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USING PANEL DATA DEA TO MEASURE CEOS' FOCUS OF ATTENTION: AN APPLICATION TO THE STUDY OF COGNITIVE GROUP MEMBERSHIP AND PERFORMANCE

JORDI SURROCA,[1]* DIEGO PRIOR,[2] and JOSEP A. TRIBÓ GINÉ[1]
[1] *Department of Business Administration, Universidad Carlos III de Madrid, Getafe (Madrid), Spain*
[2] *Department of Business Economics, Universitat Autònoma Barcelona, Bellaterra (Barcelona), Spain*

In this study, we examine the existence and performance of cognitive groups. In accordance with the attention-based view of managerial cognition, cognitive groups are defined as groups of firms in which the CEOs focus their attention on similar strategic elements when seeking to maximize their firm's competitive advantage. We developed a panel data extension of the original Data Envelopment Analysis to gauge CEOs' focus of attention and then clustered firms into groups. We compared our approach with other approaches that use content analysis of CEOs' letters to shareholders and CEOs' demographic characteristics to measure CEOs' attention. Although the different approaches are related, indicating the existence of a common underlying construct (i.e., mental models), our approach explains a higher proportion of the variation in organizational performance.

INTRODUCTION

Due to bounded rationality (Cyert and March, 1963; Simon, 1955), managers use mental models and the associated heuristics to shape strategic choices thought to be appropriate to their industry (Johnson and Hoopes, 2003). Many managerial cognition scholars have adopted the strategic group framework for studying the industry's competitive structures (Kabanoff and Brown, 2008; Osborne, Stubbart, and Ramaprasad, 2001; Porac, Thomas, and Baden-Fuller, 1989; Reger and Huff, 1993). Their studies place two sociocognitive processes at the center of strategic group formation. The first process involves interactions with other firms, which allow managers to develop a shared understanding about ways of competing. The second is a process of social comparison and imitation that leads managers to categorize rival firms into groups and copy the behavior of those deemed similar (Johnson and Hoopes, 2003). The cognitive groups (CGs) that result from these processes therefore comprise firms within an industry with managers who possess similar or shared mental models of strategy (Porac *et al.*, 1989).

A major challenge for scholars in this research stream is the measurement of managers' cognitions (Hodgkinson and Healey, 2008; Kaplan, 2011). Some researchers have used managers' demographic characteristics as proxies of cognition (e.g., Hambrick and Mason, 1984), although these proxies sometimes fail to capture contextual characteristics that influence decision making

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*Correspondence to: Jordi Surroca, Universidad Carlos III de Madrid, Department of Business Administration, Calle Madrid, 126, Getafe, Madrid 28903, Spain. E-mail: jsurroca@emp.uc3m.es

(Barr, Stimpert, and Huff, 1992). Other scholars have measured cognition through interviews, surveys, or case studies. Yet criticism has persisted: Interviews may suffer from problems of reliability and replicability, it is difficult to capture past cognitions by means of surveys, and case studies do not necessarily represent broader populations. Moreover, although surveys have proved useful in measuring cognitions, their cross-sectional nature makes it difficult to perform dynamic analyses (Hodgkinson, Maule, and Bown, 2004; Kaplan, 2011) given the low response rate (Kaplan, 2011) when scholars have attempted to conduct surveys on the same population at different points in time (Plambeck and Weber, 2009). A third group of scholars, the majority, has addressed all these measurement problems by conducting a computer-aided textual analysis of company documents over time (e.g., Barr *et al.*, 1992; Cho and Hambrick, 2006; Kabanoff and Brown, 2008; Kaplan, 2008; Nadkarni and Barr, 2008; Osborne *et al.*, 2001), on the assumption that the words frequently used by CEOs in their communications, especially their letters to shareholders in annual reports, reflect the issues and answers to which CEOs are more likely to attend (Ocasio, 1997, 2011). The prevalence of this approach in empirical research has not avoided criticism, however: Letters are a biased source of information, given that they are prepared for specific business audiences, they are written to convey positive impressions of the firm, and they are usually designed by communication professionals rather than the CEOs themselves (Hodgkinson *et al.*, 2004; Kaplan, 2011).

Our study addresses these challenges by adopting a new approach to the description and measurement of cognitions. Consistent with Ocasio's (1997, 2011) attention-based view of managerial cognition, our approach entails a description of the strategic dimensions on which CEOs focus their attention. The measurement of CEOs' attention is based on a panel data refinement of the original Data Envelopment Analysis (DEA). DEA is a linear programming-based methodology for measuring the relative performance of organizations, and scholars have long recognized its potential in the study of a variety of strategy-related phenomena (Majumdar, 1998), including strategic groups (Athanassopoulos, 2003; Day, Lewin, and Li, 1995; Prior and Surroca, 2006). DEA yields a result that makes it particularly well suited for ascertaining CEOs' attention patterns: a set of dual variables (multipliers or weights), which solve the DEA optimization algorithm, can be used as a measure of the level of managerial attention actually paid to each input and output, in order to reach the focal organization's maximum performance in comparison to other organizations.

By relying on DEA weights as measures of CEO attention, we analyze the influence of the CEO attention on a firm's competitive positioning and performance over time. To examine competition, our study builds on the CGs framework (e.g., Porac *et al.*, 1989; Reger and Huff, 1993) and the attention-based view (Ocasio, 1997, 2011). Accordingly, we propose that there are groups of firms within an industry in which the CEOs focus their attention on similar strategic dimensions, and that these groups differ in their performance.

DEA suffers from a major limitation, however—one that must be tackled before using its weights for clustering purposes. Because DEA typically relies on cross-sectional data to estimate performance, the resulting DEA weights that solve each cross-sectional optimization cannot be directly compared (Tulkens and Vanden Eeckaut, 1995). In a previous study, for example, we (Prior and Surroca, 2006) used an existing cross-sectional DEA algorithm for a direct measure of the ratios of weights (i.e., marginal relations between strategy variables) in a sample of Spanish commercial and savings banks, and then identified strategic groups based on the similarities in these ratios, which were interpreted as proxies of the flexibility of banks to change their strategies. Because the algorithm does not incorporate information from the time series nature of the data, one source of concern with this cross-sectional algorithm is the possible presence of measurement errors in the estimation of these weight ratios, if its use is extended over time for conducting a longitudinal analysis (Ruggiero, 2007). This concern is critical in strategic group research because, if scholars do not expand static analyses to longitudinal analyses in order to characterize firms' strategies and examine industry dynamics, the resulting groupings of firms will have little predictive validity, and the practical value of the strategic group concept will therefore be called into question (Cool and Schendel, 1987). Unfortunately, available DEA algorithms, including those of the Prior and Surroca (2006) study, appeared to be inadequate for handling

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panel data sets (Tulkens and Vanden Eeckaut, 1995).

In response to this limitation, we departed from previous research by using a new DEA algorithm that allowed us to perform longitudinal analyses, thereby exploiting the dynamic properties of panel data to estimate the weights assigned to strategic variables (instead of the cross-sectional ratios of weights, as we did in our previous study). We therefore clustered firms (savings banks in this case) in terms of similarities in these weights in order to construct CGs. In this setting, the panel data DEA we propose is useful in capturing managerial cognitions over time. Specifically, the new algorithm generates estimates of the level of attention granted by the CEO to each strategy dimension, to improve the long-run relative competitive position of the focal firm within the industry. These features of panel data DEA may help to enrich the framework for analyzing the formation of strategic groups in a dynamic context. In addition, this approach resolves a concern of former studies that used cross-sectional data to measure managerial mental models. These studies have not always produced a clear separation of cognitions from other explanations, and the researchers were not able to attribute any causality to the relationship between cross-sectional measures of cognition and outcomes (Kaplan, 2008, 2011).

After the application of this new approach to the identification of CGs, we further examined the ability of our approach to explain performance differences relative to other approaches that use direct (i.e., letters to shareholders) and indirect (i.e., managers' demographic characteristics) measures of managers' cognitions. The results of this analysis have key implications for future research and practice.

CONCEPTUAL BACKGROUND TO THE DEVELOPMENT OF A METHODOLOGICAL APPROACH FOR MEASURING CEOS' ATTENTION

In this section, we describe the CGs framework used to apply our methodology for measuring managerial cognitions. We did not seek to develop theory, therefore, but used the testing of the CGs framework to examine the soundness of the methodology proposed. The central tenets of this literature are described in the next subsections.

Hypothesis on the existence of CGs

According to cognitive theorists, top managers are confronted with more information than their cognitive capacity can assimilate; they therefore focus their attention on what they perceive to be critical domains, while ignoring others (Daft and Weick, 1984; Dutton and Jackson, 1987; Hambrick and Mason, 1984). Attention, which is understood to occupy the consciousness of individuals (Fiske and Taylor, 1991), is therefore key, because it is the primary filter through which managers identify issues (Nadkarni and Barr, 2008). Attention subsequently influences the interpretation that infuses external stimuli with additional meaning, and such interpretation, in turn, affects managers' actions (Dutton and Jackson, 1987), including their resource allocation decisions (Barr *et al.*, 1992; Kunc and Morecroft, 2010). Hence, managerial attention determines the events that will be included in the firm's strategic agenda (Dutton and Jackson, 1987; Nadkarni and Barr, 2008).

In accordance with existing studies (for a review, see Ocasio, 2011), we examined the attention that CEOs paid to the internal organizational context after deregulation. By focusing on the CEO, our study adopts an assumption widely held in the literature: the top management team, specifically the CEO, plays a critical role in focusing organizational attention toward particular issues, interpreting that information, and legitimizing a specific course of action among available options (Cho and Hambrick, 2006; Daft and Weick, 1984; Eggers and Kaplan, 2009; Kaplan, 2008; Lyles and Schwenk, 1992).[1]

There is a vast number of internal factors that CEOs may attend to, although not all of them are equally viable (Ketchen *et al.*, 1997). One popular typology to describe all feasible strategic dimensions in an industry consists of identifying two main competitive traits (Cool and Schendel, 1987; Hofer and Schendel, 1978): *scope of operations* (product scope, geographic scope, and product diversity) and *resource deployment decisions* (human, material, and financial). This typology provides one of the broadest sets of strategy variables among the existing approaches to defining strategic configurations, and it substantially reduces the likelihood

[1] As explained in the "Data and sample" section, this is not a strong assumption in our empirical setting, as existing empirical evidence on the Spanish banking industry has shown that CEOs of Spanish savings banks possess substantial discretion in determining the strategic agenda of banks.

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of making errors when classifying firms (Ketchen *et al.*, 1997).

Despite the broad set of strategic options, cognitive scholars have shown that CEOs in certain industries share similar beliefs about their environments and organizations (Abrahamson and Fombrun, 1994; Abrahamson and Hambrick, 1997; Porac *et al.*, 1989; Reger and Huff, 1993). Over time, CEOs develop consensual beliefs about environmental threats and opportunities, which lead them to focus on common strategic dimensions in order to succeed in an increasingly competitive environment (Porac *et al.*, 1989). The set of firms with CEOs who share these common beliefs forms what has been called a "cognitive group" (CG) or, to use Porac and colleagues' (1989) terminology, a "cognitive community."

Cognitive scholars have long been concerned with the development of these CGs (Porac *et al.*, 1989, 1995). For Abrahamson and Hambrick (1997), the level of managerial discretion is a critical dimension for understanding the formation of similarity in the focus of CEOs' attention—attentional homogeneity.[2] When discretion is low, CEOs tend to focus their attention on a few dimensions, while when discretion is high, for CEOs to focus on the same dimensions would be unlikely.

The coexistence of different CGs within an industry requires that the focal industry should present some but not a great deal of homogeneity of attention (Porac *et al.*, 1989; Reger and Huff, 1993). In other words, there must be sufficient cognitive "space" (the cognitive analog to the concept of "strategic space") among the attention focuses of rival CEOs in order for CGs to emerge (Hodgkinson, 1997). Homogeneity of attention implies that CEOs recognize the same challenges to their industry, interpret them similarly, and agree upon the weights they assign to each aspect of their organizations in facing these challenges (Abrahamson and Fombrun, 1994; Cho and Hambrick, 2006; Ocasio, 1997). Top managers of highly regulated industries show extreme homogeneity in the dimensions on which they focus. This was the situation in the banking industry before the deregulatory process experienced in the United States and other Western countries during the 1980s and the early part of the 1990s (Reger and Palmer, 1996). The environmental dynamism created by the process of deregulation increased the degree of managerial discretion to the extent that, in the post-regulated era, CEOs in the banking industry showed a middle level of homogeneity of attention across all industries (Abrahamson and Hambrick, 1997). In that instance, the deregulation process that increased the heterogeneity of attention should lead to the identification of different groups of CEOs holding homogeneous beliefs about the strategic dimensions to which they should attend. Moreover, these beliefs turn out to be heterogeneous across CEOs of different groups (Kabanoff and Brown, 2008). Thus,

Hypothesis 1: Following a period of environmental dynamism like deregulation, different CGs will emerge in the industry, based upon similarities in the resource and scope deployment decisions to which CEOs focus their attention.

Performance differences across CGs

A key prediction of the CG literature is that CGs differ in terms of performance (Hodgkinson, 1997). Within each CG, managers interpret environmental signals in a similar way, and therefore focus on the same strategic dimensions when competing; yet their interpretations may differ across groups (Kabanoff and Brown, 2008). CGs, then, do experience subsequent differences in performance, given that some strategic choices fit better with environmental conditions than others do (Kabanoff and Brown, 2008; Osborne *et al.*, 2001). These differences in performance are, in turn, sustainable over time (Kabanoff and Brown, 2008), as the mental models that allow top managers to enact their competitive environment and position their firms within the industry may also serve as potential sources of inertia and myopia (Kaplan, 2008; Tripsas and Gavetti, 2000). Even when environmental conditions change rapidly, mental models change gradually (Hodgkinson, 1997; Reger and Palmer, 1996). Cognitive inertia emerges, then, as a source of mobility barriers, preventing managers from refocusing their attention on other strategic dimensions and moving from one CG to another, thereby resulting in stable groupings of firms with different levels of performance (Kabanoff and Brown, 2008; Porac *et al.*, 1989). We propose:

[2] For a more comprehensive examination of the drivers of discretion, see Hambrick and Finkelstein (1987).

Hypothesis 2: CG membership predicts sustainable performance differentials among firms.

Empirical research has provided wide support for this hypothesis (e.g., Reger and Huff, 1993). Some scholars still remain skeptical about this relationship, however, and suggest that the documented connection between CGs and performance may be spurious, because (1) cognitions have not always been adequately captured, and (2) the cross-sectional nature of most studies does not allow for the attribution of any form of causality (Kaplan, 2011). A solution to these problems has been the use of letters to shareholders to measure cognitions. Letters are superior to the use of managers' demographic profiles because they can capture learning from specific situations (Barr *et al.*, 1992). The use of letters is also superior to interviews, surveys, or case studies, because it allows the measurement of cognitions over time for large samples through a systematic, replicable approach (Kabanoff and Brown, 2008). These features may explain the success of studies that use these letters to establish a causal relationship between a firm's CG membership and its performance (Kabanoff and Brown, 2008; Osborne *et al.*, 2001). Criticism persisted, notwithstanding, as some authors argued that letters may serve the purpose of impression management (Abrahamson and Hambrick, 1997; Nadkarni and Barr, 2008). Thus, in order to establish causality between CGs and performance, researchers must use approaches for measuring management cognition that, firstly, capture context-specific knowledge; secondly, are less likely to be influenced by the communication strategies of the firm and rely, to a greater extent, on realized managerial decisions like those involving a firm's resources and scope commitments; and thirdly, allow the exploitation of both cross-sectional and longitudinal data (Kaplan, 2011). The approach proposed in this paper to characterize CGs combines these three features, as we explain next.

MEASUREMENT OF CEO ATTENTION

Researchers have used myriad approaches for measuring managerial attention. Several studies used CEOs' demographic variables to gauge attention patterns (e.g., Tuggle, Schnatterly, and Johnson, 2010), for instance, despite the weak and indirect connection between demography and cognition (Barr *et al.*, 1992). To measure attention more directly, the most prevalent approach is the textual analysis of letters to shareholders (Ocasio, 2011), although this approach is not without its problems. A major concern is the possibility of a gap between the realized strategy and the strategy reflected in these communications (Leask and Parker, 2006). This divergence may occur for various reasons: letters to shareholders may be affected by attempts at impression management, letters may not properly capture the CEO's unconscious beliefs that influence decision making, and letters do not incorporate new relevant information that may lead CEOs to shift their attention to other strategy dimensions over time (Abrahamson and Hambrick, 1997; Cho and Hambrick, 2006; Nadkarni and Barr, 2008). In the next section, we describe how the DEA approach that we propose, which relies on information about realized strategies obtained from financial accounts, can efficiently measure the CEO's attention across time, thereby representing an improvement over other approaches.

Assessing attention focus with DEA

Our approach uses publicly available measures of resource and scope commitments to identify the strategic commitments to which CEOs focus their attention when trying to enjoy a competitive advantage over rivals. In accordance with strategy research, competitive advantage is expressed in terms of a firm's ability to achieve and sustain greater efficiency than its competitors enjoy (Barney, 1991; Lippman and Rumelt, 1982; Peteraf, 1993; Peteraf and Barney, 2003). Adopting this view, the approach we propose in order to identify the CEO's attention patterns incorporates information about realized strategies into the DEA algorithm, subsequently measuring the importance that the CEO attaches to a particular resource and scope commitments, in order to attain the firm's maximum efficiency over time—in comparison to that of its competitors. Strategic commitments that have a greater effect on the long-run efficiency of a firm identify the elements that the CEO is weighing more heavily in defining the firm's strategic agenda. Moreover, unlike letters to shareholders, which may reflect the CEO's attempts at impression management (Nadkarni and Barr, 2008), the attention focus derived from our approach

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promises to represent a better approximation to the CEO's cognitions. This contention is supported by the expectation that the CEO will be driven to attend to particular strategic options (i.e., realized attention) given the belief, based on an interpretation of actual environmental conditions, that the implementation of these strategies will allow the firm to outperform its competitors. We predict, therefore, that the CGs formed under our approach will have a greater ability to explain differences in the performance of firms within an industry than will other commonly used approaches, such as managerial characteristics and letters to shareholders.

DEA is suited to an analysis of the factors that CEOs believe will enable their firms to compete more efficiently than their competitors can (Cooper, Seiford, and Tone, 2007). DEA is a linear programming-based methodology for measuring the relative efficiency of a broadly homogeneous set of organizational units (e.g., banks or schools) that use a number of resources to secure a number of outputs. By applying DEA to available firm-specific information on inputs and outputs, it is possible to obtain a ratio of efficiency for each firm, in comparison to the other observations. This index measures the distance between each firm and a nonparametric empirical frontier defined by the complete set of efficient firms: those that, with their current commitment of resources, reach the maximum output level.[3] Apart from this measure of relative efficiency of each firm, DEA ascertains the importance that management attaches to each input and output, in order to maximize the firm's efficiency ratio. Remarkably, the inputs and outputs with a larger impact on efficiency—the so-called virtual inputs and outputs—identify the strategic elements to which CEOs focus their attention when trying to obtain a sustainable competitive advantage over their rivals.

An improved DEA for assessing attention

Original DEA and most of its subsequent extensions are cross-sectional, which represents a major limitation for elucidating attention patterns; as cognition scholars have noted, an adequate measurement of managers' mental models requires longitudinal research designs (e.g., Hodgkinson and Healey, 2008; Kaplan, 2011). DEA window analysis (DEAWA) (Charnes *et al.*, 1984), and intertemporal DEA (IDEA) (Tulkens and Vanden Eeckaut, 1995), allow for such longitudinal analysis. Although IDEA uses the entire panel data, each firm-year is regarded as a single observation, without consideration of any panel structure of the data. The DEAWA reproduces this problem, as it is a particular case of IDEA, and it even presents additional concerns (for a more detailed discussion, see Tulkens and Vanden Eeckaut, 1995).[4] In response to these concerns, our panel data DEA uses the entire data set to construct a frontier that goes beyond a pure time series analysis. In efficiency analysis of time series, all cross-sections are pooled together forming an intertemporal production set that uses, and treats separately, all observations from all time periods. As in IDEA, we also use the full dataset, but our approach is unlike IDEA in that we take advantage of the panel structure of the data for computing an efficiency estimate for each observation for the complete time window. This estimate is not simply the result of averaging over periods covered by the window (as is the case with the DEAWA) because panel data DEA uses information on the evolution of firms' observations along time. Then, our approach is analogous of a fixed-effect regression estimation in a nonparametric setting and, unlike the IDEA approach, allows estimating long-run efficiency coefficients. The use of panel data DEA thus illuminates the strategic elements of CEOs' focus on a framework that uses cross-sectional and time series data. Furthermore, with this novel approach it is possible to respond to the call for methods that, by exploiting large panel data sets, allow measuring cognitions in a consistent manner across managers over time (Kaplan, 2011).

[3] We are adopting an output maximization approach. When using an input reduction perspective, the frontier will be defined by those firms that, with the current output level, consume the fewest resources.

[4] The DEAWA is sometimes referred to as a "locally" intertemporal DEA, because the complete period is divided into successive time windows of (usually) three periods (i.e., $t=0$, $t=1$, $t=2$; $t=1$, $t=2$, $t=3$; …; $t=T-2$, $t=T-1$, $t=T$). The efficiency score of each firm year in each window (as in the IDEA) is then computed, and the resulting scores averaged over the three periods of the window. So, in addition to the problem inherent in IDEA, three more sources of criticism surround DEAWA: (1) the frontiers defined by each window are not nested, (2) the number of periods covered by the window is set by the researcher, and (3) averaging over the periods of the window is not sufficiently justified (Tulkens and Vanden Eeckaut, 1995).

DOI: 10.1002/smj

METHODS

Developing a panel data DEA-based measure of CEO attention

Standard DEA provides the ratio of efficiency for each firm, by computing the relationship between the values of the outputs provided to customers and the cost of inputs consumed. The measurement of this ratio requires the definition of a set of weights—the outputs and inputs shadow prices—that describe the importance of each variable. As prices are not always available, Charnes, Cooper, and Rhodes (1978) solved this problem by comparing observed and optimal values of revenues/outputs and costs/inputs by using outputs and inputs shadow prices. Adapting their proposal to our empirical setting (described in the next subsections), there are 42 banks ($r = 1, \ldots, 42$), each committing varying amounts, x_{jr}, of the three resources to produce varying amounts, y_{ir}, of the eight scope dimensions. DEA maximizes the ratio of weighted scope variables to weighted resources by comparing the ratio of the unit under analysis—o—to the ratio of the rest of the banks:

$$\max_{u_i, v_j} e_o = \left(\sum_{i=1}^{8} u_i y_{io}\right) / \left(\sum_{j=1}^{3} v_j x_{jo}\right) \quad (1)$$

$$\text{subject to} : \left(\sum_{i=1}^{8} u_i y_{ir}\right) / \left(\sum_{j=1}^{3} v_j x_{jr}\right) \leq 1;\ r = 1, \ldots, 42 \quad (2)$$

$$u_i, v_j \geq 0;\ i = 1, \ldots, 8;\ j = 1, 2, 3. \quad (3)$$

For each bank, r, the program determines the weights of outputs, u_i, and inputs, v_j, that maximize its relative efficiency, e_r, with two constraints: The maximum efficiency cannot be greater than one and weights must be nonnegative. These weights are bank specific and identify the importance that the bank assigns to its scope and resource commitments in order to maximize efficiency. The product of these weights by the corresponding outputs and inputs —the so-called virtual outputs and inputs or normalized weights—measure the relative contribution of each variable to bank efficiency. The inputs and outputs with larger virtual values show the CEO's strategic priorities.

Our approach to extending the standard DEA to exploit both cross-sectional and longitudinal data is what we define as panel data DEA, which provides a single efficiency index and a common set of weights across all periods ($t = 1, \ldots, 5$), by maximizing the ratio of aggregate output to aggregate input (across all periods) for each bank. In maximizing this ratio, panel data DEA does not modify the underlying technology—the intertemporal frontier (Tulkens and Vanden Eeckaut, 1995). Thus, a bank that is efficient in the long run is also efficient each year. The fractional program of the panel data DEA is

$$\max_{u_i^{LR}, v_j^{LR}} e_o^{LR} = \left(\sum_{t=1}^{5}\sum_{i=1}^{8} u_i^{LR} y_{io}^{t}\right) / \left(\sum_{t=1}^{5}\sum_{j=1}^{3} v_j^{LR} x_{jo}^{t}\right) \quad (4)$$

$$\text{subject to} : \left(\sum_{i=1}^{8} u_i^{LR} y_{ir}^{t}\right) / \left(\sum_{j=1}^{3} v_j^{LR} x_{jr}^{t}\right) \leq 1;\ r = 1, \ldots, 42;\ t = 1, \ldots, 5 \quad (5)$$

$$u_i^{LR}, v_j^{LR} \geq 0; i = 1, \ldots, 8; j = 1, 2, 3 \quad (6)$$

This program is solved 42 times. For each bank, r, it estimates its aggregate long-run efficiency e_r^{LR} and a set of long-run weights for scope ($u_1^{LR}, \ldots, u_8^{LR}$) and resource ($v_1^{LR}, v_2^{LR}, v_3^{LR}$) commitments that define long-run virtual outputs ($u_i^{LR} y_{ir}^{t}$) and inputs ($v_j^{LR} x_{jr}^{t}$), which quantify the contribution to the long-run efficiency of each output and input. Thus, those long-run virtual outputs and inputs on which a bank receives higher scores define the strategic priorities of the bank's CEO. The formation of CGs will be based on these long-run virtual scope and resource commitments. It is worth noting that such virtual variables are the outcome of an algorithm that uses data about realized managerial strategic choices to ascertain the weight that the CEO has placed on each strategy dimension, in order to improve a bank's competitive position.[5] This connection between weights and competitive

[5] The linear programming DEA approach assumes that the input and output variables do not show interdependencies; that is, CEOs should focus their attention on individual actions. We have conducted a multicollinearity analysis among the 11 variables of

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advantage led us to expect clearer intra-industry stratification and a greater ability of panel data DEA to outperform other measures of managerial attention in predicting performance differentials.

Data and sample

Our empirical setting, the Spanish savings bank (SSB) industry between 1998 and 2002, is appropriate for testing our hypotheses for three reasons. First, the contours of the industry were clearly defined, and the regulatory framework remained stable during the period. Second, institutional characteristics of SSBs confer high levels of discretion to CEOs (Crespí, García-Cestona, and Salas, 2004). Third, between 1983 and 1997 (before our period of study), the industry experienced intense deregulation (Zúñiga-Vicente and Vicente-Lorente, 2006), as a result of which SSB managers felt pressured to refocus their attention (Mas-Ruiz and Ruiz-Moreno, 2011). Two confronted beliefs about the bank's strategy resulted from the new scenario: (1) Some CEOs believed that the industry's status quo strategy—based on committed personnel and a reputation for quality and customer responsiveness (De Saá-Pérez and García-Falcón, 2002)—could be successful after deregulation; and (2) other CEOs expanded SSBs operations to activities previously monopolized by banks—commercial loans, corporate business, and interbank market—and invested in information technologies, control systems, and risk management (Zúñiga-Vicente and Vicente-Lorente, 2006).

SSBs' data were drawn from the *1998–2002 Statistical Yearbook of the Spanish Confederation of Savings Banks*. The entire population comprised 50, 49, 47, 46, and 46 banks in each of the five years. Because DEA requires a complete panel (Day *et al.*, 1995), we limited our analysis to the 46 banks operating in all five years. Four of these banks were excluded from the analysis: two for lack of information and two because they were outliers—according to Wilson's (1995) method. Thus, our sample comprised a panel of 42 banks over five years, for a total of 210 observations. The volume of total assets of these banks represents 97 percent of the total Spanish banking industry in 1998 and 96.7 percent in 2002.

Strategy, performance, and control variables

Consistent with our conceptualization of strategy (Cool and Schendel, 1987) and based upon research on banking (e.g., Mehra, 1996), and specifically on the Spanish banking industry (Fuentelsaz and Gómez, 2006; Prior and Surroca, 2006), we selected 11 measures of strategic commitment, as defined in the Appendix Table A1: *resource commitments* of (1) labor, (2) physical capital, and (3) credit quality; and *scope commitments* of (1) commercial loans, (2) securities portfolio, (3) treasury, (4) service commissions, (5) savings/deposit accounts, (6) interbank position in financial markets, (7) customer proximity, and (8) geographical concentration.

We measured performance using the ratio of accounting profits to total assets (ROA) and the average ROA between t and $t+5$ for measuring long-run performance. Finally, we included measures of bank size, age, ownership structure, and regional wealth (see Table A1 for definitions) to our regression analyses in order to eliminate spurious correlations.

ANALYSIS AND RESULTS

Testing of Hypothesis 1

The empirical strategy to test Hypothesis 1 comprises four steps. As Fiegenbaum and Thomas (1990) suggested, we first identified stable strategic time periods (SSTPs). We found a 1-SSTP solution by applying four methods to test the stability of cross-sectional virtual resource and scope commitments: Bartlett's test, Wilks' lambda, Hotelling-Lawley's trace, and Pillai's trace. Second, we ran the panel data DEA for the SSTP identified to measure the long-run virtual inputs and outputs, which were the basis for the identification of CGs. Third, we applied a two-stage clustering procedure to these long-run virtual variables in order to group the banks (Ketchen and Shook, 1996). In the first stage, Ward's hierarchical algorithm defined three clusters under Fiegenbaum and Thomas's (1990)

resources and scope commitments that generate CGs classification. The result is a conditional number of 17.3. Also, the conditional number among the 11 variables of scope and resource commitments and the 4 control firm/environmental variables that appear in the estimation of performance (i.e., size, age, regional wealth, ownership structure) is 18.2. In both cases, the figures are well below the threshold of 30 that signals the existence of multicollinearity problems. Hence, it does not create a large distortion in the CGs classification to assume that manager attention is focused on a set of individual resource and scope commitments with no interdependencies and to ignore other firm/environment variables.

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criteria. In the second stage, banks were assigned to one of these three groups using the nonhierarchical *k*-means algorithm. Finally, in order to test if identified CGs really exist, we examined the between-group variability for each long-run virtual variable (ANOVA) and for all the variables simultaneously (MANOVA) (Fiegenbaum and Thomas, 1990).

The results of the application of this methodology are shown in Table 1. Our findings suggest that CEOs in CG 1 overemphasize stock market investment (securities) and place great importance on treasury, in order to have resources to develop investment opportunities. Strong emphasis is placed on the need for localizing the bank in a few big cities (low value for customer proximity and high value for geographical concentration). Physical capital (e.g., IT) is key to bank efficiency, while not requiring the bank to employ a large staff (low value for labor). This group relies, then, on high-level technology and the employment of fewer, specialized, and more productive workers. In addition, the efficiency of these banks is relatively sensitive to credit quality, given their strategy of concentrating on large clients. For these reasons, CEOs in this group focus their *attention on investment banking activities*.

CEOs in CG 2 primarily focus their attention on commercial loans. To support this activity, they rely upon geographical expansion (low value of geographical concentration) and a large staff. Bank diversification explains how little importance was accorded to credit quality. CEOs in this group, then, appear to define a bank strategy in which primary attention is placed on a diversified network with a large staff that attempts to expand commercial loans. CEOs of CG 2, therefore, focus their *attention on commercial banking activities*.

In order to outperform their competitors, CEOs in CG 3 focus on customer proximity as a way of capturing funds and charging commissions to their customers in return for financial services. This scope strategy requires that banks rely on the extensive use of their workforce (high value for labor), which is needed for establishing personalized relationships and charging commissions. Thus, CEOs in CG 3 *attend to traditional banking activities*.

From this characterization, we infer the responses of SSBs' CEOs to the regulatory changes of the 1980s and the first half of the 1990s. CEOs in CG 3 continued to focus their attention on the industry's status quo strategy, whereas CG 1's CEOs shifted their attention substantially. CG 2's CEOs shifted their attention, but less radically than CG 1's CEOs did.

The results shown in Table 1 support Hypothesis 1. ANOVA statistics are significant for almost all variables, suggesting that the dimensions that CEOs emphasize differ across CGs. The MANOVA results complement these findings, demonstrating the ability of our CG classification to separate the observations among groups.

Testing of Hypothesis 2

To test Hypothesis 2, we regressed the performance of firms on CG membership, scope, and resource variables, as well as different control variables. Results are shown in Table 2. Models 1 and 4 test Hypothesis 2. Joint significance tests show that CG membership is significant in explaining current ($\text{Chi}-\text{square} = 25.46,\ p < 0.01$) and long-term ($\text{Chi}-\text{square} = 13.17,\ p < 0.01$) performance of SSBs. This finding provides support for Hypothesis 2. In exploring the performance differences across CGs, the results of Models 1 and 4 of Table 2 show that the CG 3 banks have a higher and the CG 1 banks a lower performance than CG 2 banks (the omitted category). This finding suggests that the savings banks with CEOs who continued to focus their attention on the industry's status quo after deregulation outperformed the other banks. Among the other banks, the larger the shift of attention from the status quo, the worse their performance outcomes.

In order to verify whether our proposal mitigates concerns related to unobserved firm-level heterogeneity (connected to fixed effects), which may create an endogeneity problem between CGs and performance, we compared our results to those found using a system generalized method of moments (GMM) approach, which minimizes endogeneity/fixed effects concerns. In unreported analyses (available upon request), we found that the system GMM estimates and those of Model 1 in Table 2 were statistically equivalent, according to the Hausman test ($\text{Chi}-\text{square} = 11.42$, $p = 0.58$). This result suggests that endogeneity is not a problem in the estimation of performance with the regressors obtained from the panel data DEA. Hence, another advantage of our approach to measure CEOs' attentional focus, which has been called for by cognition scholars (e.g., Kaplan, 2011), is that it addresses endogeneity concerns

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Table 1. Final cluster means of long-run virtual resource and scope commitments

	Strategic groups				ANOVA
	1	2	3	Total	*F* test
Resource commitments					
Physical capital	0.573	0.174	0.048	0.226	38.39***
	(0.163)	(0.153)	(0.073)	(0.234)	
Labor	0.309	0.772	0.886	0.703	37.26***
	(0.161)	(0.181)	(0.092)	(0.264)	
Credit quality	0.119	0.054	0.065	0.071	3.26**
	(0.091)	(0.054)	(0.059)	(0.068)	
Scope commitments					
Commercial loans	0.047	0.497	0.065	0.287	71.89***
	(0.096)	(0.129)	(0.113)	(0.251)	
Securities portfolio	0.230	0.042	0.127	0.104	6.97***
	(0.227)	(0.051)	(0.135)	(0.147)	
Treasury	0.103	0.039	0.032	0.051	5.15***
	(0.101)	(0.037)	(0.028)	(0.061)	
Service commissions	0.206	0.081	0.295	0.164	9.77***
	(0.181)	(0.088)	(0.170)	(0.162)	
Savings/deposit accounts	0.023	0.037	0.037	0.034	0.12
	(0.069)	(0.074)	(0.077)	(0.072)	
Interbank position	0.084	0.085	0.076	0.082	0.04
	(0.097)	(0.108)	(0.066)	(0.094)	
Customer proximity	0.038	0.081	0.240	0.113	5.99***
	(0.073)	(0.115)	(0.223)	(0.161)	
Geographical concentration	0.132	0.020	0.040	0.049	4.04**
	(0.149)	(0.068)	(0.107)	(0.107)	
Number of banks	9	22	11	42	
General pattern	Attention to investment banking activities	Attention to commercial banking activities	Attention to traditional banking activities		

Standard deviations are in parentheses. MANOVA tests between-group variability for all variables simultaneously. Its *F* value (15.738) was significant at the 1 percent level.
**$p < 0.05$; ***$p < 0.01$

connected to fixed effects. Then, our approach allows properly studying a causality relationship between cognitions and firm behavior and performance.[6]

Comparison of the findings with alternative definitions of CGs

We used two other approaches to measure CEOs' cognitions: the demographic characteristics of bank CEOs and the textual analysis of bank CEOs' letters to shareholders. Based on these measures, we identified the corresponding CGs, and then examined the relationship between these groupings and our DEA-based CGs, and the performance implications of these other groupings.

CEOs' demographic characteristics

A CEO's age, tenure, international experience, experience in other industries, educational level, educational background, and functional background have been shown to reflect willingness to assume risks, which is essential to innovation and strategic change (Finkelstein and Hambrick, 1990; Hambrick and Mason, 1984; Wiersema and Bantel, 1992). We therefore identified CEO profiles in the SSB industry by conducting a cluster analysis of these characteristics (Table A1 provides details on

[6] Other endogeneity problems like omitted variable bias or reverse causality are less important because (1) we use a parsimonious specification with a large number of explanatory variables, which reduces the omitted variable problem; and (2) when we use forward ROA (columns 4–6) as dependent variable, which is less affected by reverse causality concerns, the results are consistent with those of contemporaneous ROA (columns 1–3).

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Table 2. Regression analyses of ROA on group membership, strategy, and controls

	Current ROA			Long-term ROA		
	Model 1: DEA-based	Model 2: CEO's characteristics	Model 3: CEO's letters	Model 4: DEA-based	Model 5: CEO's characteristics	Model 6: CEO's letters
Group membership						
Cognitive group 1	−0.459***	−0.138*	−0.303***	−0.200***	−0.123**	−0.305***
	(0.124)	(0.083)	(0.094)	(0.075)	(0.059)	(0.067)
Cognitive group 3	0.632***	0.475***	0.350***	0.339***	0.293***	0.222**
	(0.082)	(0.159)	(0.094)	(0.050)	(0.110)	(0.105)
Strategy dimensions						
Physical capital	0.300***	0.108*	0.234***	0.129**	0.055	0.114**
	(0.090)	(0.062)	(0.069)	(0.053)	(0.044)	(0.055)
Labor	0.195**	0.092*	0.284***	0.082*	0.080	0.085*
	(0.097)	(0.050)	(0.072)	(0.047)	(0.060)	(0.051)
Credit quality	0.058	0.017	0.013	0.047	0.019	0.095
	(0.055)	(0.187)	(0.172)	(0.118)	(0.130)	(0.114)
Commercial loans	0.106**	0.092*	0.103*	0.041*	0.011***	0.042**
	(0.049)	(0.055)	(0.063)	(0.024)	(0.004)	(0.021)
Securities portfolio	0.070**	0.022	0.030*	0.038**	0.013	0.036**
	(0.030)	(0.042)	(0.018)	(0.017)	(0.030)	(0.018)
Treasury	0.147***	0.108**	0.074***	0.067**	0.049*	0.063***
	(0.037)	(0.044)	(0.029)	(0.032)	(0.030)	(0.024)
Service commissions	0.052**	0.095*	0.104**	0.011	−0.035	0.039
	(0.026)	(0.053)	(0.038)	(0.024)	(0.023)	(0.024)
Savings/deposit accounts	−0.053	−0.212	−0.057	−0.055	−0.038	−0.121
	(0.138)	(0.183)	(0.129)	(0.101)	(0.044)	(0.121)
Interbank position	0.079*	0.119	0.100***	0.050	0.073*	0.043*
	(0.045)	(0.093)	(0.026)	(0.031)	(0.042)	(0.023)
Customer proximity	0.057**	0.038	0.056	0.010	0.050	0.037
	(0.029)	(0.039)	(0.040)	(0.030)	(0.037)	(0.037)
Geographic concentration	−0.070	−0.068	−0.060	−0.043	−0.030	−0.039
	(0.063)	(0.044)	(0.039)	(0.028)	(0.033)	(0.028)
Control variables						
Bank size	−0.128***	−0.128**	−0.134***	−0.040*	−0.042*	−0.033*
	(0.034)	(0.052)	(0.034)	(0.023)	(0.024)	(0.020)
Bank age	0.047*	0.038	0.090**	0.024	0.025	0.087
	(0.029)	(0.039)	(0.041)	(0.025)	(0.028)	(0.056)
Regional wealth	−0.101***	−0.156*	−0.169***	−0.068**	−0.074**	−0.202***
	(0.033)	(0.091)	(0.051)	(0.027)	(0.029)	(0.067)
Bank ownership type	−0.049**	−0.022	−0.038*	−0.048**	−0.042*	−0.037*
	(0.020)	(0.034)	(0.022)	(0.020)	(0.023)	(0.021)
Intercept	4.407***	3.595***	4.466***	4.230***	2.014***	4.266***
	(0.091)	(0.095)	(0.089)	(0.059)	(0.042)	(0.071)
Model statistics						
R^2 (%)	49.30	34.60	46.15	38.20	33.31	35.62
Fitness test (F-test)	6.17***	3.49***	5.65***	4.07***	3.26***	3.64***
Joint significance tests						
Cognitive group membership	25.46***	6.33**	11.07***	13.17***	10.20**	12.35***
Strategy dimensions	4.96***	1.81*	3.90***	3.22***	3.12***	3.50***
Control variables	7.41***	2.60**	8.74***	5.05***	3.53**	4.18***

All variables are standardized. Standard deviations are in parentheses.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

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their measurement). Data on CEOs' demographic characteristics were obtained from Hoover's Dun and Bradstreet, LexisNexis Academic, and the web pages of banks. To group the CEOs, we used Ketchen and Shook's (1996) two-step approach. Our findings (available upon request) show that CEO characteristics differ significantly across the three groups, which is indicative of a clear separation among the clusters.[7] At one extreme, CG 1 (38 observations) comprises CEOs with an entrepreneurial orientation: young CEOs (mean age, 46.44), with few years of tenure (4.24), experience in foreign countries (0.49) and other sectors (0.68), high levels of education (1.90), and educational (0.97) and functional (0.30) backgrounds in engineering/science or accounting/finance. At the opposite pole, CG 3 (72 observations) comprises CEOs with less propensity to change.[8] CEOs of CG 2 (100 observations) have intermediate characteristics.[9] We labeled these groups as CEOs with *positive attitudes toward risk taking* (CG 1), *neutral* (CG 2), and *negative attitudes toward risk taking* (CG 3).

CEOs' letters to shareholders

Using the DICTION 6.0 software program (Hart and Carroll, 2012), we conducted a computer-aided text analysis of the CEOs' letters, obtained from their banks' annual reports, for each SSB and year (210 letters). Other researchers (Short *et al.*, 2010; Yadav, Prabhu, and Chandy, 2007) have used DICTION software to analyze letters to shareholders in their assessment of CEOs' attentional focus. DICTION uses a set of predefined dictionaries to characterize five constructs (defined in Table A1): activity, certainty, commonality, optimism, and realism (Short and Palmer, 2008). Importantly, research has shown a high level of congruence between DICTION's constructs and researcher-coded variables in measuring specific dimensions of mental models (Bligh, Kohles, and Meindl, 2004). Our goal, therefore, was to characterize groups of managers by clustering CEOs with similar scores into the five constructs. To group the CEOs, we again applied Ketchen and Shook's (1996) two-step procedure explained under "Testing of Hypothesis 1," resulting in a three-group solution (available upon request). CG 1 comprises CEOs whose letters (1) focus on change and avoidance of inertia (high value of *activity*), (2) reflect the CEO's overconfidence and hubris (high value of *optimism*), (3) depict resoluteness and inflexibility in the CEO's posture (high value of *certainty*), (4) emphasize pragmatism as an instrument for adapting to changing conditions (high value of *realism*), and (5) promote individualism (low value of *commonality*). Like CG 1 CEOs, the CEOs in CG 2 promote individualism (low *commonality*) and inertia avoidance (high *activity*), but show low levels of confidence (*optimism*) and resoluteness to persevere (*certainty*) in their decisions in the face of challenges compared to CEOs of CG 1. Unlike the CEOs of CG 1 and CG 2, the CEOs in CG 3 foster inertia and avoid change (low *activity*) and are less concerned with immediate matters (low *realism*). They emphasize that all stakeholders are members of a single community (high *commonality*) compared to the CEOs of CG 1 and CG 2. We labeled CG 1 as comprising CEOs with a *focused entrepreneurial orientation*, CG 2 as CEOs with a *broad entrepreneurial orientation*, and CG 3 as CEOs with a *resistant-to-change orientation*.[10]

The relationship between DEA and other approaches

Table 3 shows the results of discriminant analyses conducted on the relationship between our DEA-based approach and the two other approaches described previously. The discriminant function (which uses the classification into groups derived from the DEA-based approach) was able to classify correctly 74.3 percent of the banks into the three

[7] ANOVA tests revealed significant differences across groups for each CEO characteristic. A MANOVA analysis ($F = 45.19$, $p < 0.01$) provided further robustness of the final groupings.

[8] Group 3 means: age = 68.71, tenure = 9.83, international experience = 0.41, experience in other sectors = 0.62, educational level = 1.75, educational background = 0.76, and functional background = 0.44.

[9] Group 2 means: age = 57.26, tenure = 4.57, international experience = 0.41, experience in other industries = 0.64, level of education = 1.79, educational background = 0.91, and functional background = 0.39.

[10] For CEOs in CG 1: Activity (A) = 49.05, Optimism (O) = 52.73, Certainty (C) = 46.58, Realism (R) = 45.94, Commonality (CO) = 50.85. For CG 2: A = 48.65, O = 51.84, C = 44.64, R = 45.50, CO = 50.82. And for CG 3: A = 48.24, O = 52.22, C = 45.04, R = 44.51, CO = 52.28. ANOVA and MANOVA ($F = 9.91$, $p < 0.01$) analyses revealed significant differences across groups.

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groups formed on the basis of CEOs' characteristics and 80.5 percent of the banks into the three groups based on CEOs' letters—percentages larger than the figure of 50 percent suggested in the literature to support the significance of the discriminant function. Moreover, our statistical tests showed significant relationships among the three approaches, thereby suggesting that the concept of CGs is a valid construct and that all approaches are capturing the same concept: CEOs' cognitions.

From Table 3, we can also infer that (1) CEOs who focus their attention on investment banking activities (CG 1 of our approach) have mainly a positive attitude toward risk taking (CG 1 of CEOs' characteristics) and a focused entrepreneurial orientation (CG 1 of CEOs' letters), (2) CEOs who attend to commercial banking activities (CG 2 of our approach) have mainly a neutral attitude toward risk taking (CG 2 of CEOs' characteristics) and a broad entrepreneurial orientation (CG 2 of CEOs' letters), and (3) CEOs who attend to traditional banking activities (CG 3 of our approach) have a negative attitude toward risk taking (CG 3 of CEOs' characteristics) and possess a resistant-to-change attitude (CG 3 of CEOs' letters).

Performance effects of alternative definitions of CGs

In examining the performance implications of the three definitions of CGs, Table 2 shows that CGs formed by similarities in CEO characteristics ($\text{Chi} - \text{square} = 6.33$, $p < 0.05$; Model 2) and CEO's letters ($\text{Chi} - \text{square} = 11.07$, $p < 0.01$; Model 3) are jointly significant in explaining ROA. These significance levels are lower than that of the panel data DEA approach ($\text{Chi} - \text{square} = 25.46$, $p < 0.01$). Models 4–6 also demonstrate the slight superiority of the DEA-based approach for explaining long-term performance differentials ($\text{Chi} - \text{square} = 13.17$, $p < 0.01$), compared to the other approaches ($\text{Chi} - \text{square} = 12.35$, $p < 0.01$, for CEO's letters; $\text{Chi} - \text{square} = 10.20$, $p < 0.05$, for CEO's characteristics).[11] Complementing these findings, the R^2 shows that the DEA-based approach for forming CGs has greater explanatory power than the other options do.

[11] As it can be seen in Table 2, the differences in explanatory power between the DEA-based approach and the other approaches are less pronounced in the long run than in the short run, a finding consistent with the Nath and Gruca (1997) thesis of convergence among the different approaches of forming groups of firms.

DISCUSSION AND CONCLUSIONS

Our goal in this study was to contribute to three important research streams of literature on managerial cognition: a measurement of cognitions and a demonstration of the existence of shared cognitions in an industry, an evaluation of the impact of cognitions on organizational outcomes, and an assessment of the accuracy of managers' cognitions. Accordingly, we proposed a new approach to the measurement of CEOs' attentional focus and employed it to detect cognitive groups (CGs). Finally, we compared our approach to other approaches that have been employed in the extant research.

Our approach to the measurement of managers' cognitions allowed us to identify the strategy dimensions on which CEOs focus their attention when seeking competitive advantages. Our panel data DEA approach fulfills two requirements suggested in the literature: One, it is less dependent on researcher's decisions than qualitative methodologies are, and two, it allows for the analysis of large samples in a longitudinal way, in order to extract causal relationships while tackling endogeneity concerns (Hodgkinson and Healey, 2008). Through this approach, we demonstrated that there are groups of CEOs in the industry under study that share similar attention focus. We also found support for a link between CGs and performance. Our results also indicate that our measure of CEOs' cognitions is highly correlated with other measures drawn from CEOs' demographic characteristics and their letters to shareholders. Further tests indicated that our measure has greater explanatory power of performance variations within the industry than do the other two measures. These differences tend to be less pronounced in the long run, rendering support to the Nath and Gruca's (1997) thesis of convergence among approaches to form strategic groups.

Implications for research

The first contribution refers to the use of new analytical methods in strategic management research. Stochastic approaches to measuring efficiency have evolved to account for panel data sets. However, DEA—a nonparametric approach—typically continues to rely on cross-sectional data. The approach proposed in this study combines the benefits of DEA (e.g., it is a distribution-free approach and

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Table 3. Relationships among different approaches for forming groups

	Predicted group					
	CEO's demographic characteristics			CEO's letters to shareholders		
DEA-based group	Group 1: positive attitude toward risk taking	Group 2: neutral attitude toward risk taking	Group 3: negative attitude toward risk taking	Group 1: focused entrepreneurial orientation	Group 2: broad entrepreneurial orientation	Group 3: resistant-to-change orientation
Group 1: attention to investment banking activities	30 14.29%	3 1.43%	12 5.71%	41 19.52%	0 0%	4 1.90%
Group 2: attention to commercial banking activities	0 0%	88 41.90%	22 10.48%	19 9.05%	81 38.57%	10 4.76%
Group 3: attention to traditional banking activities	8 3.81%	9 4.29%	38 18.10%	2 0.95%	6 2.86%	47 22.38%
Number of observations % correctly classified:	38	100	72 74.29%	62	87	61 80.48%
Statistical test on classification results						
Chi-square test[a]			131.74***			216.06***
Likelihood-ratio test[a]			121.81***			209.55***
Cramer's V			0.56**			0.72**
Goodman and Kruskal's gamma			0.62**			0.88**
Kendall's tau-b			0.45**			0.72**

[a] Chi-square and Likelihood-ratio test the null hypothesis that both distributions are independent.
**$p < 0.05$; ***$p < 0.01$

allows for multiple outputs simultaneously) with the advantages of panel data estimation (e.g., it tackles causality/endogeneity concerns).

Several researchers have stressed the potential of DEA to strategic groups research (Athanassopoulos, 2003; Day *et al.*, 1995; Prior and Surroca, 2006), although they have failed to resolve the conflict between the cross-sectional nature of DEA algorithms and the requirement of longitudinal analyses to study the formation of strategic groups and the evaluation of their performance. The panel data DEA proposed addresses this limitation.

Our study also contributes to the managerial cognition literature in four ways. First, our approach overcomes two major shortcomings of existing methodologies for measuring cognitions: (1) the textual analysis of letters to shareholders (i.e., letters may serve impression management purposes), and (2) the use of managers' demographics (i.e., demographics cannot capture variations in contextual conditions). Our approach overcomes these shortcomings by using realized strategy rather than intended strategy. By relying on realized strategies, we posit that DEA weights can provide information about the degree of attention paid to each strategy dimension. In this way, we are adopting an attentional view of strategy (Ocasio, 1997), according to which top managers, when designing their firms' strategy, focus their attention on a limited set of strategy elements leading to higher performance outcomes.

Our second contribution to the literature is an examination of the relationships among various approaches to eliciting the mental models of CEOs, which also adds to the discussion about the most appropriate methods for measuring cognitions (see Hodgkinson and Healey, 2008). The significant relationships among these approaches may suggest that they are measuring different aspects of a common construct: CEOs' mental models. Our results indicate, however, that not all these aspects are equally important in explaining performance heterogeneity. Moreover, this study shows that there is some discrepancy between the issues that managers should be attending to, according to their demographics or their messages to business audiences, on the one hand, and their actual focus, on the other.

Third, this study contributes to the research stream on the evaluation of outcomes of cognitions. The results reported here have demonstrated that CEOs' cognitions are a critical determinant of organizational performance. Moreover, the ability of our approach to measure cognitions in panel data sets has allowed us to tease out the difficulty of attributing any form of causality to the cognition-outcomes relationship that has characterized such cross-sectional approaches as interviews or surveys of top managers (Kaplan, 2011).

Our fourth contribution to the literature is the insight this paper provides on the accuracy of mental models. Our results have demonstrated that, in a context of significant environmental changes, the banks that performed better were those with CEOs who attended to traditional banking activities. This finding suggests that accuracy depends upon the CEO's ability to identify and evaluate the business environment correctly *and* to understand the resources that can lead each strategy to deliver a competitive advantage.

Implications for practice

Four practical implications stem from these findings: First, our research provides evidence that top managers should *not* shift their attention to a more entrepreneurial orientation following substantial deregulation (Cho and Hambrick, 2006). Second, this study highlights the importance of aligning a CEO's cognitions, the firm's resources, and strategic choices for gaining competitive advantage. Third, given the relationship between a CEO's attentional focus and demographic characteristics, close attention should be paid to the characteristics of potential CEO candidates. Finally, our approach in measuring attentional patterns may improve managerial practice as well. The application of panel data DEA, for example, reveals the strategic elements on which rival managers are actually focusing their attention. These data may therefore serve strategic benchmarking purposes.

Limitations and opportunities for future research

The very limitations of this study present opportunities for future research. This study is limited to a single industry, and the testing of our hypotheses in other industries would provide valuable findings to the literature. Furthermore, we restricted our analysis to the attentional focus of CEOs as a driver of banking behaviors and groupings, omitting the study of possible determinants of such attention patterns. In addition, the expansion of our analysis of attentional patterns from bank CEOs

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to other executives could provide the opportunity to test other predictions in the cognitive literature. The study also suffers from a weakness flowing from the formulation of DEA itself. A central theme in the strategy literature is the existence of interdependencies among firm choices, environmental conditions, and organizational performance (e.g., Levinthal, 1997; Porter, 1996; Siggelkow, 2001). Because the DEA linear programming problems are unable to capture such interdependencies, an assumption adopted in this study has been that attention can be unambiguously allocated to individual decisions. Although we are in no doubt that future research will develop DEA models that explicitly model these interdependencies, meanwhile, we have tested the consequences of this misspecification problem in our main findings. Multicollinearity analyses showed that misspecification does not generate biases either in the CGs classification or in the estimation of banks' performance in terms of this classification.

Despite these limitations, we believe that the panel data DEA approach to measuring CEOs' attentional focus represents an improvement over previous approaches. The classification in CGs that emerges from our approach has allowed us to identify clusters with larger performance differences and that better reflect the role of CEOs in defining actual competitive patterns in the industry than do the groupings that result from the most prevalent approaches for measuring attention.

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APPENDIX

Table A1. Operationalization of variables

Variable	Definition and coding
Firm's performance	
ROA	Ratio of accounting profits to total assets (%)
Long-term ROA	Average ROA between t and $t+5$ (%)
Resource commitments	
Labor	Personnel expenses/total revenues
Physical capital	Depreciation and amortization expenses/total revenues
Credit quality	Loan loss provisions and write-offs/total revenues
Scope commitments	
Commercial loans	Commercial loans/financial investments
Securities portfolio	Securities portfolio/financial investments
Treasury	Treasury/financial investments
Service commissions	Service commissions/products of financial activity
Savings and deposit accounts	Savings and deposit accounts/total liabilities
Interbank position	Creditor or debtor position/total liabilities
Geographical concentration	Herfindahl-Hirschman index of the number of branches of each bank in every Spanish province to the total number of branches of this bank
Customer proximity	Herfindahl-Hirschman index of the number of branches of each bank in every Spanish province to the total number of branches in this province

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Table A1. Continued

Variable	Definition and coding
CEO's characteristics	
Age	CEO's age
Tenure	Number of years that the CEO has been in charge of the bank
International experience	Dummy = 1 (0) if the CEO has (not) worked outside Spain
Experience in other industries	Dummy = 1 (0) if the CEO has (not) been in charge of nonfinancial firms in the past
Educational level	CEO educational level: Bachelor's degree = 1, Master's degree = 2, Doctoral degree = 3, and university professor = 4
Educational background	CEO background in arts, law, or business = 0; background in engineering or science = 1 (Wiersema and Bantel, 1992)
Functional background	Functional background in such core activities as marketing, sales, product development, production, engineering, finance and accounting = 0. Background in peripheral activities like law, administration = 1 (Hambrick and Mason, 1984)
CEO's letters to shareholders	
Activity	Language featuring movement, change, the implementation of ideas, and the avoidance of inertia
Certainty	Language indicating resoluteness, inflexibility, completeness, and a tendency to speak *ex cathedra*
Commonality	Language highlighting the agreed-upon values of a group and rejecting idiosyncratic modes of engagement
Optimism	Language endorsing some person, group, concept, or event; or highlighting their positive entailments
Realism	Language describing tangible, immediate, recognizable matters that affect people's everyday lives
Control variables	
Bank size	Log of total assets
Bank age	Number of years since bank founded
Bank ownership type	Dummy = 1 when insiders (workers and founders) hold more than 50% of the votes in the general meeting, and 0 in other cases.
Regional wealth	GDP of the region of origin of each bank

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