revenue amounted to approx. € 1.070 mill., and group profit before tax was approx. € 80 mill. Coloplast employs more than 7,000 people, 2,500 of them working in Denmark, and the firm has production

facilities in six countries with approximately 75 percent of Coloplast's products being produced in Denmark.

Coloplast's vision is to be the preferred source of medical devices and associated services, contributing to a better quality of life for the users of its products. Via close customer relationships, Coloplast aims at fulfilling the customer's needs with innovative, high-quality solutions. Further, Coloplast seeks to earn customer loyalty through responsiveness and dependability.

With respect to communicating externally about performance drivers, strategy, and knowledge resources, Coloplast is rather unique. Since 1998, Coloplast has published a supplementary section on intellectual capital, shareholders, and other external stakeholders as an integral part of its annual report. In Denmark, Coloplast's business reporting is generally regarded as a best-practise case. The company was for instance used as one of the main cases in the first Danish guideline for intellectual capital reporting,[68] and was suggested by DiPiazza and Eccles[69] as the main example of disclosing information on "how the company creates value." Furthermore, in October 2005, Coloplast won the Danish Financial Analyst Associations prize for best financial report for the second time in three years.

The Interview Data

The data collection was based on semi-structured interviews covering four themes, each with a number of associated questions according to an interview guide. If possible the wording and the order of the questions remained unchanged for all respondents; however, the respondents were allowed to talk freely and the questions were adjusted according to that. The form of interviewing chosen was based on the principle of dialogue between the interviewer and the respondent[70] and has some similarities with the type of interview that Yin[71] calls 'focused interviews.'

We interviewed all the sell-side analysts that followed Coloplast on a regular basis. The contact information of 12 analysts in total was attained from Coloplast and the analysts were contacted by the researchers after having received a letter of recommendation from Coloplast's Chief Financial Officer. All analysts confirmed that they performed regular analyses of Coloplast including the dissemination of these through analyst reports and all were willing to participate in the research project.

Of the 12 analysts actively following Coloplast eight were Scandinavian while four were large European investment banks located in Copenhagen, Stockholm, or London. The typical analyst specialized in four to six companies within the medico-technology sector and sporadically followed four to six major competing companies. However, there were also analysts with a broader focus, and some analysts were actively following up to 15 to 20 companies. All analysts were interviewed in December 2003, a few weeks after Coloplast's annual earnings announcement.

Our focus when conducting the interviews was on the general building blocks or elements that constitute a business model from the analysts' point of view. The interviews were structured around four themes. First, we focused at the *analyst's* background, experience, and specialization. Next we shifted focus to the *company*, Coloplast, asking broadly about how the analyst perceives the company, its management, strategy, value creation, and what critical information they look for, etc. Thirdly, we asked about

the analysis *process*, *i.e.*, what information is used, how the information is used, how the interaction with the company is, how the information is structured during the analysis, etc. As a continuation of the issues around the process we ended the interview by asking about the *annual report*, how it was used, how the different parts were perceived, etc.

The themes and questions were kept as close to the daily routines of the analysts as possible and we attempted to avoid referring to specific notions from the literature on business models. As a structuring device, we used an interview guide with a number of pre-determined questions or sub-themes for each interview theme. Not all questions were necessarily brought up in every interview, and as far as possible we let the analysts create their own structure during the interviews.

Analysis

Taking the nine business model characteristics identified earlier as a point of departure, *see* Figure 1, our analysis focuses on how and why these are mobilized by the respondents during the interviews.

The Overall Criteria for Performance

First of all, it is remarkable that the first characteristic, sustainable development, is not mentioned at all, while strategy was referred to rather constantly. This is rather interesting because the case company, Coloplast, spends a lot of energy in its financial report, on the Internet and in presentations on communicating about how its products relate to creating quality of life for users and how the company works towards a healthy environment in the local community and for employees.

As previously described, strategy along with competitive advantage actually represented the analysts' overall approach to understanding the business model. Strategy concerned the mobilization of the core elements of the organization. Through the notions of strategy, the analysts described, often in great detail, how Coloplast's value creation was constituted, also depicting how these elements were adjusted to Coloplast's value proposition, company values, and vision. Strategy therefore relates to the different elements of the business (model) that are an integral part of the value creation process, *i.e.*, production, distribution, and logistics, along with marketing aspects.

Strategy also relates to strategic management processes, such as disclosure strategy and the management of the financial position, such as investment and disclosure strategy. In this sense, the business model to a great extent concerns core elements of the company's value creation process. It is also intimately connected with competitive strategy, as strategy becomes important in relation to the key business model characteristics of the company, *i.e.*, how the company mobilizes each core value creation (business model) element in order to create competitive advantage. If we differentiate between corporate strategy and strategy on an operative level, it would be compelling to suggest that the company's overall strategy is its business model and strategy on the more detailed levels concerns the ways of effectuating it.

Efforts with respect to improving the business are often mentioned as points within the realm of 'changes in strategy.' Moving production facilities overseas, increased focus on cost reduction and efficiency, and efforts with respect to maintaining quality in production, thereby ensuring excellence

in products, are drawn forth meticulously by the respondents. Improving the business is also connected with innovation and product improvement. In Coloplast's case, innovation is mentioned mainly in the sense of product development. One analyst commented that, "maintaining their high degree of product innovation is a key driver of growth [for Coloplast]." Thus, innovation is connected to future performance from an excellence perspective in the sense that market growth is achieved through better than average products.

Performance-Related Elements

The second category, performance-related elements, relates to overall modules that make up the company. For example, the value proposition or offering of the company relates to what the products or services do for users and customers. The resource base concerns the assets and inputs necessary for creating the offering, while the value chain regards the structure of the company and its value creation process. The resource base is related to the assets and inputs that are prerequisites for making the company's products. Thus it is a prerequisite for value creation. In production companies inputs are normally raw materials or components. In Coloplast's case, this would be plastic and other materials. But assets and inputs are more than merely materials. First of all, being a capital intensive production company, financial assets become of the utmost importance. For example, capital is a necessity for increasing production capacity. An important resource base is also technology. In Coloplast's case, it is the so-called adhesive-technology that is the central aspect. This technology was emphasized as the main synergy connecting Coloplast's various business areas, although some analysts declared it too low-technological to be a distinct competitive advantage for the company.

Also among the core resources in Coloplast are the employees. Respondents argued for the importance in not only having the right employees, but moreover having satisfied employees. Finally, knowledge about the customer and the customer's needs are a central resource for Coloplast's value creation.

The value chain perspective was also partly illustrated above in the analysts' understanding of strategy and the business model. When the analysts were asked about their views of Coloplast's strategy, a major part of their reasoning was based on different elements of the business model, also elements pertaining to the value chain. This, of course, should be viewed in the light of the fact that Coloplast in essence is a traditional production company and thus is largely structured according to the value chain ideas. The value chain characteristic is mobilized in connection with production and distribution features. With respect to production characteristics regarding the value chain, "Coloplast has gone from having everything in-house to develop their production strategy by first outsourcing production to contractors, e.g. Mærsk Medical, and second step in this development story is to move own production from Denmark overseas."

Distribution features concern mainly their forward-integration strategy through, for example, their distribution affiliates HSC and Sterling, but also their progression into the home care segment is perceived as a successful operation by several of the respondents. The only worries aired in this connection have been that the operating margins in this section of the business are significantly lower than the other more lucrative areas. It

seems that Coloplast must evaluate the costs and benefits of attaining a lower average return on invested capital against maintaining closer relationships with the markets and customers.

Finally, within this category, the business model is associated with the value proposition of the company, *i.e.*, the use value of the products or services delivered. In this sense the business model illustrates how the company goes about delivering its market offering, in other words, depicting the value creation process. Essentially, Coloplast is a production company, mass producing standard single use medical devices. But, Coloplast differentiates itself from being 'merely' a mass production company by basing its operations on an alternative set of values. One analyst summed up the link between Coloplast's value proposition and business model in the following manner: "Coloplast puts the patient first, and does not consider bulk production. Coloplast asks themselves how they are able to improve the quality of life for patients and the users of our products and that is why they invest so much money in improving products, always being first to market with improved versions of products that are sellable at marginally higher prices, and all this has turned out to be a rather lucrative strategy for Coloplast." Thus, through the improving the quality of life proposition, Coloplast's business model is product-innovation and customer-needs oriented rather than production focused.

Relationships Among Elements

As opposed to the previous category of characteristics, relationships among elements are more concerned with an action perspective of the business model, *i.e.*, what the processes are, what is done, etc. The three characteristics pertaining to this category are:

1. Value drivers;
2. Value creation processes; and
3. Causal links between different activities and elements of the business model.

Value drivers are in a sense key success factors with respect to the company's future performance both competition-wise and financially. When asked to describe the value drivers of the company, most of the analysts apply the terminology "growth drivers." This reveals the analysts' focus on their valuation models, in which the growth rate of the company plays a central role. Although not mentioned explicitly, there seemed to be a consensus that a growth rate of 10 percent a year was vital in relation to the valuation of the company. The reason behind this very specific number may be because the Boston Consulting Group matrix, which is widely applied in most business schools worldwide, differentiates between high- and low-growth companies at precisely this level.

There does not exist a final definition of what a value driver is and what a growth driver is. The analysts used them interchangeably along with a third term, trigger points. A slight difference between the two terms could be that growth drivers often are connected to these share-triggers, while value drivers would be considered to be more long term.

Along the line of argumentation that trigger points and value drivers are not the same, one analyst stated that "everything revolves around value drivers. What you could say is that some information differs from value drivers with respect to being what we call trigger points." Furthermore the analyst elaborated

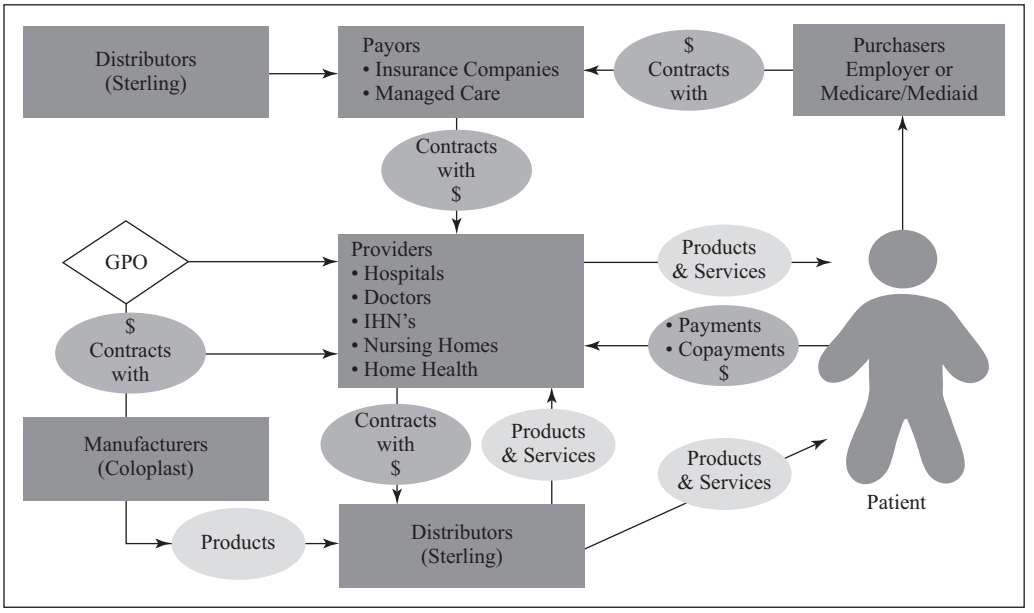
that, "value drivers typically have duration of one to two years; whereas, when you talk of trigger points, then you are talking more about the kind of news flow that moves the share price." Our empirical evidence also leads us to suggest that a discontinuity in a value driver constitutes a trigger point.

The value drivers emphasized by the analysts included the already elaborated aspect of innovation, marketing and distribution, and a business model based on excellence. In addition, penetration of the US market was among the most debated themes in the interviews. In connection with Coloplast's recently released objectives for the next five years, the issue of establishing itself on the US market was given a key role. Finally, and quite surprisingly, only two analysts mentioned demography as a value driver. The fact that the fraction of older people will increase significantly in the next 20 years is a considerable growth driver of the market in which Coloplast operates.

Surprisingly, value creation and value creation processes as such are not mentioned in connection with the business model. From the analysts' perspectives, value creation is only thought of in terms of attaining revenues and thereby boosting profits and other shareholder value measures. An important insight from this study is, therefore, that the financial analysts have grave difficulties in distinguishing between the health care companies' business model and the model by which the payment of revenues are allocated between end users and reimbursing organizations. These revenue streams are illustrated in greater detail in Figure 2, where it is evident that the revenue streams indeed are complex.

The final characteristic in this category, causality, concerns the identification and

Figure 2. The Health Care Revenue Model



significance of links between activities, resources, processes, and other value drivers. Although Coloplast, according to one analyst, operates in a sector that is not especially homogenous, causality between Coloplast's product segments is attained through its core adhesive technology: "Coloplast is a much diversified company seen from a product portfolio perspective. Despite this, there is a connection between the divisions. There are some technological connections, *i.e.*, the adhesive technology." However, other respondents disagree with this statement. One opponent comments that, "with regard to the general structure of the company, some of the divisions are total misfits. I cannot see any synergies in those divisions at all."

As the grand finale, causality is the key to the success of Coloplast's business model. First of all, there is an inevitable link between Coloplast's vision and values and the customer segment it serves. This is the link between improving quality of life and a business model based on excellence. Excellence was also the key causal relationship identified among market relationships, product innovation, and production. This causal relationship among this tripartite is the key to understanding Coloplast's business model; whereas, the link between vision, values, industry segment, and the former tripartite functions as a test of the appropriateness of these causalities, precisely like the narrative test of the business model that Magretta suggests.[72]

Conclusion

The initial literature review identified a series of focal-points concerning the content of a general definition of business models. Here, three overall *business model* themes, namely:

1. The overall criteria that determine long-term performance;
2. The point(s) of departure for value creation; and
3. The key interconnections that drive the value generation of the company, were identified.

Hence, in the following empirical sections, the financial analysts' perceptions of a health care company's business model was analyzed in accordance with these themes.

Having taken our point of departure in how analysts understand strategy and which elements they perceive as constituting the business model of the health care company, we were able to examine whether the characteristics suggested in the literature review were reflected empirically. By studying the financial analysts' perceptions of the health care company's business model, its structure, competitive strengths, and strategy, we are able to point out a number of critical success factors for communicating business models and other forward-looking statements.

First, the analysis demonstrated that 'excellence' was the key notion of a number of the characteristics that were identified for the business model of Coloplast. The business model was seen to revolve around a link between improving quality of life and a competitive strategy based on excellence. Excellence was also the key causal relationship identified among market relationships, product innovation, and production. The causal relationships among this tripartite is identified as the key to understanding Coloplast's business model.

This study indicates that the financial analysts' understanding incorporated a wide array of elements of the business model. For example, the analysts described the method of doing business: focusing on the whole enterprise system and the company's architecture for generating value as well emphasizing roles and relationships, describing the uniqueness of the value generating infrastructure, links, processes, and causal relationships.

The analysts' understanding of Coloplast's business model was strongly related to the company's distribution strategy, where there were marked differences across product and market segments. This made it difficult to describe Coloplast's business model very precisely, at least on an aggregated level, suggesting that Coloplast operates with fragmented distribution (business) models on the geographical and segment levels. Also, it was by many respondents stated that Coloplast's competitive advantage lies in its adhesive technology. Rather than being product-development oriented, Coloplast's business model was focused around a marketing relationship and excellence perspective.

If the business model should be useful in the communication of the company's strategy, it should be able to simultaneously express the uniqueness of the company's strategy and the market it operates in and at a general level facilitate a comparison between the company and its competitors. In the analysis it was indicated that the business model constitutes an explicit link to understanding the company's uniqueness, competitive advantage, and strategy—in a sense, being a link to understanding the key causal relationships that make up a businesses value creation process. Thus, if management is able to convey its understanding of the company's value creation logic in a way that corresponds to that of external stakeholders, communication would be eased significantly.

While the financial analysts studied in this article all had direct access to the company's management team, private investors do not have access to the same sources and amounts of information. Therefore, disclosing more information of the same type as used by the financial analysts via reporting media, *e.g.*, in relation to the business model, would be a significant improvement for the private investors, despite the fact that the analysts may not indicate that they in fact need such types of information. The latter is due to the fact, as stated earlier in this article, that financial analysts primarily get the more complex types of information directly from the company and not through voluntary reporting. Eccles *et al.*[73] have argued for better disclosure from this point of view, but still the investors would be left with little clue about how indicators on, for example, intellectual capital should be interpreted.

Sometimes companies report in their annual reports only key performance indicators or similar information without disclosing them within the context of the business model that explains their interconnectedness and why it is precisely this bundle of indicators that is relevant for understanding this particular companies' strategy and value creation. If this is the case, the interpretation must be done by the readers of the report. However, at the present there exists only limited research-based insight into how this reading and interpretation is conducted.

From an accounting point of view, improved disclosure is more or less about determining the types of information that most significantly explains market value, in

order that these numbers can be disclosed and fed into the decision-making process, maybe even capitalized, but at least used for benchmarking purposes. It is, however, questionable whether the financial market, *i.e.*, investors and analysts, would regard capitalization or standardised non-accounting information as improved disclosure.

The analysts and professional investors already have deep insight into a lot of details on the company, and the most important information is likely to be related to the specific strategies of the companies and hence difficult to compare and interpret unless it is disclosed as an integral part of a framework that explains how value is created. Since understanding value configurations and customer value creation is more of interest from a strategy point of view, a possible reconciliation of the reporting-understanding gap could be for the company to disclose its business model, *i.e.*, the story that explains how the enterprise works, who the customer is, and what the customer values—and based on this—determine how the company is supposed to make money. As previously noted in this article, such a description should also help the financial community in understanding the differences between the—often complicated—*revenue model* of the health care company, and its *strategic* business model.

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Security Market Reaction to FDA Fast Track Designations

Christopher W. Anderson and Ying "Jenny" Zhang

Pharmaceutical firms can apply for the Food and Drug Administration to 'fast track' research and development on new drugs, accelerating clinical trials and expediting regulatory review required prior to marketing to consumers. We investigate security market reaction to more than 100 fast track designations from 1998 to 2004. Fast track designation appears to enhance investor recognition of firm value. Specifically, fast track designation coincides with abnormal trading volume and excess daily stock returns for sponsoring firms. Institutional ownership and analyst attention also increase. Market response is more pronounced for firms that are smaller, do not yet market products, and have low institutional ownership. Keywords: *Fast track, FDA, pharmaceuticals, research and development, announcement returns, clinical trials.*

"Fast, fast, fast track your drug
Swiftly down the pipeline.
Merrily, merrily, merrily, merrily
Cash is a biotech's lifeline!"
—Tom Jacobs writing for
The Motley Fool in 2002[1]

The US Food and Drug Administration (FDA) requirements for safety and efficacy testing impose substantial costs on pharmaceutical companies seeking to discover and commercialize new drugs and medical devices. Since passage of the 1997 Food and Drug Administration Modernization Act (FDAMA), the FDA has been authorized to grant drug sponsors so-called fast track status to expedite development and approval of drugs with potential to address unmet needs for serious or life-threatening conditions. While fast tracked drugs remain subject to a low frequency of ultimate commercialization, recent studies suggest that fast track status reduces clinical development time by as much as three years from the standard time of more than eight years, potentially saving drug developers hundreds of millions of dollars for each new drug.[2] In addition, researching and developing drugs under fast track designation may favorably resolve uncertainty regarding the real options embedded in a pharmaceutical firm's drug pipeline and therefore enhance firm value for investors.

In this study we investigate how the security market responds when publicly traded pharmaceutical companies announce that the FDA has granted fast track designation to a sponsored drug. Notably, these fast track announcements convey no incremental scientific data and little specific economic information about a drug's medical or commercial potential. For example, these announcements are not made coincidental with news about whether a drug has been successful in phase-one, -two, or -three clinical trials, and the drugs still face stringent scientific and costly regulatory hurdles that must be cleared prior to commercialization. Nevertheless, we find that financial markets respond favorably in several dimensions when a pharmaceutical firm announces that one of its new drugs has

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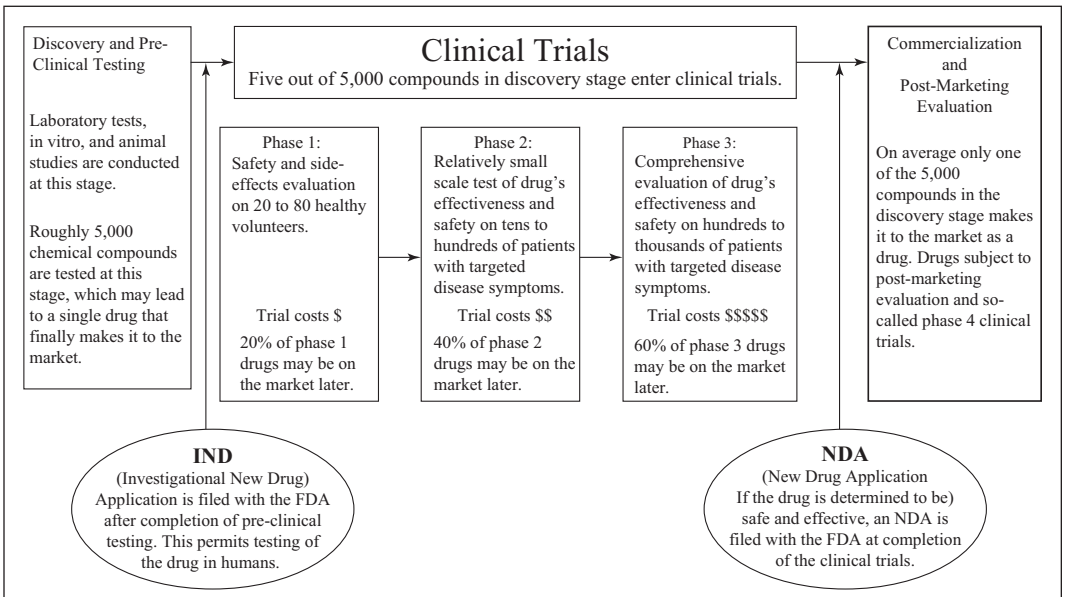
been granted fast track designation by the FDA.

Specifically, we identify more than 100 instances between 1998 and 2004 in which pharmaceutical firms with publicly traded common equity announce FDA award of fast track designation for sponsored drugs. We then investigate how trading volume, stock prices, institutional ownership, and analyst coverage respond to the announcement of the fast track designation. We find that fast track announcements coincide with abnormal trading volume and positive abnormal stock returns that average about 9 percent across several alternative benchmarking techniques. Abnormal returns are highest among small firms, firms that have yet to commercialize a product, and firms with low levels of institutional ownership. Institutional ownership increases materially around fast track events, especially for small firms, and analyst coverage improves and becomes more favorable. Overall, our results suggest that the award of fast track designation conveys positive information about a drug's sponsoring company. Market response suggests that fast track designation lowers expected regulatory costs, reveals positive information about the quality of the firm's growth opportunities, and enhances investor recognition.

The FDA Drug Approval Process and Fast Track Designation

Testing for safety and efficacy as regulated by the FDA imposes substantial costs on the development of new drugs and delays the commercialization of innovations in health care.[3] Figure 1 summarizes the various aspects of new drug discovery

Figure 1. The Drug Discovery and FDA Approval Process



Sources: Food and Drug Administration, "The FDA's Drug Review Process: Ensuring Drugs Are Safe and Effective, *FDA Consumer Magazine*, July–Aug. 2002, Pub. No. FDA05-3242, available at *http://www.fda.gov/fdac/features/2002/402_drug.html.*

and the FDA approval process.[4] Identifying potentially valuable new drugs in preclinical testing, obtaining investigational new drug (IND) status, conducting successful phase-one, -two, and -three clinical trials on human subjects, and obtaining approval for a new drug application (NDA) prior to a product's commercialization require considerable time and money. The FDA recently estimated that the total capitalized cost of developing a new drug is $1.7 billion, considerably higher than earlier estimates of $231 million as of 1987 and $800 million as of 2000.[5] Furthermore, new drug approvals fell to 20 for 2005, compared to 36 for 2004, and the time to complete clinical trials required for FDA approval now averages 8.5 years.[6] In response to these alarming trends, the FDA has recently proposed new rules to reduce drug development costs and has sponsored new programs aimed at fostering innovative practices among pharmaceutical firms, research institutes, and universities with the goal of accelerating clinical trials.

Earlier concerns about whether the FDA approval process had become too burdensome preceded the passage of the FDAMA in 1997. In particular, the US Congress acted in response to criticisms from the AIDS and cancer victims' communities about the slow pace of drug development in the face of increasing incidence of disease and a lack of innovation that would decrease mortality rates.[7] Among the provisions of the FDAMA is the allowance for so-called fast track designation for products in the review process. Specifically, Section 112 of the FDAMA directs the FDA to "at the request of the sponsor of a new drug, facilitate the development and expedite the review of such drug if it is intended for the treatment of a serious life-threatening condition and it demonstrates the potential to address unmet medical needs for such a condition."[8]

A new drug is eligible for several FDA programs upon being granted fast track status, including:

1. Closer communication with the FDA in designing clinical trials and regulatory review, enhancing predictability in FDA decisions;
2. Greater likelihood of receiving priority review when an NDA is submitted, reducing FDA review time from ten to six months; and
3 Access to the accelerated approval process under which a drug may be commercialized with conditional FDA approval on the basis of incomplete but promising clinical trials.[9]

Several of these FDA programs, including accelerated approval, predate the 1997 FDAMA but were underutilized by drug companies due to excessive bureaucratic red tape and regulatory opacity.[10]

Industry response to the FDAMA has been enthusiastic even though some FDA officials and industry observers initially indicated that fast track would not materially affect FDA procedures.[11] According to Milne and Bergman's[12] survey of pharmaceutical firms, respondents cited the following among various operational factors responsible for the fast track program's benefits:

- Better interaction with the FDA—83 percent;
- Publicity from designation—65 percent;
- Face-to-face contact at the FDA—61 percent; and
- Indication of likely priority review—57 percent.[13]

Furthermore, evidence seems to suggest that fast track has succeeded in reducing the time required for FDA approval. A recent study released by the Tufts Center for Drug Development suggests that clinical development time for fast track drugs approved between 1998 and 2003 was two-and-a-half years shorter than for non-fast tracked drugs.[14] Extrapolating from the evidence in DiMasi, Hansen, and Grabowski,[15] reducing clinical trial time by 25 percent would reduce total drug development costs by nearly 15 percent or almost $130 million per new drug on average.[16] Consequently, analysts who follow drug companies often applaud fast track designations for their likely positive effect on company finances.[17]

Nevertheless, a fast tracked drug is by no means guaranteed eventual FDA approval of a NDA nor eventual success in the pharmaceutical marketplace. In particular, fast tracked drugs still frequently fail to meet scientific criteria for safety and efficacy and related regulatory hurdles and therefore are never commercialized. For example, one online industry publication advised caution for investors seeking to interpret fast track announcements:

First of all, the list of indications that fast track products target reads like a Hit Parade of notoriously incurable diseases. Add to that the fact that fast track drugs tend to involve new approaches and cutting edge technologies and you've got a recipe for high stakes, high-risk drug development at its most unpredictable.[18]

In particular, while priority review and accelerated approval are likely to be sought for fast tracked drugs with promising phase-two clinical trials for small-scale efficacy or phase-three trials for large-scale efficacy, many drugs are designated as fast track drugs prior to phase-two trials or even on the basis of animal testing that precedes trials with human subjects. For many such drugs, fast track may very well mean a fast track to failure, which would be a good outcome for the sponsoring drug company if such a conclusion would have been reached with delay and at greater cost in the absence of fast track mechanisms.[19] Notably, even drugs that receive accelerated approval on the basis of promising but incomplete testing are subject to negative FDA advisories or even product recall if additional post-marketing trials reveal adverse information about safety or efficacy.[20]

Market Reaction to Fast Track Announcements

The pharmaceutical industry provides an interesting laboratory in which natural experiments of interest to financial economists occur. The industry is driven by research and development, and pharmaceutical and biotech firms are typically classified as the ultimate growth firms, *i.e.*, firms whose value is largely attributable to intangible assets, such as risky real options created by costly and time-consuming research and development.[21] The investment growth options embedded in these risky but potentially profitable new drug therapies may be exercised and turned into marketable products that generate future cash flows, or these options may be abandoned due to lack of commercial viability.[22] Unlike growth firms in sectors such as microelectronics or Internet communications, the development and exercise of growth options by US pharmaceutical firms takes place under the regulatory scrutiny of the FDA. As discussed in the prior section, the regulatory process can be

burdensome and costly. For investors and scholars, however, the highly regulated drug development and testing process results in externally visible news events that reveal the value of a firm's growth options. In particular, investors scrutinize publication of clinical trial results, announcements about the commencement of next phase trials, and other non-traditional information about growth options that might materially affect firm valuation and stock price movements. Consequently, observable regulatory events concerning pharmaceutical firms are excellent candidates for the event-study method of analysis.

Several studies employ event-study methods to examine the effect of proposed health care price controls or other adverse regulations on the value and investment plans of the pharmaceutical industry.[23] Other studies examine the impact of firm-specific news such as patent awards or FDA approval of drugs on prices of equity securities for the affected firms.[24] In general, these studies find that the stock prices of pharmaceutical firms are very sensitive to information revealed through regulatory decisions because such decisions are often decisive about risk and value of intangible assets such as unproven drugs. One study also examines fast track announcements for stock price reaction. Alefantis, Kulkarni, and Vora[25] examine 26 fast track announcements between 1998 and mid-2001 and report a 10 percent two-day abnormal return for sponsoring firms. We also rely on an event study design to discern the stock price impact of fast track designations, but our sample period is longer, our sample size is considerably larger, and we extend the analysis in several dimensions. Specifically, we examine not only stock price reaction but also trading volume, institutional ownership, and analyst coverage, as well as how fast track effects vary across sample firms according to firm-specific characteristics such as firm size, existence of marketed products, and institutional ownership levels.

To implement this study, we collect a sample of announcements by pharmaceutical firms that they have received fast track designation for a sponsored drug. The FDA does not provide an independent listing of such designations, nor of any clinical drug trial outcomes short of NDA approvals. Consequently, we rely on self-disclosure of fast track designations by affected firms. We search on the *Factiva* new archive using keywords such as "fast track" in conjunction with terms such as "drugs, pharmaceuticals, biotech, FDA," and so on. We also compare our sample with a listing of pharmaceutical firm announcements of fast track status maintained by Recombinant Capital's database (ReCap). We find that the sample derived from ReCap is a subset of our *Factiva*-based sample. As shown in panel A of Figure 2, this search results in 162 announcements of fast track designation for drugs sponsored by 169 companies. We impose the requirement that any announcements are for US-traded public firms with stock-price data available on the Center for Research in Securities Prices (CRSP) database. We identify a single primary sponsor for each drug, and we do not double count a small number of announcements of multiple fast tracked drugs that occur on the same day.

The resulting sample is 109 fast track announcements by 82 firms (60 firms with one announcement, 17 with two, and five with three). Panel A of Figure 2 shows the distribution of sample announcements over 1998 to 2004, showing that over one half of

Figure 2. Sample of Announcements of Fast Track Designation

Panel A shows the distribution of fast track designations as revealed by a Factiva search for years 1998 through 2004, and how the sample is reduced to a final sample of 109 single-date announcements for primary sponsor firms with CRSP stock price data. Panel B shows descriptive information on sample firms. Market capitalization of common equity is calculated on the day before the fast track designation announcement, as is number of years since the firm's IPO. The information on institutional holdings is reported at the end of quarter prior to each sponsoring firm's very first fast track designation. There are 60 firms with a single announcement, 17 firms with two distinct announcements, and five firms with three distinct announcements. We infer whether a firm has already marketed products to consumers through examination of press releases, company Web sites, and disclosure documents, such as 10-Ks and proxy statements.

Year	All Fast Track Announcements in *Factiva*	Sponsoring Firms	Announcements with Two Sponsors	Firms with Multiple Announcements	Firms with CRSP Data	Final Sample of Announcements
1998	12	12	0	0	7	7
1999	14	15	1	0	13	12
2000	15	17	2	0	12	10
2001	12	13	1	0	11	9
2002	22	23	2	1	15	15
2003	39	41	2	1	29	28
2004	48	48	1	1	30	28
Total	162	169	9	3	117	109

	N	Mean	75th	Median	25th
Market capitalization in millions	109	$4,375	$1,180	$443	$129
Years since IPO	109	10.9	12.9	7.8	3.4
Institutional stockholders	82	94	109	51	18
Institutional stock holdings %	82	36.8%	58.0%	30.5%	15.3%
Firms with marketed products	36				
Firms without marketed products	73				

the announcements (56) occurred in the last two sample years.[26] Two sample fast track announcements occur within one month of the sponsor firm's initial public offering (IPO). When we examine trading volume and returns, we eliminate these two observations, reducing the sample to 107 announcements.

Panel B of Figure 2 provides some sample statistics with respect to firm size, institutional holdings of stock for the quarter prior to the fast track announcement, and the number of firms with marketed products as identified in fast track announcements texts, company Web sites, and disclosure documents, such as 10-Ks and proxy statements. With respect to market value of equity, the sample of firms is skewed, with a mean of $4,375 million and a median of $443 million. There is

a similar skew with respect to firm age, with a mean of 10.9 years since a firm's IPO and a median of 7.8 years. Notable, one quarter of the sample is made up of relatively small firms with market capitalization less than $129 million and vintage since IPO of fewer than 3.4 years. There are parallel skews with respect to number of institutions that hold the stock and the percentage of stock held by institutions. Finally, while 36 announcements are made by firms that have already commercialized pharmaceutical products, 73 announcements are by firms without any products in the market place at the time of the announcement. In short, the sample is composed of fast track announcements by some large, widely held, well-established firms that have already marketed drugs and some smaller, younger firms with fewer institutional shareholders and without any commercialized products. We exploit this heterogeneity with respect to firm characteristics to better understand when fast track designation is more likely to be material with respect to a company's value and the trading characteristics of its stock.

Empirical Results

For each announcement we conduct event study analysis with respect to trading activity, short-term and long-run stock price changes, institutional ownership, and analyst coverage. With respect to each of these various dimensions we investigate whether fast track designation coincides with unusual trading volume, abnormal stock returns, unusual changes in institutional ownership, and unusual changes in analyst coverage and recommendations. We also investigate how changes in stock prices and trading activity vary by firm-specific characteristics such as firm size, maturity of each firm's portfolio of products, and institutional ownership.

Trading Activity

For each announcement, we obtain from CRSP the daily volume (number of shares traded) and daily turnover (shares traded shares outstanding) for the period from −131 trading days to −31 trading days before the fast track announcement and for the 21-day period centered on the date of the fast track announcement. For the announcement day and for the ten preceding and ten following days we calculate abnormal volume and abnormal turnover as follows:[27]

$$\text{AbnormalVolume}_t = \frac{V_t - \overline{V}_{-131,-31}}{\sigma_{V_{-131,-31}}} \quad (1)$$

$$\text{Abnormal Turnover}_t = \frac{TO_t - \overline{TO}_{-131,-31}}{\sigma_{TO_{-131,-31}}} \quad (2)$$

Figure 3 presents the results of our analysis of abnormal trading activity. Trading activity is indeed unusually high when firms announce fast track designation for their sponsored drugs. In particular, on day zero mean excess trading volume (turnover) is 7.88 times (7.49 times) the standard deviation of trading volume observed in the day −131 to day −31 estimation period. Based on sample means, trading volume and turnover appear unusually high from about day −5 through day +2 relative to the fast track announcement date. These measures of trading activity are skewed, however, as median abnormal volume (turnover) is 1.87x (1.72x) on day zero, with no observable trends on surrounding days. Nevertheless, the median excess volume and excess turnover on day zero suggest that fast track announcements are

associated with unusually high levels of trading activity among sample firms.

Figure 4 tracks median abnormal turnover relative to the fast track announcement day, clearly showing a spike in trading activity for the announcement date and the day after. Post-announcement trading activity appears to revert to normal levels, however. In short, information contained in fast track announcements appears to be material because such

Figure 3. Stock Trading Volume and Turnover Surrounding Fast Track Designations

Figure 3 shows measures of abnormal trading activity in the stocks of firms for the 21 days centered on announcement of fast track designation for a sponsored drug. Panel A shows results for abnormal trading volume (measured as number of shares traded) relative to benchmarked volume for days −131 to −31 prior to the fast track announcement on day zero. Panel B shows results for abnormal trading turnover relative to benchmarked turnover (measured as shares traded relative to total shares outstanding) for days −131 to −31 prior to the fast track announcement on day zero. Asterisks indicate p-values associated with t-tests for means and sign tests for percent positive.

Event Day	Mean		75%	Median	25%	%Positive	
−10	0.34	**	0.60	−0.27	−0.49	39.45	**
−9	0.17		0.40	−0.24	−0.52	33.03	**
−8	0.06		0.38	−0.24	−0.50	35.78	***
−7	0.19		0.36	−0.24	−0.52	33.94	***
−6	1.35		0.41	−0.23	−0.54	34.86	***
−5	0.58	*	0.33	−0.21	−0.55	37.61	**
−4	0.36	*	0.49	−0.22	−0.47	33.03	***
−3	0.28	**	0.51	−0.17	−0.47	35.78	***
−2	0.52	**	0.89	−0.24	−0.51	35.78	***
−1	0.65	***	0.72	0.03	−0.40	53.21	
0	7.88	***	6.14	1.87	0.42	78.90	***
1	4.87	**	1.89	0.35	−0.15	63.30	***
2	2.24	**	1.02	0.08	−0.27	55.96	
3	6.71		0.64	−0.04	−0.42	47.71	
4	2.73		0.85	−0.06	−0.45	47.71	
5	1.96		0.91	−0.10	−0.49	47.71	
6	1.02		0.85	−0.04	−0.38	45.87	
7	1.22		0.87	−0.14	−0.47	45.87	
8	1.05	**	0.82	−0.12	−0.44	45.87	
9	0.87	**	0.85	−0.06	−0.52	46.79	
10	0.87	***	0.60	−0.02	−0.42	46.79	

Figure 3. ***Continued...***

Panel B: Abnormal turnovert $= \dfrac{TO_t - \overline{TO}_{-131,-31}}{\sigma_{TO_{-131,-31}}}$

Event day	Mean		75%	Median	25%	%positive	
−10	0.30	*	0.55	−0.28	−0.53	34.86	***
−9	0.13		0.36	−0.26	−0.52	30.28	***
−8	0.02		0.35	−0.28	−0.53	33.03	***
−7	0.15		0.26	−0.28	−0.53	29.36	***
−6	1.28		0.35	−0.24	−0.57	32.11	***
−5	0.53	*	0.30	−0.24	−0.56	33.94	***
−4	0.32		0.45	−0.24	−0.51	32.11	***
−3	0.23	*	0.49	−0.22	−0.49	33.94	***
−2	0.46	**	0.82	−0.24	−0.54	35.78	***
−1	0.56	***	0.67	0.02	−0.44	50.46	
0	7.49	***	5.76	1.72	0.30	78.90	***
1	4.64	*	1.82	0.30	−0.20	61.47	***
2	2.12	**	0.97	0.05	−0.28	51.38	
3	6.63		0.51	−0.05	−0.44	46.79	
4	2.62		0.80	−0.07	−0.46	46.79	
5	1.83		0.87	−0.15	−0.49	45.87	
6	0.87		0.76	−0.08	−0.42	44.04	
7	1.05	*	0.71	−0.14	−0.50	45.87	
8	0.82	*	0.76	−0.15	−0.44	43.12	
9	0.74	**	0.83	−0.10	−0.53	44.04	
10	0.70	**	0.42	−0.08	−0.46	42.20	

*** significance at *p*-value<1%, ** significance at *p*-value<5%,
* significance at *p*-value<10%

announcements coincide with significantly higher than normal trading activity.[28]

Figure 5 shows abnormal turnover and volume for sample firms sorted by firm size into quartiles, by whether a firm has a marketed product, and by institutional ownership of each firm's common equity. The results shown in Figure 5 indicate that changes in trading activity in response to fast track announcements are greater for smaller firms, for firms that have yet to market a product, and for firms with lower institutional ownership. Specifically, abnormal turnover and volume both decrease as firm size increases, and abnormal trading activity is insignificantly positive for the largest quartile of firms. Similarly, abnormal trading activity is only significantly positive for the 73 sample firms that have yet to market a pharmaceutical product. Finally, increases in turnover and

volume are decreasing in the level of institutional ownership. In summary, these results suggest that fast track announcements vary in materiality by firm size, product portfolio, and institutional ownership.

Stock Returns

We next examine if firms announcing fast track designations for sponsored drugs experience unusual stock-price movements coincidental with and following the announcement. We anticipate that benchmarking of returns, especially long-run returns, will be problematic for our sample. Specifically, by design our sample is composed of high growth stocks that have been shown to under-perform more balanced portfolios of stocks on average. Second, our sample spans both large established firms and small young firms. Finally, our sample is concentrated in a single industry, and pharmaceutical stocks in general have been shown to deviate from overall market movements, especially in response to common events such as proposed or rumored changes in regulation.[29] Consequently, we employ a variety of benchmarks, each designed to address some aspects of the unique nature of our sample.

Figure 4. Median Abnormal Turnover Surrounding Fast Track Designations

Figure 4 shows the median daily abnormal turnover relative to benchmarked turnover (measured as shares traded relative to total shares outstanding) for days −131 to −31 prior to the fast track announcement on day zero. Daily abnormal turnover is estimated according to equation (2) as follows:

$$\text{Abnormal Turnover}_t = \frac{TO_t - \overline{TO}_{-131,-31}}{\sigma_{TO_{-131,-31}}}$$

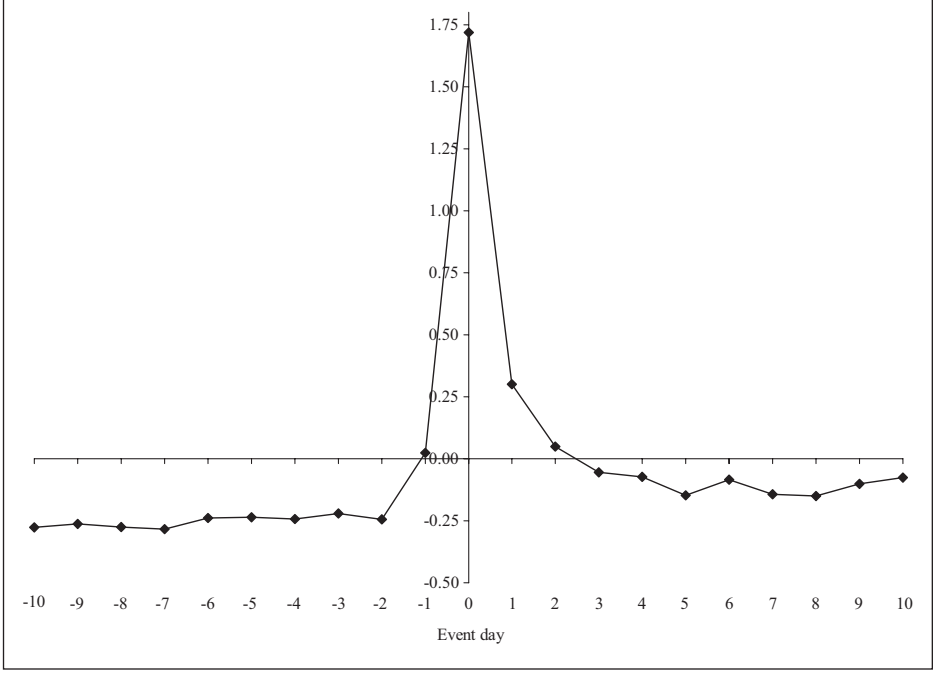


Figure 5. Stock Trading Activity Surrounding Fast Track Designations for Firms Distinguished by Size, Products, and Institutional Ownership

The sample of announcements of fast track designation is divided into sub-samples based on, alternatively, market value of equity, whether the sponsor firm has commercialized a product or not, and the level of institutional holdings in the quarter prior to the announcement. Measures of abnormal trading volume and abnormal turnover, measured as per equations (1) and (2), are provided for each respective sub-sample for the announcement day. Asterisks indicate *p*-values for sign tests associated with %positive.

	N	Mean Abnormal Volume	Median Abnormal Volume	%Positive		Mean Abnormal Turnover	Median Abnormal Turnover	%Positive	
Smallest quartile	27	22.47	5.89	96.3	***	21.71	5.70	96.3	***
Quartile 2	26	6.45	2.89	77.8	***	5.85	2.25	77.8	***
Quartile 3	27	2.74	1.71	82.1	***	2.54	1.46	82.1	***
Largest quartile	27	0.54	0.52	59.3		0.49	0.61	59.3	
No products	72	10.83	2.84	87.7	***	10.30	2.45	87.7	***
Marketed products	35	1.80	0.66	61.1		1.70	0.66	61.1	
<25%	39	12.68	4.24	82.9	***	12.15	3.74	82.9	***
25%-50%	29	6.90	1.90	89.7	***	6.36	1.90	89.7	***
>50%	39	3.81	0.77	66.7	**	3.66	0.71	66.7	**

*** significance at *p*-value<1%, ** significance at *p*-value<5%, * significance at *p*-value<10%

For each announcement we obtain daily returns for the period from −131 trading days to −31 trading days before the fast track announcement and for the 21-day period centered on the date of the fast track announcement. We use days −131 to −31 to estimate parameters for alternative benchmark models of expected returns. We first estimate a Fama-French three-factor model of returns using daily returns from day −131 to −31:

$$AR_{j,t} = R_{j,t} - \hat{\alpha}_j - \hat{\beta}_j R_{M,t} - \hat{s}_j SMB_t - \hat{h}_j HML_t \quad (3)$$

$R_{j,t}$ is the return to firm j on day t, $R_{M,t}$ is daily return on the value-weighted market portfolio, SMB_t is the difference between the daily return on a portfolio of small stocks minus the return on a portfolio of large-cap stocks, and HML_t is the daily return on a portfolio of value stocks minus the return on a portfolio of growth stocks. The daily returns for sample stocks are obtained from CRSP, and the factor returns are obtained from Kenneth French's data library.[30] Coefficient estimates for each firm are then used to estimate abnormal daily return for any day t around the fast track announcement as follows:

$$R_{j,t} = \alpha_j + \beta_j R_{M,t} + s_j SMB_t + h_j HML_t + \varepsilon_{j,t} \quad (4)$$

We also report results for single-factor versions of equations (3) and (4) in which we employ alternatively as a single pricing factor one of the following: the returns to the value-weighted market portfolio, the equally weighted market portfolio, a drug company stock index, or a biotech company stock index.

Figure 6 reports abnormal stock returns coincidental with the announcement of fast track designation for a sponsored drug. The upper section of Figure 6 shows the abnormal return on the day of the announcement. Average announcement day returns range from 8.60 percent for the biotech index benchmarked model of expected returns to

Figure 6. Abnormal Stock Returns Surrounding Announcements of Fast Track Designation

Figure 6 shows abnormal returns upon announcement of fast track designation of a sponsored drug on day zero and cumulative abnormal returns for the three-day period centered on day zero. Abnormal returns are estimated relative to a three-factor Fama-French model of returns estimated over days −131 to −31 relative to the announcement, or alternatively by one of four single-factor models employing alternative market portfolios or sector-specific indexes. For example, the three-factor model abnormal returns for firm j on day t are calculated according to equation (4) as follows:

$AR_{j,t} = R_{j,t} - \hat{\alpha}_j - \hat{\beta}_j R_{M,t} - \hat{s}_j SMB_t - \hat{h}_j HML_t$**, where the three factors are the daily return on the value-weighted CRSP market portfolio, the differential return on small stocks net returns on big stocks, and the differential return on value stocks net returns on growth stocks. The three pricing factors are obtained from Ken French's on-line data library. The single factor models employ, alternatively, the equally weighted market return, the value-weighted market return, returns to a drug industry index, and returns to a biotech index. Asterisks indicate *p*-values for t-tests of mean returns and sign tests for median returns.**

	Mean		75%	Median		25%
Day 0 returns						
Three-factor model	9.69%	***	9.91%	5.40%	***	0.48%
Equally weighted market model	9.73%	***	10.25%	5.56%	***	0.73%
Value-weighted market model	9.62%	***	10.02%	4.91%	***	0.74%
Drug industry index model	9.63%	***	9.59%	5.02%	***	1.10%
Biotech index model	8.60%	***	10.10%	4.41%	***	0.63%
Day −1 to +1 returns						
FF 3-factor model	10.11%	***	13.10%	4.50%	***	−1.24%
Market model (equal w.)	10.28%	***	14.27%	4.46%	***	−0.88%
Market model (value w.)	10.05%	***	13.43%	4.56%	***	−1.21%
Drug index model adjusted	10.14%	***	13.95%	3.98%	***	−0.41%
Biotech index model adjusted	8.70%	***	14.52%	3.27%	***	−0.94%

*** significance at *p*-value<1%

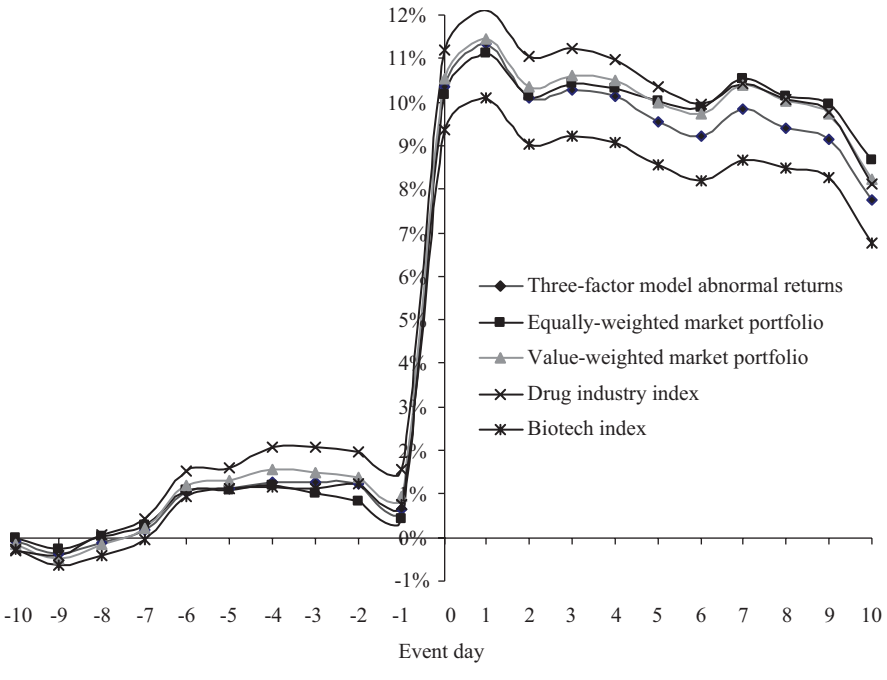
9.73 percent for the equally weighted market index model. Median abnormal returns range from 4.41 percent for the biotech index model to 5.56 percent for the equally weighted market index model. Both means and medians are significantly different from zero at *p*-values below 1 percent. Figure 6 also shows the cumulative abnormal returns for the three-day period centered on the fast track announcement. Mean three-day returns are slightly higher than the single-day returns, median three-day returns are slightly lower, and a smaller percentage of three-day returns are positive. Nevertheless, abnormal returns appear meaningfully different from zero for this three-day window, too.

Figure 7 shows the pattern of average cumulative abnormal return according to various benchmarks over the 21-day period centered on the day zero fast track

Figure 7. Cumulative Abnormal Returns Surrounding Announcements of Fast Track Designations

Figure 7 shows mean cumulative abnormal returns for days −10 to +10 relative to the announcement of fast track designation of a sponsored drug on day zero. Abnormal returns are estimated relative to a three-factor Fama-French model of returns estimated over days −131 to −31 relative to the announcement, or alternatively by one of four single-factor models employing alternative market portfolios or sector-specific indexes. For example, the three-factor model abnormal returns for firm j on day t are calculated according to equation (4) as follows:

$$AR_{j,t} = R_{j,t} - \hat{\alpha}_j - \hat{\beta}_j R_{M,t} - \hat{s}_j SMB_t - \hat{h}_j HML_t$$



announcement. Taken together, the results reported in Figure 6 and Figure 7 suggest that the fast track announcement is a material event in terms of stock price movement across several alternative benchmarks for expected daily returns.

Figure 8 shows mean and median abnormal returns on fast track announcement days for sample partitions based on market capitalization, whether a sample firm already markets pharmaceutical products at the time of the announcement and the level of institutional ownership of the firm's stock prior to the fast track announcement. Exhibit 8 indicates that abnormal returns are higher for smaller firms, for firms that

Figure 8. Abnormal returns surrounding fast track designations for firms distinguished by size, products, and institutional ownership

Figure 8 shows the mean (median) abnormal returns on the day of a fast track designation announcement under alternative model benchmarks and for sample splits by firm size, by whether a firm has already marketed products to consumers, and by institutional ownership of common equity.

	Mean (median) abnormal returns under alternative models for benchmarked expected returns				
	Three-Factor Model	**Equally Weighted Market**	**Value-Weighted Market**	**Drug Industry Index**	**Biotech Index**
Smallest quartile (median MVE $61 million)	21.92% (10.19%)	21.99% (10.13%)	21.96% (10.23%)	22.20% (9.87%)	19.07% (11.41%)
Quartile 2 (median MVE $224 million	11.26% (8.52%)	11.04% (8.21%)	10.85% (7.95%)	10.40% (6.85%)	10.40% (5.80%)
Quartile 3 (median MVE $676 million)	5.21% (5.38%)	5.38% (5.36%)	5.07% (4.92%)	4.92% (4.85%)	4.78% (4.22%)
Largest quartile (median MVE $3,965 million	1.05% (0.43%)	1.18% (0.63%)	1.28% (0.62%)	1.66% (0.96%)	0.87% (0.73%)
No products (72 firms)	12.89% (6.43%)	12.87% (6.64%)	12.75% (6.36%)	12.78% (6.40%)	11.36% (5.71%)
Marketed products (35 firms)	3.11% (1.02%)	3.27% (1.36%)	3.20% (1.41%)	3.13% (1.33%)	2.85% (1.24%)
Holdings<10% (23 firms)	18.92% (9.38%)	18.88% (10.25%)	18.67% (10.04%)	18.79% (9.59%)	15.03% (6.00%)
10%<Holdings<25% (16 firms)	10.47% (8.41%)	10.45% (8.02%)	10.51% (8.09%)	10.31% (8.21%)	10.51% (8.77%)
25%<Holdings<50% (29 firms)	11.50% (7.15%)	11.41% (6.64%)	11.25% (5.99%)	11.02% (6.61%)	10.65% (5.95%)
Holdings >50% (39 firms)	2.59% (2.10%)	2.79% (1.40%)	2.71% (1.41%)	2.91% (2.11%)	2.53% (1.34%)

have yet to market products, and for firms whose stock is subject to lower levels of institutional ownership. These three characteristics are positively but imperfectly correlated, so we next turn to cross-sectional regression analysis to determine which characteristics affect the level of abnormal returns in response to fast track announcements. Figure 9 reports regression results where the dependent variable is abnormal return on the announcement date based on the three-factor model; results are similar when alternative benchmarks or three-day return measures are employed. Regression coefficient estimates for each characteristic confirm the prima facie impressions from Figure 8; abnormal returns are inversely related to market capitalization, an indicator variable for commercialized products, and institutional ownership. Combining any two of these factors or all three together suggests that market capitalization and institutional ownership are both related inversely to abnormal returns, but that the effect of the indicator variable for existing commercialized products attenuates after controlling for firm size.

We also investigate whether the clinical trial phase of the fast tracked drug affects the security price reaction. Fast track drugs in earlier phases might enjoy faster clinical trials and subsequently lower cumulative development costs than drugs that are fast tracked only in last phases of clinical trials.

Figure 9. Regression Analysis of Abnormal Returns

Figure 9 reports estimated results for cross-sectional regressions of abnormal returns. The dependent variable is the announcement day abnormal return estimated using the three-factor model (see equations (3) and (4)). Explanatory variables are the natural log of the market value of equity, an indicator variable equal to one if a firm has already marketed products to consumers, and the natural log of 1+ the percentage of a firm's common equity held by institutions at the end of the prior quarter. The number of observations equals 107 for all estimations. The figures reported below the coefficient estimates in parentheses are t-statistics.

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Intercept	0.8154	0.1289	0.1893	0.7790	0.2090	0.7186	0.6407
	(5.01)	(6.27)	(6.20)	(4.04)	(6.75)	(4.29)	(3.19)
ln (MVE)	−0.0360			−0.0339		−0.0284	−0.0238
	(−4.43)			(−3.39)		(−3.21)	(−2.18)
Marketed products (0 or 1)		−0.0977		−0.0150	−0.0834		−0.0297
		(−2.72)		(−0.36)	(−2.41)		(−0.71)
ln (1+ %institutional holdings)			−0.3049		−0.2797	−0.1820	−0.1928
			(−3.59)		(−3.34)	(−2.02)	(−2.11)
F-test	19.66	7.41	12.88	9.81	9.64	12.16	8.24
p-value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
R^2	0.1577	0.0659	0.1093	0.1587	0.1565	0.1896	0.1935
adj. R^2	0.1497	0.0570	0.1008	0.1425	0.1402	0.1740	0.1700

On the other hand, the likelihood that drugs in early phases will eventually qualify for an NDA and result in marketable products is much lower than for late-phase drugs. Consequently, it is difficult to predict how clinical trial phase affects stock price reaction to fast track announcements. We divide the sample of 107 observations into announcements concerning drugs at phase two or earlier (42 announcements) versus later phases (60 announcements); we could not identify clinical trial phase for five announcements. Our empirical results from this exercise show no material difference in stock price reaction for early stage versus late stage drugs, even after controlling for firm-specific characteristics. For the sake of parsimony we do not report these results.

We next turn our attention to long-term measures of stock price movement following fast track announcements. Cumulative abnormal returns (CARs) over various multiple day periods are reported in Figure 10. Panel A shows long-term returns across several alternative benchmarks. In general, the average post-announcement CARs are negative, although none is significantly different from zero. In contrast, CARs for the entire (−30 days, +120 days) period are positive for all benchmarks except the equally

Figure 10. Long-Run Abnormal Returns

Figure 10 shows mean cumulative abnormal returns for alternative time periods, under alternative benchmark models for expected returns, and for sample firms segmented by market capitalization. Asterisks indicate *p*-values associated with t-tests.

	Mean Abnormal Returns Under Alternative Models for Benchmarked Expected Returns				
Time Period	**Three-Factor Model**	**Equally Weighted Market**	**Value-Weighted Market**	**Drug Industry Index**	**Biotech Index**
(+1, +30)	−4.39%	−4.17%	−4.13%	−4.29%	−4.09%
(+1, +60)	−7.87%	−9.72% *	−6.85%	−6.93%	−7.13%
(+1, +90)	−6.28%	−12.41% *	−5.38%	−7.89%	−6.96%
(+1, +120)	−6.18%	−14.58% *	−5.71%	−11.14%	−9.85%
(-30, +120)	4.79%	−4.19%	5.51%	0.71%	0.30%

	Mean Abnormal Returns by Firm Size Quartile							
Return Model and Time Period	**Small Quartile**		**Quartile 2**		**Quartile 3**	**Large Quartile**		
Three-factor model								
(+1, +120)	23.36%		−19.25%		−4.94%	−23.32%		
(−30, +120)	45.68%	**	−2.28%		−0.37%	−22.41%	*	
Drug industry index model								
(+1, +120)	35.47%	**	−32.95%	**	−16.64%	−29.33%	***	
(−30, +120)	57.83%	***	−17.59%		−12.48%	−22.99%	**	

*** significance at *p*-value<1%, ** significance at *p*-value<5%, * significance at *p*-value<10%

weighted index model, but none of these longer-term CARs is reliably different from zero. In contrast to our results, Alefantis, Kulkarni, and Vora[31] report positive long-run returns following fast track designations for their 26 sample events. Our different findings for larger sample and a longer sample period suggest that this prior finding is confined to their small sample of merely 26 events that occur between 1998 and 2001.

Panel B of Figure 10 shows the CARs across sample partitions based on firm size. These results suggest that longer period returns are positive for smaller firms, negative but indistinguishable from zero for mid-sized firms, and negative for large firms. That fast track announcements would have a larger and more longer-lasting effect on stock price for small firms is consistent with the evidence on the announcement day return itself. That long-term returns are negative for the larger firms in the sample (especially after adjusting for size and valuation effects in the three-factor model) is a puzzle. We conjecture that idiosyncratic events within our sample period regarding other aspects of these large firms' businesses may explain these long-term negative returns.

Institutional Ownership

We next turn to additional aspects of security market response. We first examine institutional holdings data furnished by Thompson Financial based on 13F filings to see if the number of institutional investors and their total holdings as a percentage of outstanding shares change in the calendar quarters around announcements of fast track designations. We divide the sample into three sub-samples based on percentage institutional holdings at the end of the calendar quarter preceding the fast track announcement. Specifically, we distinguish firms with initially low institutional ownership (<25 percent of outstanding shares held by institutions of all types), medium institutional ownership (between 25 percent and 50 percent of shares), and high institutional ownership (>50 percent of shares). Results are shown in Figure 11.

Figure 11 shows that the number of institutional investors and their total holdings tend to increase in the period surrounding fast track announcements. For a narrow event window that compares the quarter prior to the fast track announcement (Q_{-1}) to the second following quarter (Q_{+1}), Figure 11 shows that the number of institutions and their total holdings increase most materially for the sub-sample of firms with initially low institutional holdings. For a longer event window that compares Q_{-3} to Q_{+3} there appears to be a material increase in institutional holdings across all three sub-samples.

Analyst Coverage

As a final dimension of capital market response to fast track announcements we examine behavior by financial analysts. From Thompson Financial we collect earnings forecasts for sample firms provided up to 180 days prior to the fast track announcement by financial analysts. We then examine whether earnings forecasts are revised upwardly or downwardly within 30 days of the fast track announcement. Panel A of Figure 12 shows the results. For the entire sample, there are substantially more upward revisions (59.8 percent) versus downward revisions (39.6 percent). However, further analysis reveals that the upward revisions are concentrated among firms that have marketed products (upward revisions by 64.7 percent of analysts) and for the firms in the sample with market capitalizations that

Figure 11. Institutional Stock Holdings in Quarters Surrounding Fast Track Designations

Figure 11 shows the mean (median) number of institutions holding common equity of sample firms and their mean (median) percentage holdings in quarters surrounding the announcement of a fast track designation in quarter zero (Q_0). The sample is split into three sub-samples based on the percentage institutional holdings as of quarter −1 (Q_{-1}). The number of firm-level observations varies across calendar quarters. The mean values (medians) reported for each calendar quarter are for all firms with data for the respective quarter. The mean (median) changes reported in the last two columns are only for firms with valid data for both respective quarters. Consequently, differences in the quarter-by-quarter columns do not equal the reported changes over calendar quarters. Data are from Thompson Financial and are based on 13F filings by institutions. Asterisks indicate p-values associated with t-tests of differences in means across calendar quarters.

	Calendar Quarter Relative to Fast Track Designation										
	Q_{-3}	Q_{-2}	Q_{-1}	Q_0	Q_{+1}	Q_{+2}	Q_{+3}	ΔQ_{-1} to Q_{+1}		ΔQ_{-3} to Q_{+3}	
Number of institutions											
Holdings <25% in Q-1	36	28	31	36	43	40	54	10	***	18	***
	(18)	(17)	(17)	(23)	(33)	(26)	(35)	(4)		(9)	
25%<Holdings<50% in Q-1	58	63	67	69	76	84	90	9	**	32	***
	(55)	(56)	(58)	(61)	(61)	(67)	(79)	(5)		(26)	
Holdings >50% in Q-1	170	174	184	189	154	158	158	2		24	***
	(100)	(103)	(114)	(127)	(128)	(120)	(117)	(2)		(26)	
Percentage holdings											
Holdings <25% in Q-1	9.1%	9.2%	10.5%	13.7%	15.7%	17.3%	20.1%	6.1%	***	9.9%	***
	6.5%	6.9%	8.4%	11.0%	11.8%	11.2%	14.9%	(1.4%)		(2.9%)	
25%<Holdings<50% in Q-1	30.0%	33.1%	34.2%	33.5%	34.2%	40.2%	36.4%	0.1%		7.0%	**
	29.8%	32.1%	31.7%	32.9%	32.3%	33.7%	34.0%	(1.5%)		(6.9%)	
Holdings >50% in Q-1	62.1%	63.5%	67.8%	69.7%	70.2%	69.8%	67.1%	2.8%	*	6.5%	**
	(62.5%)	(63.6%)	(64.8%)	(67.9%)	(71.0%)	(66.6%)	(70.6%)	(1.3%)		(5.7%)	

*** significance at *p*-value<1%, ** significance at *p*-value<5%, * significance at *p*-value<10%

exceed $1 billion (upward revisions by 66 percent of analysts). There is no evidence of upward revisions among analysts for small firms or firms without marketed products. At first this result might seem surprising given the evidence on abnormal stock returns concentrated among small firms as shown in Figure 8 and Figure 9. What is more surprising is that we see any systematic skew in earnings forecasts revisions at all. Specifically, fast tracked drugs are unlikely to generate revenues that would affect earnings within any reasonable forecast horizon for any of the sample firms due to the delays between clinical trials, NDA application, and commercialization of products—for both small and large firms and for both firms with products and those without. That analysts' forecasts systematically improve among large firms and firms with products suggest either

Figure 12. Analyst Coverage of Firms That Announce Fast Track Designations

Figure 12 shows activity by financial analysts concerning firms that announce fast track designations. Panel A shows revisions in earnings forecasts made by financial analysts as reported in I/B/E/S as reported by Thompson Financial. Panel B shows changes in analyst recommendations and coverage initiations as reported by the Yahoo Finance Web site (*http://finance.yahoo.com/*).

	Earnings Forecast Revisions		
	Downward	**No Change**	**Upward**
Entire sample	193	3	291
487 earnings forecasts	(39.6%)	(0.6%)	(59.8%)
Firms with marketed products	127	0	233
360 earnings forecasts	(35.3%)	(0.0%)	(64.7%)
Firms without marketed products	66	3	58
127 earnings forecasts	(52.0%)	(2.4%)	(45.7%)
MVE>$1 billion	105	0	204
309 earnings forecasts	(34.0%)	(0.0%)	(66.0%)
MVE<$1 billion	88	3	87
178 earnings forecasts	(49.4%)	(1.7%)	(48.9%)
	Analyst Recommendations or Actions		
	Downgrade	**Upgrade**	**Initiation**
30 days prior to fast track designation	4	4	11
19 analyst recommendations or coverage initiations	(21%)	(21%)	(58%)
30 days after fast track designation	2	5	18
25 analyst recommendations or coverage initiations	(8%)	(20%)	(72%)

that analysts infer positive synergies from fast track relations with the FDA for other products in various stages of development or commercialization, or that there is some secular trend in unexpected earnings growth among large multi-product pharmaceutical firms within our sample period.

Panel B of Figure 12 shows data from the popular finance Web site sponsored by *yahoo.com* on the number of analysts who upgrade or downgrade their investment recommendations or initiate coverage of a stock around the time of the fast track announcements. Over the 30 days prior to the fast track announcement there are a substantial number of coverage initiations, but upgrades and downgrades balance out at four of each. After the fast track announcement there are even more coverage initiations and upgrades exceed downgrades. Taken in conjunction with the evidence on earnings forecasts shown in panel A of Figure 12, this evidence suggests that a fast track announcement attracts analysts' attention and elicits their optimism about the sponsoring firm's stock.

Conclusions

The FDA is authorized to designate fast track status for new drugs with potential to address unmet needs for serious or life-threatening conditions. Drugs on the fast track benefit from accelerated clinical trials and expedited FDA reviews for safety and efficacy. We hypothesize that fast track designation accelerates resolution of uncertainty regarding the real options embedded in a pharmaceutical firm's drug pipeline and enhances value for investors, and we investigate security market response to announcements of fast track designation. Specifically, we examine patterns in trading activity, stock prices, institutional holdings, and analyst coverage around fast track designations for publicly traded pharmaceutical firms.

We find that financial markets respond favorably to fast track announcements. Specifically, for 107 fast track announcements that occurred between 1998 and 2004 we find evidence of abnormal trading volume in sponsor firms' common equity and positive abnormal stock returns that average about 9 percent across several alternative benchmarking techniques. Abnormal trading activity and stock returns are highest among smaller firms, firms that have yet to commercialize a product, and firms with low levels of institutional ownership. Institutional ownership increases materially around fast track events, especially for small firms, and analyst coverage improves and becomes more favorable. Our findings suggest that the award of fast track designation conveys positive information about a drug's sponsoring company. The positive market response suggests that fast track designation lowers expected regulatory costs and reveals positive information about the quality of the firm's growth opportunities.

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Nursing Home Safety: Does Financial Performance Matter?

Reid M. Oetjen, Mei Zhao, Darren Liu, and Henry J. Carretta

Objectives: This study examines the relationship between financial performance and selected safety measures of nursing homes in the State of Florida.

Methods: We used descriptive analysis on a total sample of 1,197. Safety information was from the Online Survey, Certification and Reporting (OSCAR) data of 2003 to 2005, while the financial performance measures were from the Medicare cost reports of 2002 to 2004. Finally, we examined the most frequently cited deficiencies as well as the relationship between financial performance and quality indicators.

Results: Nursing homes in the bottom quartile of financial performance perform poorly on most resident-safety measures of care; however, nursing homes in the top two financial categories also experienced a higher number of deficiencies. Nursing homes in the next to lowest quartile of financial performance category best perform on most of these safety measures.

Conclusions: The results reinforce the need to monitor nursing home quality and resident safety in US nursing homes, especially among facilities with poor overall financial performance.

Key words: Nursing homes, safety, quality, financial performance.

Florida's nursing home industry has experienced close scrutiny since the mid-1990s when it had a significant increase in litigation for poor quality.[1] In 2004, Florida's state legislature enacted Senate Bill 1202, which raised nursing home staffing standards in an attempt to improve the quality of care provided in nursing homes. Its nursing homes have achieved a reduction in total deficiencies, in both frequency and severity, since the enactment of this law. The quality of care in Florida nursing homes, however, still cannot compete with that of the majority of states, with Florida ranking 35th in total number of nursing home deficiencies in 2006.[2] These issues warrant a closer look at nursing home safety.

Around the same time of the passage of this bill, Florida's nursing home industry experienced significant financial difficulties. In 2003, its average shortfall in Medicaid reimbursement equaled $11.76 per Medicaid patient-day. This number increased to $14.38 in 2004 and again to $14.58 in 2006.[3] Medicare has historically cross-subsidized these nursing homes, but this source of revenue has declined with refinements to the Medicare payment system.[4]

The multidimensional concept of quality includes many dimensions, especially as it pertains to nursing homes.[5] The Joint Commission[6] and the Institute of Medicine[7] include safety as one of their dimensions of quality; the Joint Commission defining it as "the degree to which the healthcare intervention minimizes risks of adverse

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outcomes for both patient and provider and the degree to which the risk of an intervention and risk in the care environment are reduced for the patient and others, including the healthcare provider."[8]

Despite the fact that many continue to examine nursing home industry quality, only a few pieces of literature address nursing home safety as compared with care delivered in other settings. Previous research on nursing home quality focused on organizational issues in nursing homes, such as quality improvement initiatives, teamwork, communication, and leadership. Other studies investigated such specific patient-safety issues as falls, pressure sores, restraint usage, medication administration, and infection rates.[9] To date, only O'Neill, Harrington, Kitchener, and Saliba[10] have linked nursing home financial performance to quality of nursing home care. Although many of these studies examined safety issues in nursing homes, no research to date has investigated the relationship between financial performance and nursing home safety.

Despite the lack of research in this area, a link regarding the financial performance and safety can be hypothesized based upon the fact that one can argue that investments that affect staffing levels, training budgets, and the provision of additional direct care services ultimately impact nursing home quality and safety. Given that many of these activities that enhance resident care quality involve considerable costs, the financial performance of nursing facilities may prove to be a valuable predicator of safety, one of the key dimensions of quality performance. Therefore, nursing homes experiencing poor financial performance may eliminate some of these activities. In fact, existing quality studies in the hospital industry support this assertion.[11] This study is exploratory in nature and examines the relationship between financial performance and select safety measures in nursing homes in Florida from 2003 to 2005.

Financial viability and quality of nursing home care are of significant interest to Florida's taxpayers and government agencies, as nearly 17 percent of the population has reached the age of 65 or older—the highest percentage of any state.[12] Efforts in monitoring financial stability and safety of the care in Florida's nursing homes prove critical to ensuring care for the state's elder population.

Methods

Sample and Data

Data were collected from Florida's federally certified nursing homes for the years 2003 to 2005. Only freestanding nursing homes were included in the analysis. Nursing homes that were part of another facility, such as an acute-care or rehabilitation hospital, were excluded because these facilities generally have higher reimbursement and staffing levels.

The data sources for this study included the Online Survey, Certification and Reporting (OSCAR) data reports for 2003 to 2005 and the Centers for Medicare & Medicaid Services (CMS) Medicare cost reports for 2002 to 2004.

A national database, OSCAR comprises self-reported nursing home information provided to state surveyor agencies during annual inspections. This database included data on quality and resident safety indicators—the total number of deficiencies cited during each standard recertification survey. The Medicare cost-reports data for

nursing homes provided data on financial performance.

To eliminate extreme outliers, nursing homes with a total margin beyond three standard deviation points from the mean in either direction were excluded. Approximately 400 nursing homes remained in each year, for a total sample of 1,197; the study used descriptive analysis.

Safety Measures

This study utilized nine safety measures from OSCAR data—specifically, the total number of deficiencies reported for each nursing home by surveyors as a result of the annual federal survey mandated by CMS for all facilities participating in the Medicaid or Medicare programs. Although federal law requires nursing homes to be surveyed each fiscal year, investigators can conduct surveys up to 15 months from the previous survey.[13] CMS defines the standards the nursing home industry must meet to receive reimbursement from Medicare and Medicaid. Violations of these standards result in deficiencies, reported through OSCAR databases.[14]

Figure 1 shows the most frequently cited deficiencies in Florida related to safety for 2006.[15] Among the top-20 cited deficiencies, this study focused on the following nine to represent nursing home safety:

1. Food sanitation (F-371);
2. Records complete (F-514);
3. Accuracy of assessments (F-278);
4. Assessment by qualified staff (F-282);
5. Drug storage (F-432);
6. Pharmacy procedures (F-426);
7. Infection control (F-441);
8. Medication errors greater than 5 percent (F-332); and
9. Unnecessary drugs (F-329).

These nine measures represent both organizational issues and specific clinical processes related to resident safety.

To better understand what each measure entails, a brief description of the intent and safety implications of each regulation

Figure 1. Most Frequently Cited Nursing Home Deficiencies in Florida, 2006

Rank	Tag	Requirement	Facilities Cited (%)
1	F-371	Food sanitation	50.73%
5	F-514	Records complete	28.01%
7	F-278	Accuracy of assessments	20.09%
8	F-282	Assessment by qualified staff	18.18%
10	F-432	Drug storage	17.45%
12	F-426	Pharmacy procedures	16.86%
13	F-441	Infection control	16.42%
18	F-332	Medication errors > 5%	14.22%
20	F-329	Unnecessary drugs	11.44%

Adapted from Cowles CM: *Nursing Home Statistical Yearbook*. McMinnville, OR, Cowles Research Group, 2007.

follows together with the validity of these measures.

Food Sanitation

The food sanitation regulation aims to prevent the spread of food-borne illness by ensuring that nursing homes store, prepare, distribute, and serve food under sanitary conditions. Compliance with this regulation proves especially important because food-borne illness often becomes fatal for nursing home residents.[16]

Records Complete

The records complete regulation endeavors to ensure each nursing home maintains accurate, organized, accessible, and complete clinical records for each resident. The presence of a complete record that provides an accurate functional representation of the actual experience of the resident signals an indication that the facility knows the status of its patients and has adequately planned for each resident's care.[17] Previous research has shown that the communication of inappropriate or inaccurate information in nursing homes were barriers to timely care, which ultimately has the potential of affecting the safety of nursing home residents. Based upon this reasoning, the completeness and accuracy of a resident's record could have a significant impact on the resident's safety.[18]

Accuracy of Assessments

The accuracy of assessments regulation attempts to guarantee each resident receives an accurate assessment by appropriate personnel to ascertain each resident's medical, functional, and psychosocial problems. This assessment provides a baseline for ongoing assessment and assures residents have safe-care plans.[19]

Assessment by Qualified Staff

The purpose of the assessment by qualified staff regulation is to ensure qualified staff members care for residents. Direct caregivers must be knowledgeable about the care, services, and expected outcomes of the care they provide; otherwise, the safety of this care can become suspect.[20] This is an important indicator of safety because research has shown that improved outcomes are associated with use of properly trained nurses.[21] Thus, residents who are assessed by unqualified, or poorly trained staff, may be at risk of receiving improper assessments which could negatively impact patient safety.

Drug Storage

The drug storage regulation maintains only authorized personnel should have access to drugs. Nursing homes must limit access to drugs to authorized personnel and store all drugs in locked compartments in accordance with all state and federal laws to prevent residents from becoming exposed to potentially dangerous situations.[22]

Pharmacy Procedures

The pharmacy procedures regulation attempts to safeguard the drug needs of each resident. To maintain the optimal health and functional status of each resident, each facility "must provide pharmaceutical services (including procedures that assure the accurate acquiring, receiving, dispensing, and administering of all drugs and biologicals) to meet the needs of each resident."[23] Previous research regarding adverse drug events (ADEs) in nursing homes found that most errors occurred most often at the stage of prescribing and monitoring.[24] Thus, there is a clear link between the proper distribution

and storage of drugs (drug storage, pharmacy procedures) and patient safety.

Infection Control

The infection control regulation requires the facility to have an effective infection control program for investigating, controlling, and preventing infection; it ensures each facility protects its residents from the transmission of disease and infection and provides a safe, sanitary, and comfortable environment. Better nursing home outcomes have been linked to the presence of an effective infection control program; thus, an effective infection control program is critical in maintaining patient safety.[25]

Medication Errors Greater Than 5 Percent

This regulation aims to safeguard residents from medication errors in excess of 5 percent. If facilities have error rates in excess of 5 percent, this indicates systemic problems exist within their drug-distribution systems.[26] Previous study regarding medication errors in nursing homes has shown that medication errors have the potential to impact patient safety. In fact, researchers have shown that 7 percent of medication errors have the potential to harm patients.[27]

Unnecessary Drugs

The unnecessary drugs regulation addresses each resident's drug regimen to ensure they are not prescribed any unnecessary drugs. In the interest of safety, residents should only receive prescriptions for psychopharmacological drugs when they suffer from mental illness and not from underlying environmental or psychosocial stressors.[28]

Florida's Most Frequently Cited Deficiencies

These nine deficiencies help paint a picture of resident safety. Unnecessary drugs, drug storage, pharmacy procedures, and medication errors represent critical measures necessary to assuring residents receive proper medications and dosages. Complete records, accurate assessments conducted by qualified staff members, and infection control serves as a proxy underlying management practices. The presence of deficiencies in these areas may indicate managerial oversight lacks something critical to providing the best quality of care. Among these measures, food sanitation represents the number 1 deficiency in Florida's nursing homes.[29]

Financial Performance Measures

Total margin, the excess of revenue over expenses divided by total revenues, represented financial performance in this analysis. It reflects profits from both nursing home operations and nonoperational sources (typically investment income). Owing to typical lag in time that occurs between a facility's financial problems and any subsequent quality and safety changes, nursing home financial measures from the previous year were collected.

This study classified the financial performance of each nursing home relative to all nursing homes based on their rank in the percentile distribution of total margin. In particular, it distinguished facilities based on whether they fell into the first, second, third, or fourth quartiles. Previous studies have used the percentile distribution of financial indicators to distinguish nursing facilities' financial performance. The advantage of classifying nursing homes in this way emerges from the ability to assess whether relatively broad financial performance

categories, rather than small incremental differences, are associated with resident safety problems for study subjects.

Results

The median total margin for this analysis was 0.8 percent (ranging from −93.2% to 29.3%); the first quartile was −4.2 percent, and the third quartile was 4.2 percent. Figure 2 presents results for the four drug-related quality indicators. Drug storage, prescription administration, and distribution play important roles in meeting the needs of residents and ensuring nursing home safety. Figure 3 presents the results for the infection, staffing, and management quality indicators. The food sanitation indicator stands alone, because it represents the most commonly occurring deficiency (*see* Figure 3).

Drug-related deficiencies were found in 5.9 percent to 24.1 percent of the facilities, depending on their financial performance (*see* Figure 2), and from 8.7 percent to 23.1 percent for the indicators in Figure 3. The proportion of nursing homes with deficiencies was higher in the lowest financial performance group (quartile 1), compared with facilities in the second lowest financial performing category (quartile 2). For example, 21.4 percent of nursing homes in the lowest financial performance category received citations for deficiencies in accuracy of assessments; this number was only 13.9 percent in the second lowest financial performance category. Similarly, drug storage citation was 24.1 percent and 16.4 percent for the poorest financial performance category and the second poorest category, respectively.

Figure 2. % of Facilities Cited for Deficiencies over Four Financial Categories: Drugs and Management

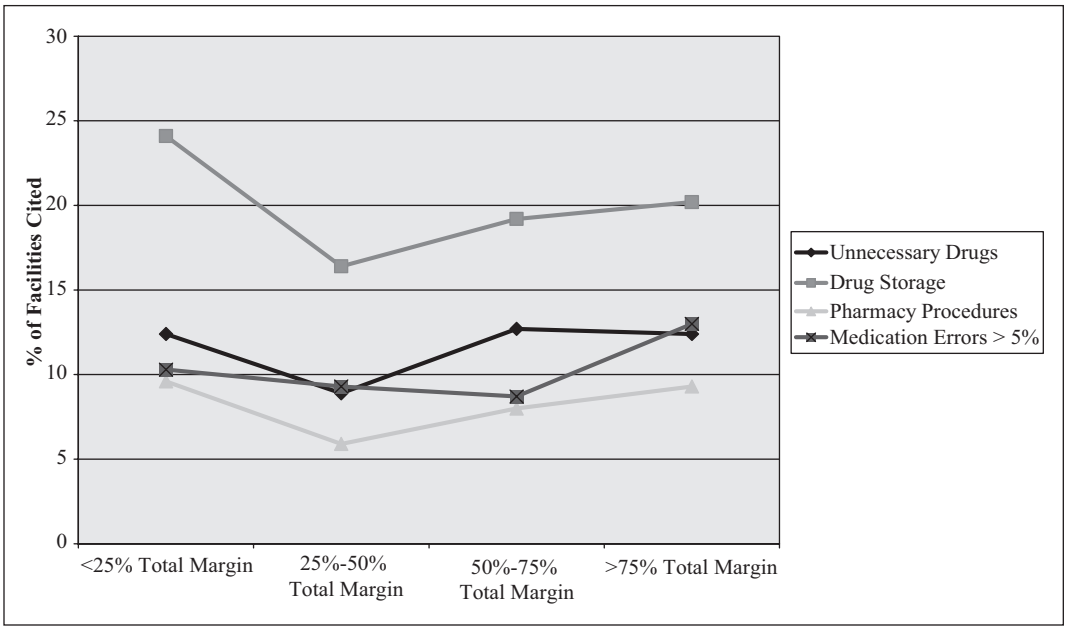
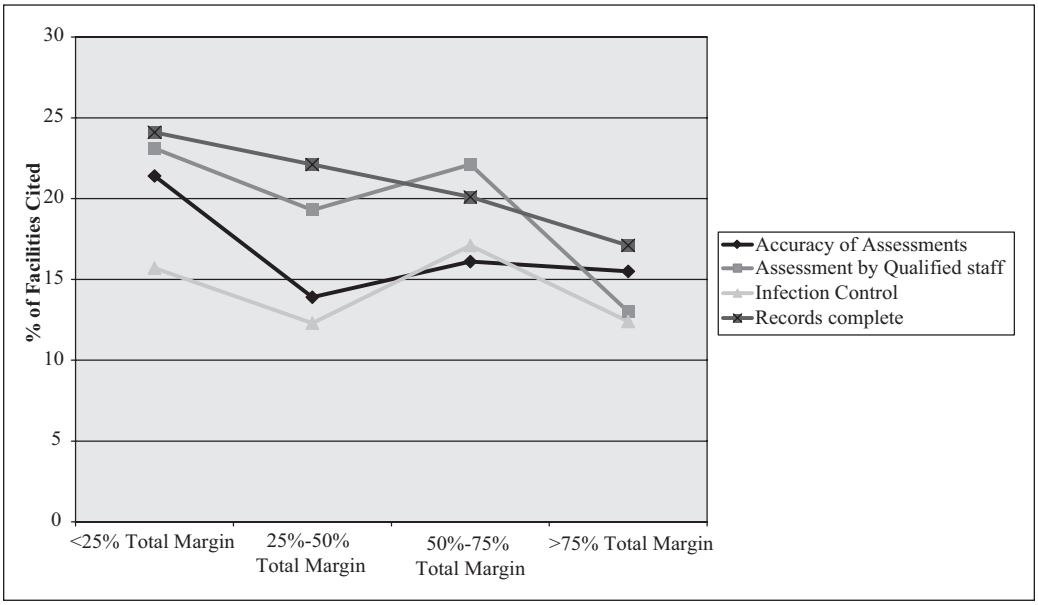


Figure 3. % of Facilities Cited for Deficiencies over Four Financial Categories: Staffing and Management



Interestingly, six of these eight safety indicators occurred less often among nursing homes in the second lowest performance category, rather than those in the highest financial performers in the third and fourth quartiles. For example, the proportion of nursing homes cited for infection control was 12.3 percent in the second lowest financial performance quartile, compared with 17.1 percent in the second highest financial performing category (*see* Figure 3).

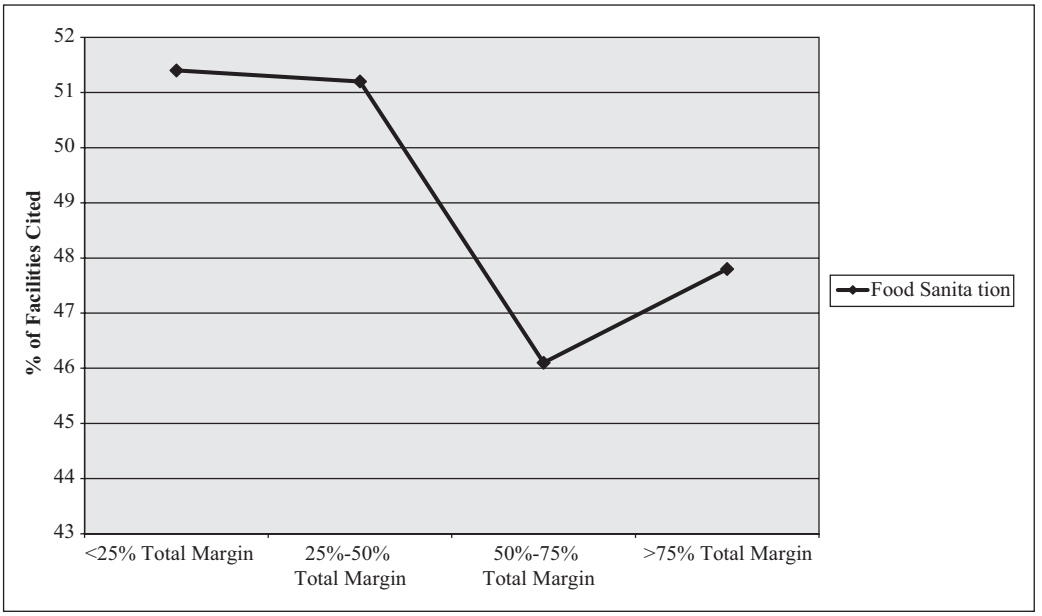
Similarly, unnecessary drug citations occurred in only 8.9 percent of the facilities in the second quartile compared with 12.7 percent in the third quartile (*see* Figure 2). This finding implies nursing homes experiencing very poor financial performance may not have sufficient resources to ensure resident safety and the proper level of quality to meet the requirements for federal and state survey agencies. Therefore, they are more likely to receive citations. On the other hand, nursing homes with the highest margins may have achieved these results by sacrificing the quality of care provided to and safety of its residents.

Figure 4 illustrates the relationship between financial performance and food-sanitation citations. Nursing homes in the poorest financial group had the highest percentage of food sanitation citations, whereas those in the third financial group had the lowest proportion of citations for food deficiencies. This contradicts the findings for most of the other indicators, which occurred least in the second financial group.

Discussion

The nursing home industry in Florida has undergone an intense period of public scrutiny regarding quality and resident

Figure 4. % of Facilities Cited for Deficiencies over Four Financial Categories: Food Sanitation



safety while simultaneously experiencing widespread financial difficulties. The findings from this study suggest these two phenomena may have some relation to each other.

Results indicate nursing homes in the bottom quartile of financial performance perform poorly on most of the resident safety measures of care. However, nursing homes in the next to lowest quartile of financial performance category perform the best on most of these safety measures. Nursing homes in the higher margin categories (quartiles 3 and 4) tend to have more deficiency citations, as compared with those in the second quartile of financial performance. These findings are consistent with previous study findings that found increased margin is more likely to affect quality adversely in proprietary facilities.[30]

Our study had several limitations. First, although Florida has more than 600 nursing homes, this study represents only 4 percent of US nursing facilities. Therefore, the results of this analysis cannot be generalized to other states. Future studies should expand the sample size to the national nursing homes and further examine the relationship between financial performance and specific safety indicators. Second, because this study only includes nine measures of nursing home safety, these measures cannot fully reflect the dimension of nursing home quality. Future research should examine other indicators that relate to safety.

Third, data in the OSCAR and CMS cost report files have limitations associated with the study of nursing home safety. That is, the surveyors who collect OSCAR exercise judgment could only base on their education

and experience. This may lead to a low inter-rater reliability among surveyors. This may understate or overstate the frequency and severity of quality issues in the annual survey process.[31]

Fourth, data from OSCAR surveyors summarize facility-level data, rather than resident-level data, which preclude a more refined approach than one might use with patient-level assessment of safety measures. Additionally, OSCAR data only provide a snapshot of safety at a point in time; they may not accurately represent some facilities over longer periods. Nursing home financial data from CMS may have shortcomings in relation to their accuracy and completeness because many financial statements were not audited.

Finally, the analysis only comprised one measure of financial performance; future research should include many other factors that could influence nursing home resident safety, such as size, ownership, chain affiliation, and staffing, so that the potentially confounding effects could be controlled for.

Despite these limitations, this study does suggest the importance of certain issues for policy makers and providers. In particular, the results reinforce the need to monitor nursing home quality and resident safety in US nursing homes, especially among facilities with poor overall financial performance. Nursing homes with the weakest financial performance appear to have more deficiency citations relevant to patient-safety measures. This suggests that such homes may not have financial resources to provide residents with a safe environment. Policymakers may want to consider increased surveillance of these poor performers or changes to reimbursement formulas to increase the likelihood that residents in these facilities remain safe.

Nursing homes in the top two financial categories also experienced a higher number of deficiencies. This suggests that the top performers may overemphasize financial performance at the expense of resident safety. On the other hand, nursing homes in the second performance category outperformed both lower performing and higher performing facilities in all but two safety measures. This implies they may have arrived at a more optimal level of resource allocation for patient safety measures than other facilities in this study; this might prove useful in further assessment of the relationship between financial performance and nursing home patient safety indicators.

Conclusion

The nursing home industry plays a critical role in providing long-term care to elders. This study makes several contributions to the literature on nursing home safety. First, it examines the overall financial health of nursing homes, rather than the effects of a specific policy change. Second, this study has clearly shown the poorest performing nursing homes produce the least favorable safety results. In order for this segment of the industry to improve quality, it must either improve efficiency or rely on policy makers to increase reimbursement. Lastly, it provides evidence that nursing homes in the top two financial performance categories have more deficiency citations compared with those in the second quartile of financial performance. This finding warrants closer examination and further study to ensure Florida nursing homes provide their residents a safe, quality environment.

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Health Care Providers Under Pressure: Making the Most of Challenging Times

Scott B. Davis and Phillip J. Robinson

Between the slowing economic recovery, tight credit markets, increasing costs, and the uncertainty surrounding health care reform, the health care industry faces some sizeable challenges. These factors have put considerable strain on the industry's traditional financing options that the industry has relied on in the past—bonds, banks, finance companies, private equity, venture capital, real estate investment trusts, private philanthropy, and grants. At the same time, providers are dealing with rising costs, lower reimbursement rates, shrinking demand for elective procedures, higher levels of charitable care and bad debt, and increased scrutiny of tax-exempt hospitals. Providers face these challenges against a background of uncertainty created by health care reform.

While the current challenges are numerous, health care is a dynamic and growing industry that currently commands 17 percent of the US gross domestic product (GDP) and is expected to increase to 19 percent over the next ten years (*see* Figure 1). The opportunities in the US health care industry are nearly limitless when you consider the high demand and prioritization for health care in the United States.

Health care providers must take a strategic and forward-looking approach to these obstacles and challenges to be successful. What follows is an overview of the major challenges facing the industry and recommendations for positioning your organization to survive the current downturn and capitalize on potential opportunities.

Industry Challenges

Demographic and Economic Trends Affecting Health Care Providers

Current US demographic and economic trends are putting a growing strain on health care systems. Rising unemployment levels have negatively affected many systems' payer mix. Most states are experiencing severe deficits and consequently are cutting health care funding. At the same time, health care providers are dealing with increasing acuity levels due to an aging population with worsening health. While there has been some economic recovery in 2010, the Federal Reserve Board recently noted that the pace of the recovery has slowed.

There is significant demand from employers, consumers, and government to reduce costs as health care cost increases are far exceeding inflation. Moreover, the weak economy is causing an unprecedented

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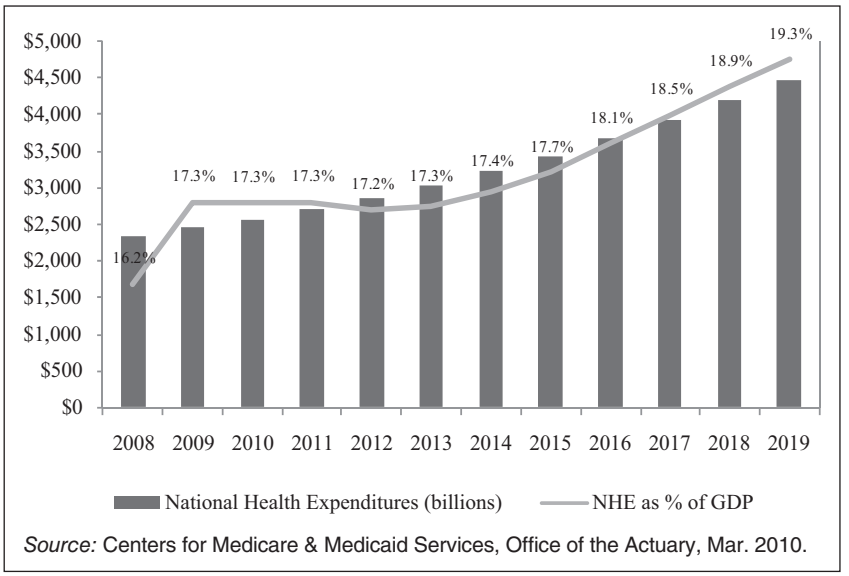
Figure 1.



Source: Centers for Medicare & Medicaid Services, Office of the Actuary, Mar. 2010.

reduction in charitable contributions and grants, and mixed returns on investment portfolios. Endowed institutions have suffered severe portfolio write-downs and have significantly less investment income. Making matters worse, significant capital investment is needed to replace aging physical plants that need to be modernized to enable providers to deliver quality health care and remain competitive.

Operating and Financial Pressures

The decline in demand for hospital beds driven by the increased usage of outpatient services at the same time as costs are rising faster than reimbursement rates has made it harder than ever for health care providers to remain "in the black" (*see* Figure 2).

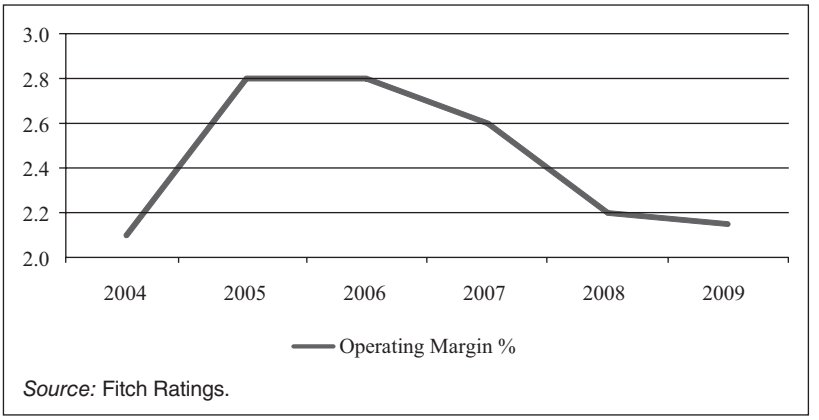
Labor costs also present a challenge. Labor costs are far and away the largest cost of providers. Managing labor cost includes:

- Working closely with organized labor to maintain a compensation model and working conditions that are fair but do not unduly stress the system;
- Establishing and adhering to staffing grids that properly staff medical departments; and
- Encouraging the use of new medical or administrative technology that helps to minimize labor cost.

Malpractice liability is also a significant cost. High insurance premiums, potential crippling malpractice settlements, and the high cost of practicing defensive medicine add up fast.

Access to capital is a growing issue for many providers. Limited access to capital severely restricts many providers' ability to update aging facilities, and upgrade information technology and medical equipment. Failure to improve technology makes it more difficult to compete. At the same time, recent regulatory mandates require health care organizations to invest in electronic health records and data security.

Figure 2. Operating Margins for Nonprofit Hospitals and Health Care Systems



Source: Fitch Ratings.

In the face of these financial pressures, stand-alone health care facilities find it very difficult to compete with multi-state and multi-hospital systems. Consolidation of health care providers is a growing trend, driven by limitations on access to capital, mandates on quality of care and survival due to pressure on the bottom line. Future consolidation will likely be driven by pressure to reduce costs that cannot be passed along to payers, as well as higher capital investment requirements and continuing economic uncertainty.

Uncertainties Related to Health Care Reform

Health care reform has created a great deal of uncertainty, which is contributing to difficulties among health care providers. The major effect of recent legislation for providers is that 32 million Americans who previously did not have medical insurance will soon be covered. It is far from clear if quality health care services can be delivered to these added enrollees given that, arguably, the existing facilities, medical professionals, and systems are inadequate for the existing level of patients.

There is little doubt that the increase in access to health care services will significantly reduce uncompensated care and charity care. However, the estimated $1 trillion cost of health care reform will be paid, in part, from anticipated reductions in the cost of health care delivery and reduction of current reimbursement rates to providers and insurers. This will be difficult to accomplish. Health care reform also places a major emphasis on pay-for-performance and quality-of-care initiatives that will likely come with a high price tag. It remains to be seen whether the positive impact of having more insured patients will offset the effect of reduced reimbursement rates and the added strain on the already stressed health care delivery system.

We know that major health care policy changes always create winners and losers, as the Balanced Budget Act of 1997 demonstrated. The impact of health care reform will be much broader and will have a lasting impact on every provider.

What Your Organization Be Doing Now

Given the many changes and pressures, what should your organization be doing now to address these challenges and position itself effectively for the future? We offer the following eight recommendations:

1. Perform a self-evaluation;
2. Update your strategic plan;
3. Seek out opportunities for synergistic consolidation and joint ventures;
4. Optimize cost structure and improve margins;
5. Explore all available financing strategies;
6. Protect liquidity;
7. Minimize collection risk and maximize revenues; and
8. Consider an integrated health care model.

Perform a Self-Evaluation

Now is the time for a close and forthright evaluation of where your organization stands relative to the competition. Ask questions including,

- What is our current position in the marketplace?
- Where do we want to be?
- How do we best serve our community given our local demographics, competition, and mission?
- What will it take to get there?
- Do we have the management depth, access to capital, and infrastructure that we need to succeed?
- Can we achieve these objectives alone or should we consider a joint venture or consolidation?

Update Your Strategic Plan

Given the uncertainties, now is the time for effective strategic planning at the board and senior-management levels. It's essential to establish a plan and communicate it throughout your organization. Obtaining buy-in from employees, physicians, labor unions, and community leaders is also critical.

The board and management should update the organization's strategic plan to ensure that it is appropriately focused on service structure, local conditions, payer mix, and cost structure. The plan should also address issues including quality of care, patient flow, management effectiveness, communication plans, the governmental/political environment, and financial strength. The plan should be monitored and modified periodically and as regulatory and economic conditions change. Also, health care reform developments should be closely monitored since these impact strategic planning.

Seek Out Opportunities for Synergistic Consolidation and Joint Venture

Smaller systems are seeing that their very survival may be dependent on merging with or being acquired by another system. Consolidated systems generally have better access to capital and also tend to have higher bond ratings than stand-alone systems. In the current environment, consolidation can be an opportunity for health care systems, large and small, to be better positioned to fulfill their mission and deliver quality, cost-effective care.

If you don't have strong market share, a dedicated medical staff, and easy access to capital, consider consolidation options, strategic partnerships, or joint ventures with other providers in your marketplace, such as physician practices, ambulatory care centers, surgery centers, and imaging centers. Also consider public-private partnerships whereby government funding is combined with private provider health care delivery expertise

to meet local challenges. A strong partnership with a primary care physician organization will be important as health care reform adds 32 million new patients into the system, who are expected to primarily utilize traditional entry points rather than emergency rooms.

Optimize Cost Structure and Improve Margins

Knowing where to cut expenses is key to maintaining efficient and stable operations since cost reductions typically provide quicker results than revenue-enhancement efforts. Focus on expenses with the greatest impact. Labor and medical supplies are generally the two largest cost centers of health care organizations' operating expenses. Analyze these categories of spending thoroughly to get the highest potential savings impact. Examine your administrative expenses, such as use of consultants, temporary staff, and managerial salaries, as well as your entire indirect cost structure to ensure that it links directly with patient services. Take the view that all costs are variable, particularly administrative costs, then justify their value by linking them with the revenue-generating activities that the cost supports. Also, take this opportunity to implement metrics and benchmarking to evaluate service lines that either need to be fixed or dropped.

Explore All Available Financing Strategies

Given that many health care lenders have exited the market and access to the tax-exempt bond market has been interrupted in the last two years, many health care organizations are scrambling to secure financing. Commercial lending activity is on the rise but terms and covenants are more restrictive than before. Stronger systems can pursue tax-exempt bond financing but weaker ones typically cannot, which puts them at a distinct disadvantage due to the higher cost of capital.

View all assets—tangible and intangible—and activities of the hospital as potential sources of capital or financing. If structured properly, you can maintain quality and operating control via a sale/leaseback or some other contractual arrangement. Aggressively access nontraditional financing sources including sales of assets, joint ventures, and public and private grants. Facility capital spending demands are so large that they leave less capital for equipment spending, which is needed to remain competitive. Utilize all available leasing/financing options for the smaller equipment purchases. Equipment leasing continues to grow as a means of financing smaller transactions. Focus on how each capital asset acquired or leased will improve financial performance and meet organization goals.

Now is also an ideal time to negotiate with suppliers for consignment opportunities, extended terms, and larger, early-pay discounts. If your health care system has multiple facilities, consider opportunities to consolidate its buying power into a centralized purchasing department in order to purchase more for less.

Protect Liquidity

In recent months, many health care organizations have found out the hard way that cash matters more than earnings. A slower economy puts additional pressure on cash flow because payers are likely to pay more slowly, third-party reimbursement rates may be reduced, revenues and profitability may diminish, and banks are less inclined to lend against insufficient or aging collateral. If not

monitored closely, liquidity can become constrained very quickly and without warning.

Establishing a cash-flow projection and then closely monitoring adherence to that projection is essential for health care organizations. This will give advance warning of points at which cash may not be sufficient to maintain existing operating levels or maintain compliance with loan covenants involving cash balances. This discipline will also give you the ability to aggressively manage cash as necessary under the circumstances.

Minimize Collection Risk and Maximize Revenues

The staggeringly high rates of unpaid medical bills are growing quickly as more patients lose employment, insurance coverage, and their ability to pay for care. To minimize the impact of collection risk to your liquidity and your bottom line, strengthen your registration and admissions process, verify data inputs, and maintain accurate and complete medical records. This will allow you to avoid costly payment deferrals and denials.

Analyze clinical documentation to ensure all reimbursable complications or comorbidities are captured in order to maximize revenue. Stay ahead of third-party contract renewals, and realign incentives when possible. In many recent hospital failures a major contributing factor has been the inability to capture and bill for all the charges that are being incurred.

It is also a good idea to speed up the collection process. Create an atmosphere of zero tolerance for significant delays to collect. After patient care, managing the revenue cycle is the most complex process in provider management. Seamless operational integration and flawless execution are essential to maximize net-revenue realization.

Consider an Integrated Health Care Model

Many health care systems are moving toward an integrated health care model, in which there is a high degree of collaboration and communication among health care professionals and their patients. In this model, physicians, hospitals, ambulatory care centers, system management, and primary health plans are coordinated with common goals and incentives, both financially and as they pertain to quality of care.

Integrated health care will be highly dependent on information technology capabilities because of the required sharing of data among various constituents including the patient. Providers that are able to adopt this approach effectively undoubtedly will be better positioned for the future than those that do not.

Looking Ahead

The forces competing for quality patient care, patient access, and affordability, combined with the uncertainties surrounding health care reform and a challenging economic environment, exert a tremendous amount of pressure on the health care industry. This pressure demands a back-to-basics approach that embraces sound business practices and requires health care executives to aggressively address issues and respond to signs of danger. This means considering a range of strategic options and seeking help as needed from outside advisers before your hospital or health system experiences significant distress. Organizations that do so effectively will not only have a greater number of options and alternatives available to them, but also will be ready to capitalize on opportunities in the future.

Inpatient Cancer Treatment: An Analysis of Financial and Nonfinancial Performance Measures by Hospital-Ownership Type

Ashley N. Newton and Sid R. Ewer

This study uses longitudinal data of inpatient treatment from the Agency for Healthcare Research and Quality's (AHRQ's) Healthcare Cost and Utilization Project (HCUP) to examine the differences in historical trends and build future projections of charges, costs, and lengths of stay (LOS) for inpatient treatment of four of the most prevalent cancer types: breast, colon, lung, and prostate. We stratify our data by hospital ownership type and for the aforementioned four major cancer types. We use the Kruskal-Wallis (nonparametric ANOVA) Test and time series models to analyze variance and build projections, respectively, for mean charges per discharge, mean costs per discharge, mean LOS per discharge, mean charges per day, and mean costs per day. We find that significant differences exist in both the mean charges per discharge and mean charges per day for breast, colon, lung, and prostate cancers and in the mean LOS per discharge for breast cancer. Additionally, we find that both mean charges and mean costs are forecast to continue increasing while mean LOS are forecast to continue decreasing over the forecast period 2008 to 2012. The methodologies we employ may be used by individual hospital systems, and by health care policy-makers, for various financial planning purposes. Future studies could examine additional financial and nonfinancial variables for these and other cancer types, test for geographic disparities, or focus on procedural-level hospital measures. Key words: *cancer treatment, hospital ownership types,mean charges, mean costs, mean LOS.*

Both common sense and economic theory demonstrate that the competitive behavior and financial performance of nonprofit hospitals—including the incentive to raise prices when faced with less competition—will not differ materially from investor-owned hospitals.[1]

— Robert E. Bloch, Antitrust Division, US Department of Justice

Cancer accounts for approximately one fourth of all deaths in the United States, second only to heart diseases. Cancer ranked as the third most costly illness in the United States for 2008 with an estimated cost of $70 billion (*see* Figure 1).[2] The relationship among cancer inpatient charges, cancer inpatient costs, and length of stay (LOS), stratified by hospital ownership type (for-profit, government, and not-for-profit), has never been evaluated in a nationally representative sample for time series forecasting purposes, to our knowledge. Hospital-level decision-makers study actual and projected hospital utilization, charges, and costs when allocating resources. Local, state, and national policymakers study these factors when making decisions of a broader scope. Statistics on actual and projected patient outcomes, such as LOS, help to identify and correct potential deficiencies in the quality of medical care. Given that cancer is relatively more prevalent among elderly populations when compared

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Figure 1. Top Ten Most Costly Illnesses for 2008

1. Heart Conditions—$76 billion
2. Trauma disorders—$72 billion
3. Cancer—$70 billion
4. Mental disorders, including depression—$56 billion
5. Asthma and chronic obstructive pulmonary disease—$54 billion
6. High blood pressure—$42 billion
7. Type 2 diabetes—$34 billion
8. Osteoarthritis and other joint diseases—$34 billion
9. Back problems—$32 billion
10. Normal childbirth—$32 billion

Source: Agency for Healthcare Research and Quality's News and Numbers, 2008.

to younger populations, and that baby boomers in the aggregate are facing increased cancer risk as they age, uncertainty about future costs and outcomes of cancer care has never been greater.

The Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ), provides health care databases and software tools used to assess a wide range of health policy issues, including trend analyses of cost, quality, access, outcomes, and market dynamics indicators for specific illnesses.[3] We extracted longitudinal data for mean charge per discharge (1998–2007), mean cost per discharge (2000–2007), and mean LOS per discharge (1998–2007) for each of breast, colon, lung, and prostate cancers, stratified into for-profit, government, and not-for-profit ownership types using HCUP. We limit our scope to these four cancers because they historically represent:

- The most frequently diagnosed cancers; and
- The largest proportion of cancer deaths as a percentage of all cancer patients in a given year.[4]

We use the Kruskal-Wallis (nonparametric ANOVA) Test and time series models to analyze variance and build projections, respectively, for mean charges per discharge, mean costs per discharge, mean lengths of stay per discharge, mean charges per day, and mean costs per day, stratified by hospital ownership type and for four major cancer types: breast, colon, lung, and prostate. We recognize that hospitals will not collect what they charge primarily because they contractually adjust their charges to third-party payers (insurance companies, Medicare, Medicaid, etc.). Nevertheless, hospital charges reflect management judgment about the value they place on their institutions' services and the pecuniary direction those services will be taking. Our goal is not to make a determination as to which hospital ownership type is the most effective or efficient, but rather illustrate trends and build forecasts for each of these variables.

Prior Research: Hospital Ownership Structure

Prior research has documented significant similarities and differences among hospital

ownership types, both financial and nonfinancial in nature. These elements include hospital profitability, expenditures, pricing, capital structure, patient outcomes, corporate governance, and regulatory constraints.

Profitability

Prior research has documented mixed findings about whether hospital ownership structure is causally related to hospital profitability. Valvona and Sloan[5] use Center for Research in Security Prices (CRSP), Compustat, American Hospital Association (AHA) surveys, and both 10-K and annual reports to compare the financial performance of the "five largest for-profit hospital companies in continuous existence from 1972 through 1985"[6] with the financial performance of other hospital ownership types as well as with companies from five other industries: manufacturing, transportation, communications, commercial, and public utility. They find that for-profit (investor-owned) hospitals reported substantially higher margins and return on equity than other hospital types, and "stock returns more than twice as large as returns for other industries between 1972 and 1983."[7]

Twenty years later and in direct contrast to Valvona and Sloan's finding that for-profit hospitals are more profitable than other hospital types, Alam, Elshafie, and Jarjoura[8] find that not-for-profit hospitals are in fact more profitable when compared with for-profit and government hospitals. They caution the reader that this generality was made based on a sample of 125 hospitals in the State of Washington consisting of for-profit, government, and not-for-profit ownership types, and that similar methods should be applied to other states in order to evaluate the generality's merit.

Gowrisankaran and Town[9] use a dynamic model to identify key differences between for-profit and not-for-profit hospitals. One key difference they document is that for-profit hospitals are in fact profit maximizers while not-for-profit hospitals focus on some combination of service quality and profit.

Deneffe and Masson[10] test pertinent hypotheses on a sample of Virginia not-for-profit hospitals and conclude that these hospitals consider both profits and output as objectives; that is, they show that not-for-profit hospitals exclusively maximize neither profit nor output. Clearly, much disparity prevails about this issue.

Expenditures

Hospital profitability differentials across ownership types may find their explanation, at least in part, by carefully analyzing expenditures. Carter, Massa, and Power[11] confirm prior findings (e.g., see Pattison and Katz),[12] that for-profit hospitals face greater expenditures than their not-for-profit counterparts. Despite this generality, the researchers did find that for-profit hospitals see operational expenses, administrative salaries, and number of employees that are actually less and fewer than those of other hospital ownership types. Kessler and McClellan[13] analyze cases of heart attack over the period 1985 to 1996, stratified by hospital ownership type, and find that regions with a presence of for-profit hospitals are associated with a decrease of approximately 2.4 percent in total hospital expenditures with virtually no difference in patient outcomes. The researchers' rationale was that the existence of a competitive market (i.e., one with a presence of for-profit hospitals) causes not-for-profit hospitals to become more productive and cost-efficient. Similarly, Duggan[14] finds that not-for-profit hospitals tend to mimic the behavior of their

for-profit equivalents when there is a significant presence of for-profit providers.

Pricing

Hospital charges have been used as a basis for allocating hospital resources. Based on an analysis of all hospitals included in the Healthcare Cost Report Information System (HCRIS) in 2004, Anderson[15] finds disproportionate pricing structures across hospital ownership types. Specifically, Anderson identifies differences in the ratio of total charges/total costs in the order of 2.49 (government hospitals), 2.99 (voluntary hospitals), and 4.10 (proprietary hospitals). Lynk[16] analyzed a sample of California hospitals to find that private not-for-profit hospitals have a significantly lower association between higher prices and higher market share in cases of hospital mergers. In fact, increased not-for-profit market share is shown to be associated with lower, not higher, prices.

Capital Structure

Fundamental differences arise in the capital structure arrangements of for-profit, government, and not-for-profit hospitals. Gowrisankaran and Town[17] pinpoint the not-for-profit hospital's unique ability to issue tax-exempt bonds as a provision that contributes to differing costs of capital when comparing not-for-profit hospitals to other ownership types. One decade earlier, Valvona and Sloan[18] find that for-profit hospitals assume significant levels of leverage when compared to other hospital ownership types and even more so than other industries.

Patient Outcomes

Researchers have shown that minimal disparity exists in patient health outcomes across various hospital ownership types. Sloan et al.[19] studied the quality of care for Medicare patients in for-profit hospitals versus not-for-profit and government hospitals. They found no difference in health care quality across the ownership types, with quality defined in terms of mortality rates as well as changes in functional and cognitive states (specific to particular illnesses). Similarly, Baker et al.[20] conduct an extensive synthesis of existing literature to find that associations between hospital ownership type and patient outcomes will vary only as a function of the outcome variable studied. They also find mixed or inconclusive evidence about differentials in access to care, morbidity, and mortality across hospital ownership types.

Corporate Governance and Regulatory Constraints

Two other differences among ownership types pertain to corporate governance and the government hospital budget constraint. Eldenburg *et al*.[21] find that poor financial performance is associated with CEO and governing board member turnover across all hospital ownership types except for those that are government owned. Duggan[22] identifies the soft budget constraint of government hospitals as the critical difference among for-profit, government, and not-for-profit hospital ownership types. This soft budget constraint is evident when government hospitals choose not to respond to financial incentives because the local governments that own the hospitals will capture any increase in revenues.

Prior Research: Cancer Costs, Charges, and Outcomes

Cancer is one of the most costly and devastating illnesses. Cancer accounted for

approximately one fourth of all deaths in the United States, second only to heart disease. In 2006, there were 559,688 cancer deaths in the United States. As previously mentioned, cancer ranked as the third most costly illness in the United States for 2008 with an estimated cost of $70 billion.[23] A major complicating factor in patients' ability to afford cancer treatment is lack of adequate health insurance coverage. According to a 2008 National Health Interview Survey (NHIS) estimate, 43.8 million persons of all ages (14.7 percent of the total population) were uninsured at the time of the NHIS interview and 55.9 million (18.7 percent) were underinsured for at least a portion of the year prior to the interview.[24] Without sufficient insurance coverage, patients are deprived of adequate access to care, an especially dangerous situation for cancer patients who often require extensive medical care.

Incidence and Prevalence

Certain types of cancer are historically more frequently diagnosed. A forecasted 1.5 million new cancer cases were to be diagnosed in 2009. Prostate and breast cancers were expected to be the two most frequently diagnosed types in men and women, respectively, followed by lung and colorectal cancers for both men and women. In fact, these four cancer types are historically the most frequently diagnosed cancers. Furthermore, these four cancer types, given the number of cases, are the most fatal of all cancers. According to the American Cancer Society, mortality incidence rates among all cancer deaths, ranked from highest to lowest (2008 estimates) were: lung cancer (30 percent), prostate (9 percent) and colon and rectum (9 percent) for men; and lung (26 percent), breast (15 percent), and colon and rectum (9 percent) for women.[25] Fortunately, according to the National Cancer Institute, mortality rates for these most common cancers, in addition to rates for all cancers combined, are decreasing.[26] Despite a decline in mortality rates in the aggregate, cancer patients continue to face numerous physical, mental, emotional, and financial concerns.

Cost of Care

The cost of cancer care is relevant for many reasons. With cancer consuming a larger proportion of the elderly population over younger populations, concern exists about the degree of impact an aging baby boomer generation will have on cancer costs in the aggregate and fluctuations in cost per case therein. In 2005, 42.5 million Americans were enrolled in Medicare; by 2030, this number is expected to grow to nearly 70 million.[27] Brown et al.[28] analyze Medicare claims linked to surveillance, epidemiology, and end results data (SEER-Medicare database) for breast and colorectal cancer patients to find that "the cost profile for each individual has the appearance of a 'U'-shaped curve. … [In terms of] phase-specific estimates, the two vertical segments of the U represent initial and terminal phase costs, and the bottom of the U represents continuing care costs."[29] That is, initial- and end-stage costs consume more medical resources than do middle-stage costs. Jacobson *et al*.[30] find that patient and provider discretion over the choice of cancer treatment regimen and therapy directly influence expenditure levels. An aging population combined with the introduction of new technology, therapeutic agents, and unconventional treatment methods are sure to pose difficulty in making accurate projections of cancer care costs into the future.

Inpatient Cancer Care

As is the case for many chronic illnesses, patients seek treatment on both an outpatient and inpatient basis. Warren et al.[31] document that hospitalization costs accounted for the largest portion of total payments for each of breast, colon, lung, and prostate cancers in 2002. Suda, Motl, and Kuth[32] compared cancer inpatients with non-cancer inpatients. They find that cancer patients had a significantly longer LOS, significantly higher average case mix index, utilized more hospice services, or expired more frequently when compared to non-cancer patients. Ho and Aloia[33] find that high levels of surgeon volume—and not high levels of hospital volume—is associated with lower inpatient surgery costs. They further elaborate that this relationship has strengthened over recent years.

Research Questions

Prior research presents mixed results about charge, cost, and outcome differentials among hospital ownership types. Furthermore, the relationship among cancer inpatient charges, cancer inpatient costs, and lengths of stay (LOS), stratified by hospital ownership type, has never been evaluated in a nationally representative sample for time series forecasting purposes, to our knowledge. We analyze the variance and test for significant differences in the mean charges per discharge, mean costs per discharge, mean LOS, mean charges per day, and mean costs per day for each of the four cancer types: breast, colon, lung, and prostate. We compare results across hospital ownership types (for-profit, government, not-for-profit). Due to the availability of HCUP data, our period of analysis extends from 1998 to 2007 for hospital charges and LOS from 2000 to 2007 for hospital costs. Using the same set of longitudinal data, we build forecasts about how these variables will behave over the period 2008 to 2012.

Sample

The Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ), provides a wealth of health care databases and software tools used to assess essential health policy issues. HCUP represents the largest collection of longitudinal hospital care data in the United States and the only national hospital database of all-payer hospital charges. Patient-level, all-payer data allows research on many policy issues, including cost, quality, access, outcomes, and market dynamics. HCUP summary data are freely accessible through HCUPnet, an online query system (http://hcupnet.ahrq.gov). Raw data sets are available for purchase and include a Nationwide Inpatient Sample (NIS), Statewide Inpatient Database (SID), and Kids' Inpatient Database (KID), to name a few.[34]

In 1988, its first year of existence, NIS data consisted of discharges from community hospitals across eight participating states; in 2007, NIS data consist of 1,044 hospitals in 40 states, representing an approximately 20 percent stratified sample of all US community hospitals. More precisely, "the sampling frame for the 2007 NIS is a sample of hospitals that represents approximately 90 percent of all hospital discharges in the United States."[35] For HCUP purposes, community hospitals are defined as:

> short-term, non-Federal, general and other hospitals, excluding hospital

> units of other institutions (e.g., prisons). Community hospitals (and HCUP data) include OB-GYN, ENT, orthopedic, cancer, pediatric, public, and academic medical hospitals. They exclude hospitals whose main focus is long-term care, psychiatric, and alcoholism and chemical dependency treatment, although discharges from these types of units that are part of community hospitals are included.[36]

HCUP classifies data into disease- and procedure-specific categories using diagnosis related groups (DRG), major diagnostic categories (MDC), ICD-9-CM billing codes, and clinical classification codes (CCS). The CCS system, a compilation of codes unique to HCUP, was created by collapsing the more than 14,000 diagnosis and 3,900 procedure ICD-9-CM codes into clinically meaningful categories that are not directly subjected to the frequent changes affecting DRG, ICD-9-CM, and MDC coding systems.[37]

A researcher using HCUPnet will define his or her sample through a series of steps. First, the researcher must choose a database to query (*e.g.*, NIS, SID, KID, etc.), followed by a type of query (specific diagnoses, specific procedures, all hospital stays, trends, or a rank order of specific diagnoses or procedures). Next, he or she will select the year of interest and subsequently decide what coding classification to use when identifying the disease or procedure of interest (CCS, ICD-9-CM, DRG, or MDC). For disease-specific analyses, HCUPnet will then ask whether the researcher wishes to include discharges where the disease was the principal diagnosis (chief reason for the hospital stay) or include them among all-listed diagnoses (includes all principal diagnoses and coexisting diagnoses, both at time of admission and those that develop during the hospital stay). Finally, the researcher will specify what outcomes and measures to gather statistics for (*e.g.*, mean, median or aggregate measures of hospital charge, hospital cost, or LOS), followed by what patient and hospital characteristics by which to stratify. Examples of patient characteristics include patient age, gender, payer status, and median income by patients' zip code (low vs. not low, using income ranges defined by the Census Bureau); examples of hospital characteristics include hospital region (Northwest, Midwest, South, or West, as defined by the Census Bureau), ownership type (for-profit, government, or not-for-profit), teaching status (teaching vs. not teaching, as defined by the AHA), and bed size (small, medium, or large). Results will display on the active Internet window but can be exported to Microsoft Excel if the researcher so chooses.

Study Design

We used HCUPnet to query the NIS about breast, colon, lung, and prostate cancers for the period 1998 to 2007. Although HCUPnet data for 1997 were available, substantial changes made to the HCUP database during that year led us to exclude 1997 data. According to Houchens and Elixhauser,[38] "[in] 1998 the [HCUP] sampling method changed to better reflect the cross-sectional population of hospitals. The hospital stratification variables were redefined, rehabilitation facilities were dropped from the target universe, and sampling preference was no longer given to prior year NIS hospitals."[39] Furthermore, "this definitional change causes a 'discontinuity' between 1997 and 1998 in estimates of trends in totals, such as total discharges."[40]

We used CCS codes to identify hospital discharges where one of these four cancer types was classified as the primary diagnosis; that is, the patient's cancer illness is the chief reason for being admitted to a hospital. We recognize that in some cases, patients will seek medical care during their hospital stay for ailments that are unrelated to the primary diagnosis of a specific cancer. The charges, costs, and LOS data on medical care sought for these secondary ailments may introduce bias into our variables of interest. On average, however, hospitals and policy-makers must recognize the inevitability of secondary ailments in some of their cancer patients and plan accordingly.

Our variables of interest included mean hospital charges, mean hospital costs, and mean LOS. Used here, a mean hospital charge is the average hospital charge across all discharges for a certain cancer type, excluding professional (MD) fees. The mean hospital cost is derived using Medicare Cost Report (MCR) cost-to-charge ratios (CCR). Every provider of services to Medicare beneficiaries files a MCR annually, and the CCR worksheet (Worksheet C) is used to specify pertinent costs and charges on a cost-center (*i.e.*, outpatient, inpatient, ancillary) basis. Asper[41] explains that while Medicare payments are a simple way to estimate the provider's "cost," the CCR is a frequently used alternative.[42] HCUP converts charges to costs using hospital-wide CCRs since detailed charges are not available in all HCUP states. The average ratio for a hospital's stratum (as defined by bed size, location, ownership, region, and teaching status) was used in cases where a hospital's CCR was not available. The mean LOS is the average number of nights a patient remained in the hospital during his or her entire hospital stay. Any patient admitted and discharged on the same day is assigned a "0" LOS.[43] We filtered these data by hospital ownership type (for-profit, government, not-for-profit).

As mentioned, hospital costs were derived using hospital-wide CCRs. However, because the CCRs applied by HCUP are hospital-wide rather than department-specific, cases that generate a high proportion of ancillary charges (such as major surgeries) tend to be overestimated and cases that generate a high proportion of room and board charges (such as mental illnesses) tend to be underestimated. Song and Friedman[44] employed a more precise and accurate cost estimation alternative by applying department-level CCRs to each CCS and APR-DRG category in a sample of ten HCUP states reporting detailed charges in 2006. When comparing their department-level CCR estimates of cost per discharge to HCUP's hospital-wide CCR estimates of cost per discharge, the two amounts were significantly different (less than 10 percent) in less than one third of all cases. The ten-state average adjustment factor applied to hospital-wide CCRs for breast, colon, lung, and prostate cancers were 0.87, 0.95, 1.02, and 0.86, respectively.[45] An example of such computations is shown in Figure 2. We chose to apply these adjustment

Figure 2. Example on the Application of CCS Adjustment Factors. The computation below applies the colon cancer CCS adjustment factor to not-for-profit mean costs in 2007.

Mean Cost, from HCUPnet	$17,427
x Adj. Factor*	0.95
= Adj. Mean Cost	$16,556

*Source: Song and Friedman, 2008.

factors to the 2000-2007 raw cost estimates acquired from HCUPnet.

Longitudinal descriptive statistics about our data sample are presented in Figures 3 through 9. We analyze these data using the Kruskal-Wallis Test of variance analysis to test for significant differences in mean charges per discharge, mean costs per discharge, mean LOS, mean charges per day, and mean costs per day across hospital ownership types. We then use linear time series models to build projections for our variables of interest (mean charges, mean costs, and mean LOS) and for each cancer type (breast, colon, lung, and prostate), comparing these projections across ownership types.

Results

Annual Trends in Variables of Interest

Figure 3 shows that the number of hospital discharges for each cancer type exhibits no definitive trend over the time period of interest, 1998 to 2007. Figure 3 reveals the supremacy of not-for-profit hospitals in terms of numbers of hospital discharges when compared to other ownership types. An informal review of our sample shows that not-for-profit hospitals constitute at least 75 percent of total hospital discharges in nearly all years and for any given cancer.

Figure 4 (mean charges) and 5 (mean costs) demonstrate a distinctive upward trend over the years examined, across all cancer and hospital types studied. Figure 6 (mean LOS), on the other hand, exhibits a downward trend over the years, across all cancer and hospital types studied. Figures 7 (mean charges per day) and 8 (mean costs per day) combine LOS data with charge and cost data, respectively. These figures reveal that decreasing LOS for cancer patients has done little to ameliorate inpatient charges or costs. Per day charges and per day costs have markedly increased over the years. Figure 9 presents total changes over the time period in absolute and percentage terms. Even though LOS percentage changes are all negative, charge and cost percentage changes are all positive, and the per day charge and cost percentage changes are all greater than their respective mean charges and costs. These results could reflect the well-recognized accretion over the years in health care costs and/or enhanced (and more expensive) treatment options that have developed during this time period. Whether better patient outcomes have occurred during this period is beyond the scope of this study, but could be fodder for additional research. It is worthy to note that per charge data for for-profit hospitals have accelerated faster than for other ownership types for breast, colon, and lung cancers, and per cost data for for-profit hospitals have risen more slowly than for other ownership types for all cancers studied. Comparison of these variables among hospital types is within the scope of our study and is presented in the next section.

Comparisons of Financial and Nonfinancial Performance Measures Across Ownership Types

We use variance analysis to test our hypotheses that, when analyzed over the given time frame, mean charges per discharge, mean costs per discharge, mean LOS, mean charges per day, and mean costs per day are significantly different across hospital ownership types. In examining for normality, we determined our longitudinal data for mean charges, mean costs, and mean LOS for our cancers of interest are not normally distributed. The Kruskal-Wallis Test—a

Figure 3. Number of Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 1998–2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Breast Cancer										
Total	$122,723	$120,425	$122,276	$118,985	$109,309	$95,963	$91,635	$91,283	$84,518	$95,113
For-profit	$11,666	$12,026	$11,852	$13,290	$11,012	$9,551	$8,384	$10,266	$9,079	$8,381
Government	$16,046	$13,758	$14,922	$14,758	$14,092	$12,972	$12,008	$12,236	$12,004	$13,201
Not-for-profit	$95,010	$94,641	$95,502	$90,936	$84,205	$73,440	$71,243	$68,780	$63,435	$73,531
Colon Cancer										
Total	$119,446	$118,715	$118,459	$117,528	$117,056	$114,583	$112,904	$112,242	$107,498	$108,146
For-profit	$15,339	$13,602	$12,407	$13,738	$12,761	$13,317	$13,070	$13,462	$12,241	$12,449
Government	$13,333	$12,659	$12,505	$12,954	$13,513	$12,831	$12,769	$13,200	$13,006	$13,797
Not-for-profit	$90,774	$92,454	$93,546	$90,835	$90,782	$88,435	$87,065	$85,579	$82,251	$81,900
Lung Cancer										
Total	$154,709	$149,933	$151,450	$153,180	$150,632	$151,632	$151,573	$159,739	$149,885	$153,017
For-profit	$17,749	$15,713	$15,518	$17,477	$16,103	$17,049	$16,324	$18,808	$16,434	$15,610
Government	$19,738	$16,206	$17,522	$18,344	$19,947	$19,149	$19,366	$20,668	$20,054	$20,424
Not-for-profit	$117,223	$118,015	$118,410	$117,359	$114,582	$115,434	$115,883	$120,263	$113,397	$116,983
Prostate Cancer										
Total	$88,062	$102,258	$94,004	$99,661	$98,794	$90,328	$81,254	$82,855	$89,010	$102,346
For-profit	$10,558	$9,907	$9,141	$10,660	$10,955	$9,650	$8,574	$10,964	$10,321	$7,687
Government	$8,946	$9,357	$8,273	$10,400	$11,335	$9,704	$8,498	$11,215	$9,055	$13,374
Not-for-profit	$68,558	$82,995	$76,591	$78,601	$76,504	$70,974	$64,182	$60,676	$69,633	$81,284

Source: http://hcupnet.ahrq.gov.

Figure 4. Mean Charges per Discharge for Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 1998–2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Breast Cancer										
All types	$10,863	$11,310	$12,210	$13,157	$15,131	$17,219	$18,522	$20,219	$22,332	$26,591
For-profit	$11,631	$13,685	$20,293	$18,961	$21,832	$22,558	$24,786	$27,427	$29,922	$34,304
Government	$12,979	$11,075	$11,325	$12,139	$13,638	$15,867	$15,837	$17,136	$18,022	$23,305
Not-for-profit	$10,407	$11,049	$11,273	$12,462	$14,475	$16,743	$18,228	$19,678	$22,054	$26,292
Colon Cancer										
All types	$25,289	$25,855	$28,349	$32,040	$35,847	$39,166	$41,466	$44,889	$48,557	$51,569
For-profit	$32,609	$33,964	$38,530	$45,549	$51,542	$55,268	$55,820	$62,797	$67,419	$73,176
Government	$22,164	$25,328	$27,350	$28,540	$29,763	$33,058	$35,290	$38,305	$40,733	$44,869
Not-for-profit	$24,496	$24,747	$26,947	$30,470	$34,492	$37,573	$40,176	$43,054	$46,953	$49,367
Lung Cancer										
All types	$21,715	$22,592	$24,995	$27,726	$31,475	$34,794	$35,117	$39,140	$41,438	$45,473
For-profit	$25,082	$26,791	$32,458	$35,583	$43,385	$45,976	$42,629	$52,029	$52,559	$59,233
Government	$19,605	$21,197	$22,186	$22,651	$26,835	$28,894	$28,744	$32,529	$33,738	$40,860
Not-for-profit	$21,558	$22,232	$24,325	$27,331	$30,578	$34,100	$35,118	$38,252	$41,185	$44,419
Prostate Cancer										
All types	$12,979	$12,977	$14,704	$16,534	$17,867	$20,193	$21,328	$23,841	$25,750	$31,225
For-profit	$17,269	$17,684	$22,326	$23,860	$27,329	$27,361	$30,012	$28,748	$31,382	$41,812
Government	$10,959	$12,951	$13,095	$15,510	$15,917	$19,847	$18,238	$18,524	$20,967	$25,849
Not-for-profit	$12,571	$12,439	$13,955	$15,661	$16,753	$19,224	$20,545	$23,940	$25,532	$31,107

Source: http://hcupnet.ahrq.gov.

Figure 5. Mean Costs per Discharge for Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 2000–2007

	2000	2001	2002	2003	2004	2005	2006	2007
Breast Cancer								
All types	$4,735	$4,911	$5,294	$5,595	$5,991	$6,378	$6,791	$8,064
For-profit	$6,419	$5,829	$5,966	$5,588	$6,087	$6,791	$7,049	$7,606
Government	$5,133	$5,485	$6,329	$5,899	$6,294	$6,507	$6,931	$8,405
Not-for-profit	$4,448	$4,685	$5,024	$5,539	$5,927	$6,291	$6,727	$8,054
Colon Cancer								
All types	$12,124	$12,949	$13,677	$13,979	$14,795	$15,514	$16,201	$16,688
For-profit	$13,859	$13,859	$14,704	$14,843	$15,162	$16,392	$16,903	$16,632
Government	$13,482	$14,045	$14,661	$14,065	$14,902	$16,271	$16,947	$17,498
Not-for-profit	$11,675	$12,654	$13,379	$13,832	$14,722	$15,253	$15,974	$16,556
Lung Cancer								
All types	$11,205	$11,740	$12,698	$13,063	$13,340	$14,208	$14,498	$15,704
For-profit	$12,136	$11,439	$13,301	$12,998	$12,201	$14,458	$13,842	$14,133
Government	$11,533	$11,529	$14,757	$12,423	$13,033	$14,407	$14,623	$17,287
Not-for-profit	$11,024	$11,819	$12,249	$13,181	$13,556	$14,133	$14,573	$15,635
Prostate Cancer								
All types	$5,631	$5,926	$6,192	$6,405	$6,953	$7,376	$7,646	$9,304
For-profit	$7,085	$6,313	$6,822	$6,529	$7,115	$7,200	$7,232	$8,574
Government	$5,952	$6,755	$7,631	$6,828	$7,080	$6,810	$8,030	$9,192
Not-for-profit	$5,416	$5,764	$5,879	$6,327	$6,912	$7,516	$7,657	$9,393

Source: http://hcupnet.ahrq.gov. Mean costs per HCUP were adjusted using factors determined by Song and Friedman (2008); see Figure 2 for an example of how these adjustment factors were applied.

nonparametric alternative to one-way ANOVA testing—was used to determine the significance of differences among ownership types for our five dependent variables. Under the Kruskal-Wallis Test, our null hypothesis is that the distribution of each dependent variable (mean charges, mean costs, mean LOS, mean charges per day, mean costs per day) is the same in for-profit, government, and not-for-profit (independently sampled) populations for breast, colon, lung, and prostate cancer; our alternate hypothesis is that at least two of the populations differ with respect to their medians, at the 5 percent level of significance ($\alpha = .05$). Results of these tests, which were conducted using SAS 9.1, are shown in Figures 10 and 11. Mean charges per discharge among ownership types were significantly different for all cancers studied ($p = 0.0263, 0.0062, 0.0164$, and 0.0097, for breast, colon, lung, and prostate cancers, respectively). Mean charges per day among ownership types were also significantly different for all cancers studied

Figure 6. Mean LOS (in Days) for Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 1998–2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Breast Cancer										
All types	2.95	2.92	2.72	2.48	2.51	2.71	2.72	2.75	2.58	2.53
For-profit	2.71	2.54	3.02	2.65	2.52	2.62	2.61	2.66	2.61	2.53
Government	4.08	3.41	2.80	2.65	3.12	2.74	2.65	2.65	2.77	2.77
Not-for-profit	2.79	2.90	2.67	2.43	2.40	2.71	2.75	2.79	2.54	2.49
Colon Cancer										
All types	9.41	9.38	9.35	9.23	9.24	9.12	9.00	8.97	8.86	8.57
For-profit	9.31	8.60	9.22	9.34	8.99	8.91	9.06	8.77	9.28	8.48
Government	9.16	9.50	9.54	9.37	9.35	8.79	8.70	8.86	8.88	8.48
Not-for-profit	9.47	9.47	9.34	9.19	9.26	9.20	9.04	9.02	8.80	8.60
Lung Cancer										
All types	7.92	8.09	8.03	7.72	7.77	7.84	7.78	7.77	7.47	7.30
For-profit	7.70	7.49	7.62	7.70	7.86	7.86	7.30	7.58	7.51	7.30
Government	7.75	8.05	7.85	7.91	8.21	7.52	7.32	7.38	7.36	7.55
Not-for-profit	7.98	8.18	8.10	7.69	7.68	7.89	7.92	7.86	7.48	7.26
Prostate Cancer										
All types	3.93	3.77	3.70	3.53	3.40	3.50	3.44	3.31	2.85	2.61
For-profit	3.73	3.43	3.77	3.62	3.39	3.25	3.35	2.66	2.89	2.86
Government	4.08	3.75	3.90	3.52	3.90	3.54	3.54	3.10	3.28	2.84
Not-for-profit	3.94	3.81	3.67	3.51	3.33	3.53	3.43	3.47	2.78	2.54

Source: http://hcupnet.ahrq.gov.

($p = 0.0152$, 0.0084, 0.0176, and 0.0310, for breast, colon, lung, and prostate cancers, respectively). Mean LOS among ownership types were significantly different for breast cancer ($p = 0.0399$) but not significantly different for colon, lung, or prostate cancers. Neither mean costs per discharge nor mean costs per day were significantly different among ownership types for any of the four cancers studied.

We also used Kruskal-Wallis Tests for pair-wise comparisons among the three hospital ownership types. Results of these tests, also conducted using SAS 9.1, are shown in Figures 12 and 13. Mean charges per discharge for for-profit versus government hospitals were significantly different for all cancer types studied ($p = 0.0126$, 0.0032, 0.0102, and 0.0041, for breast, colon, lung, and prostate cancers, respectively). Likewise, mean charges per day for for-profit versus government hospitals were significantly different for all cancer types studied ($p = 0.0065$, 0.0052, 0.0082, and 0.0102, for breast, colon, lung, and prostate cancers, respectively). Mean charges per discharge for

Figure 7. Mean Charges per Day for Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 1998–2007, Computed as a Ratio of Mean Charges to Mean LOS

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Breast Cancer										
All types	$3,682	$3,873	$4,489	$5,305	$6,028	$6,354	$6,810	$7,352	$8,656	$10,510
For-profit	$4,292	$5,388	$6,720	$7,155	$8,663	$8,610	$9,497	$10,311	$11,464	$13,559
Government	$3,181	$3,248	$4,045	$4,581	$4,371	$5,791	$5,976	$6,466	$6,506	$8,413
Not-for-profit	$3,730	$3,810	$4,222	$5,128	$6,031	$6,178	$6,628	$7,053	$8,683	$10,559
Colon Cancer										
All types	$2,687	$2,756	$3,032	$3,471	$3,880	$4,295	$4,607	$5,004	$5,480	$6,017
For-profit	$3,503	$3,949	$4,179	$4,877	$5,733	$6,203	$6,161	$7,160	$7,265	$8,629
Government	$2,420	$2,666	$2,867	$3,046	$3,183	$3,761	$4,056	$4,323	$4,587	$5,291
Not-for-profit	$2,587	$2,613	$2,885	$3,316	$3,725	$4,084	$4,444	$4,773	$5,336	$5,740
Lung Cancer										
All types	$2,742	$2,793	$3,113	$3,591	$4,051	$4,438	$4,514	$5,037	$5,547	$6,229
For-profit	$3,257	$3,577	$4,260	$4,621	$5,520	$5,849	$5,840	$6,864	$6,999	$8,114
Government	$2,530	$2,633	$2,826	$2,864	$3,269	$3,842	$3,927	$4,408	$4,584	$5,412
Not-for-profit	$2,702	$2,718	$3,003	$3,554	$3,982	$4,322	$4,434	$4,867	$5,506	$6,118
Prostate Cancer										
All types	$3,303	$3,442	$3,974	$4,684	$5,255	$5,769	$6,200	$7,203	$9,035	$11,964
For-profit	$4,630	$5,156	$5,922	$6,591	$8,062	$8,419	$8,959	$10,808	$10,859	$14,620
Government	$2,686	$3,454	$3,358	$4,406	$4,081	$5,606	$5,152	$5,975	$6,392	$9,102
Not-for-profit	$3,191	$3,265	$3,802	$4,462	$5,031	$5,446	$5,990	$6,899	$9,184	$12,247

Source: http://hcupnet.ahrq.gov.

Figure 8. Mean Costs per Day for Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 2000–2007, Computed as a Ratio of Mean Costs to Mean LOS

	2000	2001	2002	2003	2004	2005	2006	2007
Breast Cancer								
All types	$1,741	$1,980	$2,109	$2,065	$2,203	$2,319	$2,632	$3,187
For-profit	$2,125	$2,200	$2,367	$2,133	$2,332	$2,553	$2,701	$3,006
Government	$1,833	$2,070	$2,029	$2,153	$2,375	$2,455	$2,502	$3,034
Not-for-profit	$1,666	$1,928	$2,093	$2,044	$2,155	$2,255	$2,648	$3,235
Colon Cancer								
All types	$1,297	$1,403	$1,480	$1,533	$1,644	$1,730	$1,829	$1,947
For-profit	$1,503	$1,484	$1,636	$1,666	$1,674	$1,869	$1,821	$1,961
Government	$1,413	$1,499	$1,568	$1,600	$1,713	$1,836	$1,908	$2,063
Not-for-profit	$1,250	$1,377	$1,445	$1,503	$1,629	$1,691	$1,815	$1,925
Lung Cancer								
All types	$1,395	$1,521	$1,634	$1,666	$1,715	$1,829	$1,941	$2,151
For-profit	$1,593	$1,486	$1,692	$1,654	$1,671	$1,907	$1,843	$1,936
Government	$1,469	$1,458	$1,797	$1,652	$1,780	$1,952	$1,987	$2,290
Not-for-profit	$1,361	$1,537	$1,595	$1,671	$1,712	$1,798	$1,948	$2,154
Prostate Cancer								
All types	$1,522	$1,679	$1,821	$1,830	$2,021	$2,228	$2,683	$3,565
For-profit	$1,879	$1,744	$2,012	$2,009	$2,124	$2,707	$2,502	$2,998
Government	$1,526	$1,919	$1,957	$1,929	$2,000	$2,197	$2,448	$3,237
Not-for-profit	$1,476	$1,642	$1,765	$1,792	$2,015	$2,166	$2,754	$3,698

Source: http://hcupnet.ahrq.gov. Mean costs per HCUP were adjusted using factors determined by Song and Friedman (2008); see Figure 2 for an example of how these adjustment factors were applied.

for-profit versus not-for-profit hospitals were significantly different for all cancer types studied ($p = 0.0343$, 0.0156, 0.0494, and 0.0233, for breast, colon, lung, and prostate cancers, respectively). Mean charges per day for for-profit versus not-for-profit hospitals were significantly different for breast, colon, and lung cancers ($p = 0.0494$, 0.0156, and 0.0494, respectively). Neither mean charges per discharge nor mean charges per day for government versus not-for-profit hospitals were significantly different for any of the cancers studied. Thus, these results, given for-profit's higher charges across the board, signify that for-profit charges are significantly higher when compared to either government hospitals or not-for-profit hospitals. Mean LOS for breast cancer were significantly different for for-profit versus government hospitals ($p = 0.0082$) but not significantly different for either for-profit versus not-for-profit hospitals or government versus

Figure 9. Net Changes in Mean Charges, Mean Costs, and Mean LOS per Discharge and per Day for Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 1998–2007, Presented in Dollar and Percentage Terms

	Mean Charge		Mean Cost		Mean LOS		Mean Charge per Day		Mean Cost per Day	
	Ä ($)	Ä (%)	Ä ($)	Ä (%)	Ä (Days)	Ä (%)	Ä ($)	Ä (%)	Ä ($)	Ä (%)
Breast Cancer										
All types	$15,727	144.8%	$3,328	70.3%	-0.42	-14.1%	$6,828	185.4%	$1,447	83.1%
For-profit	$22,673	194.9%	$1,187	18.5%	-0.18	-6.5%	$9,267	215.9%	$881	41.4%
Government	$10,326	79.6%	$3,272	63.8%	-1.31	-32.1%	$5,232	164.5%	$1,201	65.5%
Not-for-profit	$15,885	152.6%	$3,606	81.1%	-0.30	-10.7%	$6,829	183.1%	$1,569	94.2%
Colon Cancer										
All types	$26,280	103.9%	$4,564	37.6%	-0.84	-8.9%	$3,330	123.9%	$651	50.2%
For-profit	$40,567	124.4%	$2,772	20.0%	-0.83	-8.9%	$5,127	146.4%	$458	30.5%
Government	$22,705	102.4%	$4,016	29.8%	-0.68	-7.4%	$2,872	118.7%	$650	46.0%
Not-for-profit	$24,871	101.5%	$4,880	41.8%	-0.86	-9.1%	$3,154	121.9%	$675	54.0%
Lung Cancer										
All types	$23,758	109.4%	$4,499	40.2%	-0.62	-7.8%	$3,487	127.2%	$756	54.2%
For-profit	$34,151	136.2%	$1,998	16.5%	-0.40	-5.2%	$4,857	149.1%	$343	21.6%
Government	$21,255	108.4%	$5,754	49.9%	-0.19	-2.5%	$2,882	113.9%	$820	55.8%
Not-for-profit	$22,862	106.0%	$4,611	41.8%	-0.73	-9.1%	$3,417	126.5%	$793	58.2%
Prostate Cancer										
All types	$18,247	140.6%	$3,673	65.2%	-1.33	-33.7%	$8,661	262.3%	$2,043	134.2%
For-profit	$24,543	142.1%	$1,490	21.0%	-0.87	-23.4%	$9,990	215.8%	$1,119	59.5%
Government	$14,890	135.9%	$3,239	54.4%	-1.24	-30.3%	$6,416	238.9%	$1,710	112.1%
Not-for-profit	$18,536	147.5%	$3,977	73.4%	-1.40	-35.5%	$9,056	283.8%	$2,222	150.6%

Figure 10. Results of Kruskal-Wallis (nonparametric ANOVA) Tests on Mean Charges per Discharge, Mean Costs per Discharge, and Mean Lengths of Stay for Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 1998–2007

Dependent variable	x^2	p-value
Breast Cancer		
Mean Charges	7.28	0.0263*
Mean Costs	2.24	0.3263
Mean LOS	6.44	0.0399*
Colon Cancer		
Mean Charges	10.16	0.0062**
Mean Costs	2.18	0.3362
Mean LOS	1.00	0.6069
Lung Cancer		
Mean Charges	8.22	0.0164*
Mean Costs	0.72	0.6977
Mean LOS	2.90	0.2348
Prostate Cancer		
Mean Charges	9.26	0.0097**
Mean Costs	0.74	0.6907
Mean LOS	2.25	0.3250

* Significant at 5% level
** Significant at 1% level

Figure 11. Results of Kruskal-Wallis (nonparametric ANOVA) Tests on Mean Charges per Day and Mean Costs per Day for Breast, Colon, Lung, and Prostate Cancer Hospital Discharges in HCUP NIS, Stratified by Hospital Ownership Type, 1998–2007

Dependent variable	x^2	p-value
Breast Cancer		
Mean Charges	8.37	0.0152*
Mean Costs	1.68	0.4317
Colon Cancer		
Mean Charges	9.56	0.0084**
Mean Costs	1.52	0.4677
Lung Cancer		
Mean Charges	8.09	0.0176*
Mean Costs	0.30	0.8586
Prostate Cancer		
Mean Charges	6.95	0.0310*
Mean Costs	0.62	0.7334

* Significant at 5% level
** Significant at 1% level

not-for-profit hospitals. This indicates that the LOS for breast cancer patients is consistently and significantly lower in government hospitals when compared to for-profit hospitals.

Five-Year Forecast Projections

We project mean charges per discharge, mean costs per discharge, mean LOS, mean charges per day, and mean costs per day for our variables and cancers of interest, differentiating by hospital ownership type, into future years using time series forecasting models. Longitudinal, annual point estimates for mean charges (1998 to 2007), mean costs (2000 to 2007), mean LOS (1998 to 2007), mean charges per day (1998 to 2007), and mean costs per day (2000 to 2007) were used to build forecasts for the five-year period 2008 to 2012. We allowed SAS 9.1 to automatically fit time series models by minimizing the root mean square error of each variable. We exported the forecast output from SAS to Microsoft Excel in order to create plots and compute parameter estimates for slopes and confidence intervals. Upper and lower 95 percent control limits for five-year forecasts (UCL and LCL, respectively)

Figure 12. Pair-wise Comparisons of Hospital Ownership Types Using Kruskal-Wallis Tests for Mean Charges per Discharge (All Cancer Types) and Mean LOS (Breast Cancer), 1998–2007

Dependent variable	x^2	p-value
Breast Cancer: Mean Charges		
For-profit vs. Government	6.22	0.0126*
For-profit vs. Not-for-Profit	4.48	0.0343*
Government vs. Not-for-Profit	0.05	0.8206
Colon Cancer: Mean Charges		
For-profit vs. Government	8.69	0.0032**
For-profit vs. Not-for-Profit	5.85	0.0156*
Government vs. Not-for-Profit	0.46	0.4963
Lung Cancer: Mean Charges		
For-profit vs. Government	6.61	0.0102*
For-profit vs. Not-for-Profit	3.86	0.0494*
Government vs. Not-for-Profit	1.85	0.1736
Prostate Cancer: Mean Charges		
For-profit vs. Government	8.25	0.0041**
For-profit vs. Not-for-Profit	5.14	0.0233*
Government vs. Not-for-Profit	0.28	0.5967
Breast Cancer: Mean LOS		
For-profit vs. Government	7.00	0.0082**
For-profit vs. Not-for-Profit	0.14	0.7055
Government vs. Not-for-Profit	2.52	0.1124

* Significant at 5% level
** Significant at 1% level

Figure 13. Pair-wise Comparisons of Hospital Ownership Types Using Kruskal-Wallis Tests for Mean Charges per Day (All Cancer Types), 1998–2007

Dependent variable	x^2	p-value
Breast Cancer: Mean Charges		
For-profit vs. Government	7.41	0.0065**
For-profit vs. Not-for-Profit	3.86	0.0494*
Government vs. Not-for-Profit	1.12	0.2899
Colon Cancer: Mean Charges		
For-profit vs. Government	7.82	0.0052**
For-profit vs. Not-for-Profit	5.85	0.0156*
Government vs. Not-for-Profit	0.46	0.4963
Lung Cancer: Mean Charges		
For-profit vs. Government	7.00	0.0082**
For-profit vs. Not-for-Profit	3.86	0.0494*
Government vs. Not-for-Profit	1.12	0.2899
Prostate Cancer: Mean Charges		
For-profit vs. Government	6.61	0.0102*
For-profit vs. Not-for-Profit	3.29	0.0696
Government vs. Not-for-Profit	0.37	0.5453

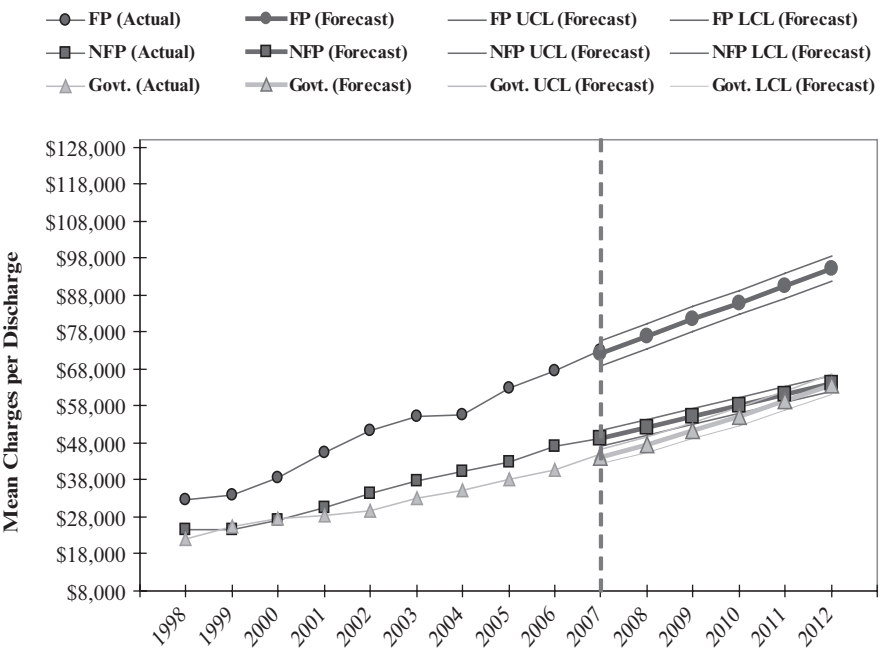
* Significant at 5% level
** Significant at 1% level

are indicated on each graph. Forecast plots, parameter estimates, and time series model identifications are presented in Figures 14 through 33. Figures 15, 19, and 23 plotting forecasted mean charges, mean costs and mean lengths of stay for colon cancer have been provided in the printed version of this article as a sample to the reader; all Figures 14 through 33 can be viewed in the online version at *www.healthbusinessandpolicy.com.*

In general, the ranking of mean charges *per discharge* by hospital ownership type (highest to lowest) over the period 1998 to 2007 were (1) for-profit, (2) not-for-profit, and (3) government. Charges have been consistently trending upward over the ten-year period studied and are projected to increase over the forecast period 2008 to 2012. According to forecast output (Figure 14), mean charges per discharge for breast cancer hospital stays in not-for-profit hospitals will actually exceed for-profit hospitals by 2011. Forecasted charges for governmental hospitals, while projected to continue rising, are projected to remain below both for-profit and not-for-profit hospital charges.

Figure 15.

Colon Cancer: Forecast Mean Charges per Discharge by Hospital Ownership Type
Government (Govt.), Not-for-Profit (NFP), For-Profit (FP)



Historical trends and future projections in the mean charge per hospital discharge for patients with a primary diagnosis of colon cancer. Historical (actual) data are plotted for 1998 through 2007 and projected (forecast) data are plotted for 2008 to 2012.

For-profit mean charge data were forecast using a linear trend model.

The model : $Y_t = \beta_0 + \beta_1 t + \varepsilon_t$ The forecast : $\hat{Y}_t = \beta_0 + \beta_1 t + \varepsilon_t$, where :
β_0 = linear intercept; β_1 = slope; t = time; ε_t = random error term
Here, $\beta_0 = 26495$; $\beta_1 = 4577$ and thus, e.g., $\hat{Y}_{2008} = 26495 + 4577(11) = \$76{,}842$

Government mean charge data were forecast using a log linear model.

The model : $\ln(Y_t) = \beta_0 + \beta_1 t + \varepsilon_t$ The forecast : $\hat{Y}_t = e^{(\ln Y_t + \sigma^2/2)}$, where :
β_0 = linear intercept; β_1 = slope; t = time; ε_t = random error term
Here, $\beta_0 = 9.96462$; $\beta_1 = .07333$; $\sigma^2 \approx .00051$ and thus, e.g., $\ln(Y_t) = 9.96462 + .07333(11) \approx 10.7713$
and $\hat{Y}_{2008} \approx e^{(10.7713 + .00051/2)} \approx e^{10.7716} \approx \$47{,}648$

Not-for-profit mean charge data were forecast using a linear trend model.

The model : $Y_t = \beta_0 + \beta_1 t + \varepsilon_t$ The forecast : $\hat{Y}_t = \beta_0 + \beta_1 t + \varepsilon_t$, where :
β_0 = linear intercept; β_1 = slope; t = time; ε_t = random error term
Here, $\beta_0 = 19427$; $\beta_1 = 2982$ and thus, e.g., $\hat{Y}_{2008} = 19427 + 2982(11) = \$52{,}229$

Figure 15 notes that mean charges per discharge in not-for-profit hospitals will align with government hospital charges by 2011 for colon cancer and by 2012 for lung cancer (Figure 16). In both colon cancer and lung cancer, for-profit charges are forecasted to rise and remain higher than the charges in the other two types of hospitals. Mean charges per discharge for prostate cancer hospital stays (Figure 17) are forecast to remain consistent with historical trends; that is, the ranking of charges by ownership type (highest to lowest) will remain (1) for-profit, (2) not-for-profit, and (3) government. However, the slopes of the rise in prostate cancer charges for all hospital types are forecasted to remain modestly positive.

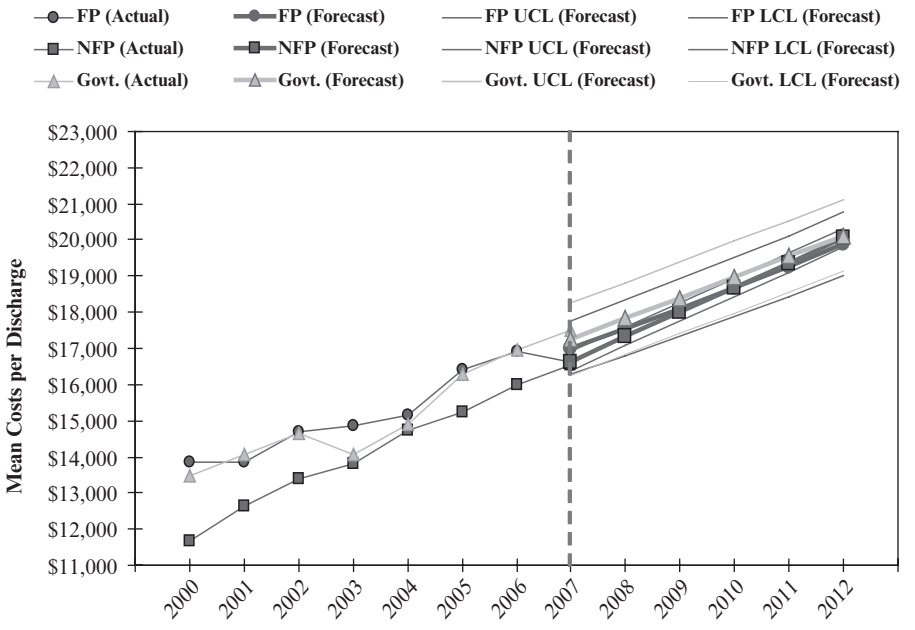
Although exhibiting a generally upward linear trend overall, historical trends in mean costs *per discharge* are highly variable and the ranking of highest to lowest cost by hospital ownership type varies from year to year. According to forecast output, mean costs per discharge for both breast cancer (Figure 18) and prostate cancer (Figure 21) hospital stays will follow a ranking (highest to lowest) of (1) not-for-profit, (2) government, and (3) for-profit. Mean costs per discharge for lung cancer hospital stays (Figure 20) will follow a ranking of (1) government, (2) not-for-profit, and (3) for-profit. These forecast results warrant further examination. First, note that for-profit costs are forecast to drop below the other two hospital types in these cancers. As we observed when we discussed Figure 9 (net changes in our variables over the years), for-profit costs rose at a much lesser rate than they did for the other hospital types, and our forecasts reflect this. Mean costs per discharge for colon cancer (Figure 19) for all three hospital ownership types are forecast to nearly align with each other by 2012.

Similar to mean costs, historical trends in mean LOS per discharge are highly variable and the ranking of highest to lowest LOS by hospital ownership type varies from year to year. Generally, a lower LOS is indicative of more efficient service, all else being equal. According to forecast output, mean LOS for colon cancer (Figure 23) and lung cancer (Figure 24) will follow a ranking (highest to lowest) of (1) for-profit, (2) not-for-profit, and (3) government. Colon cancer LOS are projected to remain consistent over the forecasted periods for for-profit hospitals, while they are predicted to decrease for other hospital types. For lung cancer, LOS are predicted to decrease for all hospital types, although for-profit LOS are expected to decrease more slowly. Mean lengths of stay for breast cancer (Figure 22) and prostate cancer (Figure 25) are forecast to be highest in government hospitals and comparably lower in both for-profit and not-for-profit hospitals.

In general, the ranking of mean charges *per day* (Figures 26 through 29) by hospital ownership type (highest to lowest) over the period 1998 to 2007 were (1) for-profit, (2) not-for-profit, and (3) government. Charges have been consistently trending upward over the ten-year period studied and are projected to increase over the forecast period 2008 to 2012. According to forecast output, mean charges per day for breast cancer (Figure 26) hospital stays in not-for-profit hospitals will approximate for-profit hospitals by 2012. Mean charges per day in not-for-profit hospitals will nearly align with government hospital charges by 2011 for colon cancer (Figure 27) and lung cancer (Figure 28). The forecasted charges per day for lung cancer patients will remain higher in for-profit hospitals. Mean charges per day for prostate cancer hospital stays (Figure 29) are forecast

Figure 19.

Colon Cancer: Forecast Mean Charges per Discharge by Hospital Ownership Type
Government (Govt.), Not-for-Profit (NFP), For-Profit (FP)



Historical trends and future projections in the mean cost per hospital discharge for patients with a primary diagnosis of colon cancer. Historical (actual) data are plotted for 2000 through 2007 and projected (forecast) data are plotted for 2008 to 2012.

For-profit mean cost data were forecast using a log linear trend model.

The model: $\ln(Y_t) = \beta_0 + \beta_1 t + \varepsilon_t$ The forecast: $\hat{Y}_t = e^{(\ln Y_t + \sigma^2/2)}$, where:
β_0 = linear intercept; β_1 = slope; t = time; ε_t = random error term
Here, $\beta_0 = 9.49232; \beta_1 = .03115; \sigma^2 \approx .00049$ and thus, e.g., $\ln(Y_t) = 9.49232 + .03115(9) \approx 9.7727$
and $\hat{Y}_{2008} \approx e^{(9.7727 + .00049/2)} \approx e^{9.7729} \approx \$17{,}552$

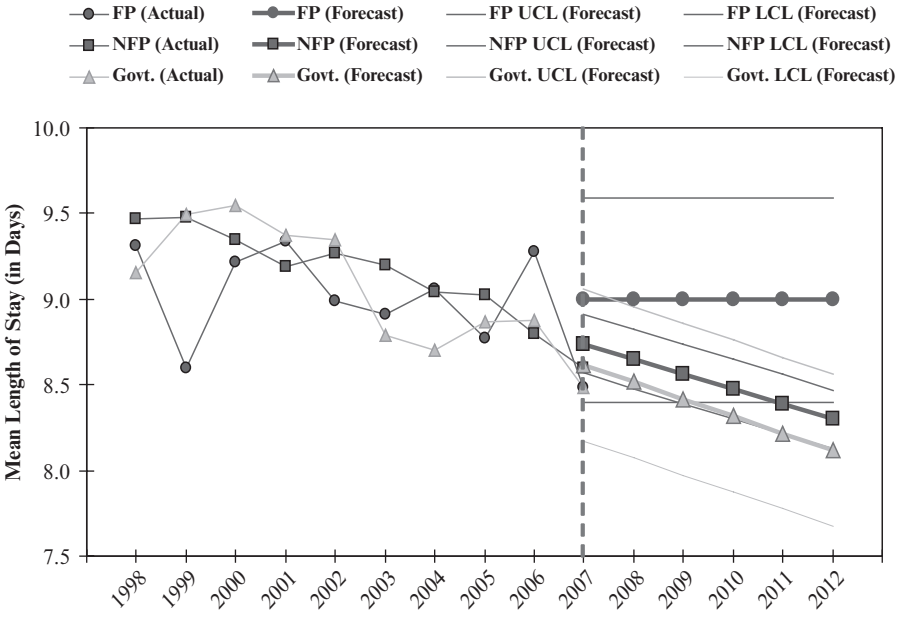
Government mean cost data were forecast using a linear trend model.

The model: $Y_t = \beta_0 + \beta_1 t + \varepsilon_t$ The forecast: $\hat{Y}_t = \beta_0 + \beta_1 t + \varepsilon_t$, where:
β_0 = linear intercept; β_1 = slope; t = time; ε_t = random error term
Here, $\beta_0 = 12647; \beta_1 = 575$ and thus, e.g., $\hat{Y}_{2008} = 12647 + 575(9) = \$17{,}822$

Not-for-profit mean cost data were forecast using a linear trend model.

The model: $Y_t = \beta_0 + \beta_1 t + \varepsilon_t$ The forecast: $\hat{Y}_t = \beta_0 + \beta_1 t + \varepsilon_t$, where:
β_0 = linear intercept; β_1 = slope; t = time; ε_t = random error term
Here, $\beta_0 = 11187; \beta_1 = 682$ and thus, e.g., $\hat{Y}_{2008} = 11187 + 682(9) = \$17{,}325$

Figure 23.



Historical trends and future projections in the mean LOS per hospital discharge for patients with a primary diagnosis of colon cancer. Historical (actual) data are plotted for 1998 through 2007 and projected (forecast) data are plotted for 2008 to 2012.

For-profit mean LOS data were forecast using the mean of historical data.

$$\text{The model}: Y_t = \mu_t + \varepsilon_t \quad \text{The forecast}: \hat{Y}_t = \mu_t + \varepsilon_t, \text{where}:$$
$$\mu_t = \text{mean of the series}; \ \varepsilon_t = \text{random error term}$$
$$\text{Here, } \mu_t = 8.99509 \text{ and thus, e.g., } \hat{Y}_{2008} \approx 8.9951$$

Government mean LOS data were forecast using a linear trend model.

$$\text{The model}: Y_t = \beta_0 + \beta_1 t + \varepsilon_t \quad \text{The forecast}: \hat{Y}_t = \beta_0 + \beta_1 t + \varepsilon_t, \text{where}:$$
$$\beta_0 = \text{linear intercept}; \beta_1 = \text{slope}; \text{t} = \text{time}; \varepsilon_t = \text{random error term}$$
$$\text{Here, } \beta_0 = 9.61019; \beta_1 = \text{-}.09947 \text{ and thus, e.g., } \hat{Y}_{2008} = 9.61019 + -.09947(11) \approx 8.5160$$

Not-for-profit mean LOS data were forecast using a linear trend model.

$$\text{The model}: Y_t = \beta_0 + \beta_1 t + \varepsilon_t \quad \text{The forecast}: \hat{Y}_t = \beta_0 + \beta_1 t + \varepsilon_t, \text{where}:$$
$$\beta_0 = \text{linear intercept}; \beta_1 = \text{slope}; \text{t} = \text{time}; \varepsilon_t = \text{random error term}$$
$$\text{Here, } \beta_0 = 9.62845; \beta_1 = \text{-}.08872 \text{ and thus, e.g., } \hat{Y}_{2008} = 9.62845 + -.08872(11) \approx 8.6525$$

to be (highest to lowest) (1) not-for-profit, (2) for-profit, and (3) government over the five-year forecast period, thereby deviating from the historical norm.

Similar to mean costs per discharge, historical mean costs *per day* exhibit a generally upward yet highly variable trend. According to forecast output, mean costs per day for both breast cancer (Figure 30) and prostate cancer (Figure 33) hospital stays will follow a ranking (highest to lowest) of (1) not-for-profit, (2) government, and (3) for-profit. Mean costs per day for lung cancer (Figure 32) hospital stays will follow a ranking of (1) government, (2) not-for-profit, and (3) for-profit. Mean costs per day for colon cancer hospital stays (Figure 31) in government hospitals are forecast to exceed the comparable forecast costs for for-profit and not-for-profit hospital ownership types throughout the five-year forecast period.

Upon reviewing forecast plots, we caution the reader to take notice of the upper (UCL) and lower (LCL) 95 percent control limits. In some cases, confidence intervals are relatively wide and allow for significant variation during the forecast period (for example, see forecast breast cancer charges per discharge for not-for-profit hospitals in Figure 14). In other instances, confidence intervals are relatively narrow and indicative of very precise projections (see forecast lung cancer charges per discharge for not-for-profit hospitals in Figure 16). When used correctly, confidence intervals allow the reader to better interpret the accuracy of forecasts.

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

Simone Rauscher and John R.C. Wheeler

The continuing efforts of government payers to contain hospital costs have raised concerns among hospital managers that serving publicly insured patients may undermine their ability to manage the revenue cycle successfully. This study uses financial information from two sources—Medicare cost reports for all US hospitals for 2002 to 2007 and audited financial statements for all bond-issuing, not-for-profit hospitals for 2000 to 2006—to examine the relationship between hospitals' shares of Medicare and Medicaid patients and the amount of patient care revenue they generate as well as the speed with which they collect their revenue. Hospital-level fixed effects regression analysis finds that hospitals with higher Medicare and Medicaid payer mix collect somewhat higher average patient care revenues than hospitals with more privately insured and self-pay patients. Hospitals with more Medicare patients also collect on this revenue faster; serving more Medicaid patients is not associated with the speed of patient revenue collection. For hospital managers, these findings may represent good news. They suggest that, despite increases in the number of publicly insured patients served, managers have frequently been able to generate adequate amounts of patient revenue and collect it in a timely fashion. Key words: *payer mix, patient care revenue, average collection times, revenue cycle management.*

In recent years, budget pressures combined with the acceleration in the growth of hospital costs have forced policymakers at both federal and state levels to limit future increases in government payers' reimbursement rates or even cut the rates they currently pay providers. These cost containment efforts have resulted in substantial payment shortfalls for hospitals. According to the American Hospital Association, between 2000 and 2007, the average payment-to-cost ratios for Medicare and Medicaid patients fell from 99 to 91 percent and from 95 to 88 percent, respectively, while the average payment-to-cost ratio for privately insured patients rose from 116 to 132 percent.[1]

Hospital participation in Medicare and Medicaid is voluntary, yet—given that these two programs account for 55 percent of care provided by hospitals—very few hospitals can afford not to serve publicly insured patients. Consequently, most hospitals have no choice but to accept the payment rates and terms that lawmakers set for the treatment of Medicare and Medicaid patients. However, given government payers' continued efforts to contain health care costs, hospital managers have become increasingly concerned that serving Medicare and Medicaid patients could seriously undermine their performance

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at revenue cycle management, *i.e.*, their ability to generate adequate amounts of patient care revenue and to collect on this revenue in a timely fashion.

This article explores the relationship between hospitals' government payer mix, *i.e.*, their proportions of Medicare and Medicaid patients, and the amount of patient care revenue hospitals generate as well as the speed with which hospitals collect their revenue. We find that serving larger numbers of Medicare and Medicaid patients does not necessarily undermine hospitals' revenue cycle management performance. For hospital managers, these findings may represent good news. They show that, despite increases in the number of publicly insured patients served, managers have frequently been able to generate adequate amounts of patient revenue and collect it in a timely fashion.

Literature Review

Despite frequently voiced concerns by hospital practitioners that serving Medicare and Medicaid patients may undermine their ability to generate and collect patient care revenue, only a few studies have explored empirically the relationship between government payer mix and hospitals' performance at managing the revenue cycle. None of these studies has found evidence that government payers undermine hospitals' ability to generate and collect patient care revenue. In a study of US hospitals in the 1990s, Medicare and Medicaid payer mix was not associated with the average amount of net revenue hospitals generated per patient.[2] Additional evidence for this lack of a relationship between government payer mix and hospitals' ability to generate patient revenue was provided by a study of hospitals in the state of Washington in 1987, which found that hospitals' provision of charity care, a revenue deduction and thus an important determinant of hospitals' net revenue per patient, was not associated with the proportion of publicly insured patients served.[3] Moreover, with respect to hospitals' ability to collect patient care revenue in a timely fashion, a study of not-for-profit hospitals in the late 1980s found that hospitals' government payer mix did not undermine their collection performance.[4] On the contrary, for several subsets of hospitals analyzed, hospitals' shares of Medicare and Medicaid patients were inversely related to their average collection periods, implying that serving more publicly insured patients allowed hospitals to collect on their patient revenues faster.

While empirical studies of hospitals in the 1980s and 1990s found no evidence that government payer mix undermined hospitals' ability to effectively manage the revenue cycle, the continuing efforts of public payers to contain hospital costs may limit the applicability of prior empirical findings to hospitals operating in today's business environment. Using financial information from two national datasets for the years 2000 to 2007, our study expands on previous work by:

1. Analyzing the relationship between hospitals' government payer mix and their performance at revenue cycle management in today's business environment; and
2. Employing a more comprehensive set of financial indicators of revenue cycle management performance taking into account both the amount and the speed of hospitals' patient revenue collection.

Conceptual Framework

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.[5] A hospital's payer mix, *i.e.*, its relative proportions of Medicare, Medicaid, privately insured, and uninsured patients, may thus play an important role in its ability to generate adequate amounts of patient care revenue and collect on this revenue in a timely fashion.

In general, the amount of patient revenue a hospital collects is a function of the price the hospital receives 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.[6] 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 may 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 most private insurers, resulting in payment shortfalls.[7] Unless hospitals are able to offset some of the underpayments from Medicare and Medicaid by negotiating higher prices from private health insurers, hospitals serving more publicly insured patients likely collect reduced amounts of patient revenue.

A hospital's payer mix, however, not only influences the average price the hospital can charge for each service but also the 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.[8] 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 (HMOs), 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 important, but rarely discussed in the same context, a hospital's payer mix also influences its speed of revenue collection. A long time between service provision and receipt of payment places a cash flow burden on the hospital, perhaps necessitating that the hospital access short-term financing to meet payroll or debt service. Further, a long collection period means the hospital will carry relatively high levels of accounts receivable on its balance sheet. Accounts receivable is obviously an asset which must be financed at considerable cost to the hospital. Hospitals' average collection periods vary greatly by payer. While some third-party payers, such as Medicare and many

managed care organizations including Medicaid HMOs, are bound by federal or state laws to reimburse providers within specified periods of time,[9] other payers, such as private indemnity insurers, frequently take considerable amounts of time to reimburse hospitals because of disputes over coverage or reasonableness.[10] Collections from indigent and self-pay patients often prove to be particularly difficult, resulting in substantial payment delays.[11]

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 HMOs, may collect their patient revenue faster than hospitals serving more patients with traditional fee-for-service insurance coverage as well as more indigent and self-pay patients.

Methods

Analytic Model

Following previous empirical studies,[12] we modeled hospital revenue cycle management performance, RCM_{it}, as a function of payer mix, $PayerMix_{it}$, and a set of control variables, represented as X_{it}, whereby the subscripts i and t refer to hospital i in year t.

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

Because of the potential for hospital-level variation in the way hospitals manage the revenue cycle, we included a hospital-specific error term, μ_i, which represents the unobserved heterogeneity across hospitals. Revenue cycle management has 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,[13] other hospitals are characterized by a silo structure of managing the revenue cycle with little integration of the functions of different departments.[14] 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, however, indicated that fixed effects regression was preferred over random effects. For all regressions, we employed heteroskedasticity robust White standard errors to account for the clustering of observations within hospitals over time.

Measures

Hospital revenue cycle management performance, the dependent variable, was measured using three financial indicators of hospitals' ability to generate and collect patient care revenue, days in net accounts receivable, net patient revenue per adjusted discharge, and net patient revenue per total assets (*see* Figure 1). 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 hospitals' ability to collect patient revenue in a timely fashion.[15] Days in net accounts receivable is defined 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.

Whenever possible we used net patient revenue per adjusted discharge as an indicator of the amount of patient revenue generated, which adjusts net patient revenues for a hospital's wage index, case mix index, and proportion of outpatient business and thus

Figure 1. Variable Definitions, Data Sources, and Descriptive Analysis

Variable	Definition	Data source*	Mean (Standard deviation)
Revenue cycle management performance			
Days in net accounts receivable	(Net accounts receivable × 365) ÷ Net patient revenue	TR	57.16 (22.22)
		MRS	59.74 (17.50)
Net patient revenue per adjusted discharge	{[(Net patient revenue × 0.71 ÷ CMS wage index) + (Net patient revenue × 0.29)] ÷ Adjusted discharges} ÷ Case mix index whereby Adjusted discharges = Total acute care discharges × (Gross patient revenue ÷ Gross inpatient acute care revenue)	TR	5,806.46 (5,019.85)
Net patient revenue per total assets	(Net patient revenue ÷ Case mix index) ÷ Total assets	MRS	0.65 (0.27)
Payer mix indicators			
Medicare admissions	(Medicare acute care admissions ÷ Total acute care admissions) × 100%	TR	41.77 (14.21)
Medicare inpatient days	(Medicare acute care inpatient days ÷ Total acute care inpatient days) × 100%	TR	50.42 (14.91)
Medicare gross patient revenue	(Medicare gross patient service revenue ÷ Gross patient service revenue) × 100%	MRS	40.13 (11.93)
Medicaid admissions	(Medicaid acute care admissions ÷ Total acute care admissions) × 100%	TR	15.29 (11.46)
Medicaid inpatient days	(Medicaid acute care inpatient days ÷ Total acute care inpatient days) × 100%	TR	12.64 (9.88)
Medicaid gross patient revenue	(Medicaid gross patient service revenue ÷ Gross patient service revenue) × 100%	MRS	11.85 (9.45)
Managed care gross patient revenue	(Gross patient service revenue from managed care payers ÷ Gross patient service revenue) × 100%	MRS	27.85 (16.48)
Control variables			
Case mix index	Average diagnosis-related group case weight for all of a hospital's Medicare patients	TR	1.32 (0.28)
		MRS	1.33 (0.27)
Average age of plant	Accumulated depreciation ÷ Depreciation expense	MRS	10.02 (2.71)

Notes: Means were measured as the mean of hospital values averaged over the periods 2002 to 2007 for Thomson Reuters hospitals and 2000 to 2006 for Merritt hospitals.
* TR = Thompson Reuters; MRS = Merritt Research Services.

allows for comparisons across institutions. We used net patient revenue per total assets as an alternative measure in those parts of the analysis where large numbers of missing data did not allow the calculation of net patient revenue per adjusted discharge without compromising sample size. Unlike net patient revenue per adjusted discharge, net patient revenue per total assets only adjusts for differences in hospitals' case mix indices but does not take differences in wage indices and the shares of hospitals' outpatient business into account.

The independent variables of interest in this study are indicators of hospitals' government payer mix, in particular their shares of Medicare and Medicaid patients (*see* Figure 1). The reference group to which Medicare and Medicaid were compared consisted of all privately insured and self-pay patients. In general, payer mix can be defined either in terms of volumes of services provided to patients covered by each payer or revenues received from each payer. We employed three different measures of payer mix in our analyses: Medicare and Medicaid payer mix were measured first in terms of volume using acute care admissions and acute care inpatient days and second in terms of revenues using gross patient services revenue. Besides Medicare and Medicaid payer mix, we included the percentage of gross patient revenue derived from managed care payers as an additional indicator of payer mix in parts of the analysis whereby our measure of managed care payer mix included Medicare patients enrolled in Medicare Advantage plans and Medicaid patients enrolled in HMOs.

Besides payer mix, a number of factors, both internal and external to the hospital, have been found to affect revenue cycle management performance.[16] Due to the use of fixed effects regression models, however, we were unable to estimate coefficients on time-invariant covariates, which limited the number of control variables that could be included in the analyses (*see* Figure 1). In our analysis of days in net accounts receivable, we included case mix index, *i.e.*, the average diagnosis-related group case weight for all of a hospital's Medicare volume, as a control variable. More complex cases often prompt additional reviews by third-party payers in the processing of claims, which may result in payment delays for hospitals.[17] Moreover, in our analysis of net patient revenue per total assets, we included the average age of plant, defined as accumulated depreciation divided by depreciation expense, as a control variable. Hospitals may not only record higher net patient revenues per total assets because of more effective revenue cycle management but also because of changes in their asset base, which frequently is the result of aging capital assets. Finally, all analyses included year and state dummy variables to capture inter-temporal changes in revenue cycle management performance common to all hospitals and differences in revenue cycle management between hospitals across states, respectively.

Data and Samples

The data used in the analyses were from two sources: First, we analyzed financial data from Medicare cost reports collected and provided by Thomson Reuters.[18] Since almost all US hospitals have a contract with Medicare to treat Medicare beneficiaries this dataset represents close to the total population of US hospitals. Second, we analyzed audited financial statement information for all bond-issuing, not-for-profit US hospitals collected and provided by Merritt Research Services.[19] Even though the Merritt Research

Services dataset contains only a subset of US hospitals, its use allowed us to compare and reinforce our results by using several different measures of both payer mix and revenue cycle management performance and thus to determine the robustness of our results with respect to different specifications of our dependent and independent variables.

The data provided by Thomson Reuters contained financial information from Medicare cost reports 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 database, we obtained information on 4,264 hospitals and 20,655 hospital-year observations with complete data on the variables of interest. The final sample represented 60.3 percent of hospitals and 63.9 percent of hospital years in the database.

The Merritt Research Services database contained audited financial statement information beginning in 1988 for all not-for-profit hospitals that have issued tax-exempt debt. We limited the period of analysis to 2000 to 2006. Of the 1,486 hospitals and 8,707 hospital-year observations for which financial reports were available, we obtained financial information on 753 hospitals and 2,761 hospital-year observations with complete data on the variables of interest. The final panel represented 50.7 percent of hospitals and 31.7 percent of hospital years in the database.

While both data sets employed in this study had substantial missing data problems, the nature of the missing data problems varied by data source. Thomson Reuters data are based on information from hospitals' Medicare cost reports and thus unaudited financial statements, which are known to contain many inconsistencies and errors.[20] The Merritt Research Services database, on the other hand, contains financial information from audited financial statements. As a result, there were very few missing or implausible values for most financial statement items. However, there was a substantial amount of missing information on hospitals' payer mix since hospitals are not required to provide information regarding payer mix in the notes to their financial statements.

The missing data problems encountered raised the question of the extent to which the final samples were representative of all US hospitals and all bond-issuing, not-for-profit US hospitals, respectively. For this purpose, a set of organizational and financial characteristics of hospitals in the final samples was compared to those of all hospitals (*see* Figure 2). The final sample of Thomson Reuters hospitals differed substantially from all US hospitals. They were generally larger, better performing, and not-for-profit hospitals. These findings are consistent with the observation by Burkhardt[21] that hospitals with missing or inconsistent Medicare cost report data are generally smaller, poorer performing, and investor-owned hospitals. Likewise, the final sample of Merritt Research Services hospitals differed from all bond-issuing, not-for-profit US hospitals. While they were very similar in terms of size, they had higher occupancy rates and also performed better financially. Despite higher revenue deductions, both their operating and total profit margins were higher than those of all bond-issuing, not-for-profit US hospitals. As a result, since both final samples contain disproportionately many larger, better performing, and not-for-profit hospitals, the findings of this study may not apply to smaller, poorer performing, and investor-owned hospitals and caution should be exercised when interpreting and generalizing the findings.

Figure 2. Representativeness of the Final Samples

	Thomson Reuters Hospitals		Merritt Research Services Hospitals	
	Final sample	**All hospitals**	**Final sample**	**All hospitals**
Size				
Number of hospital beds	175.8**	135.4	449	441
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
Operating performance				
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/proportions are presented for all variables.
* denotes difference in means between the final sample and all hospitals was statistically significant at the five percent confidence level.
** denotes difference in means between the final sample and all hospitals was statistically significant at the one percent confidence level.

Results

Over the study period, hospitals continuously improved their performance at managing the revenue cycle. On average, hospitals reported between 57 and 60 days in net accounts receivable (*see* Figure 1). For Thomson Reuters hospitals, average collection periods decreased by around seven days, from 61.5 days in 2002 to 54.4 days in 2007. For Merritt hospitals, the improvement was even more impressive. 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. Moreover, the amounts of net patient revenue hospitals collect increased substantially over the study period. For Thomson Reuters hospitals, net patient revenue per adjusted discharge increased steadily over time, from $5,462 in 2002 to $6,321 in 2007, averaging $5,806 over the six-year study period. Likewise, for Merritt hospitals, net patient revenue per total assets increased from 61 cents per dollar invested in total assets in 2000 to 66 cents in 2006, averaging 65 cents per dollar over the seven-year study period.

Hospitals' government payer mix, the main independent variable, remained relatively stable over the study period, averaging around 55 percent of all care provided by hospitals. The percentages of gross patient revenues and acute care admissions attributable to Medicare patients averaged 40.1 and 41.8 percent (*see* Figure 1). When measured in terms of acute care inpatient days, however, Medicare payer mix averaged over 50 percent, a finding that 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 higher co-morbidity. The percentages of hospitals' acute care admissions, acute care inpatient days, and gross patient revenues attributable to Medicaid patients equaled 15.3, 12.6, and 11.9 percent, respectively.

Hospital-level fixed effects regression analysis of days in net accounts receivable showed that higher Medicare payer mix was associated with more rapid patient revenue collection (*see* Figure 3). An increase in Medicare payer mix of one percentage point

Figure 3. 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 R2	.016	.014	.056

Notes: 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. Model 3 uses Merritt Research Services data and defines payer mix in terms of gross patient services revenue. Heteroskedasticity robust White standard errors are in parentheses.

* denotes statistically significant at the 5 percent confidence level.

** denotes statistically significant at the one percent confidence level.

was associated with a decrease in hospitals' average collection period of 0.08 to 0.14 days, which translated into decreases of around 0.14 to 0.24 percent. Medicaid payer mix, on the other hand, was not associated with hospitals' average collection periods.

When analyzing hospitals' net patient revenues we found that both higher Medicare and higher Medicaid payer mix somewhat increased hospitals' average net patient revenues (*see* Figure 4). An increase in Medicare payer mix of one percentage point increased net patient revenue per adjusted discharge by between $21 and $80 per adjusted discharge, or by between 0.3 and 1.4 percent. Likewise, controlling for Medicare payer mix, an increase in a hospital's Medicaid payer mix of one percentage point was associated with increases in net patient revenue per adjusted discharge of $7, or 0.1 percent, and net patient revenue per total assets of 0.3 percentage points, or 0.5 percent.

Figure 4. 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** (269.73)	7,799.20** (240.79)	.504** (.051)
Payer mix variables			
Medicare	79.77** (4.96)	21.39* (8.69)	–.0004 (.0010)
Medicaid	7.42** (2.21)	–1.998 (4.013)	.0030* (.0014)
Managed care payers	—	—	–.00045 (.00043)
Control variables			
Average age of plant	—	—	.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 R2	.0015	.0004	.10

Notes: 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. Average age of plant is not included as a control variable in Models 4 and 5 because the dependent variable used does not depend on a hospital's total assets. Model 6 uses Merritt Research Services data and defines payer mix in terms of gross patient services revenue. Heteroskedasticity robust White standard errors are in parentheses.
* denotes statistically significant at the five percent confidence level.
** denotes statistically significant at the one percent confidence level.

Discussion

Despite the continuing efforts of government payers to contain hospital costs, we found that serving Medicare and Medicaid patients did not undermine hospitals' ability to manage the revenue cycle effectively. On the contrary, we found that hospitals with a higher Medicare and Medicaid payer mix collected slightly higher average amounts of patient revenue. Moreover, hospitals serving more Medicare patients collected their patient revenue faster while higher Medicaid payer mix was not associated with the speed of revenue collection. For hospital managers, these findings may represent good news. They show that, despite a potentially unfavorable payer mix, managers are frequently able to generate adequate amounts of patient revenue and collect it in a timely fashion.

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,[22] who found that higher Medicare payer mix was associated with lower excess collection times. It is also consistent with anecdotal evidence that suggests that, 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, and audits that could delay reimbursement are conducted rarely.[23] Medicare thus pays hospitals comparatively faster than many private third-party payers and self-pay patients,[24] which may represent an important explanation for why hospitals with higher Medicare case loads are able to collect their patient revenues faster. The exception among private payers consists of managed care organizations, which tend to pay hospitals faster, a finding that is supported by our analysis. In general, 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.[25]

Medicaid case loads, on the other hand, are not associated with hospitals' speed of collection. This result is not consistent with Prince and Ramanan who found thatat least during the late 1980shigher Medicaid payer mix was associated with lower average collection times.[26] One potential explanation for the discrepancies in findings is that Medicaid's payment policies and practices differ widely across states. While some Medicaid programs pay hospitals as quickly as within 14 days others take up to three or four months to reimburse hospitals.[27] Given that the samples of hospitals analyzed in this study cover the years 2000 to 2007, the findings may reflect relative changes in Medicaid's average speed of reimbursement over the past 15 to 20 years or, alternatively, point to a non-representative selection of hospitals and, potentially, states. Future work should thus 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 payment.

With respect to the amount of patient revenue, hospitals serving more publicly insured patients do not collect substantially more or less revenue than hospitals serving more privately insured and uninsured patients. An increase in a hospital's government payer mix

was 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 who also found small but positive associations between Medicare and Medicaid case loads and the average amount of patient revenue hospitals collected. Despite frequently voiced concerns about government payers' reimbursement rates, higher Medicare and Medicaid payer mix does no appear to undermine hospitals' ability to generate adequate amounts of patient care revenue.[28] 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 from a charitable undertaking into a profitable business.[29] 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 supporting hospitals' financial viability.

Several other factors may 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 considered 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 were concerned about hospitals' financial viability. In Michigan, for instance, Blue Cross Blue Shield has traditionally paid close attention to the total level of revenue deductions hospitals incurred—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, often agreed to pay hospitals more than what was necessary to cover their costs. More recently, however, major purchasers of health care, such as the auto industry in Michigan, have raised concerns about the financial burden they incur when compensating hospitals for public payers' contractual allowances. 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 the current business environment.

In today's world, hospitals have taken action to improve their revenue cycle by initiating a variety of organizational and managerial changes. First, more effective revenue cycle management has enabled many hospitals to increase their net patient revenues despite a potentially unfavorable payer mix. Improvement efforts frequently target the front end of the revenue cycle, including requiring patients to pay upfront for the deductibles and copayments they owe thus lowering bad debt[30] and collecting information regarding any supplementary health insurance patients may have and that hospitals could bill for some of the care provided. Moreover, 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, which reduces the proportions of claims resubmissions and denials and speeds up revenue collection.

Second, cost shifting has allowed many hospitals 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. Prior empirical evidence suggests that hospitals are 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.[31] Likewise, Wu found that hospitals were able to transfer up to 37 percent of the cuts in Medicare reimbursement rates implemented by the Balanced Budget Act in 1997 to private payers.[32] 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 116 percent in 2000 to 132 percent in 2007, providing additional evidence that hospitals are frequently able to maintain average amounts of patient revenue by charging the privately insured and the uninsured more.[33]

Third, in order to offset revenue decreases associated with changes in payer mix, hospitals may decide to change their service mix.[34] 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, openly admitted that the changes were proposed to meet the hospital's financial challenges.[35]

Finally, any increases in a hospital's Medicaid payer mix in particular are at least partially offset by decreases in the number of uninsured patients served. Despite the recent debate surrounding the amounts hospitals charge uninsured patients for their care,[36] in practice, many hospitals collect only a small percentage of the charges billed to the uninsured. As a result, even at current levels of Medicaid reimbursement, serving Medicaid rather than uninsured patients may allow hospital managers to generate more patient care revenue. In light of the recently passed health care reform bill, this finding is of particular interest to managers. The new Patient Protection and Affordable Care Act will eventually extend health insurance coverage to an additional 32 million Americans, around half of whom will be covered under expanded Medicaid programs. This will substantially reduce the financial burden of hospitals that treat many

of the currently uninsured and thus improve their revenue cycle management performance.[37] The prospect of an improved payment environment has already sparked the interest of for-profit hospital chains to acquire cash-strapped urban hospitals, which often serve as inner-city safety nets for the poor and uninsured, as exemplified by the recent announcement by Vanguard Health Systems to take over Detroit Medical Center.[38] In the future, as in the past, government payers will thus continue to play an important role in supporting hospitals' financial viability.

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