The effect of location, strategy, and operations technology on hospital performance

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Abstract
Hospitals in the US are faced with challenges in how to compete and remain viable in an increasingly competitive environment. Using data from a primary survey of hospitals and from various secondary sources, we investigate the incremental effects on hospital performance of location, strategy, and technology. We find that hospital location is significantly related to performance, but that a hospital’s choice of strategy can moderate the effect of location. Additionally, we find hospitals that invest more extensively in clinical technologies tend to be better performers regardless of location. Hospital size, measured as number of beds, captures the effects of location and technology investment in accounting for a major portion of hospital performance. While we cannot argue that larger is always better for hospitals, mergers, partnerships, and other forms of consolidation currently observed in the marketplace indicate that managers in the hospital industry understand the advantage of size. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction
As the hospital industry in the US continues to consolidate, decisions are made daily to close, merge, acquire, and sell (Japsen, 1996). Some of the stress experienced by hospitals is well understood. For example, the tremendous pressure on hospital operations from third party payors to shorten patient hospital stays and to perform procedures on an outpatient basis resulted in excess capacity throughout the industry. But there are other factors in this industry that are not clearly understood. What causes some hospitals to struggle and which management responses are most appropriate in particular settings?
 Organizations in all industries, including hospitals, develop strategies to respond to environmental factors and competitive challenges. Those strategies drive operational decisions regarding investments in new or updated technologies. The downstream effects of strategic choices and operational decisions on organizational performance are difficult to measure, but are a topic of great interest.
 We use empirical methods to assess the interplay of environmental factors with organizational strate-
Fig. 1. Hierarchical model of location, strategy, location and strategy interaction, and technology.
operational decisions, and performance. In contrast, these variables have frequently been used in studies of manufacturing operations. For example, Swamidass and Newell (1987) use environmental uncertainty to predict elements of operations strategy which in turn are used to predict business performance. Similarly, Ward et al. (1995) show that environmental factors can be used to predict the operations strategy used by successful manufacturing firms. They find that high and low performing firms use different strategies in the same environment, supporting their hypothesis that high performers develop strategies that are more responsive to environmental demands.

Little work of this type has been done in the service sector. Many authors provide insight into the development of strategy in service organizations, but they do not address the links between environment and strategy or between strategy and operational decisions (Albrecht and Zemke, 1985; Heskett, 1986; McLaughlin et al., 1991; Roth and van der Velde, 1991).

2.1. Hospital urban and rural location

Location and proximity to markets are important factors for service organizations generally and hospitals in particular. Specifically, having an urban or rural location is an important environmental factor for hospitals. Hospitals in rural locations have struggled in recent years and their survival may depend on developing strategies that are appropriate for their location (Hudson, 1995; Henry, 1994). Hospital location is important because the largest segment of a hospital’s market share comes from an area of proximity to the hospital (Robinson and Luft, 1985). Rural hospitals sometimes have no competition in their immediate region, so it is not clear that rural location by itself is an inherent disadvantage. Although a majority of hospital closures in the past occurred in rural hospitals (Cleverly, 1991), rural hospitals have increasingly become targets for purchase by hospital chains because they are often inexpensive and have little competition in their immediate region, reducing certain types of risk to investors (Campbell, 1997).

The literature generally regards rural location as a disadvantage for hospitals but provides limited empirical evidence that this is true. The size of potential markets in rural areas may be an impediment because some hospitals are located near limited populations. It is also plausible that while market size may be adequate, lack of investment in medical technologies severely limits the services that are offered. This research investigates the dichotomy of urban and rural location in the context of strategy development and technology investments.

2.2. Hospital strategy

In this study, we investigate how hospital management uses strategy to respond to the environmental factor of urban or rural location. While hospital strategies have been studied extensively, as reported in the literature, few studies address the linkage between environmental issues, such as location, and strategic decisions. In one such study, Lamont et al. (1993) evaluate the performance effects of hospital strategies in response to the environmental change in the health care industry introduced by Medicare’s prospective payment system (PPS) in the mid-1980s. In contrast to the study reported here in which the environmental factor of hospital location is dichotomous (urban or rural), Lamont et al.’s environmental factor of the introduction of a PPS is the same for all of the studied hospitals. Their results indicate that hospitals with ‘proper’ fit between environment and strategy (the hypothesized ‘best’ strategy is Miles and Snow’s (1978) differentiator strategy) have the best performance. Both financial and operations performance measures, including occupancy rate, are used to assess fit. Lamont et al. (1993) also find that hospitals can improve their performance by changing their strategy to achieve better fit with the environment. These results are important because they show that hospitals can use their strategies to respond to environmental conditions. In the study reported here, we evaluate how hospitals use strategy to respond to their urban or rural location.

Nath and Sudharshan (1994) address location relative to other hospitals as part of a hospital’s business strategy rather than as an environmental factor. They use location relative to other hospitals as a proxy for convenience, as a source of competitive advantage, but do not consider the long-term nature of location decisions. In the study reported here, we consider location as an environmental variable that, once made, cannot be changed. Nath and Sudharshan identify five strate-
gic groups based on business strategies and marketing, finance, human resources, and operations factors. While there are no significant differences in the performance of the five strategy groups, hospitals with “coherent” strategies have better performance, as measured by occupancy rate, than hospitals with incoherent strategies. Coherent strategies are defined as those with the most appropriate combinations (as defined by the authors’ industry experience) of the factors defining the groups.

In determining how to measure and classify hospital strategies, it is important to note that hospitals often use multiple strategies simultaneously (Ashmos et al., 1996). This empirical finding suggests that hospitals’ behavior deviates from the adoption of a single set of consistent activities that focus on a single strategy, as advocated in the management literature (e.g., Porter, 1980; Miles and Snow, 1978). Based on findings by Ashmos et al. and others (e.g., Calem and Rizzo, 1995) on the use of multiple strategies, we seek to identify the most prevalent hospital strategies and how strongly hospitals pursue these strategies rather than to identify a single strategy for each study hospital.

The hospital strategy data used in the study reported here are gathered using items similar to those used by Goes and Meyer (1990) who base their items on Miles and Snow’s (1978) strategic types and Porter’s (1980) generic strategies. Goes and Meyer (1990) report a longitudinal study showing that changes in hospital strategy tend to be infrequent, especially among high performers. Hospitals with few strategy changes have better efficiency than those with many changes. Efficiency is operationalized using measures of occupancy rate, assets per patient day, and average length of stay, and occupancy rate shows the largest negative effect of frequent changes in strategy. There is little difference between the performance of hospitals with frequent and infrequent strategy changes in terms of profitability.

While the literature provides several other strategy classification schemes, the current trends of hospital closures, mergers, and contracts with other health care providers make it difficult to study the implementation and performance of various strategies. The continual changes in environment and technology in this industry result in the development of new variations of existing strategies.

2.3. Hospital technology

In this study, we identify management responses that urban and rural hospitals use to improve their performance in their given environment. One of these responses is investment in medical technologies. While it is unclear from the literature whether urban and rural hospitals have different reasons for investing in technology, it is clear that they use these investments to support their strategies. For example, Hartley (1996) reports that rural hospitals purchase computerized tomography (CT) equipment because they believe that access to this medical technology improves either their economies of scale or economies of scope. There are many reasons that hospitals acquire medical technologies, including maximization of profit, clinical excellence, and technological preeminence (Teplensky et al., 1995). Investing in technologies to increase clinical excellence means a hospital is focused on providing the medical services that require use of certain technologies. Technological preeminence means being the first to market with new technologies.

Morrisey (1994) finds that the best performing rural hospitals (based on eight financial, operational, and clinical performance measures) have capital asset investments 67% higher than the median investment for rural hospitals. Similar contrasts show the best performing small urban hospitals and major teaching hospitals have capital asset investments 66 and 53% higher than their groups’ medians, respectively. Morrisey does not evaluate whether higher investment in assets improves hospital performance or, conversely, hospitals which are better performers have more capital to invest. However, capital asset investment is associated with not only financial performance measures (e.g., profitability), but also clinical (e.g., mortality rates) and operational (e.g., expenses per discharge) performance measures. This seems to indicate that asset acquisition is not merely driven by financial success, but rather is associated with other types of performance that are important to hospitals.

Research on non-profit Catholic hospitals reports these hospitals are falling behind on equipment and technology investments (Prince, 1994a,b), and shows a significant correlation between investments in medical technology and net patient revenue. However, net patient revenue may not adequately measure performance in these non-profit organizations. Finding
an appropriate performance measure in this industry which includes for-profit and non-profit organizations is a challenge for researchers.

There is no evidence from the literature that for-profit and non-profit hospitals or urban and rural hospitals have different competitive reasons for acquiring medical technologies. In the study presented here, we measure the number of medical technologies used by each of the study hospitals. Decisions to invest in medical technologies are presumed to support these hospitals’ strategies.

2.4 Hospital performance

Hospital performance can be difficult to assess because for-profit, non-profit, and government-owned organizations compete in this industry. Finding performance measures appropriate for all of these types of organizations is challenging. Occupancy rate is an industry-specific measure that has been used frequently in health care research as a indicator of performance (e.g. Nath and Sudharshan, 1994; Goes and Meyer, 1990; Ketchen et al., 1993). Occupancy rate is the average utilization rate of hospital beds, and previous research shows this measure is a significant indicator of hospital viability. Burda (1989) reports hospitals that close have an average occupancy rate of 27% versus 47% for hospitals that remain open. Lynch and Ozcan (1994) also find occupancy rate to be a significant predictor of hospital closure. Additionally, Nath and Sudharshan (1994) show that having a coherent strategy is correlated with higher occupancy, and Goes and Meyer (1990) show higher occupancy rates are associated with consistent strategies. For these reasons, we adopt occupancy rate as the primary performance measure for this study. We validate our findings using an additional operational measure, efficiency (ratio of total expenses, adjusted for medical case mix and local wages, to total number of discharges, adjusted for numbers of inpatients and outpatients), and a financial measure, leverage (ratio of long-term debt to assets).

Other hospital performance measures that have been used in the literature include clinical measures such as adjusted length of patient stay in the hospital and adjusted mortality rate (Greene, 1996; Jaklevic, 1996; Shortell et al., 1995; Morrissey, 1994; DesHarnais et al., 1991), and financial measures such as operating costs and operating margin (Shortell et al., 1995; Gaynor, 1995; Morrissey, 1994; Harkey and Vraciu, 1992).

In short, the literature identifies strategic groups in the hospital industry and begins to link strategies to decision-making and performance. More empirical evidence is needed to determine the environmental or organizational factors that prompt these strategies. In addition, the role of technology investments in strategic decision-making needs to be evaluated. Finally, assessment of strategies should be tied to hospital performance.

2.5 Hypotheses

We test the performance effects in hospitals of urban and rural location, strategy, and technology decisions. Performance is evaluated based on occupancy rate. Because the literature suggests a hospital’s location (urban or rural) is an important environmental factor, its influence on performance is evaluated first. Practitioner-based literature has supported the notion that rural hospitals are at a disadvantage to urban hospitals (Henry, 1994; Hudson, 1995). We treat location as an environmental variable that cannot be changed, but that can be reacted to through choice of strategy and technology investments. The first hypothesis addresses this issue.

Hypothesis 1. Urban location is positively associated with hospital performance.

Strategies are frequently used to counteract the effects of environmental conditions such as those associated with location. For example, Swamidass and Newell (1987) show how a strategy aimed at increasing production flexibility can dampen the effects of environmental uncertainty. Similarly, Ward et al. (1995) report that strategies adopted by successful Singapore manufacturers focus on the competitive priorities that respond to the environmental condition of rapid growth. The main effect of strategy and the extent to which strategy can be used to moderate environmental effects, in this case urban or rural location, are addressed in the second and third hypotheses.

Hypothesis 2. Hospital strategy has incremental association with performance after accounting for the effect of urban or rural location.
Hypothesis 3. The association of urban or rural location with performance is moderated by hospital strategy.

We test the research hypotheses by estimating the model shown in Fig. 1 as a hierarchical model, testing the statistical significance of the partial effect of each component shown in the model. We conservatively test the significance of partial effects of each component as it is added to the model so that only its incremental explanatory power (after accounting for the previous components in the model) is measured.

Technology investments result from a set of operational decisions that organizations make to support their strategies, i.e. organizations try to adopt technologies that will improve their performance and capitalize on their competitive strengths. The interest a hospital has in particular technology investments is in response to both environmental conditions and the strategy that the hospital has chosen to pursue.

It seems intuitive that the number of medical technologies a hospital uses would be highly correlated with its size, but there is evidence that technology investments are associated with other factors (Kimberly and Evanisko, 1981). Higher than average investment in technology is often associated with good performance in the hospital industry and therefore, hospitals that invest more heavily in technology than other hospitals with similar location and size may see improved performance (Prince, 1994a,b; Morrissey, 1994). The fourth hypothesis addresses the partial effect of technology (after accounting for location and strategy).

Hypothesis 4. Hospitals’ technology investments are incrementally associated with performance, after accounting for the effects of urban or rural location and strategy.

These hypotheses are tested using hierarchical regression analysis which is useful for determining the incremental contribution of each variable that is evaluated, as well as their interactions (Hayes, 1994). This methodology is used because we build a model that includes environmental (urban or rural location) and decision (strategy and technology investments) variables. Urban or rural location cannot be changed once hospitals are established, but it is important to account for this variable because previous research indicates that it may influence performance, and it is likely to be associated with the decision variables of strategy and technology investments. Hierarchical regression analysis allows us to determine whether the partial effects of strategy and/or technology investments as decision variables influence performance once the effect of urban and rural location has been accounted for.

3. Sample and operational definitions

Data on strategy decisions and technology investments are obtained from a questionnaire that was mailed to 160 general acute care Michigan hospitals. This study focuses on the strategies used by general acute care hospitals, so specialty hospitals (i.e. psychiatric, rehabilitation, children’s and veterans’ hospitals) are excluded from analysis. There are several advantages of using a single geographic region for this study. Solovy (1995) reports that hospital strategies vary by region in the US. Therefore, focusing on one region may be most appropriate when determining the strategies that hospitals choose to be competitive in the marketplace. In addition, hospitals generally compete for a local market. By studying a single region, the questionnaire captures the strategies used among a group of competing hospitals. Because this study investigates urban and rural hospitals, it is critical to have adequate representation of both, which the sample used here has. The limitations of using a single state for this study include the possibility of excluding strategies used in other regions (Solovy, 1995) and restricting sample size.

Questionnaires were mailed to two individuals at each hospital, mainly CEOs and Vice Presidents of Operations. Sixty-seven hospitals returned at least one survey, for a response rate of 41.9%, while 30 hospitals returned two completed questionnaires. The first response from each hospital is used in analysis, and the second responses are used to test the reliability of survey responses. Results of second rater tests are reported in Section 3.1.2. No significant difference is found between the data obtained from primary and secondary respondents, indicating the answers to the perceptual questions used in this questionnaire are reliable. Two hospitals for which published performance data are not available were removed from analysis, and
the final sample size used in this analysis is 65 hospitals.

Non-respondent bias is assessed by comparing hospitals that completed at least one questionnaire with hospitals that did not respond. Non-respondent bias based on number of hospital beds, an indicator of hospital size, is marginally significant. This bias is measured by splitting hospitals into two groups (fewer than 150 beds and greater than 150 beds) and performing a $\chi^2$-test ($\chi^2 = 3.26$, d.f. = 1, $P = 0.07$). Responding hospitals are somewhat larger on average than non-respondents. Bias based on hospital ownership (i.e. non-profit or government-owned; there are no for-profit hospitals among the respondents) is not significant ($\chi^2 = 0.72$, d.f. = 1, $P = 0.40$). Government-owned hospitals are non-profit hospitals, but a distinction is often made between them because they may attract different customer types.

Finally, bias is assessed based on occupancy rate, the performance measure used in this study. A Student’s $t$-test comparing this performance measure for respondents and non-respondents is not significant ($t = 0.80, P = 0.42$). These analyses of non-respondent bias show that, while larger hospitals responded at a rate that is higher than expected, the respondents are not different from non-respondents in terms of ownership or performance.

Following is a description of the methods used to gather data to evaluate the relationships shown in Fig. 1. Second source data are obtained for environment and performance variables, while survey data are used for measures of strategy and technology.

3.1. Operational definitions

3.1.1. Urban/rural status

Each hospital included in this study is defined as having either an urban or rural location, as designated by HCIA (1995). HCIA defines each hospital as urban or rural based on US Bureau of Census’ designation of urban and rural communities. This study includes 43 urban hospitals and 22 rural hospitals.

There are several significant differences in the populations of the urban and rural hospitals studied here. The data used to define these differences are obtained from census data, based on the zip codes of the hospitals in this study (CACP, 1991). The communities of responding rural hospitals have a significantly higher percentage of individuals over 65 years old (the age at which Medicare coverage begins) than the communities of urban hospitals. In addition, the median and per capita incomes of these rural locations are significantly lower than the urban locations on average. However, the percentage of Medicare and Medicaid patients treated in the urban and rural hospitals in this study are not significantly different (HCIA, 1995). These statistics may indicate that patients go outside their local community for medical care, that Medicare and Medicaid patients seek fewer medical services when they reside in rural communities, or that these groups’ access to medical care is somehow limited.

3.1.2. Strategy

Hospital strategy data are obtained from the questionnaire already described and include items similar to those used by Goes and Meyer (1990). Respondents were asked to rate the importance of each item in meeting their hospitals’ strategy on a seven-point Likert-type scale. Strategy items are factor analyzed (using unweighted least squares) to determine factor loadings of the items. An oblique rotation is used allowing the factors to be correlated because this rotation more accurately represents the complexity of constructs in the real world (Ford et al., 1986; Harman, 1976).

The strategy items and their correlation matrix are shown in Table 1. The first factor includes six items related to marketing and market-driven strategy, and is termed the marketing strategy factor. The items associated with this factor have loadings ranging from 0.399 to 0.833, as reported in Table 2. The second factor includes five items related to service quality and dependability, and is referred to as the operations strategy factor. The item loadings on this factor range from 0.485 to 0.794, as reported in Table 2. No variables loaded higher on a subsequent factor than on the first two factors so only the first two factors, which account for 53% of the variance in the strategy items, are used in this analysis. These two factors are correlated ($R = 0.47, P < 0.01$), indicating many hospitals pursue both strategies simultaneously. Hospitals often use more than one strategy at the same time (Ashmos et al., 1996).

Principal component analysis is used to reduce the item scores associated with each factor to single scores...
Table 1
Pearson's correlations for strategy factor items

<table>
<thead>
<tr>
<th>营销策略因素</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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<tbody>
<tr>
<td>声誉在行业中</td>
<td>1.00</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>创新</td>
<td>0.58** 0.58** 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>医院名称识别</td>
<td>0.42** 0.27* 0.42** 0.43** 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>广告</td>
<td>0.32** 0.106 0.376 0.446 0.404 0.500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>市场预测</td>
<td>0.332 0.106 0.376 0.448 0.448 0.484 1.00</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>抢占市场份额</td>
<td>0.457 0.288 0.142 0.377 0.125 0.431 0.360 0.443 0.388 0.443 0.388 1.00</td>
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</tr>
</tbody>
</table>

* P < 0.05.  
** P < 0.01.

second responses for the mailed questionnaire are used to assess inter-rater reliability of the strategy items using Shortell and Zajac's method (1990), as recommended by Boyer and Verma (2000). There is agreement within one point (on the seven-point scale) in 69% of cases for the marketing strategy items (average for six items) and 78% for the operations strategy items (average for five items). Cronbach's coefficient alpha is also used as a measure of scale reliability. Alpha coefficients are 0.81 for the marketing strategy items and 0.73 for the operations strategy items. These alpha levels are acceptable for this type of empirical research (Flynn et al., 1990; Nunnally, 1978).

Table 2
Factor analysis output for strategy items

<table>
<thead>
<tr>
<th>Item</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor 1a</td>
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<td>营销策略因素</td>
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<td>声誉在行业中</td>
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<td>创新</td>
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<td>医院名称识别</td>
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<tr>
<td>广告</td>
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<td>市场预测</td>
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</tr>
<tr>
<td>抢占市场份额</td>
<td>0.634</td>
</tr>
<tr>
<td>操作策略因素</td>
<td></td>
</tr>
<tr>
<td>高级客服</td>
<td>0.226</td>
</tr>
<tr>
<td>服务</td>
<td>0.040</td>
</tr>
<tr>
<td>经验/培训人员</td>
<td>0.167</td>
</tr>
<tr>
<td>服务</td>
<td>0.147</td>
</tr>
<tr>
<td>可提供专业医疗服务</td>
<td>0.060</td>
</tr>
</tbody>
</table>

* Marketing strategy factor.  
** Operations strategy factor.
score is calculated as the total number of the queried technologies currently used.

3.1.4. Performance

Consistent with other studies, occupancy rate is the primary performance measure used in this study. Data on average daily census and number of staffed beds are reported annually by the AHA (1995). Occupancy rate is calculated from these data (average daily census/number of staffed beds).

Two additional measures of performance—financial leverage and efficiency—are also evaluated to validate the results obtained when using occupancy rate as the performance measure. Each hospital’s rank (relative to all Michigan hospitals) on these two measures is obtained from HCIA (1995).

4. Findings

We use hierarchical regression analysis to determine the significance of the incremental contribution of each of the variables shown in Fig. 1, thus testing the hypotheses. While the final hierarchical regression model provides the same explanatory power as simultaneous regression, hierarchical analysis allows the contribution of each component of the model to be evaluated. Findings are summarized in Table 3.

Support for Hypothesis 1: The first step in the hierarchical regression analysis performed here is to test the urban/rural location dichotomy for significance. The regression equation used to test the first hypothesis is

\[ y_i = a + b_1 x_1 + e_i \]  

(1)

where \( y_i \) is the performance variable for hospital \( i \), \( a \) the constant, \( b_1 \) the weighted value of \( x_1 \) variable, \( x_1 \) the urban/rural location variable, \( x_1 = 0 \) for urban hospital, \( x_1 = 1 \) for rural hospital, \( e_i \) is the error-term. Urban/rural location is a significant predictor of performance as measured by occupancy rate. The resulting \( R^2 \) for Eq. (1) is 0.21 (\( F = 16.58, P < 0.01 \)), meaning that 21% of the variation in occupancy rate among hospitals in Michigan is accounted for by urban or rural location. This result is shown in Table 3. The average occupancy rate is 62% in urban hospitals and 44% in rural hospitals in this sample. This result supports the first hypothesis that urban or rural location has a significant effect on hospital performance.

Hypothesis 2 not supported: To assess the impact of strategy on occupancy, the marketing and operations strategy factors are added to the hierarchical regression equation containing the location variable. There is evidence from the literature that hospitals pursue multiple strategies simultaneously, so scores for both strategy factors are used in the regression equation for each of the studied hospitals. The purpose of this step is to determine whether the strategy factors make an incremental contribution toward explaining variance in hospital performance. Some of the variables in Eq. (2) are defined in Eq. (1):

\[ y_i = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + e_i \]  

(2)

where \( b_i \) is the weighted value of \( x_i \) variable, \( x_2 \) the marketing strategy, \( x_3 \) is the operations strategy.

The hypothesis is tested by evaluating the significance of the F-change (\( \Delta F \)) statistic. \( \Delta F \) measures the significance of the change in \( R^2 \) at this step in the hierarchical regression analysis. There is a minimal change in \( R^2 \) when the strategy variables are added to
the regression equation, and the $\Delta F$ is not significant as shown in Table 3. These data show that the extent to which hospitals focus on each of the measured strategies (marketing and operations) does not significantly explain the performance of the study hospitals when the effect of location is already accounted for. This result provides evidence that there is no ‘best’ strategy for hospitals to pursue because neither of the strategy factors contributes significantly to explaining hospital performance.

Support for Hypothesis 3: The third hypothesis is tested by adding the interactions between location and the strategy variables to the hierarchical model. The regression equation used to address the third hypothesis:

$$y_i = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_1x_2$$

where $b_i$ is the weighted value of $x_i$ variable, $x_1x_2$ the interaction between urban/rural location and marketing strategy, $x_1x_3$ is the interaction between urban/rural location and operations strategy.

The $x_1x_2$ and $x_1x_3$ terms account for the interactions between the urban/rural location variable and the two strategy variables. The total $R^2$ following this step in the hierarchical model development is 0.35 and the change in $R^2$ is significant at 0.13 ($\Delta F = 5.95, P < 0.05$).

These data support the third hypothesis that the effect of urban or rural hospital location can be moderated by focusing on particular strategies. Strategy is cast in the role of a “pure moderator” (Sharma et al., 1981) because there is no significant main effect of strategy on performance while there is a significant strategy–location interaction effect and a significant urban/rural location effect. In practical terms, this means that strategy can alter the significant influence of location on performance. Specifically, the negative coefficient of the marketing strategy–location interaction suggests that a marketing-oriented strategy is ineffective for rural hospitals.

Support for Hypothesis 4: The fourth hypothesis is tested by adding the technology variable to the regression equation containing location, strategies, and their interaction. Technology investments can be thought of as a set of decisions used to support the strategy or strategies that a hospital has chosen to pursue. For this sample of hospitals, adding the technology variable to the hierarchical regression equation variable to the regression equation results in $R^2 = 0.40$. The change in $R^2$ from the previous equation is significant ($\Delta F = 5.11, P < 0.10$).

The hierarchical regression statistics for this model are given in Table 3. We also tested all remaining two- and three-way interactions among the independent variables and none is significant. The resulting regression equation is

$$y_i = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_1x_2$$

$$+ b_5x_1x_3 + b_6x_4 + e_i$$

where $b_i$ is the weighted value of $x_i$ variable, $x_4$ is the technology variable.

To demonstrate that the model applies when other measures of hospital performance are used, the regression model containing the same independent variables is evaluated using hospital efficiency and financial leverage as performance measures. Using efficiency as the performance measure results in a model with $R^2 = 0.31$. Using leverage as the performance measure results in a model with $R^2 = 0.22$. Both of these models are statistically significant, generally with significant coefficients for the same regressors. Although none of the performance measures used is a perfect indicator of hospital performance, the analysis demonstrates that the findings are robust across a number of performance measures.

5. Discussion and conclusions

This study investigates the impact of urban/rural location, strategy, and technology investments on hospital performance. The findings indicate a disadvantage for hospitals in rural locations. Not surprisingly, the cost of supplying certain types of services to rural areas sometimes exceeds the financial benefits, particularly for capital-intensive services such as those provided by hospitals. In the telecommunications industry, income from urban areas has been used to support the provision of services in rural areas (Cobb, 1999; Bromby, 1998). Independent rural hospitals may find that consolidations among themselves or with urban organizations provide the redistribution of capital that they require for operation.
More important than the location issue alone, this study suggests that strategy moderates the inherent disadvantage of rural location. The identification of an interaction between hospital location and strategy provides evidence that hospitals can moderate location effects on performance through their choice of strategy. This study shows that using a marketing-oriented strategy in a rural location is not effective. Either an operations-oriented strategy, focused on building capabilities, or a combination of the two strategies results in better performance. However, it appears that the marketing strategy is effective for urban hospitals.

Investments in technology have an incremental effect on performance even after accounting for the effects of location and strategy. Hospitals with the most technologies tend to be better performers, supporting Morrisey’s (1994) findings that small hospitals with higher than average technology investments prosper while those with the least technologies sometimes struggle to survive.

Hospital size may be associated to some of the variables studied here as previous research indicates size may be a useful predictor of hospital closure and the extent of technology investment. However, the literature is inconclusive on the relationship between hospital size and performance. While some authors find small hospitals are unstable and more likely to close (Lynch and Ozcan, 1994; Snow, 1996; Longo et al., 1996), others argue that at-risk small hospitals have already closed and future downsizing will occur in larger hospitals in an effort to squeeze excess capacity out of the system (Cleverly, 1991; Rogers, 1996; Health Care Strategic Management, 1997). Additionally, Kimberly and Evanisko (1981) provide evidence that size is a confounding variable because it is a significant predictor of heavy technology investment, but that other factors are also important.

Table 4

<table>
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<th>IVs</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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</tr>
<tr>
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<td>0.47***</td>
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<tr>
<td>Number of technologies</td>
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<td>−0.21*</td>
<td>−0.06</td>
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<td>1.00</td>
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<td>DV</td>
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<td></td>
<td>Occupancy rate</td>
<td>0.70***</td>
<td>−0.46***</td>
<td>0.04</td>
</tr>
</tbody>
</table>

* P < 0.10.
** P < 0.05.
*** P < 0.01.
place indicate that managers in the hospital industry understand the advantage of size (Japsen, 1996). Small hospitals can also share mobile technologies (Hartley, 1996) and participate in outreach programs in which specialists bring previously unavailable services to their facilities. Regardless, this analysis suggests that strategy can be used to moderate the inherent disadvantage of rural location regardless of size.

While our study is limited to Michigan hospitals, the findings present clear implications for hospital managers. Hospital size, perhaps a surrogate measure for location and technology investment, is positively related to performance and consolidations among hospitals and other health care organizations will likely continue unabated for this reason. The hospital industry in states or regions with larger rural areas may result in different configurations than those in more urban areas as these hospitals find differing advantages from size and the strategies that they pursue. Regardless of size, strategies can be developed that complement a hospital’s urban or rural location. Specifically, a marketing strategy may be effective for urban hospital and pursuing an operations-oriented strategy in which specialists bring previously unavailable services to their facilities. Regardless, this analysis appears to generally pay off for rural hospitals.

References


