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BROADENING FOCUS: COMPLEMENTARITIES AND THE BENEFITS OF SPECIALIZATION IN THE HOSPITAL INDUSTRY

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ABSTRACT

Arguments in favor of organizational focus seemingly conflict with those supporting a broader scope of the firm. The literature on related diversification balances these two perspectives, suggesting multi-unit firms with a portfolio of related businesses outperform both single-unit firms and multi-unit firms composed of unrelated businesses. Explanations for this relationship between the degree of diversification and firm performance have centered on economies of scope achieved by sharing common resources, such as advertising or production capacity. We consider another potential explanation for the benefits of related diversification: complementarities, or the extent to which the marginal returns to the intensity of a focal activity are increasing in the intensity of related activities. Using patient-level data from the hospital industry, we consider the existence of complementarities with respect to focused organizational experience. Specifically, we investigate the extent to which there are returns to focused experience in cardiovascular care and the degree to which these returns depend on a hospital's intensity of services related to cardiovascular care. We find suggestive evidence of positive returns, on average, to focused experience in cardiovascular care. Moreover, we find that these returns to focused experience are contingent on the intensity with which hospitals provide clinical services that are closely related to cardiovascular care.

A key tension facing many firms concerns the optimal scope of their operations. Yet the literature on this topic presents conflicting views. The argument that narrowing an organization's set of activities improves its operational efficiency and effectiveness has endured for decades (Skinner, 1974).[1] Nevertheless, others have noted that a broader range of activities may increase firm value or improve performance (Teece, 1980; Panzar and Willig, 1981; Teece *et al*., 1994). Further, some scholars have noted that seemingly unfocused operations may outperform their focused counterparts (Ketokivi and Jokinen, 2006). In an effort to reconcile these conflicting views, we examine empirically the question of whether operational focus does, in fact, improve performance. Further, we ask whether—if such benefits exist—they are dependent on the full portfolio of activities in which an organization (or organizational unit) engages.

Part of the answer may be found in the literature on related diversification at the level of the firm. This work suggests that expanding scope into *related* businesses improves firm value, whereas becoming too unfocused by engaging in *unrelated* businesses can reduce value (Rumelt, 1974). Much of this literature ties the benefits of related diversification to economies of scope achieved by sharing common resources across the activities of the firm. Examples of such resources include fixed or semi-fixed investments such as advertising, research and development, or administrative infrastructure. In line with other scholars (Markides and Williamson, 1994), we suspect that there is a more nuanced explanation of this relationship.

Activities can be related for reasons beyond sharing a common resource; reasons that we believe may have important implications for the benefits of focus at a more transactional level, such as the activities in a plant or other operational unit. For example, the activities of two distinct product lines or services may interact in important ways, generating interdependencies between them. Theory suggests that organizing interdependent activities together can have powerful consequences. Milgrom and Roberts (1990, 1994, and 1995) capture this notion in their theory of complementarities. They define two

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[1] At the level of the individual worker, the benefits of operational focus were highlighted much earlier in Smith's (1776) example of pin manufacturing.

activities as complementary if the returns to "doing more" of one are increasing in the level or intensity of the other. The intuition is that conducting two complementary activities is beneficial not simply due to the ability to share fixed investments across them but rather because each activity affects the net marginal benefit of the other.

Perhaps the simplest approach to reconciling the claimed benefits of operational focus with those of related diversification considers the level of analysis at which each concept has been examined. Specifically, the former is described as a characteristic of a plant (or an operating unit[2] of the firm) while the latter is analyzed at the level of the firm as a whole. It is thus possible that one could imagine a firm that is quite diversified at the firm level, taking advantage of economies of scope, but highly focused at the business unit or plant level.

In this paper, however, we engage in a more stringent effort to reconcile these two concepts at a single level of analysis. That is, we consider whether there are benefits—driven by interdependencies—to engaging in related activities *at the level of an operating unit*. To do so, we draw on the theory of complementarities to examine empirically whether the benefits of focused experience, if any, depend on a unit's level of involvement in related activities. Our purpose is not simply to ask whether an operating unit that has significant focused experience in a given activity performs better with respect to that activity (e.g., Siggelkow, 2003; Cram, Rosenthal, and Vaughn-Sarrazin, 2005; Young, Foster, and Heller, 2005; Greenwald et al., 2006; Huckman and Zinner, 2007), but to examine whether the composition of that unit's *other* activities (i.e., outside of the focal area) impacts performance in the focal area.[3] This latter line of inquiry allows us to examine whether the benefits of focusing on a particular activity depend on the intensity of an organization's involvement in *related* activities. Moreover, it allows us to test the degree to which relatedness may serve as a potential explanation for why one might observe decreasing returns to focus.

[2] We define an operating unit as a division of a firm that supplies a specified product or group of products. This definition applies equally to organizations that manufacture physical products and those that provide services.
[3] We emphasize that we view an operating unit's level of focus as a continuous, rather than discrete, characteristic. As such, one might view a unit that is 40% dedicated to a particular activity—with no other activity accounting for more than, say, 5% of the unit's effort—as being relatively focused on that first activity.

We consider these issues in the context of the hospital industry in the United States, with a specific emphasis on the treatment of cardiovascular disease. We recognize that a hospital could be characterized as either an operating unit or a firm. Nevertheless, as typically circumscribed facilities, we view most hospitals as operational units, perhaps most akin to plants in the manufacturing context. We have chosen the hospital setting for several reasons. First, hospitals tend to provide services across a range of clinical areas (e.g., cardiovascular, cancer, orthopedics, and obstetrics) that appear in different proportions and combinations across different facilities. For example, some hospitals may devote a greater share of resources to treating cardiovascular patients with a comparatively small obstetrics program. Conversely, another hospital may be characterized by a focus in obstetrics with relatively little cardiovascular care.

Second, hospital discharge data includes information on every patient in a particular hospital. This characteristic of the data allows us to observe the degree to which a given hospital focuses on a clinical area (e.g., cardiovascular services) as a continuous variable based on the percentage of its total operational activity dedicated to patients in that area. This continuity is particularly useful if one aims to test for the presence of complementarities based on the degree to which the marginal return to organizational focus in one activity increases as the intensity of activity in related areas increases.

Finally, complementarities and operational focus are issues that have particular relevance in the health care industry. Industry scholars have noted the value of organizing health care delivery around "medical conditions and care cycles" (Porter and Tiesberg, 2006, 2007). This perspective explicitly calls for a focus on patient needs and the consideration of complementary capabilities. Additionally, the rise of single-specialty hospitals—a large portion of which focus on cardiovascular care—has led to a significant debate over the value of such facilities. This debate centers on whether such facilities outperform traditional "general" hospitals (Herzlinger, 1997, 2000; Dwyer, 2000; Ginsburg, 2000). Perhaps consistent with the spirited nature of this debate, however, the empirical studies on this topic offer mixed findings (Cram, Rosenthal, and Vaughn-Sarrazin, 2005; Young, Foster, and Heller, 2005; Greenwald et al., 2006; Barro, Huckman and Kessler, 2006).

Literature Review and Hypotheses

The idea that specialization improves performance by introducing simplicity and repetition into the individual worker's routine dates back to Adam Smith's (1776) example of the pin factory. Later theory likewise gives special consideration to the performance benefits of specialized work. In laying out his fourteen principles of management, Fayol (1916) proposes that "specialization belongs to the natural order", arguing for specialization as a fundamental scientific principle. Specialization is likewise implicit in Taylor's (1911) description of scientific management and the importance of matching workers to specific tasks. He maintains that organizing work in this manner allows for improved productivity and innovation.

These early arguments, though containing implications for operating units or entire organizations, largely center on the performance of the individual worker. March and Simon note that the problems of individual specialization and specialization of "organizational units" may not "have the same answers" (March and Simon, 1958). Nevertheless, subsequent thinking about focus at the level of the operating unit is consistent with earlier work on specialized labor. Skinner (1974), in particular, offered a well-known argument in favor of operational focus as a competitive weapon in his conception of the "focused factory". Translating Smith's observations from the individual level to that of the plant, Skinner notes of the focused factory: "repetition and concentration in one area allow its work force and managers to become effective and experienced in the task required for success (Skinner, 1974, p. 115)."

Several studies provide empirical support for Skinner's argument. Studies of manufacturing plants find that the number of products (Hayes and Wheelwright, 1984), the share of business attributed to a plant's largest product line (Brush and Karnani, 1996), and the degree of "manufacturing characteristics focus" (e.g., consistent processes across products) or "market requirements focus" (e.g., a limited set of customer demands) (Bozarth and Edwards, 1997) each bears on performance, with more focused operations outperforming others. Studies in health care similarly support the benefits of focus. Huckman and Zinner (2008) note that clinical trial sites focused exclusively on clinical trials perform better than sites that split their resources between clinical trials and traditional patient care, while Greenwald *et al*. (2006) found that hospitals devoting more than 45 percent of their business to treating heart patients achieve lower patient mortality rates.

Nevertheless conflicting evidence has been reported. In manufacturing, scholars observe that many plants remain unfocused while performing at a high level (Ketokivi and Jokinen, 2006); an observation that is reflected in empirical results. Studying the printed circuit board industry Suarez *et al*. (1996) find no demonstrable effect of product line breadth on manufacturing cost and product quality. Similar results have been reported at the operating-unit level in manufacturing firms. Kekre and Srinivasan (1990) find that product line breadth has a positive effect on market share, without an accompanying effect on production costs. In the financial services industry, Siggelkow (2003) finds that cash inflows to mutual funds are positively related to product line breadth. Nevertheless, he also finds that individual mutual funds managed by more focused organizations outperform similar funds managed by firms with a broader product portfolio. Finally, two studies in the hospital industry find that after controlling for procedure volume, hospitals that devote a majority of their business to cardiovascular patients perform no better in terms of patient outcomes on cardiovascular procedures (Young, Foster, and Heller, 2005; Cram, Rosenthal, and Vaughn-Sarrazin, 2005).

To the extent that these mixed results are not simply due to differences across industries, they reflect the possibility that the returns to focus may be dependent on other factors and as a result non-linear in the absolute level of focus. For example, at low levels of focus, the returns to additional focus may be quite high while, at higher levels, those returns may be smaller or even negative. Before investigating this possibility and the factors driving it, we first aim to establish the direction of the *average* relationship between focus and performance. We note that the empirical literature examining plants and operating units has only rarely suggested *negative* returns to focus. We thus offer the following baseline hypothesis:

HYPOTHESIS 1: An operating unit's level of focused experience in a particular business segment (i.e., the share of its prior activity generated by that segment) is positively related to its current operational performance in that segment.

As noted earlier, several studies of performance at the firm level have argued that increased scope, or diversification, may represent an efficient approach to organization (Teece, 1980; Panzar and Willig, 1981). The idea apparently resonates broadly in practice given that diverse, multi-product firms seem to be the rule rather than the exception (Montgomery, 1994). Nevertheless, like the previously noted literature on focus at the plant or operating-unit level, this firm-level literature offers mixed evidence. Some have documented benefits of focus in the form of a diversification discount (Rhoades, 1974; Lang and Stulz, 1994; Berger and Ofek, 1995; Servaes, 1996), while others report no discount (Campa and Kedia, 2002) or even a premium (Villalonga, 2004).

The strategy literature on *related* diversification at the firm level provides further insight into these conflicting results. This perspective strikes a balance between claims about the benefits of focus on one hand, and a diversification premium on the other. The argument begins with the contention that not all diversification decisions (i.e., those that reduce focus) are necessarily equivalent. Rumelt (1974) observes that diversification by U.S. firms during the middle of the 20th century was characterized by variation in how firms established “different patterns of relationships…among different lines of business.” In the same study, Rumelt (1974) finds the highest levels of profitability among firms that diversify into areas that draw on some “common core skill or resource”. Subsequent work has replicated these findings (Christensen and Montgomery, 1981; Rumelt, 1982). Using an alternate definition of related diversification, Palepu (1985) finds that more focused firms do not outperform diversified firms on average and that highly related diversifiers outperform highly unrelated diversifiers, particularly in terms of profitability growth. It is compelling to note that similar findings have been reported in the organizational learning literature, where scholars have shown that individuals engaged in related tasks learn at a faster rate than those focused on a single task (Schilling et al, 2003).Overall, these results suggest that some level of related diversification is beneficial, but that evolving into an unfocused enterprise by diversifying into unrelated businesses can destroy value.

Explanations for this non-linear, “inverted U-shaped” relationship between diversification and firm performance largely center on economies of scope achieved through the sharing of resources. These arguments can be tied to Coase (1937), who proposed that multiple activities should be conducted within the firm only if the cost of doing so is exceeded by the cost of conducting those activities separately, and to Penrose (1959), who argued for the firm as a pool of resources, the maximum utilization of which may allow for growth into diverse businesses. Further, Panzar and Willig (1981) have argued for the "equivalence between economies of scope and the existence of sharable inputs." Where resources or strategic capabilities are common across businesses, be they tangible (e.g., manufacturing facilities) or intangible (e.g., brands), firms can experience economies of scope (Davis and Thomas, 1993; Tanriverdi and Venkatraman, 2005). Teece (1980) has argued more specifically that when such common, sharable resources are indivisible, diversification represents an "efficient way of organizing economic activity".

The explicit or implicit assumption in this view is that the returns to related diversification are effectively economies of scale with respect to the use of shared resources. The activities of seemingly diverse businesses, however, can be related in ways beyond simply spreading the cost of shared resources across a broader scope of activity. For example, activities—and the output of activities, such as knowledge—may interact in significant ways, thereby creating interdependencies between them. The theory of complementarities suggests how these interdependencies might generate value. The theory states that activities are complementary "if doing more of any subset of them increases the returns to doing more of any subset of the remaining activities" (Milgrom and Roberts, 1994). Other scholars have made similar observations about possible synergies between a firm's diverse activities. Markides and Williamson (1994), for example, suggest that in addition to possible economies of scope, core competencies developed in one business unit may in fact be used to improve the *quality* of performance in another. Henderson and Cockburn (1996) similarly argue in favor of knowledge spillovers, which they differentiate from economies of scope. They argue that knowledge spillovers are characterized by the interaction of knowledge developed in one area with the conduct of business in another area, and an accompanying positive effect on output.

Theoretically, it is plausible that these complementarities could exist as easily across activities within a single operating unit as across operating units within a firm. We, therefore, consider whether the benefits of focus at the level of an operating unit depend on the composition of that unit's *other* (i.e., non-focal) activities. Specifically, we aim to examine whether the benefit of a given level of focus depends upon how an operating unit's non-focal activities are distributed between tasks with different levels of relatedness to the focal area. If they exist, such complementarities may provide part of the explanation for why one might observe decreasing benefits to specialization within an operating unit.

In this light, we expect that to the extent non-focal activities are allocated to more- rather than less-related activities (those with a high potential for spillovers or interaction) the returns to focused experience in the business line of interest (i.e., the focal business line) will be greater. Consistent with theory and our own expectations, we propose the following hypothesis:

Hypothesis 2: The returns to focused experience in a particular business segment are positively related to the share of an operating unit's activity that is allocated to related business segments (i.e., those with high potential for spillovers to the focal business segment).

Setting and Data

Our analysis focuses on patients receiving coronary artery bypass graft (CABG) surgery. CABG treats blockages of the coronary arteries and is an open-heart surgical procedure in which the patient is placed on a heart-lung machine while the heart is stopped. Access to the heart is gained through an incision in the chest, while a blood vessel is taken from another part of the body and used to bypass the flow of blood around the blockage in the coronary vessel. Following surgery, patients typically spend one or two days in the intensive care unit and five or six days in total receiving post-operative care in the hospital.[4]

We examine this empirical setting for several reasons. First, patients with a primary diagnosis of cardiovascular disease are numerous and tend to have a significant number of "secondary" diagnoses in non-cardiovascular areas. This tendency enables us to readily identify related clinical areas from which complementarities and knowledge spillovers may be most influential given the aggregate needs of cardiovascular patients. Second, one of the more reliably tracked outcome measures in hospital discharge

[4] This length of stay estimate is based on data from the Pennsylvania Health Care Cost Containment Council (PHC4).

data is in-hospital mortality—an outcome that occurs relatively frequently in patients receiving CABG surgery relative to other clinical areas.[5]

Our empirical analysis draws on hospital discharge data from the Nationwide Inpatient Sample (NIS).[6] The NIS contains patient-level data on hospital stays for approximately 1,000 hospitals annually. These hospitals are sampled from state-level hospital discharge databases and approximate a 20 percent stratified random sample of acute-care hospitals in the United States. Data in the NIS are reported at the level of the patient, and *all* patients admitted to a sampled hospital are included for the year in question. These data include details about the hospital, primary and secondary procedures performed, individual patient demographics, the status of the patient upon discharge from the hospital, and the patient's primary and secondary diagnoses. We estimate both hospital- and patient-level models based on individuals who underwent CABG surgery.

To develop our sample, we begin with the NIS for the years 1995 through 2004. During this time period there were a total of 661,910 discharges at 774 hospitals in the NIS data with a primary procedure of CABG surgery. We exclude 996 observations that contain insufficient data. Additionally, to control for factors that influence in-hospital mortality and to ensure greater homogeneity and comparability across patients, we limit our sample to those patients who had one of several primary diagnoses consistent with a primary procedure of CABG. These primary diagnoses include acute myocardial infarction (AMI) and various other manifestations and symptoms of coronary artery disease, including acute and chronic ischemic heart disease and angina pectoris.[7] Of the 661,910 discharges, 16,540 had a primary diagnosis of something other than cardiovascular disease and were, therefore, excluded from our data.

The number of states included in the NIS varies from 19 in 1995 to 37 in 2004. Given that the NIS is a stratified random sample, hospitals do not appear in the NIS every year. Accordingly, our longitudinal sample is an unbalanced panel. Our empirical specifications include one-year lags of certain

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[5] Cardiovascular disease represents the leading cause of death in the United States. According to the American Heart Association 452,300 people died from Coronary Heart Disease in 2004 (American Heart Association, 2005).
[6] Maintained by the Healthcare Cost and Utilization Project (HCUP), a federal, state and industry partnership supported by the Agency for Healthcare Research and Quality (AHRQ)
[7] This group includes patients with a primary ICD-9-CM diagnosis codes between 410 and 414.

variables, which require pairs of consecutive years. Therefore, we limit our sample to hospitals performing CABG surgery with at least three pairs of consecutive years in the NIS. The result is a minimum of three observations for each hospital in our sample.[8] Finally, we exclude hospitals with very low volumes of CABG procedures; we follow the practice of several public and private industry reporting organizations by limiting our sample to facilities performing at least 30 procedures annually.[9] Following these exclusions, our final sample of discharges includes 145,415 patients receiving CABG surgery in 103 hospitals (400 hospital-years) between 1996 (due to our lagged variables) and 2004. Tables 1a and 1b present summaries of our sample.

[Tables 1a and 1b here]

Dependent Variable

Our regression models capture operational performance using the dependent variable of in-hospital mortality. Due to heterogeneity in patient characteristics associated with the risk of death, raw mortality rates may be biased measures of hospital performance and may unfairly penalize (benefit) hospitals with a more- (less-) severe mix of patients. We thus estimate the risk-adjusted mortality rate ($RAMR_{jt}$) for each hospital *j* in year *t* using a logistic regression. We pool all of the patient-level CABG observations in our database. The outcome variable in this regression is $MORT_{ijt}$, an indicator that equals one if patient *i* in hospital *j* in year *t* died in the hospital, and zero otherwise. The form of this regression is as follows:

$$\ln\left(\frac{\mathrm{pr}(\mathrm{MORT}_{ijt}=1|x_i)}{1-\mathrm{pr}(\mathrm{MORT}_{ijt}=1|x_i)}\right)=\alpha+\beta X_i+\varepsilon_{ijt}$$

[8] To illustrate, a hospital meeting this minimum criteria could have a minimum of four consecutive years in the data (which combine to form three consecutive pairs) or a maximum of six years in the data consisting of three non-overlapping sets of paired consecutive years. Though we limit our main sample to hospitals with a minimum of three pairs of consecutive years, we examine the sensitivity of our results to changes in these criteria.

[9] For example, HealthGrades, a private company that publishes performance data for hospitals, does not report mortality or complication rates if a hospital had fewer than 30 annual cases in a particular area, including CABG surgery. Similarly, the states of Massachusetts and Pennsylvania publicly report mortality rates for CABG surgery, but do not do so for hospitals with fewer than 30 cases.

X_i represents a vector of patient-level risk factors, including demographic characteristics of the patient, the patient's primary condition, co-existing conditions independent of the primary condition, and other procedures performed during the same hospitalization that may indicate a higher risk of death. We control for patient gender and age, with an interaction term to capture the possibility that the effects of age may differ across gender. We categorize the patient's primary condition by the first three digits of the primary diagnosis code (ICD-9-CM code). Additionally, we categorize patients with a primary diagnosis of acute myocardial infarction (AMI), or heart attack, by the location of the infarction.[10] We measure co-existing conditions using the approach of Elixhauser *et al.* (1998), which captures the presence of 30 comorbidities using indicator variables for each.[11] Finally, we include indicators for two procedures that, if occurring with CABG, represent complicating factors: angioplasty prior to CABG and valve replacement surgery.[12]

To calculate hospital *j*'s risk-adjusted mortality rate in year *t*, $RAMR_{jt}$, we average the predicted values for each patient from the logistic regression for hospital *j* in year *t* to create the predicted mortality rate PMR_{jt}. We use this value, along with the observed mortality rate OMR_{jt}, which is defined as the total number of CABG deaths at hospital *j* in year *t* divided by the total number of CABG patients in the hospital over the same time period, to calculate $RAMR_{jt}$:

$$\mathrm{RAMR}_{jt} = \frac{\mathrm{OMR}_{jt}}{\mathrm{PMR}_{jt}} * \mathrm{AMR}$$

[10] Depending on the location of the obstruction of cardiac circulation, different parts of the heart may be affected. Medical classifications define these locations anatomically using terms such as anterior, inferior, right-ventricular, etc. As an example, an occlusion of the left anterior descending artery will result in an *anterior wall* infarction.

[11] These conditions include: Congestive Heart Failure, Valvular Disease, Pulmonary Circulation Disorders, Hypertension (uncomplicated and complicated), Paralysis, Other Neurological Disorders, Chronic Pulmonary disease, Diabetes (uncomplicated and complicated), Hypothyroidism, Renal Failure, Liver Disease, Chronic Peptic Ulcer Disease, HIV and AIDS, Lymphoma, Metastatic Cancer, Solid Tumor without Metastasis, Rheumatoid Arthritis/Collagen Vascular Disease, Coagulation Deficiency, Obesity, Weight Loss, Fluid and Electrolyte Disorders, Blood Loss Anemia, Deficiency Anemias, Alcohol Abuse, Druge Abuse, Psychoses, and Depression.

[12] PTCA, like CABG surgery, also treats coronary atherosclerosis and can be performed with or without the placement of a stent in the affected artery. If this method of treating atherosclerosis is ineffective, CABG is usually the alternative. Valve replacement surgery, like CABG, is open-heart surgery, meaning the chest cavity is opened and the patient is placed on a heart lung machine to allow the surgeons to stop the heart during surgery.

AMR represents the observed mortality rate across all hospitals for the study period and is included simply to normalize the risk-adjusted rate. Figure 1 provides temporal trends in *RAMR* between 1996 and 2004. Consistent with prior studies using other data sources (e.g., Cutler *et al.*, 2004), our data illustrate a decline in average risk-adjusted mortality during our study period.

[Figure 1 here]

Independent Variables

Though our analysis focuses on CABG patients, the NIS includes data on *every* patient in a particular hospital in a given year. This allows us to observe the degree to which a hospital focuses on a particular service area as a continuous variable based on the percentage of its operational activity occurring in that area. We measure a hospital's degree of focus in cardiovascular services ($FOCUS_{jt}$) as the percentage of patients in a particular hospital in a particular year whose primary diagnosis falls in the area of cardiovascular disease.[13] The primary diagnosis represents the patient's principal reason for hospitalization. We note that each patient receives only one principal diagnosis. We define $FOCUS_{jt}$ as,

$$\mathrm{FOCUS}_{jt} = \frac{\sum_{i=1}^{n_{jt}} \mathrm{CARDIO}_{ijt}}{n_{jt}}$$

where $CARDIO_{ijt}$ is a binary indicator that equals one if patient i—in hospital j discharged in year t—received care for a primary diagnosis in cardiovascular disease, and zero otherwise. The denominator n_{jt} represents the total number of patients discharged from hospital j during year t. We note that cardiovascular disease includes, but is not limited to, patients receiving CABG. It also includes other aspects of cardiovascular care (e.g., diagnostic cardiology, interventional cardiology and angioplasty, valve surgery, other forms of treatment for heart failure, and treatments related to cardiac rhythm management). As a continuous, share-based measure, $FOCUS_{jt}$ captures operational specialization in a more nuanced manner than studies that measure focus in a discrete way, such as a simple count of the number of activities in which the organization participates or indicators for whether an organization is

[13] We define patients with cardiovascular disease as those with a primary diagnosis in Major Diagnostic Category 5: Diseases and Disorders of the Circulatory System

involved in a particular activity (Bozarth & Edwards, 1997; Hayes & Wheelwright, 1984; Kekre & Srinivasan, 1990; Suarez & Cusumano, 1996; Villalonga, 2004, Huckman and Zinner, 2008).

Beyond testing for returns to focused experience in a given business segment, we also aim to determine whether the composition of an organization's *other* activities affects these returns. Specifically, our purpose is to examine whether the returns to focus depend on the existence and intensity of related services. To define related services, we identify hospital service categories with the greatest potential for knowledge spillovers. We do so by taking advantage of data detailing *secondary* diagnoses for each patient. Secondary diagnoses represent conditions that are present but are not the primary reason for the patient's hospitalization. We assume that the presence of these secondary conditions suggests the need for knowledge and experience specific to treating them. Each observation in the NIS database includes information on up to 15 secondary diagnoses. This information allows us to determine over time, and over a large sample of cardiovascular patients, the frequency with which specific secondary diagnoses appear in patients having a primary diagnosis of cardiovascular disease. We aggregate these secondary diagnoses into service groups using Major Diagnostic Categories (MDC). Each MDC corresponds to a single organ system or disease etiology. For example, patients with cardiovascular disease diagnoses combine to form MDC 5. Table 2 summarizes the frequency with which MDCs appear as *secondary* diagnosis categories in cardiovascular patients (those with a *primary* diagnosis in MDC 5).

[Table 2 here]

We define those service categories that appear as secondary diagnoses for at least 30% of cardiovascular patients as *related* service categories. The implication is that at least three out of every ten cardiovascular patients may benefit from expertise, or knowledge spillovers, from these related areas. Our analysis indicates that two of the 24 non-cardiovascular MDCs meet this requirement.[14] Based on this analysis, we define the degree to which hospitals are engaged in related service categories ($RELATED_j$) as follows:

[14] These include MDCs 4 (Diseases and disorders of the respiratory system), and 10 (Endocrine, nutritional and metabolic diseases and disorders).

$$RELATED_j = \frac{\sum_{i=1}^{n_t} RELATED_{ij}}{n_j}$$

Where $RELATED_{ij}$ is an indicator equal to one if patient *i* discharged from hospital *j* during the study period had a *primary* diagnosis (of which there is only one for each patient) in one of the two service areas that are defined as being most closely associated to cardiovascular care. In this case n_j represents the total number of patients discharged from hospital *j* in all years for which we have data during the study period. $RELATED_j$ thus captures the extent to which a hospital concentrates on treating patients whose *primary* need falls into those areas that most commonly appear as *secondary* needs for cardiovascular patients. We note that our choice of 30% as a cutoff for including service categories in $RELATED_j$ may seem arbitrary. This choice is based on the substantial drop in frequency (31% to 21%) from just above to just below this threshold (Table 2). Nevertheless, we investigate the robustness of our results to shifts in the location of the threshold.

We note that in our primary specification and robustness checks, $RELATED_j$ is equivalent to a combination of variables representing the share of patients in each of several individual MDCs. To validate this approach, we employed factor analysis to investigate the degree to which these individual variables load onto a common factor. Though we do not report the analysis in detail here, we note that the results support the grouping of patients from the individual MDCs.[15]

To facilitate the interpretation of interaction effects, we categorize $RELATED_j$ into discrete groups. Initially we split the sample at the median of $RELATED_j$, defining $AboveMedianRELATED_j$ and $BelowMedianRELATED_j$. In our base model, we divide relatedness into three levels ($RELATED1_j$, $RELATED2_j$, and $RELATED3_j$), with cutoffs defined at the 33rd and 66th percentiles of $RELATED_j$. Hospitals in the *RELATED1* category thus have the lowest level of services that are associated with cardiovascular care while those in the *RELATED3* category have the highest. We note that $RELATED_j$ is

[15] Factor loadings for MDCs 4, 6, 10, and 11 exceed a threshold of 0.70, while those for MDCs 8 and 20 are closer to zero. An alpha (Chronbach's) analysis similarly revealed an alpha coefficient of 0.6995 for the combination of MDCs 4, 6, 10, and 11. The removal of any one of these individual MDCs results in a slightly lower alpha.

defined only once for each hospital. This is because our models incorporate hospital fixed effects, and the discrete forms of the variable (e.g., $RELATED1_j$, $RELATED2_j$, and $RELATED3_j$) exhibit very little within-hospital variation over time.

Finally, we include the total volume of admissions at hospital *j* in year *t* ($VOLUME_{jt}$), which allows us to control for the impact of a hospital's overall volume, or size, on mortality rates. Table 3 presents summary statistics and correlations for the key variables in our analysis.

[Table 3 here]

Empirical Model

We estimate the following model using ordinary least squares (OLS) to test for the effects of focus and related services on in-hospital, risk adjusted mortality rates:

$$\begin{aligned} RAMR_{jt} &= \alpha_j + \lambda_t + \beta_1 ln(FOCUS)_{jt-1} {*} RELATED1_j + \beta_2 ln(FOCUS)_{jt-1} {*} RELATED2_j \\ &+ \beta_3 ln(FOCUS)_{jt-1} {*} RELATED3_j + \beta_4 VOLUME_{jt-1} + \varepsilon_{jt} \end{aligned} \quad \textbf{(1)}$$

Our model includes fixed effects for each hospital (α_j), which allow us to control for time-invariant characteristics of hospitals that may affect in-hospital mortality rates and otherwise bias our results. We also include year fixed effects (λ_t) to control for otherwise unobserved factors that are driving the average trend in CABG mortality over time (Figure 1). We take the natural log of focus to allow for a curvilinear relationship between *FOCUS* and *RAMR*. In doing so, we note that our data include several hospitals with extremely high values for *FOCUS* (>70% of discharges in cardiovascular care). For these hospitals, a change in *FOCUS* of, say, 5 percentage points is a less substantial shift (and is likely to have a less substantial effect on *RAMR*) than for a hospital with a much lower initial value of *FOCUS*.

We lag *FOCUS* by one year to reduce concerns about potential reverse causality in the relationship between hospital performance and focus. To further address concerns about this form of endogeneity, we also test for the effects of prior performance on focus. Specifically, we model the current level of focus as a function of risk-adjusted mortality rates, lagged one year. The results of this analysis are discussed in more detail in the results section.

We interact $FOCUS_{jt-1}$ with each of the categories of $RELATED_j$ to determine the degree to which the returns to focus—in terms of operational performance—depend on the intensity with which hospitals engage in related activities. Based on our hypotheses, we expect to find that greater focus leads to lower mortality rates, and that the marginal effects of focus become greater as hospitals move from $RELATED1_j$ to $RELATED2_j$ to $RELATED3_j$. That is, we expect the returns to focus to be increasing in the intensity of related activity.

The level of observation in (1) is the hospital. Nevertheless, each of the measures in (1) is derived from patient-level discharge data such that our outcome measure, $RAMR_{jt}$, is a function of patient-level factors. To ensure that our results are not significantly influenced by rolling patient-level data into hospital-year observations, we estimate the following conditional logistic model at the patient-level:

$$ln\left(\frac{pr(MORT_{ijt} = 1|x_i)}{1 - pr(MORT_{ijt} = 1|x_i)}\right)$$
$$= \alpha_j + \lambda_t + \beta_1 ln(FOCUS)_{jt-1} * RELATED1_{jt} + \beta_2 ln(FOCUS)_{jt-1} * RELATED2_{jt} \quad \textbf{(2)}$$
$$+ \beta_3 ln(FOCUS)_{jt-1} * RELATED3_{jt} + \beta_4 VOLUME_{jt-1} + \beta_5 X_i + \varepsilon_{ijt}$$

As before, α_j and λ_t represent hospital and year fixed effects, respectively, and our focus measure ($FOCUS_{jt-1}$) is lagged one year and interacted with the three levels of relatedness ($RELATED1_{jt}$, $RELATED2_{jt}$, and $RELATED3_{jt}$). $MORT_{ijt}$ is a binary indicator of in hospital death and X_i represents a vector of patient characteristics and risk factors.[16] Our other independent variables of interest, however, remain at the hospital-level.

Estimating interaction effects and their significance can be complicated in a logistic regression. Scholars have noted specifically that the direction and significance of interactions cannot be determined based on the reported interaction term and test statistic in logistic regressions (Ai & Norton, 2003; Hoetker, 2007).

[16] These factors include primary diagnosis, age, gender, concurrent ptca or valve procedures and the following co-existing conditions: Congestive Heart Failure, Valvular Disease, Pulmonary Circulation Disorders, Hypertension (uncomplicated and complicated), Paralysis, Other Neurological Disorders, Chronic Pulmonary disease, Diabetes (uncomplicated and complicated), Hypothyroidism, Renal Failure, Liver Disease, Chronic Peptic Ulcer Disease, HIV and AIDS, Lymphoma, Metastatic Cancer, Solid Tumor without Metastasis, Rheumatoid Arthritis/Collagen Vascular Disease, Coagulation Deficiency, Obesity, Weight Loss, Fluid and Electrolyte Disorders, Blood Loss Anemia, Deficiency Anemias, Alcohol Abuse, Druge Abuse, Psychoses, and Depression.

Thus, though we estimate (2) as a conditional logit, we rely on a linear probability model (LPM) to compare patient-level results with the hospital level results. One of the benefits of the LPM is more straightforward interpretation, as the overall effect of focus by level of relatedness can be easily tested based simply on the estimated coefficients. We compare the direction of the interaction terms from the LPM estimates to those from the conditional logit in (2) to ensure similarity. We also compare the estimates from the LPM to the estimates from (1) to address concerns that our hospital-level results may be influenced by aggregation of the patient-level data.

Results and Discussion

Table 4 presents the results for our base model. In Columns 1, 2 and 3 *FOCUS* enters as a linear variable. In Columns 4, 5 and 6 we take the natural log of *FOCUS* as previously discussed. Column 1 suggests that, on average, focus has a negative effect on risk adjusted mortality rates. This result provides support for the beneficial impact of focus identified in Hypothesis 1.

[Table 4 here]

Columns 2 and 3 present the results of models in which we interact focus with the level of relatedness. The results suggest that the marginal effect of focus on in-hospital risk adjusted mortality depends on the level of relatedness. In Column 2, focus for below median hospitals is estimated to be positive, though the estimate is not significant. For above median hospitals, however, the estimate is negative and significant at the 5% level. In Column 3, the estimated effect of focus is negative, but insignificant for hospitals in *RELATED1* and positive, but insignificant for hospitals in *RELATED2*. For hospitals in *RELATED3,* however, the estimated effect of focus on risk adjusted mortality rates is negative and significant at the 5% level. We note that this estimate is significantly different from the estimates for *RELATED1* and *RELATED2* at the 10% level.

Columns 4, 5 and 6 suggest that when we take the natural log of *FOCUS*, the results show the same pattern, with the caveat that the estimate on *FOCUS* in Column 4 is significant at the 13% level, providing only weak support for Hypothesis 1. Column 6 suggests that taking the natural log of focus provides a slightly better fit to the data. We thus rely on this model as the base specification for our test of Hypothesis 2.

The estimates in Column 6 indicate that a one standard deviation increase from the mean value of *FOCUS*—equivalent to an increase in the natural log of *FOCUS* of 0.369—results in an overall reduction of 2.9 percentage points in the mortality rate for hospitals in the *RELATED3* category. These results are significant at the 1% level. We note again that the estimate for *RELATED3* in Column 6 is significantly different than the estimates for *RELATED1* and *RELATED2* at the 5% level. Overall, the results in Table 4 suggest that hospitals with the highest intensity of related services experience significant positive returns to focus (in the form of reduced mortality rates) and that these returns are greater for this category of hospitals than for hospitals with lower levels of related services. This pattern suggests a non-linear impact of relatedness on the returns to focus, perhaps representing a threshold of relatedness beyond which returns to focus are realized. Regardless, the general pattern of these results provides support for the complementarities noted in Hypothesis 2.

Table 5 provides the results of our patient-level regressions. Columns 1 and 2 suggest that the results of the conditional logit are largely in agreement with those from the LPM in terms of the direction, pattern, and significance of the estimates. These results provide a level of confidence in reporting the patient-level LPM results for comparison with the hospital-level results. The patient-level LPM results are consistent with the hospital-level results presented in Column 4 of Table 4. Both models suggest that the marginal returns to focus are increasing in the intensity with which a hospital provides related services.

[Table 5 here]

We acknowledge that any endogeneity in our key explanatory variables may lead to biased estimates. Specifically, we recognize that hospitals with higher quality CABG programs may attract higher absolute volumes of patients, thereby increasing their level of focus on cardiovascular care. As discussed above, we address these concerns by investigating the impact of prior performance on current focus. We estimate a "reverse" regression model, with the natural log of a hospital's current focus as the dependent variable and it's lagged risk-adjusted mortality rate for CABG as the independent variable. The model includes hospital and year fixed effects. If focus is indeed endogenously related to performance, we would expect to find a negative and significant relationship between the lagged risk-adjusted mortality rate and the degree of focus in cardiovascular disease. While we find that this coefficient is negative, it is not significant at conventional levels of significance (p=0.893).[17] This result is encouraging, as it mitigates concern about a hospital's level of focus being endogenously determined by its prior performance.

As is the case with most empirical studies, our results may be sensitive to choices we have made in constructing our sample and measuring our variables of interest. To address these potential limitations, we investigate the sensitivity of our results to changes in these assumptions. First, our base results measure focus at the disease (i.e., cardiovascular care) level, rather than the procedure (i.e., CABG) level. We have done so because other recent studies of hospital specialization have defined focus at the MDC level (Cram, Rosenthal, and Vaughn-Sarrazin, 2005; Greenwald et al., 2006), and we observe that hospital's decisions about their service offerings tend to be made at the level of a disease rather than a procedure. For example, single-specialty hospitals in cardiovascular care treat nearly all aspects of cardiovascular disease (perhaps with the exception of transplants) rather than focusing on specific cardiovascular procedures, such as CABG or angioplasty. Nevertheless, we run regressions replacing our MDC level focus measure with a CABG level focus measure, $CFOCUS_{jt-1}$. The model specifications are the same as in (1), except that focus is measured as the percentage of total discharges involving at least one CABG procedure. Table 6 presents the results of these regressions.

[Table 6 here]

The estimates in Column 1 are consistent with our estimates in Table 4 measuring focus at the MDC level. Specifically, these results are consistent with the story that focus is advantageous for hospitals with a high level of related services but not for hospitals with a low level of these services.

Second, our definition of related services includes the two MDCs that account for secondary diagnoses in at least 30% of cardiovascular patients. We investigate each of these MDCs individually and

[17] The coefficient on lagged risk-adjusted mortality is 0.059 with a standard error of 0.442.

additionally consider four additional MDCs that appear in more than fifteen percent of patients (see Table 2). Finally, we consider different MDC combinations (i.e. different definitions of *RELATED*) according to the frequency with which they appear in cardiovascular patients. The model specifications for the results appearing in Tables 7 and 8 are the same as in (1) except that *RELATED1*, *RELATED2*, and *RELATED3* have been defined using the MDCs specified in each column of each table.

[Table 7 here]

[Table 8 here]

The results in Table 7 suggest that secondary MDCs appearing in at least 20 percent of cardiovascular patients (Columns 1 through 4) individually exhibit the previously observed patterns of complementarity, while those that appear less frequently (Columns 5 and 6) do not show such patterns.[18] One caveat in Table 7 is that the estimates in Column 2 (MDC 10) show effects that are not significant at conventional levels. Nevertheless, the pattern in the estimates suggests complementarity, and the effect of *FOCUS* for hospitals in *RELATED3* is weakly significant at the 15% level.

In Table 8, we consider the impact on our results of adjusting the margin for defining related services. Specifically, we successively add MDC 6 (Column 1), MDC 11 (Column 2) and MDCs 8 and 20 (Column 3) to our definition of *RELATED*. The results in Columns 1 and 2 consistently suggest that the returns to focus are increasing in the intensity of related services at the hospital. The results in Column 3 do not. This latter result, however, is not surprising, as we would expect the complementary effect of related services to decline as the definition of related services is expanded to include MDCs with increasingly less overlap with cardiovascular care.

Finally, our base sample includes all hospitals with at least three pairs of consecutive years in the NIS data. To examine the sensitivity of our findings to this choice, we also run models on samples including: (1) all hospitals with at least two pairs of consecutive years (which would provide at least two

[18] We note that MDCs 6 and 11 demonstrate a moderately high degree of correlation with MDCs 4 and 10, respectively. For example, the correlation between MDC 4 and MDC 6 if 0.5184, and that between MDC 10 and MDC 11 is 0.5370.

observations in our lagged data set) and (2) all hospitals with at least four pairs of consecutive years. These results are reported in Table 9.

[Table 9 here]

The results in Column 1 suggest that relaxing our selection criteria to include all hospitals with at least two pairs of consecutive years has virtually no effect on the magnitude of our findings, particularly with respect to the results for hospitals with the highest level of related services. In addition, the direction and significance of the estimates are consistent with our base results from Table 4. The results in Column 2 are likewise in line with our base result. Overall, the consistency of the results in Table 9 suggests that our findings are robust to changes in our sampling criteria.

Conclusion

In this study, we consider two propositions related to the impact of focus on operational performance. First, we investigate whether there are, on average, returns to focus with respect to operational performance. This is a question without a definitive empirical answer, particularly with respect to focus at the organizational level. We find some evidence in support of our hypothesized positive relationship between focus and performance. Specifically, we find that, on average, hospitals with higher levels of specialization in cardiovascular disease achieve better performance with respect to mortality rates for patients undergoing cardiac surgery.

Second, we examine the degree to which these business line-specific returns to focused experience are contingent on the nature of the operating unit's other activities; that is, whether there are complementarities in hospital services. We find that hospitals devoting a greater portion of their business to treating patients in related service categories experience higher returns to focused experience in cardiovascular disease. We note, however, that this effect does not appear to be linear. Rather, as Table 4 suggests, there appears to be a threshold of relatedness (the lower bound of RELATED3) beyond which greater returns to specialization are realized. Nevertheless, these results suggest that related activities play an important role in the connection between focus and performance at an operating-unit level and that complementarities—not just economies of scale in shared services—may be a key mechanism in explaining the benefits of related diversification. These results are robust to changes in the level of observation, definition of focus, designation of related businesses, and methods for sampling hospitals.

Our study faces several potential limitations, and its results, therefore, should be interpreted with caution. First we reiterate the standard empirical questions that we have attempted to address with the robustness checks discussed above. Second, our study is limited to one technology (CABG surgery) and one industry, which may limit the generalizability of its findings. Nevertheless, the theoretical foundation of this paper has its roots in other industries. For example, the literature on focus has largely centered on manufacturing firms (Hayes and Wheelwright, 1984; Brush and Karnani, 1996; Bozarth and Edwards, 1997), while the literature on related diversification includes large samples of firms representing a cross-section of industries (Rumelt, 1974; Christensen and Montgomery, 1981; Rumelt, 1982; Palepu, 1985). Additionally, the theory of complementarities has been applied more broadly, for example, to large Japanese firms (Milgrom and Roberts, 1994) and the manufacturing industry (Milgrom and Roberts, 1990, 1995).

Third, we consider one measure of performance—quality as captured by risk-adjusted mortality—but are not able to consider other important metrics, such as cost. As a result, our paper cannot speak to the impact of focus on overall value (e.g., cost-adjusted quality). The data used in this study do not provide information on costs. What is available is data on hospital charges, which, due to the varied discounts offered across hospitals and across services within hospitals, are not representative of either actual prices or costs. Despite this limitation, quality—which we are able to study—remains a critical component in determining the value of health care.[19]

Finally, our results suggest that complementarities exist with respect to focused experience in cardiovascular care and related services. They do not, however, provide evidence of the mechanisms driving these complementarities. We have incorporated one potential mechanism in the form of knowledge spillovers (Henderson and Cockburn, 1996). We assume that service categories we identify as

[19] We define value as the quality of services relative to their costs.

related represent those areas with the greatest potential for knowledge spillovers given the frequency with which cardiovascular patients have secondary needs in these areas. Nevertheless, our measures are based on the *potential* for knowledge spillovers, not knowledge spillovers themselves. In addition, our results only examine the "what" of the mechanism, not the "how". For example, we cannot observe whether spillovers are due to direct interactions among physicians in different specialties or key individuals who span boundaries (Tushman, 1977; Tushman and Scanlon, 1981) across clinical specialties (e.g., nurses working with patients in both focal and related areas). Additionally, while knowledge spillovers may be important in knowledge-intensive settings like health care delivery, other mechanisms may be more important in other settings. Additional work is required to investigate such mechanisms and explain how they operate.

Despite these caveats, our study highlights the potential role of complementarities in generating benefits from focus at the operating unit level. It also underscores the idea that the benefits of related diversification may derive from sources beyond the sharing of common resources; sources that originate at lower levels of the firm. For the managers of operating units, our findings suggest that the returns to specializing in the activities of a given line of business may be contingent on the degree of relatedness in the unit's other activities. In the context of the hospital industry, these findings suggest the need for a broader conceptualization of what it means to "specialize". Specifically, hospitals interested in emphasizing a specific clinical service or building specialty hospitals may need to think beyond the focal area and consider complementary capabilities as well. This is consistent with the view expressed by others that in order to deliver value for patients health care should be organized around patient medical conditions, including "all needed specialties and the prevalent comorbidities" (Porter and Teisberg, 2007). Ultimately, these results provide a potential explanation for why one might find decreasing returns to focusing a firm on a single operating activity, especially when it is feasible for the firm to invest in other activities that complement its area of concentration.

References

Ai, C., & Norton, E. 2003. Interaction terms in logit and probit models. ***Economic Letters***, 80: 123-129.

American Heart Association. 2005. Cardiovascular disease statistics. Accessed July 30, 2008, <http://www.americanheart.org/presenter.jhtml?identifier=4478>.

Baldwin, C.Y., and Clark, K.B. 2000. ***Design Rules: The Power of Modularity. Vol. 1***. Cambridge, Mass.: MIT Press.

Barro, J.R., Huckman, R.S. & Kessler, D.P. 2006. The effects of cardiac specialty hospitals on the cost and quality of medical care. ***Journal of Health Economics***, 25(4), 702-721.

Berger, P.G., & Ofek, E. 1995. Diversification's effect on firm value. ***Journal of Financial Economics***, 37: 39-65.

Bozarth, C., & Edwards, S. 1997. The impact of market requirements focus and manufacturing characteristics focus on plant performance. ***Journal of Operations Management,*** 15(3): 161-180.

Brush, T., & Karnani, A. 1996. Impact of plant size and focus on productivity: An empirical study. ***Management Science***, 42(7): 1065-1081.

Campa, J. M., & Kedia, S. 2002. Explaining the diversification discount. ***Journal of Finance***, 57(4): 1731-1762.

Christensen, H. K., & Montgomery, C. A. 1981. Corporate economic performance: Diversification strategy versus market structure. ***Strategic Management Journal***, 2(4): 327-343.

Coase, R.H. 1937. The nature of the firm. ***Economica***, New Series, 4(16): 386-405.

Cram, P., Rosenthal, G., & Vaughn-Sarrazin, M. 2005. Cardiac revascularization in specialty and general hospitals. ***New England Journal of Medicine***, 352;14: 1454-1462.

Cutler, D., Huckman, R., and Landrum, M. 2004. The Role of Information in Medical Markets: An Analysis of Publicly Reported Outcomes in Cardiac Surgery. ***American Economic Review***, 94 (2): 342-346.

Davis, R., Thomas, L.G. 1993. Direct estimation of synergy: a new approach to the diversity performance debate. ***Management Science***, 39(11): 1334-1346.

Dwyer, W. M. 2000. Globalized, focused healthcare? ***Frontiers of health services management***, 16(3): 37.

Fayol, H. 1967. ***General and industrial management***. London: Pitman.

Ginsburg, P. B. 2000. Are focused factories the wave of the future? ***Frontiers of health services management***, 16(3): 41.

Greenwald, L., Cromwell, J., Adamache, W., Bernard, S., Drozd, E., Root, E., & Devers, K. 2006. Specialty versus community hospitals: Referrals, quality, and community benefits. ***Health affairs***, 25(1): 106-118.

Hayes, R. H., & Wheelwright, S. C. 1984. ***Restoring our competitive edge : Competing through manufacturing***. New York: Wiley.

Henderson, R., & Cockburn, I. 1996. Scale, scope, and spillovers: The determinants of research productivity in drug discovery. ***RAND Journal of Economics***, 27(1): 32-59.

Herzlinger, R. E. 1996. ***Market-driven health care***. Reading, Massachusetts: Addison-Wesley Publishing Co. Inc.

Herzlinger, R. 2000. Market-driven, focused healthcare: The role of managers. ***Frontiers of health services management***, 16(3): 3.

Hoetker, G. 2007. The use of logit and probit models in strategic management research: critical issues. ***Strategic Management Journal***, 28 (4): 331-343.

Huckman, R., & Zinner, D. 2008. Does focus improve operational performance? lessons from the management of clinical trials. ***Strategic Management Journal,*** 29 (2): 173-193.

Kekre, S., & Srinivasan, K. 1990. Broader product line: A necessity to achieve success? ***Management Science***, 36(10): 1216-1231.

Ketokivi, M., & Jokinen, M. 2006. Strategy, uncertainty and the focused factory in international process manufacturing. ***Journal of Operations Management***, 24(3): 250-270.

Lang, L. H. P., & Stulz, R. M. 1994. Tobin's q, corporate diversification, and firm performance. ***Journal of Political Economy***, 102(6): 1248.

March, J., & Simon, H. 1958. ***Organizations***. New York: Wiley.

Markides C., & Williamson P.J. 1994. Related diversification, core competences and corporate performance. ***Strategic Management Journal*** 15: 149-165.

Milgrom, P., & Roberts, J. 1994. Complementarities and systems: Understanding japanese economic organization. ***Estudios Económicos***, 9(1): 3.

Milgrom, P., & Roberts, J. 1990. The economics of modern manufacturing: Technology,.. ***American Economic Review***, 80(3): 511.

Milgrom, P., & Roberts, J. 1995. Complementarities and fit strategy, structure, and organizational change in manufacturing. ***Journal of Accounting and Economics,*** 19(2-3): 179-208.

Montgomery, C. 1994. Corporate diversification. ***Journal of Economic Perspectives*** 8(3): 163-178.

Palepu, K. 1985. Diversification strategy, profit performance and the entropy measure. ***Strategic Management Journal***, 6(3): 239-255.

Panzar, J.C., & Willig, R.D. 1981. Economies of scope. ***American Economic Review***. 71(2): 268-272.

Penrose, E. 1959. ***The theory of the growth of the firm***. Oxford: Oxford University Press.

Porter, M.E., & Teisberg, E.O. 2006. ***Redefining Health Care: Creating Value-Based Competition on Results.*** Boston: Harvard Business School Press.

Porter, M.E., & Teisberg, E.O. 2007. How physicians can change the future of health care. ***Journal of the American Medical Association.*** 297: 1103-1111

Rhoades, S.A. 1974. A further evaluation of the effect of diversification on industry profit performance. ***Review of Economics and Statistics***. 56: 557-59.

Rumelt, R. P. 1974. ***Strategy, Structure, and Economic Performance***. Boston, MA: Division of Research, Graduate School of Business Administration, Harvard University.

Rumelt, R. P. 1982. Diversification strategy and profitability. ***Strategic Management Journal***, 3(4): 359-369.

Schilling, M.A. 2000. Towards a general modular systems theory and its application to interfirm product modularity. ***Academy of Management Review***, 25: 312-334.

Schilling, M., Vidal, P., Ployhart, R., Marangoni, A. 2003. Learning by doing something else: variation, relatedness, and the learning curve. ***Management Science***, 49 (1): 39-56.

Servaes, H. 1996. The value of diversification during the conglomerate merger wave. ***Journal of Finance***, 51(4): 1201-1225.

Siggelkow, N. 2003. Why focus? A study of intra-industry focus effects. ***Journal of Industrial Economics***, 51(2): 121-150.

Skinner, W. 1974. The focused factory. ***Harvard business review***, 52(3): 113-121.

Smith, A. 1776. ***An inquiry into the nature and causes of the wealth of nations***. London: Printed for W. Strahan, and T. Cadell.

Suarez, F. F., Cusumano, M. A., & Fine, C.H. 1996. An empirical study of manufacturing flexibility in printed circuit board assembly. ***Operations research***, 44(1): 223.

Tanriverdi, H. & Venkatraman, N. 2005. Knowledge relatedness and the performance of multi-business firms. ***Strategic Management Journal***, 26(2): 97-119.

Taylor, F. W. 1911. ***The principles of scientific management,***. New York, London : b Harper and Brothers ; c 1911: .

Teece, D. J. 1980. Economies of scope and the scope of the enterprise. ***Journal of Economic Behavior & Organization,*** 1(3): 223-247.

Teece, D.J., Rumelt R., Dosi, G., Winter, S. 1994. Understanding corporate coherence: theory and evidence. ***Journal of Economic Behavior & Organization***, 23(1): 1-30.

Tushman, M. 1977. Special boundary roles in the innovation process. ***Administrative Science Quarterly,*** 22: 587-605.

Tushman, M., and Scanlan, T. 1981. Boundary spanning individuals: Their role in information transfer and their antecedents. ***Academy of Management Journal***, 24 (2): 289-305.

Villalonga, B. 2004. Diversification discount or premium? new evidence from the business information tracking series. ***Journal of Finance***, 59(2): 479-506.

Young, J., Foster, D., & Heller, S. 2005. Correspondence: Cardiac revascularization in specialty and general hospitals. ***New England Journal of Medicine***, 352;26: 2754-2754.

Figure 1—Temporal trends in average risk-adjusted mortality rates

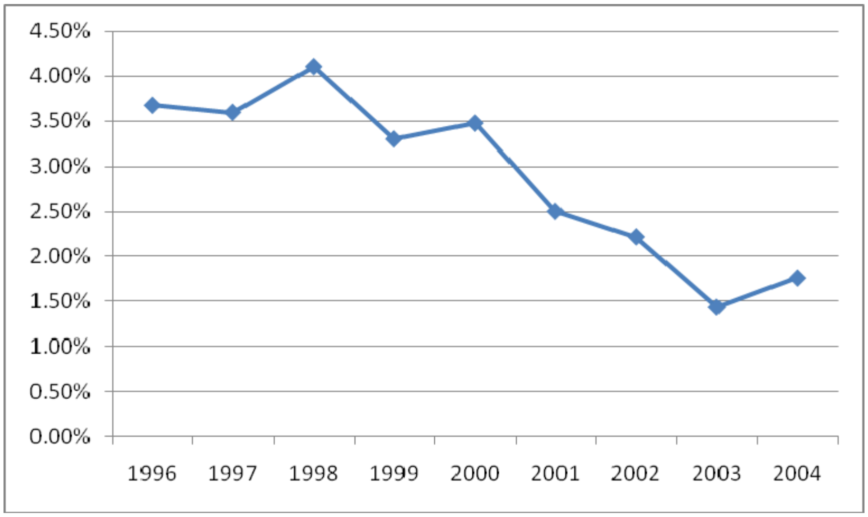

Table 1a—Sample: hospitals by number of paired consecutive years

Paired Years	Hospitals	Percent	Cum.
3	47	45.63	45.63
4	34	33.01	78.64
5	14	13.59	92.23
6	4	3.88	96.12
7	3	2.91	99.03
9	1	0.97	100
Total	103		

Table 1b—Sample: number of hospitals and CABG discharges by year

Year	Hospitals	Percent	Discharges	Percent
1996	84	21.00	33,224	22.85
1997	78	19.50	30,965	21.29
1998	66	16.50	24,496	16.85
1999	42	10.50	15,371	10.57
2000	32	8.00	9,848	6.77
2001	32	8.00	11,913	8.19
2002	23	5.75	7,717	5.31
2003	23	5.75	6,137	4.22
2004	20	5.00	5,744	3.95
Total	400		145,415	

Table 2—Frequency of secondary diagnoses in cardiovascular patients by MDC

MDC	MDC Description	Frequency
10	Endocrine, nutritional and metabolic diseases and disorders	64%
4	Diseases and disorders of the respiratory system	31%
6	Diseases and disorders of the digestive system	21%
11	Diseases and disorders of the kidney and urinary tract	20%
8	Diseases and disorders of the musculoskeletal system and connective tissue	19%
20	Alcohol/drug use and alcohol/drug-induced organic mental conditions	18%
23	Factors Influencing Health Status	15%
16	Diseases and disorders of blood, blood-forming organs and immunological disorders	15%
19	Mental diseases and disorders	14%
1	Diseases and disorders of the nervous system	13%
18	Infectious and parasitic diseases (systemic or unspecified sites)	10%
9	Diseases and disorders of the skin, subcutaneous tissue and breast	9%
12	Diseases and disorders of the male reproductive system	4%
7	Diseases and disorders of the hepatobiliary system and pancreas	4%
3	Diseases and disorders of the ear, nose, mouth and throat	4%
2	Diseases and disorders of the eye	3%
21	Injuries, poisoning and toxic effects of drugs	2%
17	Neoplastic disorders (haematological and solid neoplasms)	1%
13	Diseases and disorders of the female reproductive system	1%
25	Human Immunodeficiency Virus Infection	0%
15	Newborn and other neonates	0%
22	Burns	0%
14	Pregnancy, childbirth and the puerperium	0%

Table 3—Summary statistics and correlations

(N=400)	Mean	SD	Min	Max	RAMR	Volume	Focus	Related	Related1	Related2	Related3
RAMR	0.029	0.025	0.000	0.340	1						
Volume	18,923	10,295	2,490	68,464	-0.032	1					
Focus	0.197	0.088	0.067	0.884	-0.087	-0.161	1				
Related	0.113	0.026	0.050	0.230	0.053	-0.251	0.014	1			
Related1	0.315	0.465	0.000	1.000	-0.017	0.156	0.017	-0.710	1		
Related2	0.353	0.478	0.000	1.000	-0.038	0.005	-0.123	-0.061	-0.502	1	
Related3	0.331	0.471	0.000	1.000	0.055	-0.159	0.107	0.763	-0.478	-0.520	1

Table 4—Regressions testing the average effect of focus and relatedness on risk adjusted mortality rates (Standard errors in parentheses)

COEFFICIENT	(1) RAMR	(2) RAMR	(3) RAMR	(4) RAMR	(5) RAMR	(6) RAMR
Volume	0.0000008	0.0000008	0.0000008	0.0000008	0.0000008	0.0000008
	(0.0000007)	(0.0000007)	(0.0000007)	(0.0000007)	(0.0000007)	(0.0000006)
Focus	-0.156*			-0.0248		
	(0.0802)			(0.0158)		
Focus*BelowMedianRelated		0.0204			0.0108	
		(0.0987)			(0.0184)	
Focus*AboveMedianRelated		-0.283**			-0.0544**	
		(0.118)			(0.0229)	
Focus*Related1			-0.0643			-0.00116
			(0.0876)			(0.0193)
Focus*Related2			0.0136			0.00935
			(0.134)			(0.0234)
Focus*Related3			-0.399**			-0.0798***
			(0.156)			(0.0303)
Transformation of Focus	**None**	**None**	**None**	**Natural log**	**Natural log**	**Natural log**
Observations	400	400	400	400	400	400
Number of Hospitals	103	103	103	103	103	103
R-squared	0.106	0.127	0.138	0.101	0.129	0.145

Robust standard errors are clustered by hospital.
Regressions include a constant term not reported.
*** p<0.01, ** p<0.05, * p<0.1

Table 5—Patient level regressions (Standard errors in parentheses)

COEFFICIENT	(1) Log-odds MORT	(2) MORT
Volume	0.000007	0.000000161
	(0.000008)	(0.000000355)
Ln(Focus)*Related1	-0.2490	-0.0132
	(0.6011)	(0.0129)
Ln(Focus)*Related2	-0.6879	-0.0151
	(0.5377)	(0.0130)
Ln(Focus)*Related3	-1.0721*	-0.0371**
	(0.5579)	(0.0169)
Observations	145415	145415
Number of Hospitals	103	103
R-squared	0.108†	0.044

Robust standard errors are clustered by hospital-year.
Regressions include a constant term not reported.
*** p<0.01, ** p<0.05, * p<0.1

Table 6—Regression with focus at the CABG level (Standard errors in parentheses)

COEFFICIENT	(1) RAMR
Volume	0.000000489
	(0.000000484)
Ln(CFocus)*Related1	-0.00826
	(0.00748)
Ln(CFocus)*Related2	-0.00882**
	(0.00422)
Ln(CFocus)*Related3	-0.0212**
	(0.00998)
Observations	400
Number of hospid	103
R-squared	0.142

Robust standard errors are clustered by hospital.
Regressions include a constant term not reported.
*** p<0.01, ** p<0.05, * p<0.1

Table 7—Regressions testing the complementary effect of individual MDCs (Standard errors in parentheses)

COEFFICIENT	(1) RAMR	(2) RAMR	(3) RAMR	(4) RAMR	(5) RAMR	(6) RAMR
Volume	0.0000007	0.0000008	0.0000008	0.0000008	0.0000008	0.0000008
	(0.0000006)	(0.0000006)	(0.0000007)	(0.0000006)	(0.0000007)	(0.0000007)
Ln(Focus)*Related1	0.00221	0.00641	0.00110	-0.00412	-0.0522*	-0.0345*
	(0.0178)	(0.0221)	(0.0210)	(0.0211)	(0.0283)	(0.0192)
Ln(Focus)*Related2	-0.000002	-0.0168	-0.0207	0.0123	-0.0103	-0.0158
	(0.0234)	(0.0197)	(0.0271)	(0.0215)	(0.0280)	(0.0217)
Ln(Focus)*Related3	-0.0631**	-0.0623	-0.0448*	-0.102**	-0.00293	-0.0229
	(0.0295)	(0.0424)	(0.0248)	(0.0397)	(0.0237)	(0.0335)
MDC in Related	**4**	**10**	**6**	**11**	**8**	**20**
Observations	400	400	400	400	400	400
Number of Hospitals	103	103	103	103	103	103
R-squared	0.128	0.120	0.108	0.156	0.115	0.102

Robust standard errors are clustered by hospital.
Regressions include a constant term not reported.
*** p<0.01, ** p<0.05, * p<0.1

Table 8—Regressions testing the complementary effect of different combinations of secondary MDCs (Standard errors in parentheses)

COEFFICIENT	**(1) RAMR**	**(2) RAMR**	**(3) RAMR**
Volume	0.0000008	0.0000008	0.0000007
	(0.0000006)	(0.0000006)	(0.0000006)
Ln(Focus)*Related1	0.000298	0.00987	-0.00578
	(0.0191)	(0.0198)	(0.0141)
Ln(Focus)*Related2	0.00463	0.00392	-0.0749
	(0.0232)	(0.0222)	(0.0462)
Ln(Focus)*Related3	-0.0763**	-0.0858***	-0.0170
	(0.0314)	(0.0324)	(0.0249)
MDCs in Related	**4,6,10**	**4,6,10,11**	**4,6,8,10,11,20**
MDCs Added to Related	**6**	**11**	**8, 20**
Observations	400	400	400
Number of Hospitals	103	103	103
R-squared	0.138	0.150	0.119

Robust standard errors are clustered by hospital.
Regressions include a constant term not reported.
*** p<0.01, ** p<0.05, * p<0.1

Table 9—Regressions testing the sensitivity of results to sampling criteria (Standard errors in parentheses)

COEFFICIENT	(1) RAMR	(2) RAMR
Volume	0.000000579	0.000000860
	(0.000000589)	(0.000000706)
Ln(Focus)*Related1	-0.0142	-0.00602
	(0.0157)	(0.0309)
Ln(Focus)*Related2	-0.0165	0.0271
	(0.0211)	(0.0274)
Ln(Focus)*Related3	-0.0703***	-0.0760**
	(0.0267)	(0.0306)
Sample Restriction	**≥ 2 pairs consecutive years**	**≥ 4 pairs consecutive years**
Observations	657	259
Number of Hospitals	232	56
R-squared	0.091	0.180

Robust standard errors are clustered by hospital.
Regressions include a constant term not reported here.
*** p<0.01, ** p<0.05, * p<0.1