Changing Organizational Designs and Performance Frontiers

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Abstract

This paper develops and tests a multi-level organization contingency theory for designing headquarters-subsidiary relations. We use frontier analysis to overcome problems that have hampered advancements in organizational contingency theory in general, and headquarters-subsidiary relationships in particular. Based on a longitudinal study of a large medical group practice of 32 local community clinics, we compute the relative distance of clinics from a best-performance frontier, determine what proportions of changes in clinic performance are due to factors that are endogenous or exogenous to the clinics, and examine the organizational factors that may explain these performance changes. We find that uniform headquarters policies have differing effects on the performance of subsidiary units, benefiting some and hindering others through no fault of their own. We also find significant performance volatility with different types of unit designs, suggesting the need to examine the risks of changing organization designs.
Introduction

Striking a balance between corporate-wide policies and subsidiary unit autonomy is an ongoing challenge of multi-site organizations that have many geographically dispersed units, such as manufacturing plants, service outlets, and retail stores (Child, 2005; Dooms & van Oijen, 2008). On the one hand, organization-wide policies and procedures are necessary in order to achieve economies of scale and scope, and create reliable and branded products from all of the organization’s stores, factories, or service centers regardless of their location. On the other hand, each dispersed unit requires some autonomy and flexibility so that it is able to respond to its particularistic environmental task demands.

Most of the research on headquarters-subsidiary relations has been in multi-business and multinational firms and has focused on mechanisms used by headquarters to control their subsidiaries and the mechanisms subsidiaries use to manage their fit with their local environment (Birkinshaw, 2008). This research has mainly been concerned with the degree to which corporate control mechanisms should be tailored to allow subsidiaries to maintain the requisite autonomy to manage their relationship with the local institutional conditions and the degree to which such control mechanisms should be standardized to take advantage of economies of scale and scope (Ghoshal & Nohria, 1989; Nohria & Ghoshal, 1994). Researchers have also examined the variations of such control mechanisms across subsidiaries (e.g. Dooms & van Oijen, 2008).

While this research has uncovered mechanisms of corporate control over subsidiaries and shown how subsidiary performance is contingent on the fit between corporate control and the local environment, it has not examined the multilevel effects of macro headquarter policies and micro unit efforts on subsidiary performance. We argue and show that an understanding of the design of headquarters-subsidiary relations requires a systematic way of distinguishing between the exogenous parts of subsidiary performance that are due to macro corporate policies and the endogenous parts that are due to the micro management efforts of individual subsidiaries. Without unpacking the corporate and subsidiary components of subsidiary performance, we have no evidence for assessing the relative contributions and relationships among macro and micro levels of organizations. In addition, organization design researchers have not discriminated between the relative effects of corporate and subsidiary control mechanisms on endogenous and exogenous performance.
unit performance. Hence, our research question focuses on how corporate (macro) and subsidiary (micro) organizational control mechanisms impact subsidiary performance.

Probably the most commonly used theoretical framework to examine headquarters-subsidiary relations is contingency theory (Donaldson, 2001; Doz & Prahalad, 1991). The basic proposition of contingency theory is that organizational performance increases when subsidiary units are designed to differentially fit their local environmental demands subject to macro-organizational constraints of the headquarters (Drazin & Van de Ven, 1985; Meyer, Tsui & Hinings, 1993; Nohria & Ghoshal, 1994; Birkinshaw, 2008). Donaldson (2001) and Child (2005) review the research on this proposition, and suggest that it represents the most widely accepted view of our current state of knowledge on designing headquarters-subsidiary relationships. While intuitively straightforward, this abstract proposition glosses over three thorny problems that limit advancing organization contingency theory in general and understanding headquarters-subsidiary relationships in particular.

First, the contingency theory proposition assumes that organization design is a strategic choice (Child, 1972; Donaldson, 2001) that can be made in a purposeful and rational manner by top managers. In reality, organization design reflects some joint deliberate decisions and some emergent actions especially when multiple stakeholders with conflicting interests are involved (Pfeffer & Salancik, 1978). Designing headquarters-subsidiary relations involves some centralized coordination and some local autonomy, which can lead to unanticipated conflicts between central administration and local units (Blau, 1964; Astley & Van de Ven, 1983). In addition, most organizations face multiple and often conflicting environmental demands, structural arrangements, and performance criteria at macro and micro organizational levels (Thompson, 1967; Lewin & Minton, 1986). Achieving fitness with local environmental demands and with corporate strategies often conflict (Child, 1975; Khandwalla, 1973), and forces making trade-offs between purposeful and emergent goals at micro and macro organizational levels (Miller, 1993; Sinha & Van de Ven, 2005). These complexities make it difficult to specify in concrete terms the relationships among abstract notions of organization environment, configuration, and performance in contingency theory.

To move beyond the limits of arm-chair theorizing, we propose taking an empirical approach using methods of frontier analysis to advance our understanding of designing headquarters-subsidiary relationships.
This approach provides a systematic way to assess the relative overall performance of organizational subsidiaries facing comparable resource and environmental constraints, and for unpacking the trade-offs between micro and macro organizational factors that might have a differential impact on subsidiary unit performance.

Second, the contingency theory proposition treats corporate policies as a uniform constraint on all subsidiary units, when it should be treated as a variable that differentially affects subunits. As a constraint, it is generally assumed that headquarters policies are implemented in a uniform way in all subsidiaries. Yet, as the concept of ‘affordance’ (Gibson, 1979; Norman, 1988) suggests, any rule or policy is open to many action possibilities depending on what you make of it. These action possibilities are not only dependent on the literal policy prescriptions, but also the actor’s goals, plans, values, beliefs and past experiences. The same constraint (or policy) may or may not limit a subsidiary. It has been shown that macro policies can also enable productive pathways for subsidiary units to do things (Nelson & Sampat, 2001). In other words, macro organizational rules and policies both enable and constrain behavior (Adler & Borys, 1996). If that is the case, then macro-organizational policies may increase or decrease micro-organizational performance variations depending on how they are interpreted and implemented. Thus, Nelson (2008, p. 8) observes: “over the years empirical studies have consistently shown large differences in productivity between establishments of the same corporation producing the same things and using the same production machinery (perhaps the best of these studies remains the old one by Pratten (1976)).”

These differential connections between headquarters’ policies and subsidiary units’ behaviors have not been studied because it is very difficult to get reliable evidence for assessing the relative performance of subsidiary units and for determining what parts of subsidiary units’ performance are due to subsidiary-specific (or endogenous) factors within the control of organizational units and what parts can be attributed to headquarter-specific (or exogenous) macro-organizational policies. Using Frontier Analysis, we disentangle the endogenous subsidiary-specific components and the exogenous headquarter-specific components of a subsidiary unit’s performance. This makes it possible to examine how macro-organizational policies that impose uniformities across dispersed subsidiary units may have differential impacts on subsidiary
performance. The same policies may advantage some units but disadvantage others in unknown and unintended ways.

Third, the concept of fit in contingency theory has been criticized for being too static and unable to capture changing processes of organizational adaptation with their local environments and with other organizational levels (Anderson, Meyer, Eisenhardt, Carley & Pettigrew, 1999). Responding to these criticisms, Donaldson (2001) pointed out that even some of the classic contingency theories made the point that organizations adapt over time by moving from misfit to fit and that what is a fit changes as the contingencies change. Our longitudinal research provides an empirical way to go beyond this comparative-statics analysis of fit and misfit. Conceptually, it requires a shift in thinking of organization-environment relations from one of fit to one of adaptation. This shift is central to the organizational complexity perspective of Levinthal (1997), McKelvey (1999), and Siggelkow (2001) and their discussions of organizational adaptation on a metaphorical changing landscape over time. In the results section, we show that uniform headquarters policies shift the best performance frontier differently for various types of subsidiary units on this metaphorical landscape. The image of actors “dancing” across a fitness landscape over time is apropos, as actors adapt to each others’ steps as well as to moving frontiers. Through this process, some improve and others fall behind, reflecting the “Red Queen” dynamics (Barnett and Sorenson 2002; Derfus, Maggitti, Grimm & Smith, 2008).

The next section of this paper proposes a multi-level organization contingency theory of headquarters-subsidiary relations. We describe the method of frontier analysis that was used to empirically assess the relative performance of different types of subsidiary units and determine what parts of unit performance are attributable to the efforts of individual units and what parts are due to macro-organizational policies. Our empirical findings are based on a longitudinal study of a sample of 32 local community clinics that are all part of a large medical group practice. With longitudinal data, we construct a changing adaptiveness landscape for these organizational units, and determine what proportions of changes in clinic performance are due to endogenous or exogenous factors of the clinics. We identify several organizational characteristics that differentially influence these endogenous and exogenous sources of clinic performance.
We conclude with a discussion of how this research advances organizational contingency theory in general and headquarters-subsidiary relationships in particular.

Our paper makes at least four contributions. First and foremost, we advance a multi-level organizational contingency theory that takes into account the differential impact of headquarters policies and subsidiary managerial efforts on subsidiary performance. Second, we show that Frontier Analysis provides a systematic way to discriminate endogenous from exogenous components of subsidiary performance, which provides a first step in examining headquarters-subsidiary relations. While many studies have examined headquarter-subsidiary relations (Ghoshal & Nohria, 1989; Nohria & Ghoshal, 1994), we distinguish between two types of performance sources that might provide a more accurate assessment of subsidiary performance especially as subsidiaries are differentially affected by headquarter policies. Third, we show that macro and micro organizational control mechanisms have different performance effects. Endogenous subsidiary performance is a function of micro subsidiary control mechanisms (autonomy and interactions), while exogenous performance is a function of macro corporate control mechanisms (standardization and integration). Our results show that corporate control mechanisms (standardization and integration) that are expected to have a consistent effect on subsidiary performance have differential effects on exogenous subsidiary performance and unexpected effects on endogenous subsidiary performance. Fourth, using frontier analysis, we provide a new way of examining dynamic fit or adaptation by identifying the best performing subsidiaries and assessing their relative distance from other subsidiaries subject to the same input and environmental conditions. This provides a more cogent test of contingency theory’s arguments and avoids the pitfalls of assessing performance based on mean-level regression-based models. The empirical findings also suggest that an important area for future study is to examine the different levels of risk associated with changing organizational designs.

Conceptual Framework

Headquarters-Subsidiary Relations

The study of headquarters-subsidiary relationships has a long and rich history in organization and management literature dealing with the division of labor, departmentation, and control (Filley, House & Kerr, 1976; Galbraith, 1977; Walker & Lorsch, 1968). Work in organizations can be divided a number of
ways (e.g., by geography, product, function, or goal) and assigned to subsidiaries, departments, divisions, or other units. Filley, House & Kerr (1976, p. 360) note that early writers focused on the efficiencies of alternative forms of departmentation, and degrees of headquarters control over subsidiary units. Little consideration was given to unique conditions facing individual subsidiary units and their relative influence on headquarter-subsidiary relations. During the past 30 years, much has been learned from studies of headquarters-subsidiary relations, mostly in multinational corporations (MNC) (see reviews by Egelhoff, 1988; Gupta & Govindarajan, 1991; Prahalad & Doz, 1987; Ghoshal & Nohria, 1989; Birkinshaw, 2008). Most MNC researchers adopted an organizational contingency theory to examine headquarters-subsidiary relations. In this context, the core contingency theory proposition is that organization performance increases when subsidiary units are designed to differentially fit their local environmental demands subject to corporate-wide constraints of the headquarters (Donaldson, 2001; Child, 2005).

Implicit in this proposition is a multilevel view of subsidiary performance. It states that the performance of a subsidiary is a function in part of the behavior of managers and employees within the subsidiary, and in part a result of macro-organizational policies that subsidiaries are required to implement. Determining the relative contributions of macro-organizational policies and micro organizational behavior on subsidiary performance are important first steps for empirically understanding headquarters-subsidiary relations. A basic assumption in designing headquarters-subsidiary relations is that these macro and micro contributions are complementary or positively correlated. In other words, macro-organizational policies are intended to support the performance of most or all subsidiaries, and managers of subsidiaries are expected to adapt and implement these macro policies in constructive ways. We test this assumption in our first hypothesis.

*Hypothesis 1: There is a positive correlation between the components of subsidiary performance that are attributable to endogenous micro subsidiary efforts and to exogenous macro organizational policies.*

In addition to examining the relative contributions of micro and macro levels of organization, a contingency theory of headquarters-subsidiary relations requires study of how organizational units adapt to their local environments. In a study of 54 MNCs, Nohria & Ghoshal (1994) found support for this
Headquarters-subsidiary relations that were differentiated to fit their local contexts were associated with higher performance of the MNC as a whole. They measured two dimensions of subsidiary context (complexity of local environment and amount of subsidiary resources) and three dimensions of structural control by headquarters over its subsidiaries through centralization, formalization, and normative integration (an informal cultural dimension of shared values). They found that in high performing MNCs, greater environmental complexity was associated with lower formalization, moderate centralization and higher shared values. In addition, subsidiary resources was negatively related to centralization and shared norms was positively associated with formalization of the headquarters-subsidiary relations.

Dooms & van Oijen (2008) used variables similar to Nohria & Ghoshal (1994) to examine the relative balance between subsidiary autonomy (tailored control) and headquarters standardized control. They distinguished formal and informal dimensions of tailored control (subsidiary autonomy and communications, respectively) and formal and informal dimensions of corporate standardized control (formalization and integration or shared values, respectively). No measures of organization performance were reported. Based on a study of 100 subsidiaries of 23 corporations, they found that firms adopt a balanced combination of subsidiary autonomy and corporate standardization. Dooms & van Oijen (2008, p. 250) report that the findings were more complicated than expected. They found no corporate effect on subsidiary autonomy, but found that integration, formalization, and communication are subject to corporate influences. However, these corporate effects did not diminish large variations that were still explained by the subsidiary level.

Building on these studies, we identify four dimensions for studying headquarters-subsidiary relations: subsidiary autonomy, subsidiary interactions, corporate standardization and headquarters-subsidiary integration. These four dimensions are related, as illustrated in Table 1, and moderated by environmental complexity. Subsidiary autonomy (i.e., decentralization of decision making) and corporate standardization (i.e., formalization of policies and procedures) reflect formal structural mechanisms of controlling activities at subsidiary and headquarters levels of organization. Subsidiary interactions (interdependence and communications with headquarters) and headquarters-subsidiary integration (shared norms) refer to informal control mechanisms. These informal dimensions reflect the view that organizational culture (Martin, 1992) and interactions (Homans, 1961) minimize divergent interests and can serve as
substitutes for structural controls (Durkheim, 1964; Gouldner, 1954). Following Nohria & Ghoshal (1994) and Dooms & van Oijen (2008), we expect these formal and informal control mechanisms to compensate and complement each other.

-- Insert Table 1 here. --

Donaldson (2001) points out that these dimensions also reflect different levels of organizational differentiation and integration. Unlike Lawrence & Lorsch (1967) who viewed differentiation and integration at a single organizational level, Nohria and Ghoshal (1994) distinguish them at micro and macro levels of organization. Differentiation focuses on the subsidiary level and refers to the structural autonomy and interactions of each subsidiary unit with headquarters. Integration applies to the corporate level and refers to the control achieved by headquarters through standardized policies and procedures and cultural views of headquarters-subsidary integration. Subsidiary differentiation and headquarters integration need not be correlated. “Differentiation here is the difference between subsidiaries that may or may not need to be integrated at the corporate level” (Donaldson, 2001, p. 85). So also, integration refers to corporate policies and strategies that apply to all subunits regardless of their differentiation.

These dimensions of micro-organizational differentiation and macro-organizational integration have important implications for designing headquarter-subsidary relations. Dooms & van Oijen (2008, p. 245) point out that unit autonomy and communications are ‘tailor-made’ to each subsidiary and differentiated throughout the organization. In contrast, corporate-wide factors, such as standardization and culture involve controls that apply uniformly across organizational subsidiaries. As Table 1 illustrates, this leads us to expect that subsidiary autonomy and interactions most directly influence the component of subsidiary performance that is endogenous or within the control of subsidiaries, while corporate standardization and headquarters-subsidary integration directly predict the exogenous component of subsidiary performance that is attributable to macro organizational structure. Specifically, we hypothesize the following.

*Hypothesis 2: Micro subsidiary control mechanisms of autonomy and interactions have a positive effect on endogenous performance and no effect on exogenous performance.*
Hypothesis 3: Macro corporate control mechanisms of standardization and integration have a positive effect on exogenous performance and no effect on endogenous performance.

Finally, we expect that the complexity of the local environment served by the subsidiary will moderate these relationships. Studies of organizational contingency theory show that environmental complexity increases the need for unit autonomy to adapt flexibly to heterogeneous demands (see review by Donaldson, 2001) and that uniform corporate policies tend to be too course-grained for adapting to diverse particularistic needs (Nohria and Ghoshal, 1994; Sinha & Van de Ven, 2005). Conversely, as Thompson’s (1967) concept of coordination by programming emphasized, organizational rationality and efficiency increase when uniform rules, policies and procedures can be applied to stable and homogeneous situations. Hence, the less complex a subsidiary’s environment, the less the need for exercising autonomy and the greater the performance benefits of standardized policies and procedures. Therefore, we propose:

Hypothesis 4: Local environmental complexity enhances hypothesis 2 and dampens hypothesis 3.

In the next section, we discuss operational procedures for distinguishing endogenous and exogenous parts of subsidiary performance with a method of frontier analysis.

Methodology

Frontier Analysis

Empirical study of organizational fitness or adaptiveness involves two steps: (1) identify the most efficient organizations in a sample that best achieve performance outcomes subject to their particular resource and environmental constraints and then (2) analyze their design configurations with those of less efficient comparable organizations facing similar resource and environmental constraints (Donaldson, 2001; Meyer, Tsui & Hinings, 1993). The first step entails a constrained-maximization problem of calculating the maximum performance outputs of organizational units in a sample subject to different resource and environmental input constraints. Organizational design factors are not part of this first step. The second step treats this calculated result from step one as the dependent variable whose variance is explained in terms of a set of organizational design factors using a standard regression model.
To perform the first step of the analysis, we chose a method of frontier analysis in order to avoid a logical problem with regression-based models as used in prior studies of organizational contingency theory (e.g., Drazin & Van de Ven, 1985 and Doty, Glick & Huber, 1993). As Bryce, Engberg & Wholey (2000, p. 511) discuss, regression is designed to explain variance in average behavior; for example, Y = f(X) estimates variations in average outputs, Y, from a set of independent variables (X). In contrast, frontier analysis mathematically calculates the outlying ideal-type organization that maximizes desired performance outputs subject to its particular input constraints (Lewin & Minton, 1986). This latter estimate, at least intuitively, provides an appropriate measure of the relative efficiency of organizational units facing comparable constraints. Frontier analysis provides a more direct method of empirically identifying these most-adaptive outliers in a sample of organizations than regression methods that examine the distance of residuals from the center of a least squares line.

Frontier analysis is a method that begins with the outliers in a sample. It empirically identifies the most adapted or best performing units on the outlying frontier in the sample and then provides a way to examine the relative distance of other units in the sample from their comparable cohorts on the frontier. Frontier analysis directly addresses the constrained optimization problem in contingency theory that is central to configuration and complexity perspectives (Sinha & Van de Ven, 2005). The best performance frontier consists of organizational units that maximize desired output criteria subject to input resource and environmental constraints in comparison with others examined in the sample.

Figure 1 provides a geometric intuition on how DEA works, and the Appendix presents a technical description of DEA calculations. DEA searches for the weights that optimize outcome performance measures (the Y axis) subject to a set of input factors (on the X axis) for organizational units being investigated. Once scores are calculated, as described in the Appendix, a best performance frontier can be identified from which other units can be compared. A best performance frontier refers to the maximum output that can be attained given a set of input conditions for a sample of units that use a similar transformation process to convert inputs into outputs (Jayanthi, Kocha, and Sinha, 1996). Instead of trying to fit a regression plane through the center of the data, DEA floats a piecewise linear surface to rest on top of the most extreme observations in a
sample of organizational units (i.e., DEA envelops the observations and, hence, the name *Data Envelopment Analysis*).

-- Insert DEA illustration in Figure 1 about here. --

Compared to other frontier estimation methods, the features of DEA that make it particularly appropriate for our research objective are that (1) it can handle multiple input and output variables where each variable may be measured in different scales, (2) it does not require that functional relationships be specified between the input and output variables, and (3) it allows a non-linear shape to the frontier. We also show below how longitudinal observations of a sample of organizations can be analyzed with DEA to determine changes in performance frontiers over time and the relative adaptiveness of organizational units on and off of the shifting frontier over time.

Exemplary applications of DEA in organizational studies have been made by Lewin and Minton (1986), Chilingerian (1995), Cooper, Sinha and Sullivan (1996), and Johnson et al (1996). DEA has also been used in several health care settings: to evaluate the efficiency of U.S health maintenance organizations from 1985-1994 (Wholey & Bryce, 1997), physician efficiency in hospitals (Chilingerian, 1995), primary health care in England (Salinas-Jimenez and Smith, 1996), primary care physicians of a large HMO in the Eastern U.S. (Chilingerian and Sherman, 1996), and case workers in home health care services (Johnson, Sinha, Van de Ven, Potthoff & Kochevar, 1996). With the exception of the Wholey & Bryce (1997) study, all others used DEA to examine cross-sectional data. It is important to note that our objective and method in using the DEA frontier analysis differs from these prior applications. Past studies have used DEA results as the final deterministic criterion to evaluate and prescribe interventions for the specific organizations being investigated. Our objective is to draw inferences of study findings that go beyond the immediate sample in order to advance a more general multilevel contingency theory of designing headquarters-subsidiary relations.

**Field Research Setting**

This research is part of a larger longitudinal study of organizational integration in a large Midwestern managed healthcare system in the U.S. This system emerged as a vertically-integrated healthcare provider
(with 20,000 employees and $2 billion revenues) through a merger in 1994 of 15 hospitals, about 50 primary care clinics, a variety of homecare and ancillary services, and several health insurance plans that cover over one million people. From 1994 to 2002, our study tracked the formation and integration of the system’s medical group of primary care clinics.

This group practice was founded in 1994 with 20 clinics that were owned by Midwestern’s parent hospitals at the time of the merger. During its first few years, the group grew rapidly by acquiring 30 additional primary care clinics for strategic reasons of providing geographical coverage of the regions served by the group’s sister health plan, while others were acquired to provide primary care and patient referrals to Midwestern’s hospitals. During this acquisition period, the group experienced rising costs as it struggled with integrating its new clinics. By the end of 1996, the group’s management attention shifted from growth by acquisition to organizational integration of its now 50 clinics with 450 physicians and over 3000 employees. From 1997 to 1999, group top managers focused on introducing standardized clinic operating procedures, increasing clinic financial performance through various cost reduction and revenue generating initiatives, improving clinical quality and patient satisfaction, and strengthening employee morale.

The group developed and implemented many policy and procedural changes in all of its clinics during the study period examined in this report. They included uniform and consolidated patient billing, supplies purchasing, equipment maintenance, laboratory services and other related administrative functions. These changes required clinics to sever some old vendor relationships and develop new relationships and sometimes to let staff go who had provided these functions within the clinics. With extensive physician input, several clinical group-wide initiatives were also undertaken, such as clinical care quality improvement, drug formularies, and risk management programs. Clinic managers and physicians were charged with developing new documentation and data collection systems and modifying previous practices to comply with new clinical quality and risk management standards. To promote equity in compensation and improve productivity in all clinics, a uniform compensation system for all clinic employees was adopted, and a standardized physician productivity metric was implemented based on an industry standard of relative value per unit of care (RVU). Managers in the clinics had to adjust their previous human resource practices to match new group-wide standards, while physicians had to adjust to a different kind of performance.
measurement and compensation system than they had experienced before. Group managers consolidated some previously stand-alone clinics to decrease operating expenses, requiring clinic staff and physicians to accommodate to new locations and new working relationships. The group also adopted some new operating procedures designed to improve patient satisfaction and care quality, such as a system allowing same-day scheduling for patients and an automated electronic medical record. Clinics were charged with assembling teams to implement these new initiatives. Finally, the group practice negotiated a uniform payment reimbursement contract with health insurance companies that treated all clinics as one provider. This represented a major change from the previous procedure where individual (and more-or-less powerful) clinics negotiated their own reimbursement contracts with health plans. These are just a few of a myriad of changes that the medical group and its clinics implemented from 1997 to 1999.

This field setting provides an ideal opportunity to examine if and how these group-level policy changes are related to the organization and performance of subsidiary clinics that are serving diverse patients in local communities. This report examines the two-year 1997-1999 time period when most of the group integration initiatives mentioned above began and concluded. Of course, we cannot measure the influence of each of these macro policy changes on clinics. Instead, as discussed below, we view the cumulative effects of all macro group policies as producing the total change observed in the group performance frontier for all the clinics during the two-year study period. We then examine how this group frontier change differentially affects clinic performance.

Data Collection

Data on the clinic variables were collected in the Fall of 1997 and again in the Fall of 1999. In each wave, the data came from three different sources. First, we were given access to patient satisfaction surveys that were conducted in 1997 of 7,700 patients and in 1999 of 8,000 patients who were served by the primary care clinics. The group practice contracted with an independent healthcare survey organization to conduct the patient satisfaction surveys. After cleansing the data of any patient identification information, the vendor provided us a copy of the patient satisfaction surveys for each clinic. Second, data on clinic environmental characteristics and economic performance were obtained from organizational records. Third, we designed and conducted questionnaire surveys and obtained responses from about 1,000 employees of all clinics in
1997 and 1999 that included measures of perceived quality of health care and the other variables in our model in Table 1 of headquarters-subsidiary relations.

The specific sample of organizational units examined in this study consists of 32 primary care clinics\(^1\) that are owned by the large managed care organization. Given the relatively small number of clinics for statistical analysis, we had to restrict the scope of our data analysis and model by selecting the fewest number of clinic input and outcome variables in our DEA model.

**DEA Model Variables**

Specifying an empirical DEA model of key clinic inputs and performance outcomes is the first and perhaps most important step in the research process. Model misspecification results in selecting the wrong organizational units on and off the frontier and irrelevant findings for theory and practice. To decrease this likelihood, we collaborated with managers and lead clinicians of the medical group practice to develop an empirical model of clinic input and outcome variables that the managers used to evaluate clinic performance. This involved a series of meetings, including about three with top managers of the group practice, another meeting with district managers and medical directors, and a review session with clinic managers. The DEA model that the managers and researchers jointly developed to assess the performance of clinics is the following:

Maximize: Business Care (clinic productivity & net income) and Patient Care (patient satisfaction & care quality) subject to clinic resources (size), and for different levels of environmental complexity (patient mix).

These clinic input and performance measures are now described.

*Clinic Input Conditions.* Clinic resources (size or number of employees) was chosen as the key input factor in the DEA model for clinics serving a broad and focused mix of patients (our indicator of environmental complexity). Clinic size was selected as the major resource input factor because labor costs account for about 80 percent of annual clinic operating costs. Using size as the input variable, the DEA analysis identifies the relative performance of clinics in terms of those that accomplish the most with the resources they have. In addition, studies over the years indicate that size is perhaps one of the best overall

\(^1\) Due to missing data and combined organizational accounting statements for some clinics, some of the 50 clinics in our initial sample had to be removed for this analysis.

With regard to environmental complexity, clinic managers and physicians emphasized the importance of the mix of patients served by different clinics. An internal organizational study found that there were large differences in demands on clinics that served a broad versus narrow mix of patients. The study characterized patients of broad or heterogeneous clinics as “option seekers” (where 58% of all patients are shoppers, basing decisions on urgency, convenience, and cost). In contrast, the patients served in more focused or homogeneous clinics were referred to as “relationship seekers” (42% want long-term relationships). Medical group managers observed that smaller clinics appear more efficient and effective, but that may be due to their serving a more homogeneous set of patients. Larger clinics that serve a greater proportion of option-seekers stay open longer hours (resulting in higher overhead and staffing costs), provide urgent care and more diverse services, and deal with patients who are not easy to keep satisfied. With the assistance of the group practice managers and physicians, we classified the environmental complexity of primary care clinics in this sample into two groups based on whether they serve a broad or focused mix of patients.

Clinic Outcome Performance. Medical group managers and physicians selected two composite measures of clinic performance: patient care and business care. As Table 2 indicates, patient care is the average of patient satisfaction and staff courtesy (measured with eight and four items, respectively, in a patient survey conducted by an independent research firm) and clinical quality care (measured with five items in a survey completed by clinic healthcare providers). Business care is the average of clinic productivity (measured from organizational records as the number of standardized clinical services (RVUs) per clinic provider) and clinic net income (measured as net revenue per clinic provider from organizational records). Group practice managers confirmed the relevance of these performance measures. They reported using these measures in their performance appraisals of clinics and physicians within the clinics.

-- Insert Table 2 on measurement about here. --
Measures of Clinic-Group Relations Model

As Table 2 shows, we measured four dimensions of clinic-group relations: clinic autonomy, clinic-group interactions, group work standardization and headquarters-subsidiary integration. These dimensions were defined and measured as follows.

1. **Clinic Autonomy** is defined as the extent to which clinic employees (physicians, nurses, and staff) perceive they exercise discretion or influence decisions about what work to perform, how work is performed, and developing work policies or procedures. Survey questions for measuring these three decisions were adapted from Van de Ven & Ferry (1980).

2. **Work Standardization.** As noted above, during the period of study group practice management introduced a variety of policies and procedures that all clinics were to follow. Our measure of standardization captures the combined effects of how these group policy changes influenced the formalized structuring of work in clinics. As Table 2 indicates, work standardization was measured with four survey questions dealing with the clarity, degree, number, and enabling of work rules and procedures. Three of these items come from Van de Ven & Ferry (1980).

3. **Clinic Group Interactions** is a measure of informal clinic-group relations that is tailored to individual clinics and not specified by group policies (Dooms & van Oijen, 2008, p. 247). It was measured as the degree of perceived interdependence and communications between individual clinics and group headquarters with the five survey items outlined in Table 2.

4. **Headquarters-subsidiary Integration.** Creating an integrated medical group practice out of many previously independent clinics was a major objective of group managers. Nearly bi-weekly meetings and semi-annual retreats of clinical and managerial employees occurred during the study period that featured discussions of group culture, shared norms, and integrative synergies. These meetings provided an informal mechanism for group coordination and integration. The survey included ten questions outlined in Table 2 for measuring the perceived degree of headquarters-subsidiary integration.

The right column of Table 2 shows the inter-item reliabilities (coefficient alpha), the intra-class correlations (ICC(1)) (Bliese, 2000), and the within-clinic inter-rater reliabilities ($r_{wg}$) (James, Demaree, &
Wolf, 1984) for the four organizational dimensions. The alpha values for the four constructs range from .68 to .86, providing good evidence of reliabilities among items used for measuring the four constructs. In addition, the inter-rater reliability estimates with $r_{wg}$ among all informants within clinics are clearly in an acceptable range from .73 to .94. Moreover, the ICC(1) values (ranging from .42 to .46) are significant and comparable to the median ICC(1) values of aggregated constructs reported in the organizational literature (see Bliese, 2000 and Zellmer-Bruhn & Gibson, 2006).

Table 3 presents the results of a confirmatory factor analysis of the 21 survey items that were used to measure the four organizational dimensions. The table shows the structure matrix produced by a principal components analysis using an oblimin rotation procedure with Kaiser normalization. The results show strong evidence of convergent and discriminant validities. All items intended to measure one of the four organizational constructs converge with high loadings on a single factor and clearly discriminate by having low loadings on all other factors. The four factors explain about 60 percent of the common variance, and each factor contributes a substantial percentage to this cumulative common variance.

DEA Performance Analysis

DEA was performed on the sample of clinics measured in 1997 and then again on data collected in 1999. As explained in the Appendix, DEA computes the efficiency of clinics (called decision-making units (DMU) in the DEA literature) with the following equation:

$$\text{Maximize } E_u = \frac{\sum_{s=1}^{s} y_{ru} O_{ru}}{\sum_{i=1}^{m} x_{iu} I_{iu}} \cdots \cdots (1)$$

where $u$ represents the units of DMU; $E$ represents performance efficiency; $I$ and $O$ represent respectively all inputs and outputs for each DMU; and $x$ and $y$ represent the weights assigned to each input and output. These weights are chosen in such a way that the DEA efficiency ratio is maximized for each DMU in the interval [0, 1]. As Figure 1 illustrates, this frontier bounds (“envelops”) the remaining data points from above, and the interior observations of DMUs below the frontier receive non-negative scores less than 1 based on their proximity to the frontier. (Bryce, Engberg & Wholey, 2000, p. 513).
As noted before, we follow two methodological procedures to analyze the DEA model and the clinic-group design model. First, we use the DEA procedure to identify the organizational units on a best-performance frontier as discussed in the Appendix. Applied to our longitudinal data, we compute a Malmquist Index developed by Fare, Grosskopf, Norris & Zhang (1994) to determine what parts of changes in unit DEA productivity are due to endogenous efforts of organizational units (often called ‘managerial’ efficiency) and to exogenous shifts in the environment or macro-organization (also called ‘policy’ efficiency by Thanassoulis, 2001). Subsequently, we use these DEA results as the dependent variables to analyze the clinic-group relations model using a standard regression-based model and to examine how organizational units adapt over time in their relative positions on or off the best performance frontier and how this frontier changes over time to produce Red Queen dynamics.

Findings

Descriptive Statistics

Table 4 shows the correlations among clinic performance measures of business and patient care. As expected, the two measures of business care are significantly correlated, as are the three indicators of patient care. The table also shows very low correlations between the measures of patient and business care. This latter finding was gratifying to clinic physicians and managers who feared that clinic cost-cutting efforts were compromising patient care quality. They indicate that clinic business care and patient care are independent; advancing one outcome does not decrease or increase attaining the other desired outcome in this sample of clinics.

-- Insert Tables 4 and 5 about here. --

Table 5 presents a comparison of the clinics serving a broad (heterogeneous) versus focused (homogeneous) mix of patients. The table shows that the two groups of clinics are significantly different in terms of size, patient care and group frontier change, but not in terms of organizational design, business care, and clinic DEA performance change over time. (These DEA performance measures are discussed below). On average, clinics with a more complex heterogeneous mix of patients are larger (staffed with about 58 clinicians) than clinics serving a less complex and homogeneous mix of patients (with 27 employees). The
more focused mix of patients in these clinics tend to serve OB/GYN for expectant families, or patients with diabetes and other chronic diseases, or more acute needs of elderly patients. In addition to these kinds of patients, the broad clinics also serve a more heterogeneous array of patients and families seeking less acute and chronic health care services, such vaccinations, medical checkups, colds, flues, cuts, scrapes and drug prescriptions. Because they have medical conditions requiring long and repeated care, a greater proportion of patients in focused clinics seek a long-term relationship with their “own” doctor, while more patients of broad clinics seek immediate, competent and comprehensive health care services when it is convenient for their busy work and family schedules.

Clinic site visits by the researchers revealed that the more complex broad (compared to focused) clinics were not only larger but much busier with full waiting rooms and a constant buzz of clinicians and patients going in all directions. Given these different patient expectations and practices, the findings in Table 5 are not surprising that patients served by less-complex focused clinics are more satisfied with their care, perceive clinic staff as more courteous, and staff perceive they provide a higher quality of health care than broad clinics. The insignificant statistical differences between broad and focused clinics on organizational and business care dimensions may be due to the much greater standard deviations in these dimensions among focused clinics than among broad clinics. When reporting these findings, managers of the clinic group practice stated that the cost structure of focused clinics was lower than broad clinics. They referred to an internal study by the health insurance plan (a sister division of the Midwestern system) that found that the per-member per-month cost of the average patient served in the broad-mix clinics was $153, while it was $98 in the focused-mix clinics. These observed differences between the two types of primary care clinics provide an ideal natural field setting to examine how uniform macro-organizational policies might have differential effects on the performance of subsidiary clinics depending on their type.

**DEA Analyses Results**

Following Thanassoulis (2001), we evaluated clinics’ efficiency in two DEA steps. The results of these two steps, repeated in each time period (1997 and 1999), are reported in the columns, labeled “DEA-Step 1” and “DEA-Step 2” in Table 6. Step 1 evaluates each clinic’s efficiency in comparison with clinics serving the same type of patient mix (i.e., either broad or focused types), while Step 2 reports each clinic’s
efficiency in comparison with all types of clinics in the sample. In terms of an adaptiveness landscape metaphor, the DEA-Step 1 compares the relative performance among clinics located on their own design hill, while DEA-Step 2 compares the relative performance among clinics located on all (both broad and focused) hills.

-- Insert DEA results in Tables 6 about here. --

As the DEA Step 1 columns show in both time periods, each design group has its own best-performing clinics. Clinics with DEA efficiency ratings of 100 in Tables 6 are on the best performance frontier for this sample, while the DEA scores of clinics with DEA effectiveness ratings lower than 100 indicate how far the clinics are off the frontier (relative to their best-performing peers). In time 1, clinics C23, C24 and C31 were on the frontier among broad clinics; whereas C17, C32, C41 and C57 were on the frontier among focused clinics in that year. Two years later clinics C14 and C31 were on the frontier among broad clinics; whereas C17, C32, C42 and C60 were on the frontier among focused clinics in that year. Only clinic C31 among broad patient care clinics, and clinics C17 and C32 remained on the frontier in both years, while other clinics came on and fell off the frontier relative to their cohorts.

-- Insert scatter plot in Figure 2 about here. --

The relative performance efficiency of broad and focused clinics operating in complex and simple environments (respectively) in each year is indicated in the DEA Step 2 columns of Tables 6. The Table shows that focused clinics have higher DEA efficiency scores than do the clinics serving a broad mix of patients. In fact, not one broad clinic has a DEA efficiency score that exceeds the lowest-performing focused clinic. This is shown in Figure 2, which plots the clinics on their DEA-Step 2 scores in 1997 and 1999. As the figure shows, there are dramatic DEA performance differences between broad and focused clinics in both time periods. Equally clear from the figure is the close clustering among broad clinics in the low DEA efficiency range, and the even closer clustering among focused clinics in the high performance range in 1997 and 1999. The correlation between times 1 and 2 DEA efficiency for all clinics is .97 (statistically significant), while it is only .33 among clinics within each design type.
As these data suggest, while there is some shifting in DEA performance among clinic peers of each type, the relative performance of all clinics remained the same during the study period. Focused and broad types of clinics are located on different organization design hills of our metaphorical landscape, with the focused design hill much higher in performance than the broad clinic design hills. In terms of red queen competitive dynamics (Barnett and Sorenson 2002; Derfus, et al 2008), the clinic managers may have “run as fast as they could for two years, and then found their performance relatively unchanged.” As we now examine, this may be a result of the endogenous efforts and capabilities of clinic managers, and/or it may be due to exogenous policy or environmental reasons that are beyond immediate control of clinic managers.

**Findings on Endogenous and Exogenous Components of Clinic Performance**

The last three columns of Table 6 report the values of the Malmquist Index in terms of change over time in each clinic’s productivity that is attributable to the clinic’s endogenous efficiency and its exogenous frontier. The clinic’s endogenous efficiency change consists of the change in the clinic’s performance with respect to its peers of the same clinic type, while the clinic’s exogenous efficiency change consists of the change in the clinic’s performance with respect to all the clinics in the sample. See the Appendix for computations. The correlation between endogenous efficiency change and exogenous frontier change is -0.14, statistically insignificant. This finding rejects hypothesis 1. Contrary to expectations, in this sample of clinics no positive relationship exists between the components of clinic performance that are due to endogenous managerial efforts within the clinics and exogenous macro policies at the group level. Instead, endogenous and exogenous components of clinic performance are unrelated and in a slightly negative direction. This low correlation may be due to the absence of a relationship between group and clinic performance, or it may be due to a wash-out effect of group-level policy changes benefiting the performance of some clinics and hurting others.

To examine these possibilities, we plot all clinics in terms of clinic efficiency change, group frontier change and total productivity changes from 1997 to 1999 (i.e., the right three columns of Table 6) on the 3-dimensional graph in Figure 3. The graph shows that all of the more complex clinics serving a broad patient mix lie to the left and all of the less complex focused clinics with a homogeneous mix of patients lie to the right of the line separating the clinics on group frontier change. The figure shows that changes over time in
endogenous clinic performance varied from a 40 percent decrease to a 60 percent increase among both focused and broad clinics. With respect to group frontier changes, however, it is clear that all focused clinics lie along the positive range (from 10 to 40 percent increases), while all broad clinics are in the negative range (from 0 to 20 percent decreases) in group frontier changes. These data show that the focused clinics uniformly benefit much more from exogenous group frontier changes than do their counterparts who serve a broad mix of patients.

---Insert Figures 3 about here---

These results might lead managers to decide to change the design of clinics from serving a broad to narrow mix of patients. This conclusion, however, does not take into consideration the performance risks in making such design changes. The peaks and troughs in the changing performance landscape of the clinics in Figure 3 suggest that the performance volatility or risk of focused and broad clinics is not the same. Changes in the size and locations of performance peaks and troughs of clinics in Figure 3 call attention to such risks. The organizational design of focused clinics reaches a higher performance peak, but also has a deeper trough of performance declines than that of the broad clinics. In other words, the focused organizational design that has the greatest total productivity gains also has the highest total productivity losses over the same time period and in the same sample of clinics.

The organization design literature has largely ignored the risks associated with changing organizations. Organizational ecologists, of course, have highlighted the liabilities of organization change due to inertial forces (Stinchcombe, 1965; Hannan & Freeman, 1977; 1989). Organizational inertia, however, is different from risk. Whereas inertia focuses on the difficulties or rigidities of changing organizations, risk deals with the likelihood of alternative consequences of changing organizations regardless of the difficulties of doing so. Theories of risk are prominent in finance literature (e.g., Gollier, 2001), and volatility is the commonly-used indicator of risk in this literature. The greater performance volatility of focused versus broad clinics shown in Figure 3 calls for an examination of the risk-return tradeoffs of changing different kinds of organizational designs. While switching from broad to focused designs may increase the likelihood of higher total clinic productivity gains, it comes at the risk of experiencing greater productivity losses. As a
consequence, the return-to-risk ratio of the broad clinic design may not be inferior to that of the focused clinic design

The organizational complexity literature (e.g., Levinthal and Warglein, 1999; Anderson, et al, 1999; Siggelkow, 2001) that models organizational adaptiveness on changing landscapes using Kaufman’s NKC model also does not address this risk, for it assumes a base of zero or higher performance to a design hill, and does not entertain negative valleys or troughs in a performance landscape. In effect, these organizational simulation models right-censure simulation data to zero or greater performance of alternative design hills, and thereby forfeit the opportunity to examine the risk-return tradeoffs of alternative organizational designs (Elton & Gruber, 1997).

A literature on organization design that begins to touch on this risk-return tradeoff is complementarity theory, which suggests that during organization change, performance may reflect a steep decline for several periods and then improves slowly with time (Milgrom & Roberts 1995; Whittington & Pettigrew 2003). The peaks and troughs in Figure 3 suggest that this curvilinear relationship may be possible if clinics change from the broad to the focused type. However, as Figure 2 shows, no shifts between broad and focused clinic designs were observed during the study period.

Our study suggests (but does not demonstrate) that a multi-level explanation of the risk-return tradeoff is needed. Significant organizational changes may not be within the endogenous capabilities of organizational subsidiaries or subunits. Other studies indicate that exogenous interventions are often needed for organizational units to undertake radical changes (Virany, Tushman & Romanelli, 1992; Van de Ven, Polley, Garud & Venkataraman, 1999). This may explain why the clinics in our sample did not change from serving a broad to focused mix of patients. No exogenous macro policy decision and resource investments occurred to make it feasible for the clinics to undertake this transformative change. As a consequence, as we will now see, the broad clinics did the best they could with their endogenous (but limited) resources and capabilities to adapt to changing conditions in serving their heterogeneous mix of patients. Focused clinics did the same and performed better collectively as a result of the performance benefits they received from exogenous group-level frontier changes.
Findings on Model of Headquarters-Subsidiary Relations

Finally, we examine hypotheses 2-4 in our multi-level contingency model of headquarters-subsidiary design. As discussed before and illustrated in Table 1, we expect the unit differentiation dimensions (clinic autonomy and clinic-group interactions) to influence the endogenous component of clinic performance that is attributable to clinic managerial efforts, while the group integration dimensions (standardization and headquarters-subsidiary integration) to influence the exogenous component of clinic performance that is attributable to changes in group frontier. Table 7 shows the results of two regression analyses of these organizational dimensions on the endogenous and exogenous components of clinic performance changes. The equations also include a control variable for patient mix (broad or focused) in order to capture the influence of environmental complexity that featured prominently in the preceding DEA analysis.

--Insert Table 7 about here--

The first regression equation in Table 7 examines the effects of unit differentiation dimensions (clinic autonomy and clinic-group interactions) and group integration dimensions (standardization and headquarters-subsidiary integration) on the endogenous change in clinic performance. Partially supporting hypothesis 2, the results suggest that increases in clinic autonomy have a significant positive effect on the endogenous change in clinic performance while group-integration dimensions (standardization and headquarters-subsidiary integration) have no significant effect on the endogenous change in clinic performance. Contrary to hypothesis 2 however, the results suggest that clinic-group interactions have a significant negative effect on endogenous change in clinic performance. As an indicator of informal clinic-group coordination, we expected clinic-group interactions to be a mechanism for tailoring headquarters-subsidiary relations to serve the particularistic needs of local clinics as Dooms & van Oijen (2008) found. Instead, the data suggest these clinic-group interactions hampered clinics’ efforts to achieve the highest performance changes given their resources.

The second regression in Table 7 examines the effects of unit differentiation dimensions (clinic autonomy and clinic-group interactions) and group integration dimensions (standardization and headquarters-subsidiary integration) on the exogenous change in clinic performance or group frontier change. Partially
supporting hypothesis 3, the results suggest that increases in headquarters-subsidiary integration have a significant positive effect on the exogenous change in clinic performance while clinic autonomy has no significant effect on the exogenous change in clinic performance. Contrary to hypothesis 3, the results suggest that clinic-group interactions has a significant negative effect on the exogenous change in clinic performance while standardization has no effect the exogenous change in clinic performance.

Hypothesis 4 predicted that clinic environmental complexity moderates these relationships. Unfortunately, we do not have sufficient degrees of freedom to add interaction terms in our regression equations to test this hypothesis. As an alternative, we examine the simple correlations for clinics serving a simple (focused) versus complex (broad) mix of patients. Table 8 shows the correlations among clinic autonomy (a dimension of subsidiary differentiation) and standardization (a dimension of headquarters integration) with endogenous and exogenous changes in clinic performance. The correlations are in the directions hypothesized by our multi-level contingency model. As expected, clinic autonomy is positively correlated with the endogenous change in clinic performance and negatively correlated with the exogenous change in clinic performance or group frontier change for broad complex clinics, but uncorrelated for simple focused clinics. Conversely, group standardization is strongly correlated with both endogenous and exogenous performance changes for simple focused clinics, while these correlations are very low for complex broad clinics.

These results remind us of the principle of opposite part-whole relationships (Simmel, 1955; Dahrendorf, 1979; Astley & Van de Ven, 1983). Many organization design problems and relationships manifest themselves in different and contradictory ways at different organizational levels. At the micro level, the focus is on the particularistic needs of patients served by local community clinics and on the autonomous discretion of clinicians to decide how best to enable this. This clinic autonomy does not necessarily advance macro group level objectives where the focus is on strategic policies, structural arrangements and building an integrative culture. Moreover, the substantive effects of clinic design factors can be different for different kinds of clinics, depending on their structure and patient-mix.
Concluding Discussion

This paper advanced a multi-level organizational contingency theory that takes into account the differential impact of headquarters policies and subsidiary managerial efforts on subsidiary performance. Our paper built on the contingency theory view of designing headquarters-subsidiary relations by proposing that organization performance increases when subsidiary units are designed to differentially fit their local environments subject to corporate constraints. An important contribution of this research is that it addressed three thorny problems with this contingency theory proposition: (1) satisfying multiple and often conflicting dimensions of organizational context, design and performance at micro and macro levels, (2) disentangling what parts of the performance of organizational units are attributable to endogenous and exogenous factors, and (3) examining dynamic patterns of organizational adaptation on changing fitness landscapes over time. These problems have hampered advancements in organizational contingency theory in general and headquarters-subsidiary relationships in particular. To move beyond the limits of arm-chair theorizing, we took an empirical approach using frontier analysis to deal with these challenges.

Based on our longitudinal study of a large medical group practice of 32 local community clinics, we used Data Envelopment Analysis (DEA) in order to determine the clinics that best achieve a set of desired performance criteria subject to their resource constraints and environmental complexity. This provides an analytical way to address the first problem of identifying comparable organizational units and determining how well they satisfy multiple and often conflicting environmental demands and performance criteria. It also provides a direct way to empirically identify the best-fit ideal type units that are necessary for testing contingency theory. DEA does this by identifying the outlying most adaptive or fit units in a sample that define the contours of a best performance frontier and from which the relative distance of other less-adaptive units can be determined.

We showed how the DEA method of frontier analysis provides a systematic way to disentangle endogenous and exogenous components of unit performance. This is crucial for addressing the second thorny problem in designing headquarters-subsidiary relations – difficulties in assessing fit across micro and macro levels of organization design. Organization change and performance are simultaneously subject to macro and micro forces that may differ in direction and degree. Without a method of partitioning unit performance into
its endogenous and exogenous components, one cannot study the relative influence and interactions of units at different levels in a nested organizational hierarchy. We have shown how the two-step DEA process and the Malmquist index provide ways to partition unit adaptiveness at a given time and performance changes over time into endogenous and exogenous components which also addresses the third problem of examining the dynamic patterns of organizational adaptation on changing fitness landscapes over time.

This methodology provided the opportunity to make an important substantive contribution of developing and examining a multi-level model of headquarters-subsidiary relations. The model predicted that clinic autonomy and interactions with the group would most directly influence the endogenous component of clinic performance change, while group standardization and headquarters-subsidiary integration would predict the exogenous component of clinic performance change. We also hypothesized that local environmental complexity moderates these relationships. The data provided some support for the model. As expected, clinic autonomy was a significant positive predictor of endogenous clinic performance change but unrelated to exogenous group frontier change. From a macro view, headquarters-subsidiary integration or shared values was a significant positive predictor of exogenous group frontier change but unrelated to endogenous clinic performance change. Contrary to expectations, however, standardization was not a significant predictor of group frontier change, and clinic-group interactions was a significant negative predictor of both clinic endogenous and exogenous performance change.

Overall, however, these findings clearly show that different organizational dimensions influence different sources of organizational performance under different environmental conditions. This finding is important, for the literature tends to assume that all organizational design variables must fit together both internally and externally (Donaldson, 2001). For example, configuration theory proposes that organizational structure, systems, culture, incentives, and strategies must all be internally coherent and fit environmental demands (Meyer, Tsui, & Hinings, 1993; Nadler and Tushman, 1999). Our research findings suggest a more complex model is needed – one that anticipates how different organizational characteristics are designed to accomplish different criteria or components of organizational performance.

We found that the correlation between the endogenous component of clinic performance or efficiency change and the exogenous component of clinic performance change or frontier change was only -
While not statistically significant, this finding calls into question the commonplace expectation that micro and macro organizational performance are positively related in a complementary manner rather than being independent of each other or negatively related such that one level is sacrificed for the other. We found that the small correlation was the result of a cancelling-out effect where some clinics were helped and others hurt by changes in the group performance frontier over the two year study period. We observed that performance changes in group frontier only benefited the focused clinics serving a homogeneous mix of patients and not the general clinics serving a heterogeneous mix of patients. The latter gained no performance benefits from macro policy frontier changes over time. By contrast, focused clinics gained significant productivity benefits from both exogenous frontier and endogenous clinic changes.

This finding has important implications for organizational performance appraisals. Because the benefits and costs of corporate policies on organizational subunits are seldom known or turn out as intended, they also tend to be overlooked in performance assessments of organizational units. This is especially so when it is difficult to attribute what aspects of observed changes in performance of organizational units are due to macro-organizational policies or unit-specific factors. As a result, the units benefiting from organization-wide policies tend to be unfairly rewarded for performance improvements that are not the result of their own efforts, while other units disadvantaged by uniform policies tend to be disproportionately reprimanded for performance declines produced through no fault of their own.

During the study period, we found that clinics with a focused design showed significantly higher and lower performance changes than clinics serving a broad mix of patients. The organizational designs with the highest performance peaks also have the lowest performance declines. This volatility of performance changes is illustrated in Figure 3, from which we drew the inference that some organization designs are more risky than others on a changing performance landscape. This volatility of performance changes calls attention to the risks associated with changing organizational designs. We noted that while organizational inertia (i.e., the difficulties of change) has received considerable attention, the risks (i.e., likely performance consequences) of changing organizational designs have been largely ignored. We think an important future direction in studying organizational change is to incorporate theories of risk in designing organizations.
Donaldson (1999) has made an effort in this direction. Drawing on portfolio theory in finance, he proposed that certain environmental factors (e.g., business cycle) and internal organizational characteristics (e.g., diversification) affect the level of performance risk (performance fluctuation) and that a greater level of risk makes an organization more likely to change. Donaldson (1999) also links risk across organizational levels by suggesting that a subsidiary’s performance risk, which arises from local industry characteristics, contributes to the risk of the overall organization.

Following Donaldson (1999), we think that designing headquarters-subsidiary relations requires consideration of the different risks and returns of design changes at different organizational levels. For example, we observed no instance of any clinic in our sample changing from serving a broad to focused mix of patients. In terms of a fitness landscape metaphor, broad and focused clinics occupy different design hills, compete with one another to be the ‘king or queen of their hill,’ but did not engage in hill jumping. The latter represents a major design change that may not be within the endogenous capabilities of organizational units. Clinics may not have changed their designs because no exogenous macro policy decision or resource investment occurred to make it feasible for the clinics to undertake transformative change. Unlike many organizations where headquarters adopt contingent policies that are implemented differently in selective subsidiaries, the medical group examined here focused on developing and implementing its macro policies uniformly across all of its clinics.²

But the fact that no clinic-contingent policy interventions were observed does not imply that the medical group had no effects on its clinics or that the observed associations are just random perturbations. The latter, of course, is the null hypotheses that we believe has been rejected by our study data. The Field Research Setting section described numerous headquarters policies and procedures that the medical group implemented in all of its clinics during the study period. While we cannot measure the effects of individual group interventions on clinics, we argued that the cumulative effects of all macro group interventions produced the changes observed in the group performance frontier. Our statistical analysis showed that this group frontier change benefited focused clinics and unintentionally hurt the performance of broad clinics.

² Including such contingent macro policies increases the complexity of correctly specifying a DEA model of headquarters-subsidiary relations. However, the steps in the DEA methodology would be similar to our treatment of broad and focused clinics in this study.
Moreover, the regression analyses indicate that the clinic-group relationships were not totally random perturbations. Indeed, our measures of clinic-group relations explained 36% and 85% of the variation in clinic endogenous and exogenous performance changes, respectively (shown in Table 7).

Finally, while we believe our study findings generalize to a theory of headquarters-subsidiary relationships, a major limitation is that they are limited to, and cannot be generalized beyond the sample of organizational units observed. Our sample of medical group clinics may be unique in certain respects (such as the group’s uniform treatment of clinics and the different demands on clinics serving a broad versus focused mix of patients). In addition, our small sample of 32 clinics of one group practice limited abilities to systematically examine the organizational design configurations of clinics moving on and off the frontier over time. We think that limited generality of research findings is a necessary tradeoff for developing a more penetrating understanding of organization design in real-world settings. As other studies in different contexts accumulate, meta-analysis projects can provide opportunities to examine the generality of research findings across samples and contexts of organizations.
References


Appendix: Computation of DEA Efficiency and Malmquist Index

Data Envelopment Analysis (DEA) is a non-parametric frontier estimation method that was developed by Charnes and Cooper (1962) and Charnes, Cooper, and Rhodes (1978). Banker, Charnes, and Cooper (1984), Banker, Charnes, Cooper, Swarts and Thomas (1989), Charnes, Cooper, Lewin, and Seiford (1994). DEA contrasts with Stochastic Frontier Analysis (SFA), which is another major form of frontier analysis. Most importantly, SFA assumes that some random elements in an efficiency analysis follow stochastic distributions and can be specified; DEA is deterministic and does not make this assumption. Thanassoulis (2001) provides an informative introduction to DEA.

DEA computes the performance (or efficiency) of the decision-making units (DMUs) in question with the following equation:

\[
\text{Maximize } E_u = \frac{\sum_{r=1}^{s} y_{ru} O_{ru}}{\sum_{i=1}^{m} x_{iu} I_{iu}} \quad \text{subject to} \quad \sum_{s=1}^{s} x_{ru} \leq 1; \forall u; \text{ and } \sum_{i=1}^{m} y_{iu} \leq 1; \forall i \quad \text{for all DMUs} \quad (1)
\]

where \( u \) represents the units of DMU; \( E \) represents performance; \( I \) and \( O \) represent respectively all inputs and outputs for each DMU; and \( x \) and \( y \) represent respectively the weights assigned to each input and output.

Two constraints are placed on this DEA equation (1) to allow for optimization and comparison purposes: (a) the assigned weights cannot be negative, and (b) any assigned weight for a specific DMU can be applied across all DMUs so that it will not lead any DMU to achieve an efficiency ratio greater than one. These constraints also avoid infinite results due to weight assignments. Formally:

\[
\begin{align*}
x_{ru} & \geq 0; r = 1, \ldots, s \\
y_{iu} & \geq 0; i = 1, \ldots, m \\
\text{and} \\
\frac{\sum_{s=1}^{s} y_{ru} O_{ru}}{\sum_{i=1}^{m} x_{iu} I_{iu}} & \leq 1; \forall \text{DMUs} \\
\end{align*}
\]

(2) and (3)

Given the above constraints, DEA uses a linear programming algorithm to compute \( x \) and \( y \) (the weights). Specifically, we adopted a non-parametric, deterministic, output-based, variable-returns-to-scale
specification of the DEA model. This DEA model enables us to identify the clinics that maximize multiple outcomes (patient and business care) with the least amount of resource inputs (clinic size). The first step of this computed DEA score identifies the efficiency of each clinic relative to its comparable broad or focused cohort. The second DEA step estimates the relative efficiency all clinics together across all cohorts.

**The Malmquist Index**

Best performance frontiers are not static; they change over time (Sinha, 1996). This implies that the frontier is a moving target and that clinics move on and off the shifting frontier over time. Longitudinal analysis of DMUs (e.g. healthcare clinics) involves the use of the Malmquist Index, developed by Fare et al. (1994). The Malmquist Index (MI) assesses productivity change by considering the efficiency of a DMU (in comparison with other DMUs) in two different time periods according to the following equation:

\[
M.I. = \left[ \frac{\text{Efficiency of DMU}_j \text{ at Time}_1 \text{ with respect to Time}_1}{\text{Efficiency of DMU}_j \text{ at Time}_2 \text{ with respect to Time}_2} \times \frac{\text{Efficiency of DMU}_j \text{ at Time}_2 \text{ with respect to Time}_2}{\text{Efficiency of DMU}_j \text{ at Time}_1 \text{ with respect to Time}_1} \right]^{1/2}
\]

This equation computes a geometric mean of the efficiency change of a particular DMU at two different time points. In the above formula, the two terms “Efficiency of DMU$_j$ at Time$_1$ with respect to Time$_1$,” and “Efficiency of DMU$_j$ at Time$_2$ with respect to Time$_2$” are relatively straightforward. In our case, they are simply the DEA scores of a particular clinic in 1997 and 1999.

Methodological requirements of computing the MI assume constant returns to scale. While this is technically different from our DEA Steps 1 and 2 above, it does not affect our analysis substantively. The other two terms “Efficiency of DMU$_j$ at Time$_2$ with respect to Time$_1$,” and “Efficiency of DMU$_j$ at Time$_1$ with respect to Time$_2$” evaluate the efficiency of a focal clinic in one year with respect to all clinics (including the focal clinic itself) in another year.

An example of how the MI is computed, we examine the productivity change of clinic C1 in our sample. According to the above equation, we conduct four DEA runs and obtain the following four measures regarding clinic C1’s efficiency:

---

3 There are of course alternative ways to compute unit efficiency. Bryce, Engberg & Wholey (2000) compare three commonly-used approaches: DEA (as described here), stochastic production frontier (Aigner, Lovell & Schmidt, 1977), and fixed-effects regression. Based on data from 585 HMOs operating from 1985-1994, they find that the results from the three methods identify the same industry trends and those correlations of individual unit efficiency scores from the three methods vary from .67 to .79. While these results show high agreement, Bryce, Engberg & Wholey (2000) caution that the results are not identical because, indeed, the different methods are designed for different purposes.
Efficiency at 1997 (Time 1) with respect to 1997 (Time 1): 28.50
Efficiency at 1999 (Time 2) with respect to 1999 (Time 2): 13.50
Efficiency at 1997 (Time 1) with respect to 1999 (Time 2): 25.10
Efficiency at 1999 (Time 2) with respect to 1997 (Time 1): 15.10

MI for clinic C1 is therefore:

\[ M.I. \text{ for Clinic 1:} \, \sqrt{\frac{15.10}{28.50} \times \frac{13.50}{25.10}} = 0.53 \]

To facilitate interpretations, we subtract 1 from this number. Thus, total productivity change for clinic C1 is now -0.47. The negative sign indicates that clinic C1 experienced a decline in total productivity between 1997 and 1999. We perform this simple transformation for all the clinics in our sample, and the values are presented in the last column of Table 6.

Mathematically, MI can be decomposed into two components (that which is attributable to the DMU’s endogenous efficiency change and that due to an exogenous frontier policy or environmental change) (Fare et al. 1994). The first component is the ratio between Efficiency of DMU, at Time, and Time,:

\[
\left( \frac{\text{Efficiency of DMU, at Time}_2 \text{ with respect to Time}_2}{\text{Efficiency of DMU, at Time}_1 \text{ with respect to Time}_1} \right) &= \text{(or Clinic Efficiency Change)}
\]

The second component has a form very similar to the MI index, but there is an important difference: The denominator of the first term and the numerator of the second term interchange:

\[
\left[ \frac{\text{Efficiency of DMU, at Time}_2 \text{ with respect to Time}_1}{\text{Efficiency of DMU, at Time}_2 \text{ with respect to Time}_2} \right] \times \left[ \frac{\text{Efficiency of DMU, at Time}_1 \text{ with respect to Time}_2}{\text{Efficiency of DMU, at Time}_1 \text{ with respect to Time}_1} \right]^{1/2} = \text{(or Frontier Change)}
\]

The Malmquist Index is equal to the multiplication between these terms: MI = Clinic Efficiency Change times the Frontier Change. In the case of Clinic 1, its endogenous efficiency is 13.50/28.50 = 0.47.

Frontier change is \( \sqrt{\frac{15.10}{13.50} \times \frac{28.50}{25.10}} = 1.13 \). So its MI is 0.53 * 1.13. As mentioned, we subtract 1 from the original value. Thus, a positive MI value indicates an increase in productivity and a negative value indicates a decrease in productivity. The last three columns of Table 6 report the values of MI in terms of total productivity change, clinic’s endogenous efficiency change and exogenous frontier change for all clinics.
Table 1. Formal and Informal Dimensions of Headquarters-Subsidiary Relations

<table>
<thead>
<tr>
<th></th>
<th>Formal Dimensions</th>
<th>Informal Dimensions</th>
<th>Environmental Complexity</th>
<th>Expected Performance Effects</th>
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<tbody>
<tr>
<td><strong>Unit Differentiation</strong></td>
<td>Autonomy</td>
<td>Interactions</td>
<td></td>
<td>Endogenous</td>
</tr>
<tr>
<td></td>
<td>- Decentralization</td>
<td>- Interdependence</td>
<td></td>
<td>- That part of unit performance that is due to unit’s own action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Communications</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Corporate Integration</strong></td>
<td>Standardization</td>
<td>Integration</td>
<td></td>
<td>Exogenous</td>
</tr>
<tr>
<td></td>
<td>- Standardization</td>
<td>- Shared norms</td>
<td></td>
<td>- That part of unit performance that is due to corporate policies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Culture</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Table 2. Measurement of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measures</th>
<th>Alpha, ICC, Rwg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic Resources (size)</td>
<td>Number of full-time equivalent positions, from organization records</td>
<td></td>
</tr>
<tr>
<td>Clinic environmental complexity</td>
<td>Mix of patients served by a clinic, coded by group managers as broad (heterogeneous) or focused (homogeneous) mix of patients</td>
<td></td>
</tr>
<tr>
<td>Clinic productivity</td>
<td>The number of relative value units (RVU) of care per provider. The RVU is an industry standard established by Medicare to measure the units of patient care delivered by healthcare providers.</td>
<td></td>
</tr>
<tr>
<td>Clinic net income</td>
<td>Net revenue per provider, from organization records</td>
<td></td>
</tr>
</tbody>
</table>
| Patient satisfaction as perceived by patients served by clinic | Mean of eight items in patient survey conducted by independent research firm contracted by medical group practice:  
  1. chance to explain reason for visit  
  2. provider listened  
  3. received answers to questions  
  4. trust in provider  
  5. treated with respect  
  6. involved in treatment decisions  
  7. sufficient time with provider  
  8. provider courtesy | $\alpha = .84$                                                                                                                                  |                                 |
| Patients’ perceptions of clinic staff courtesy | Mean of four items in patient survey conducted by independent research firm contracted by medical group practice:  
  1. courtesy of appointment maker  
  2. courtesy of office staff  
  3. courtesy of telephone advice staff  
  4. rating of telephone advice received | $\alpha = .86$                                                                                                                                  |                                 |
| Patient care quality                          | Mean of five items in employee survey about the extent of agreement on following process indicators of quality of care provided to patients:  
  1. patients see same physician  
  2. clinicians meet to discuss patient care  
  3. patient information is available when needed  
  4. follow-up phone calls are made  
  5. patients are reminded when they need additional care | $\alpha = .74$                                                                                                                                  |                                 |
| Clinic autonomy                               | Mean of three items in employee survey about amount of influence in making decisions about:  
  1. what work perform  
  2. how work is performed  
  3. work policies and procedures | $\alpha = .80$  
  ICC(1) =.43*  
  Rwg = .73                                                                 |                                 |
| Work standardization                          | Mean of four items in employee survey about the extent to which:  
  1. work is clearly defined  
  2. work requires following rules and procedures  
  3. number of rules and procedures to follow.  
  4. rules make work easier | $\alpha = .68$  
  ICC(1) =.41*  
  Rwg = .85                                                                 |                                 |
| Clinic-Group Interactions                     | Mean of five items in employee survey about:  
  1. clinic’s dependence on group  
  2. group’s dependence on clinic  
  3. frequency of communications with people in group  
  4. how often work with people in group  
  5. frequency of meetings with people in group | $\alpha = .84$  
  ICC(1) =.46*  
  Rwg = .74                                                                 |                                 |
| Headquarters-subsidiary integration           | Mean of ten items in employee survey about the extent to which the medical clinics and group:  
  1. complement each other  
  2. consider each other in their actions  
  3. share a primary focus on patient care  
  4. respect each other’s views and values  
  5. go out of their way to help each other  
  6. get in each other’s way (reverse scored)  
  7. believe that their future is tied to one another  
  8. feel they have a better chance succeeding together  
  9. share information that is helpful  
  10. have incentives that are aligned | $\alpha = .86$  
  ICC(1) =.42*  
  Rwg = .94                                                                 |                                 |

* p<.001
Table 3. Confirmatory Factor Analysis on Clinic-Group Relations Measures

<table>
<thead>
<tr>
<th></th>
<th>Headquarter-subsidiary Integration</th>
<th>Clinic-Group Interactions</th>
<th>Clinic Autonomy</th>
<th>Work Standardization</th>
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<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>Work Standardization</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>work clearly defined</td>
<td>0.24</td>
<td>-0.13</td>
<td>-0.27</td>
<td>0.42</td>
</tr>
<tr>
<td>degree follow rules</td>
<td>0.18</td>
<td>-0.13</td>
<td>0.12</td>
<td>0.83</td>
</tr>
<tr>
<td>number of rules</td>
<td>0.11</td>
<td>-0.07</td>
<td>0.16</td>
<td>0.83</td>
</tr>
<tr>
<td>rules enable work</td>
<td>0.36</td>
<td>-0.07</td>
<td>-0.11</td>
<td>0.71</td>
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<tr>
<td><strong>Clinic Autonomy</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Decide what work to do</td>
<td>0.00</td>
<td>0.20</td>
<td>-0.88</td>
<td>-0.10</td>
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<tr>
<td>Decide how to do work</td>
<td>0.00</td>
<td>0.16</td>
<td>-0.83</td>
<td>-0.03</td>
</tr>
<tr>
<td>decide work policies</td>
<td>0.00</td>
<td>0.19</td>
<td>-0.77</td>
<td>-0.06</td>
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<tr>
<td><strong>Clinic-Group Interactions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>clinic depends on group</td>
<td>-0.01</td>
<td>0.73</td>
<td>-0.12</td>
<td>-0.12</td>
</tr>
<tr>
<td>group depends on clinic</td>
<td>0.00</td>
<td>0.64</td>
<td>-0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>communication frequency</td>
<td>-0.03</td>
<td>0.85</td>
<td>-0.20</td>
<td>-0.14</td>
</tr>
<tr>
<td>work frequency</td>
<td>-0.04</td>
<td>0.87</td>
<td>-0.18</td>
<td>-0.11</td>
</tr>
<tr>
<td>meetings frequency</td>
<td>-0.06</td>
<td>0.78</td>
<td>-0.24</td>
<td>-0.23</td>
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<tr>
<td><strong>Headquarters-subsidiary Integration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>complement each other</td>
<td>0.70</td>
<td>-0.04</td>
<td>-0.04</td>
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<tr>
<td>consider each other</td>
<td>0.80</td>
<td>-0.09</td>
<td>0.01</td>
<td>0.19</td>
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<td>share a primary focus</td>
<td>0.75</td>
<td>0.05</td>
<td>-0.15</td>
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<tr>
<td>respect each other</td>
<td>0.84</td>
<td>-0.01</td>
<td>-0.08</td>
<td>0.23</td>
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<tr>
<td>help each other</td>
<td>0.82</td>
<td>-0.05</td>
<td>-0.05</td>
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</tr>
<tr>
<td>get in other's way (reverse)</td>
<td>-0.46</td>
<td>0.20</td>
<td>-0.07</td>
<td>-0.31</td>
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<tr>
<td>future is tied together</td>
<td>0.68</td>
<td>0.04</td>
<td>-0.04</td>
<td>0.10</td>
</tr>
<tr>
<td>succeed together</td>
<td>0.75</td>
<td>0.03</td>
<td>0.00</td>
<td>0.13</td>
</tr>
<tr>
<td>share helpful information</td>
<td>0.78</td>
<td>-0.09</td>
<td>-0.05</td>
<td>0.21</td>
</tr>
<tr>
<td>incentives are aligned</td>
<td>0.77</td>
<td>-0.08</td>
<td>-0.02</td>
<td>0.21</td>
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<td><strong>Eigenvalues</strong></td>
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<td>3.51</td>
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<td>1.79</td>
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<td><strong>Cum % Common Variance</strong></td>
<td>26.50%</td>
<td>42.50%</td>
<td>51.20%</td>
<td>59.30%</td>
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Notes: n=1205 respondents
Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
Table 4. Correlations among Clinic Performance Measures.

<table>
<thead>
<tr>
<th></th>
<th>Patient Care Composite</th>
<th>Patient Satisfaction</th>
<th>Staff courtesy</th>
<th>Patient Care Quality</th>
<th>Business Care Composite</th>
<th>Productivity RVU’s per provider</th>
<th>Net Revenue Per Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient Care</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Care Composite</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Patient Satisfaction</td>
<td>0.89**</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Staff courtesy</td>
<td>0.68**</td>
<td>0.41**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Care Quality</td>
<td>0.17**</td>
<td>-0.05*</td>
<td>0.61*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Business Care</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Care Composite</td>
<td>-0.10</td>
<td>-0.04</td>
<td>-0.10</td>
<td>0.05</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RVU’s per provider</td>
<td>-0.03</td>
<td>0.005</td>
<td>-0.13</td>
<td>0.001</td>
<td>0.72**</td>
<td>1</td>
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</tr>
<tr>
<td>Net Revenue per provider</td>
<td>-0.14</td>
<td>-0.12</td>
<td>-0.02</td>
<td>0.15</td>
<td>0.79**</td>
<td>0.18**</td>
<td>1</td>
</tr>
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</table>

*p<.05 ** p<.01
Table 5. Clinics Serving Broad and Narrow Mix of Patient

<table>
<thead>
<tr>
<th></th>
<th>Broad Clinics</th>
<th></th>
<th>Focused Clinics</th>
<th></th>
<th>Group Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heterogeneous Mix</td>
<td></td>
<td>Homogeneous Mix</td>
<td></td>
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</tr>
<tr>
<td>Number of clinics</td>
<td>18</td>
<td>14</td>
<td></td>
<td></td>
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<tr>
<td>Mean</td>
<td></td>
<td></td>
<td>Mean</td>
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<tr>
<td>Std. Dev.</td>
<td>28.28</td>
<td></td>
<td>20.25</td>
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<tr>
<td>Resources (# Personnel)</td>
<td>57.73</td>
<td></td>
<td>26.95</td>
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<tr>
<td>Organization Design</td>
<td></td>
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<td>Autonomy</td>
<td>3.16</td>
<td>3.22</td>
<td>3.16</td>
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<td>3.65</td>
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<td>2.43</td>
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<td>3.06</td>
<td>3.19</td>
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<tr>
<td>Clinic Performance</td>
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<td>Business Care Composite</td>
<td>2.08</td>
<td>1.95</td>
<td>2.08</td>
<td>1.95</td>
<td>.36</td>
</tr>
<tr>
<td>Rvu Productivity/Provider</td>
<td>6403.93</td>
<td>6855.58</td>
<td>6403.93</td>
<td>6855.58</td>
<td>.36</td>
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<td>Patient Care Composite</td>
<td>1.48</td>
<td>2.56</td>
<td>1.48</td>
<td>2.56</td>
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<tr>
<td>Patient Satisfaction</td>
<td>2.79</td>
<td>2.85</td>
<td>2.79</td>
<td>2.85</td>
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<tr>
<td>Staff Courtesy</td>
<td>3.87</td>
<td>4.05</td>
<td>3.87</td>
<td>4.05</td>
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</tr>
<tr>
<td>Perceived Care Quality</td>
<td>3.48</td>
<td>3.84</td>
<td>3.48</td>
<td>3.84</td>
<td>**</td>
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<tr>
<td>DEA Performance (from Table 6)</td>
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<td>Clinic Performance</td>
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</tr>
<tr>
<td>Change</td>
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<td>.81</td>
<td>.93</td>
<td>.81</td>
<td>.35</td>
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<td>Group Frontier Change</td>
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<td>1.13</td>
<td>1.03</td>
<td>1.13</td>
<td>.35</td>
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</tbody>
</table>

** p<.01

<table>
<thead>
<tr>
<th>Clinic ID</th>
<th>Macro Policy Type</th>
<th>1997 DEA</th>
<th>1999 DEA</th>
<th>Malmquist Index</th>
<th>Total Productivity Change (T)</th>
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<tbody>
<tr>
<td></td>
<td>Within-Type (Step 1)</td>
<td>Between-Types (Step 2)</td>
<td>Within-Type (Step 1)</td>
<td>Between-Types (Step 2)</td>
<td>Change (C)</td>
</tr>
<tr>
<td>C16</td>
<td>Broad</td>
<td>71.28</td>
<td>73.68</td>
<td>84.42</td>
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<td>70.78</td>
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<td>71.66</td>
<td>69.70</td>
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<td>69.45</td>
<td>74.84</td>
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<tr>
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</tr>
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<td>98.30</td>
<td>69.51</td>
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<td>100.00</td>
<td>83.44</td>
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</tbody>
</table>

*Notes.
1. Clinics sorted by Type and Total Productivity Change (in descending order).
2. All values in the table represent relative productivity. The first four columns are presented in terms of percentage, within the range of 0 and 100%. 100% means maximal efficiency in DEA; other values are productivity relative to 100%. The last three columns are raw values according to the MI computations, but have been subtracted by 1. Thus, a positive value means an increase in efficiency and a negative value means a decrease in efficiency; a value of 0 means no change.
Table 7. Regression Results on Clinic Performance Change & Group Frontier Change

<table>
<thead>
<tr>
<th></th>
<th>Clinic Performance</th>
<th></th>
<th>Group Frontier</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Endogenous Change</td>
<td></td>
<td>Exogenous Change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>beta</td>
<td>P-value</td>
<td>beta</td>
<td>P-value</td>
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<tr>
<td><strong>Unit Differentiation Dimensions</strong></td>
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<td></td>
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<tr>
<td>Clinic Autonomy</td>
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<td>.05</td>
<td>.02</td>
<td>.80</td>
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<td>Clinic-group interactions</td>
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<td>.01</td>
<td>-.27</td>
<td>.02</td>
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<td><strong>Group Integration Dimensions</strong></td>
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<tr>
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<td>.08</td>
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<td>.21</td>
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<td>Headquarters-subsidiary Integration</td>
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<td>.03</td>
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<td><strong>Local Environment Complexity</strong></td>
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<tr>
<td>Patient Mix (heterogeneous-homogeneous)</td>
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<td>.71</td>
<td>.96</td>
<td>.00</td>
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<tr>
<td><strong>R Square</strong></td>
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<tr>
<td><strong>F statistic</strong></td>
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<td>.07</td>
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Table 8. Correlations of Clinic and Group Design and Performance Measures

<table>
<thead>
<tr>
<th>Clinic Performance Endogenous Change</th>
<th>Group Frontier Exogenous Change</th>
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</thead>
<tbody>
<tr>
<td>Complex (broad) Patient Mix</td>
<td>Complex (broad) Patient Mix</td>
</tr>
<tr>
<td>Simple (focused) Patient Mix</td>
<td>Simple (focused) Patient Mix</td>
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<tr>
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<tr>
<td></td>
<td>-0.002</td>
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<tr>
<td>Standardization</td>
<td>-0.13</td>
</tr>
<tr>
<td></td>
<td>0.44</td>
</tr>
</tbody>
</table>

Clinic Performance Endogenous Change

Patient Mix | Complex (broad) | Simple (focused) |
-------------|-----------------|------------------|
Complex (broad) | 0.34            | -0.002           |
Simple (focused) | -0.34           | 0.07             |

Group Frontier Exogenous Change

Patient Mix | Complex (broad) | Simple (focused) |
-------------|-----------------|------------------|
Complex (broad) | -0.13           | 0.44             |
Simple (focused) | -0.01           | 0.35             |
Figure 1. Geometric Portrayal of Frontier with DEA

- Performance:
  - Net income
  - Productivity
  - Patient satisfaction
  - Care quality

Inputs: Resources (# of personnel)
Environmental complexity (patient mix)
Figure 2. Scatter-Plot of 1997 - 1999 Clinic DEA Efficiency
Figure 3. Change in Clinic Performance, Group Frontier & Total Productivity

Notes: This 3-D graph uses a negative exponential smoothing technique that applies a Gaussian weight function to the data and a quadratic fit. The diagonal line distinguishes where the broad and focused clinics are plotted in the figure.