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THE RELATIONSHIP BETWEEN ENVIRONMENTAL UNCERTAINTY AND ENTERPRISE PERFORMANCE. A FUZZY-SET ANALYSIS

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Abstract: The purpose of this paper is to explore causal complexity in the relationship between environmental uncertainty and firm's performance. Due to complexity in the external and internal environment, the relationship between environment and firm performance rests not only on a single attribute but on the interrelation and complementarities between multiple characteristics such as firm features and external factors. This study examines the influence of a firm's specific characteristics and the dimensions of environmental uncertainty on the company's performance. Fuzzy-set qualitative comparative analysis is used to analyze data collected via questionnaires from 58 Polish small and medium enterprises (SMEs). The results suggest that characteristics of the general business environment, as well as the firm-specific characteristics all matter to firm performance. In addition, our findings clearly demonstrate that the determination of high firm performance is underpinned by substantial interdependence among the selected conditions and complexity. Therefore, any particular condition may have a different or even opposite effect on the outcome depending on the presence or absence of other conditions. Based on this, we conclude that external environmental uncertainty characteristics, with the dimensions of competitive intensity, technological turbulence and market/demand turbulence, are not as important as the other conditions for high-performing firms. The study offers a new perspective on the relationship between environmental uncertainty and firm performance with its systematic comparative analysis of complex cases. It identifies different combinations of conditions (paths) leading to a high firm performance.

Keywords: environmental uncertainty, firm performance, fuzzy-set analysis, SME

1. INTRODUCTION

Environmental uncertainty is a measure of the complexity of changing external forces faced by an organization and it crucially impacts the responses of organizations in order to stay competitive. The relationship between environmental uncertainty and firm performance represents a perplexing issue in the literature (López-Gamero et al., 2009). This is because, while some studies have documented a positive relationship (e.g. Aragón-Correa and Rubio-López, 2007; Galdeano-Gómez et al., 2008; Nakao et al., 2007), others do not identify a positive impact of environment on firm performance (Link and Naveh, 2006; Wagner, 2005; Watson et al., 2004). The debate also focuses on the concept of 'firm performance'. Some authors believe that this concept involves financial performance measures, and they then focus on the impact of environment on financial performance (Al-Tuwaijri et al., 2004; Link and Naveh, 2006; Nakao et al., 2007; Wahba, 2008). Other authors use competitive advantage measures to represent firm performance. Christmann (2000) examine the potential outcomes of being environmentally proactive, arguing that it contributes to improvements in competitive advantage, by lowering costs and improving differentiation. The challenge is to find out what really matters in the creation of the effect (Fiss, 2011). The vast majority of literature only examines a small number of conditions in the relationship because each additional condition adds to the complexity of the analysis and interpretation of the

results. In this way, the complexity of the empirical world is greatly reduced, leading to significant generalizations that usually result in the emergence of conflicting findings (e.g. Russo and Fouts, 1997). Inferences from empirical observations of the relationship between environment and firm performance are only correct if all important factors that influence the relationship are identified and incorporated in the empirical model. The challenge to ascertain what really matters in this relationship still remains. In response, this study examines the influence of a firm's specific characteristics, dimensions of environmental uncertainty on its performance. The key question is not about independent effects, but how these causal conditions or features combine together and what is their outcome.

The causal conditions (firm-specific characteristics covered by the organizational life cycle stages, dimensions of environmental uncertainty – competitive intensity, market/demand turbulence and technological turbulence) were selected on the basis of previous research that confirmed their influence on the relationship between environmental uncertainty and firm performance (e.g. Shrivastava, 1995, Aragón-Correa and Sharma, 2003). Researchers mainly studied these areas separately and only limited studies analyzed their intersection.

The current study is important for several reasons. First, it addresses the relationship between environmental and firm performance more holistically by including a number of the firm's external and internal factors identified as important in past research. Second, it offers a new perspective on the relationship with its systematic comparative analysis of complex cases. Next, it identifies different combinations of conditions (paths) leading to a high firm performance and, finally, the core-complementary model allowed us to explore which factors are essential and which are less important or even irrelevant to high-performing firms. Due to its unique features, we used the fuzzy-set qualitative comparative analysis (fsQCA), which will enable to answer the following research question: "Which combinations of organizational life cycle stages, dimensions of environmental uncertainty: competitive intensity, market/demand turbulence and technological turbulence are likely to improve firm performance?"

We begin by briefly reviewing the literature on a set of conditions, namely the organizational life cycle theory and environmental uncertainty. We then present the basic idea of fsQCA and describe the research design and data. The results of the analysis are discussed in the following section. We conclude by summarizing the results, considering the importance of the new insights for theory development and practice, and providing directions for future research.

2. THEORETICAL FRAMEWORK

Given that the main objective of the study is to explore paths leading to high firm performance, the study focuses on the following set of conditions: organizational life cycle stages, and the dimensions of environmental uncertainty.

In general, organizational life cycle models identify several phases of development and the organizational characteristics, resources, behaviours and practices exhibited within each stage (Vohora and Lockett, 2004). Researchers agreed that organizational development is quite structured and each stage is uniqueall emphasize that the nature of a business changes as it grows (Clarysse, et. al., 2005). For example, in the five-stage model organizations are predicted to evolve through the birth, growth, maturity, revival, and decline stages (Miller and Friesen, 1984). Although each stage is unique, the combination of various complementary variables (e.g. strategies, structural, decision-making) that determine the organizational life cycle stages establishes the degree of innovativeness and proactivity as similar in two groups of stages, namely the highly innovative birth, growth stages, and the more conservative maturity and decline stages (Lester et al., 2003; Miller and Friesen, 1984; Quinn and Cameron, 1983).

There have been several researchers who have studied and conceptualized the organization's environment and its impact on organizational performance (e.g. Hart and

Banbury, 1994). The stream of research which has most extensively conceptualized environmental turbulence is the Ansoffian strategic success paradigm (Ansoff, 1987). The general idea in this research stream is that businesses must assess the turbulence of the environment in which they operate and match their aggressiveness, capabilities, and responsiveness to the environmental turbulence. Other research streams have also recognized the importance of environmental uncertainty as a driver of organizational behavior and responses. In this research, based on literature, we propose to operationalize the external environmental uncertainty of an organization with the dimensions of competitive intensity, technological turbulence and market/demand turbulence. Competitive intensity is the degree of competition that a firm faces from organizations within its industry and competitive reference set (Grewal and Tansuhaj, 2001). Technological turbulence refers to the degree and rate of technological change relevant to the products and processes of the organization (Jaworski and Kohli, 1993). Market/demand turbulence relates to the degree and pace of instability and uncertainty within a firm's markets and customers (Jaworski and Kohli, 1993).

3. METHODOLOGY OF RESEARCH

The finding that environmental uncertainty has a positive or negative net effect on firm performance does not help us understand in which contexts this occurs and in combination with which additional factors. Therefore, rather than estimating the relative importance of different conditions across all cases, it is better to examine which make sense for which kinds of firms to produce a desired outcome (Fiss, 2007). Accordingly, in order to explore how the conditions contribute to the outcome in question, the current study employs a set-theoretic approach based on the fuzzy-set qualitative comparative analysis (fsQCA).

The fuzzy-set theoretic method of QCA, as propounded by Charles Ragin, is a comparative case-oriented research technique that uses the concepts of Boolean algebra for the analysis of social science statements in terms of set relations (Marx et al., 2013). Ragin (2000) argues that the logic of the comparative case study is configurational, whereby cases (or firms) are considered as the configuration (or constellation) of attributes, and can only be analyzed holistically as packages. Thus, researchers looking at comparative configurations examine how different determinants (termed as causes in QCA parlance) of a case fit together and combine to create the outputs (termed as outcomes in QCA parlance; Fiss et al., 2013). Other benefits of QCA include systematic comparison, acknowledgment of multiple conjunctural causation and equifinality, identifying necessary and sufficient conditions, and ascertaining core and peripheral conditions leading to the desired outcome (Fiss, 2011).

In QCA the basic unit of analysis is set (defined as the certain condition or outcome of interest). After defining the set, researchers code cases for whether they have membership in the set of causal conditions and outcome. This information is then summarized as a truth table using fsQCA software and logical algorithms are used to reduce the configurations found in the truth table to a few causal recipes (specifying which causes must be combined) to produce the outcome (Ragin, 2008; Ragin and Sean, 2009; Schneider and Wagemann, 2012). QCA also allows researchers to check the relative importance of a causal recipe and overall solution by measuring "coverage," that is, the relative importance of different paths to an outcome, and "consistency," that is, what proportion of observed cases are consistent with the pattern (Fiss, 2011; Ragin, 2000; Schneider and Wagemann, 2012).

We used data drawn from a sample of 58 small and medium enterprises (SMEs) located in Silesian Province in Poland. The data were collected at the end of 2016 using a survey sent to the founders and/or CEOs as these persons have the most profound knowledge about the environmental practices and performance of their firms (Calantone et al., 2002). Prior to the survey, we conducted 20 interviews with managers to ensure the relevance of the concepts, and that the phrasing of the items and meaning of the concepts were equally understood.

After three rounds of reminder e-mails, we received 276 responses, representing a response rate of 13.3 percent. From this initial sample used in another study and on the basis of the industry type and completeness of the information provided, we were able to identify 58 firms relevant for our study.

All measures stem from established scales in the management literature. Drawing on established measurement scales is necessary as improper measurement may result in questionable findings and potentially unwarranted conclusions.

The study employs a growth-based measure of firm performance as SMEs are usually prospectors pursuing growth oriented strategies (Miles and Snow, 1978). To measure the construct of firm performance (Cronbach Alpha = 0.76), we employed a set of established perceptual measures from the literature. Respondents were asked to indicate how successful their firm operated with regard to profit growth, sales growth, market share growth, and employee growth relative to their strongest competitor in the last fiscal year. Statement-style items capturing growth-based firm performance were measured on five point Likert-scales (1 = much poorer to 5 = much better).

Prior to performing fsQCA, the original scales need to be calibrated into set membership values (indicating the degree of membership in a set) ranging from 0 to 1. To arrive at continuous set membership values (in the range between 0 and 1), the log odds method described by Ragin (2008) is applied. Consistent with recommendations in the literature (Ragin, 2008), three anchor points were used to perform this calibration: the 5%-percentile, the median, and the 95%-percentile of a variable. The extreme points define full non-membership/full membership in a set, whereas the median is the crossover point indicating that a case is neither in nor out of a set.

The organizational life cycle scale included five descriptions for each of the five organizational life cycle stages. The descriptions contained characteristics from the existing literature (Miller and Friesen, 1984; Quinn and Cameron, 1983) that appeared to be indicators of the organizational life cycle stages: decision-making, structure, situation, level of innovation, and sales growth. A respondent's firm was categorized into one of the organizational life cycle stages based on the description of the situation that best fits the firm. Following this approach, seven firms are in stage 1, nineteen in stage 2, twenty in stage 3, seven in stage 4 and five in stage 5. This approach of classifying into the organizational life cycle stages was employed after we found Lester et al.'s scale (2003) inappropriate for the current study due to unacceptable coefficient Alpha's (< 0.7). To limit the complexity of the model and accompanying problems of limited diversity (which occur when not all theoretically possible combinations of conditions are empirically observable), the firms were further classified into the innovative (birth, growth, revival) and conservative stages (maturity, decline). According to proactivity and innovativeness factors, these two groups are internally consistent (Miller and Friesen, 1984; Quinn and Cameron, 1983). The calibration of the organizational life cycle condition is accomplished through use of a crisp-set QCA (csQCA). In csQCA, only the membership values 1 (perfect membership) and 0 (perfect non-membership) can be used (Schneider and Wagemann, 2012). Perfect membership was assigned to cases belonging to the birth, growth, or revival stages, whereas non-perfect membership was assigned to cases belonging to the maturity or decline stages.

To measure the three dimensions of the environment i.e., competitive intensity, market/demand turbulence, and technological turbulence, we adopted 10 items from Jaworski and Kohli (1993) for competitive intensity and technological turbulence and four items from Grewal and Tansuhaj (2001) for market/demand turbulence. The items of competitive intensity scale assessed the behaviour, competitor resources and ability of competitors to differentiate themselves. The market/demand turbulence scale assessed the stability of customer preferences which tend to change over time. Technological turbulence scale measured the extent of change and pace in technology relevant to the organization. A five-point scoring format was used for all items (1 = strongly disagree; 5 = strongly agree).

The factor analysis of the environmental uncertainties with nine remaining items reduced to three factors which we analyzed. The authors were in agreement that the three factors can be usefully titled competitive intensity, demand turbulence, and technological turbulence. A cut-off loading of 0.40 was used and all factor loadings were above 0.50, exhibiting a high level of significance. The results from our factor analysis of the measurement items for each of the categories shows that measures used in this study have construct validity (Nunnally, 1978). The Cronbach Alpha scores for each scale were good with overall Alpha reported between 0.7-0.83. For all three conditions we used the same measures of membership: fully out for a response of "neutral" (3.01) and fully in (4.00) for a response of "agree." The crossover point was 3.49.

4. RESULTS

Existing research establishes that the innovative stage of the organizational life cycle and competitive intensity are likely to be associated with improved SME performance. We therefore integrated the presence of a competitive intensity and the innovative stage of the organizational life cycle as easy counterfactuals in the analysis of sufficient conditions for the high firm performance outcome.

The sufficiency analysis found four consistent paths leading to high firm performance (table 1). Utilizing the notation system from Ragin and Fiss (2008), each column in the Table 1 represents a configuration of conditions linked to the respective outcome. Full circles (●) indicate the presence of a condition while barred circles (⊖) indicate a condition's absence, blank spaces indicate "don't care". Each panel represents the alternative causal combinations or recipes for the outcome (Ragin, 2008). These are consecutively numbered S1, S2, S3 and S4.

Table 1
Configurations for achieving high firm performance

Condition	Solution			
	S1	S2	S3	S4
Innovative stage of organizational life cycle	●	●	⊖	
Competitive intensity		●	●	●
Market/demand turbulence	⊖		⊖	⊖
Technological turbulence	⊖			⊖
Consistency	0.74	0.93	0.94	0.95
Raw coverage	0.26	0.18	0.37	0.28
Unique coverage	0.17	0.03	0.001	0.01
Solution consistency	0.85			
Solution coverage	0.73			

The first configuration S1 combines innovative stages of the organizational life cycle and absence of market/demand turbulence and technological turbulence. The second configuration S2 combines innovative stages of the organizational life cycle and competitive intensity. Configuration S3 and S4 combine absence of market/demand turbulence and presence of competitive intensity with absence of innovative stages of the organizational life cycle (S3) or absence of technological turbulence (S4). Overall, the presence of competitive intensity occurs as a condition in each configuration, except for S1, whereas the absence of market/demand turbulence in the general business environment is commonly associated with high SME performance. The analysis also shows that the competitive intensity condition leads to high SME performance only when combined with the presence or absence of specific attributes (presence of innovative stage of organizational life cycle in solution S2 and absence of market/demand turbulence with absence of innovative stage of organizational life cycle in solution S3 or with absence of technological turbulence in solution S4).

We report two measures of fit in table 1: consistency and coverage. The measure of consistency assesses the degree to which cases sharing a given combination of conditions agree in displaying the outcome. It can range between 0 and 1, where 1 implies perfect consistency. The score is calculated for each configuration separately and for the solution as a whole. The scores for the solution (0.85) and for each configuration separately (0.74-0.95) suggest the presence of clear set-theoretic relationships. Solution coverage (0.73), by contrast, assesses the empirical importance of the solution. The raw coverage measures the degree to which an outcome is covered by each configuration. We are also interested in how much of the outcome is covered only by a specific configuration, i.e. unique coverage. Different configurations can overlap, meaning that the same case can follow multiple paths toward the outcome. Hence, we also provide a measure of each configuration's unique contribution to the outcome. An analysis of the coverage suggests S1 is relatively distinct because of its high unique coverage. S3 and S4 have fairly raw coverage but lack unique coverage, indicating that these configurations overlap with other configurations (Schneider and Wagemann, 2012).

5. DISCUSSION AND CONCLUSION

Instead of trying to isolate which variables, namely dimensions of the environmental uncertainty and stages in the organizational life cycle, provide the largest contribution to explaining the variance in firm performance, the current study examines which of these conditions and their combinations commonly occur across cases achieving a superior SME performance. The results suggest that this conditions all matter to SME performance. In addition, our findings clearly demonstrate that the determination of high SME performance is underpinned by substantial interdependence among the selected conditions and complexity. Therefore, any particular condition may have a different or even opposite effect on the outcome depending on the presence or absence of other conditions. Based on this, we conclude that environmental uncertainty is not as important as the other conditions for high-performing SMEs. The analysis shows that, in case one of dimensions of environmental uncertainty, namely competitive intensity and at the same time an absence of market/demand turbulence, or technological turbulence with combination of the presence or absence of the innovative stages of the organizational life cycle, SMEs were achieved high-performance. What more SMEs in the innovative stages of the organizational life cycle achieve a high firm performance regardless of their attitude to the environment. The result of the analysis might differ across sectors of the economy or the size of firms and thus future research is needed to also examine other companies.

The implications of the different paths to an outcome for managers are clear. The identification of multiple paths provides managers with a range of choices regarding their strategy formulation and implementation. By contrast, the results of correlational analysis only show the relative importance of different variables. In this way, managers may feel that the possibilities to achieve a positive outcome are limited. Findings from the fsQCA are relevant for different firms so a firm's strategies can be tailored to suit specific needs. Therefore, identifying different paths allows for greater flexibility in choosing an appropriate approach. The results also indicate that the successful development and implementation of strategies is dependent on the general business environment. Reducing anxiety through environmental scanning and taking actions to retain control is thus necessary.

The current study has two significant limitations. First, it is possible that the configurations may not be generalized to other property spaces constructed with the same conditions in different samples. Second, the inclusion of different conditions constructs different configurations. Therefore, the results are bound by the conditions included in the study. Trying to analyze an intermediate and large number of cases in the future would improve the study. Similarly, the study would also benefit from adding other conditions that appeared to be important for the outcome in past research.

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