A Scientific Approach to Business Strategy

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Abstract:

Prior research has shown that a scientific approach to making strategic decisions—in which executives craft a theory for a strategy's potential success and then test the theory with evidence—leads to success in small, young firms. We examine whether such a scientific approach also works in larger, more mature firms. To do so, we devise a survey that measures scientific Strategy Practices, and we administer it to 262 chief executives who are alumni of Harvard Business School. The survey yields four key findings. First, large firms are more likely to adopt scientific Strategy Practices than small firms, suggesting that scientific learning matters beyond entrepreneurial ventures. Second, firms with greater adoption of Strategy Practices outperform their peers: they grow faster and are more profitable, especially in industries with greater strategic complexity. Third, this outperformance appears to be driven not by firm-specific effects but by the appointment of CEOs with a scientific style. This raises the question of how an executive comes to adopt scientific Strategy Practices. Our fourth finding provides a partial answer: business education can have a lasting impact on a CEO's Strategy Practices, as evidenced by a regression discontinuity analysis centered around a curriculum change at Harvard Business School.

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1. Introduction

A fundamental premise across economics, finance, strategy, and management is that CEOs shape the outcomes of their companies through the strategic decisions they make (Andrews, 1971; Drucker, 1967; Porter, 1980; Tirole, 1988; Bertrand and Schoar, 2003). Yet, despite a large theoretical literature (Gavetti and Porac, 2018), we have remarkably little systematic empirical evidence about *how* CEOs make those strategic decisions.

At the same time, a fast-growing literature in entrepreneurship has argued for a particular way of making strategic decisions: a scientific approach to learning and evidence-based decision-making (Felin and Zenger, 2009; Lafley et al., 2012; Camuffo et al., 2020; Zellweger and Zenger, 2021; Yang et al., 2022). In this approach, company leaders craft a theory that explicates the causal reasoning for a strategy's potential success and then test it with empirical evidence. The scientific approach has been shown to help firms generate especially novel strategies (Felin and Zenger, 2009), deal with uncertainty (Camuffo et al., 2020), confront complexity (Zellweger and Zenger, 2021), and overcome behavioral biases (Coali et al., 2022; Yang et al., 2022) in a proactive and evidence-based way. Empirical evidence on the adoption and benefits of the scientific approach to strategic decision making, however, has focused mainly on relatively small, young, and even nascent firms, which are often developing their first business strategies. Large organizations face important challenges beyond developing and testing theories, specifically the need for persuasion of and buy-in by the many stakeholders across the organization.

The lack of evidence regarding scientific strategic decision-making beyond entrepreneurial firms leads us to a set of questions: How widely are scientific strategy practices adopted across firms of all sizes and ages? Do large firms adopt scientific strategy practices more or less commonly than small firms? Do firms with scientific practices outperform their competitors, in samples beyond entrepreneurial ventures?

To answer these questions, this paper develops a new survey instrument that allows us to measure the adoption of a scientific approach to business strategy in a comparable way across a wide range of firms. We refer to this new measure of scientific strategic decision-making, including practices for persuasion and stakeholder buy-in, as “Strategy Practices.” Our Strategy Practice measure provides a quantitative index, with higher values corresponding to greater adoption of scientific strategy practices. For example, the measure captures the degree to which CEOs specify hypotheses for why strategies work as well as the usage of custom-tailored

hypothesis testing (Lafley et al., 2012). The index also measures the adoption of practices that promote "peer-review" among senior executives, persuasion of stakeholders beyond top management through communication, incentives for implementation, and accommodation of potential resistance. The latter practices are especially relevant for large organizations pursuing a scientific approach to strategy, as they have to coordinate a large number of stakeholders.

We combine the new survey instrument with double blind, open-ended questions and structured scoring as in the World Management Survey (WMS) (Bloom & Van Reenen, 2007; Bloom, et al., 2019) in order to extend the insights from the literature on scientific learning in entrepreneurship (Felin and Zenger, 2009; Lafley et al., 2012; Camuffo et al., 2020; Zellweger and Zenger, 2021) to a broader set of firms. The survey design gives us both systematic data for examining cross-firm differences in decision processes and detailed information about how particular processes correlate with firm performance.

We deploy our new survey instrument in a sample of 262 CEOs who are alumni of Harvard Business School (HBS). This is a strongly selected sample of successful executives, and they lead firms that are unusually large (the average firm employs around 2,000 employees), mature (average firm age is 47 years old), and more likely than the typical firm to be publicly traded. Though all of our respondents are graduates of a single school, we find large variation in Strategy Practices, most of which cannot be explained by industry differences. The remainder of the paper therefore carefully documents the nature of the variation of scientific Strategy Practices as well as potential explanations for the large degree of variation in our selected sample.

Our first main question is whether large firms adopt scientific Strategy Practicees at different rates from entrepreneurial ventures. We explore three broad areas of strategy process. “Formalization” captures the ability of the chief executive to articulate clearly the goals, scope, and distinctive advantage of the company. “Development” of strategic theories includes practices to abductively specify initial assumptions or hypotheses and subject them to rigorous debate among top managers. “Implementation” of strategic theories includes practices to validate and test theories as well as persuade stakeholders beyond top management to buy-in. We show that Formalization, Development, and Implementation practices are all more strongly adopted at large firms than small firms, consistent with the view that scientific learning matters not just for entrepreneurial ventures. Additionally, we find that Development and Implementation practices are frequently adopted together by large firms, consistent with recent evidence by Agarwal et al.

(2023b) showing the complementarity of theory development and hypothesis testing for entrepreneurs in Tanzania.[1]

One potential explanation for the large variation in scientific Strategy Practices is that our survey mostly reflects measurement error. If this were the case, our scientific Strategy Practice score would not be significantly correlated with firm performance. We merge our Strategy Practices measures with administrative data from the US Census Bureau, which allows us to correlate scientific Strategy Practices with firm performance data from IRS tax records. We show that firms with higher Strategy Practice scores systematically outperform their competitors in the same industry in terms of profitability. While these results should not be interpreted as a causal impact of Strategy Practices on firm performance, they do rule out that our Strategy Practice score is dominated by measurement error.

We further validate that our Strategy Practice score captures relevant variation on scientific learning by investigating the mechanism for why firms with more scientific Strategy Practices outperform firms with less. While the entrepreneurship literature has emphasized the benefits of scientific learning for generating novel ideas (Felin and Zenger, 2009) and for learning about the quality of ideas (Camuffo et al., 2020), large firms are especially challenged by strategic complexity, defined as need to manage many firm activities and their interdependencies (Rivkin, 2000). In our view, scientific learning helps to manage strategic complexity as theories are tools to simplify complexity and guide attention. Consistent with the role of scientific learning for managing strategic complexity, we find that firms with more scientific Strategy Practices tend to outperform especially in industries with a high degree of strategic complexity.

Although we cannot conclusively demonstrate that scientific Strategy Practices cause firms to outperform their competitors, we can at least rule out some forms of endogeneity. Specifically, using data on CEO appointment dates together with panel data on firm growth, we show that firms start to outgrow their competitors only after they hire CEOs with high Strategy Practice scores. In this context, we rule out CEO selection based on pre-trends as one form of endogeneity. Our findings are also inconsistent with reverse causality under which better firm performance causes better scientific Strategy Practices. Instead, these empirical results suggest that scientific Strategy Practices capture a CEO's decision-making style (Bertrand and Schoar, 2003). This view that

[1] Appendix A3 provides additional evidence showing that joint adoption of Development and Implementation increases profitability in our sample – which is again consistent with complementarity.

scientific practice adoption reflects CEO style helps explain why we find such a large degree of variation of Strategy Practices, even in our selected sample: Person-level determinants of CEO style, such as experience and educational background can vary widely and will therefore imply large variation in adoption of scientific Strategy Practices.

The fact that scientific Strategy Practices are part of a CEO's style raises the question of how one can boost adoption of scientific Strategy Practices by CEOs. One possible way is business education, but we know little about how effective it is to shape CEO's styles. We therefore exploit a feature of our data, namely the fact that our sample of CEOs attended HBS. This enables us to consider a unique natural experiment: the radical restructuring of the core strategy class in the HBS MBA curriculum in 1983 by Michael Porter. Utilizing a Regression Discontinuity Design (RDD), we show that among the students (later, executives) who were exposed to it, Porter's new curriculum significantly increased strategy Formalization: these executives articulate their firms' choices about goals, scope, uniqueness, and advantage more clearly than do executives who attended HBS before Porter's revamp. This result suggests that it is possible to influence CEOs' strategy style in a persistent way. However, we also find a negative impact of the Porter curriculum change on adoption of scientific practices in the area of Implementation, which includes testing and validation of theories. This suggests that increased training in one area can reduce scientific decision-making in another area. This would be true, for example, if overall attention of executives during formative educational years is limited.

This paper contributes to the literature on scientific approaches to strategy (Felin and Zenger, 2009; Lafley et al., 2012; Camuffo et al., 2020; Zellweger and Zenger, 2021; Yang et al., 2022; Novelli and Spina, 2022). Previous work in this literature has focused on entrepreneurial firms. By generalizing insights to a broader set of firms, including large corporations, we demonstrate the potential value of a scientific approach to a wider set of firms. We develop a new survey methodology to measure Strategy Practices in an accurate way and validate the survey using administrative data including IRS tax records. The paper can therefore be considered a "proof of concept" which enables future research to collect comparable data on firms' strategic decision-making across large samples of firms, and possibly also in other contexts, such as other industries and countries or even nonprofit organizations or government agencies.

Our study complements recent research on management practices (Bloom and Van Reenen, 2007; Bloom et al., 2019) but is distinct from this prior work. The management practices literature

focuses on operations, or the sum of tasks and activities used to produce a given set of firm offerings. It emphasizes structured practices for monitoring, target setting, and incentives within firms, with the typical respondent being an establishment manager. In contrast, we focus on strategic decision making by CEOs, which determines firm offerings and the general direction of the business. And while our survey covers practices on strategy implementation, these components are focused on how implementation feeds back into strategic decision making by CEOs through (scientific) learning (Weiser, Jarzabkowski and Laamanen, 2020). Neither of these topics is addressed in the main datasets used in the management practices literature: the WMS and the Management and Organizational Practices Survey (MOPS). Our survey topic is also distinct from data-driven decision-making (Brynjolfsson and McElheran, 2016; McElheran, Brynjolfsson and Yang, 2022), which is a set of "practices surrounding the collection and analysis of external and internal data" (Brynjolfsson, Hitt and Kim, 2011). Although it shares with data-driven decision-making its emphasis on evidence-based decisions, a key emphasis of scientific learning is the generation of novel theories even without large samples of data (Felin and Zenger, 2009). Indeed, a focus of our survey instrument is the articulation of initial assumptions and hypotheses whenever there is no data on which to base a strategic decision. Additionally, measures of data-driven decision-making from MOPS as used in McElheran, Brynjolfsson and Yang (2022) focus on data collected and used in operations instead of CEO-level strategic decision-making.

This paper is structured as follows. Following this introduction, Section 2 outlines our empirical methodology, including a detailed description of the survey instrument central to this study. Section 3 discusses our empirical findings related to variation of adoption of Strategy Practices, and Section 4 discusses the correlations between CEOs' strategic decision practices and a set of performance variables. Then, Section 5 explores one possible explanation for the variation we observe in how firms make strategic decisions: business education. Finally, Section 6 concludes by summarizing our findings and identifying potential areas for future research.

2. Empirical Methodology

In the past, three main challenges have limited broad, systematic empirical research on CEOs' strategic decision-making and Strategy Practices. First, the top executives who usually make these decisions are rarely willing to complete in-depth surveys (Bandiera et al., 2019). The difficulty of securing high numbers of study participants often limits empirical research in this area

to qualitative work that focuses on a small selection of case studies and a narrow subset of strategic decision types. Second, differences in how managers make strategic decisions are typically hard to capture systematically in large samples. Frameworks that would make data capture easier—such as a taxonomy of different strategy processes or an agreed-upon way to distinguish between "good" and "bad" ways to make strategic decisions—do not exist to our knowledge. Third, it is difficult to elicit truthful answers from top managers on how they really make decisions, as CEOs often face strong pressures to give socially desirable responses to external audiences.

We overcome these challenges and explore our central research question by utilizing a novel survey methodology and sampling strategy to gather in-depth data on a large sample of firms within the U.S., Canadian, and U.K. manufacturing sectors. We overcome the first challenge—the reluctance of CEOs to complete surveys—by surveying alumni of a business school, Harvard Business School (HBS), where two authors of the paper are based. We hoped that alumni would respond at a high rate to a survey invitation from HBS faculty, and the hope turned out to be well-founded. While CEOs trained at HBS are by no means a representative sample of CEOs, evidence of heterogeneity in Strategy Practices within this highly selected set of managers would—if anything—represent a lower bound on the heterogeneity among the broader population of CEOs. We overcome the second challenge—the lack of a systematic way to classify differences in strategy processes—by creating a novel survey instrument that captures differences in the way managers develop, select, and implement new strategic ideas. Finally, we try to minimize biases on the part of both interviewees and interviewers by using several interview tactics that reduce these biases and by employing trained interviewers to score responses in a double-blind manner. This approach, modeled on the method of the WMS (Bloom and Van Reenen; 2007; Bloom et al., 2019), helps us gather high-quality and comparable assessments of strategy practices across a wide variety of firms.

2.1 Developing a Strategy Practices Survey Instrument

To develop our survey instrument, we proceeded in the following steps. First, we set the scope of topics for the survey and generated a draft survey based on both academic and practitioner literatures. Our core aim was to measure practices that help CEOs learn about strategy "like an empirical scientist." This guideline was consistent with previous work by some on the author team (see Lafley et al., 2012) and was a natural fit for a team of empirical social scientists. Additionally,

we were interested in practices that facilitate coordination and buy-in to support strategic execution, both within the top management team and beyond. For these supporting practices, we broadly reviewed the management literature—much written for practitioners—that examines how executives do and should make strategic decisions (e.g., Drucker, 1966; Garvin and Roberto, 2001; Mankin and Steele, 2005 and 2006).[2]

Second, we conducted explicit cognitive testing to ensure that potential participants would understand our questions correctly and answer in an unbiased way. We started with a focus group of participants in a senior executive education program at HBS. Then, we piloted the draft instrument with a set of former chief executives whom we know well[3] and with dozens of HBS alumni volunteers. These experienced "test pilots" helped us refine the open-ended questions and follow-up questions. This was critical for us to design questions that were not so open that respondents would spend a long time on unrelated topics. In response to their input, we eliminated questions on supporting practices that led to off-topic responses, such as questions on "resource reallocation," "orchestrating resources and core competencies," and "access to unfiltered information from frontline employees." This phase was also critical in helping us to reframe questions so that practicing managers would understand them more clearly.

Third, we ran a pilot survey with two different senior HBS executive education programs, for which we recruited a handful of HBS MBA students as interviewers. The pilot survey was designed to show us whether MBA students could be trained to execute the survey, which was critical for collecting data from hundreds of CEOs. In response to input from executives and interviewers, we added questions about specific aspects of decision making that the literature review missed and eliminated questions deemed irrelevant in reality. For example, some of the literature suggested that high-performing executive teams might conduct a "vote" among the team in order to finalize critical strategic decisions (Csaszar and Eggers, 2013), and thus we asked executives during our pilot interviews if they ever voted to make strategic decisions. Virtually none of our pilot interviewees engaged in this practice, and many articulated compelling reasons that this was a detrimental practice. In finalizing the survey instrument, we therefore eliminated questions about voting. Appendix 2 provides more details on cognitive testing for the survey.

[2] Several questions we initially drafted (e.g. on "motivation through vision/purpose," "coordination of value chain activities," and "adaptation to new environments") ended up with an unclear set of recommended practices.

[3] We thank Kevin Sharer and Dan Simpson for their feedback in the initial stages of the survey development. See Appendix 1 for more details on our cognitive testing procedure.

2.2 Scoring Strategy Practices

This development process yielded a survey instrument that focused on three broad areas of Strategy Practices: Formalization, Development, and Implementation. Within each of these areas, we characterized the approaches that each executive follows and then assessed where those approaches fall on a spectrum that runs from informal, unstructured, reactive, and intuitive on one end, to formalized, consistent, proactive, and evidence-based on the other end.

To anchor CEOs' responses to their actual process for making strategic decisions, at the beginning of the interview we first gave the respondent a brief definition of a "strategic decision" as any decision that "significantly impacts your business or changes your strategy." We then gave examples such as "significant investments," "entering a new line of business," or "entering a new geographic area." We abstained from any more specific definitions of "strategic change," both because what constitutes a strategic decision can vary significantly among firms (e.g., small vs. large firms make strategy decisions on different scales) and to avoid confusing interviewees with excessively abstract concepts. To ensure comparability of responses and to ensure that interviewees' responses were reflective of their actual strategy practices, we also asked the respondent to give us three different examples of "typical strategic changes" in his or her firm from the previous five years. These examples both grounded interviewees in their actual process for making strategic decisions (versus what they thought they *should* be doing) and kept the conversation from becoming too abstract. We referred back to these examples throughout the interview to keep the conversation grounded. We also classified these decisions independently into potentially overlapping sets of 17 different decision types, including "M&A," "new business," "geographic expansion," and so on. **Appendix Table 1** provides details on the 17 different types of strategic changes into which we categorized the example decisions.

We then moved into the main body of the survey, using the questions shown in Figure 1. Our questions started with the very broad "What is your company's strategy?" and progressively dove into much deeper specifics (e.g., "How do you typically first come to consider changes to strategy?" and "How would you typically know whether a strategic change has succeeded or failed?")

Within the main body of the survey, we asked first about strategy Formalization, which is the only section that measures the actual content of strategies. This section captures elements of

CEO's strategic theory for their firms, defined as hypotheses for why firms compete in certain markets and how it generates competitive advantage (Ehrig and Schmidt, 2022). Additionally, we measure fundamental concepts of strategy, such as strategy as the deliberate choice of "a different set of activities to deliver a unique mix of value" (Porter, 1996) or as "key choices that guide other choices" (Van den Steen, 2017). We considered three factors:

- **F1 Strategy statement:** the ability of the executive to state concisely the goals, scope, and competitive advantage of his or her company (Collis and Rukstad, 2008).
- **F2 Deliberate scope and advantage:** whether the executive could articulate clearly the markets the company prioritizes and the way it intends to win in those markets (Porter, 1980; Lafley and Martin 2013).
- **F3 Deliberate strategic distinctiveness:** whether the executive could say how the company differs from its main competitors (Porter 1996; Litov et al., 2012).

Most of the survey focuses on strategy process, specifically strategy development, (henceforth Development) and strategy implementation (henceforth Implementation) and the feedback between Implementation and Development.

The concepts in the Development section of our instrument correspond closely to the structure of Felin and Zenger (2009), which discusses scientific learning in the context of entrepreneurial strategy.[4] The Development section explores the following concepts:

- **D1 Initialization:** whether strategic hypotheses or theories were proactively generated based on subtle environmental cues (Felin and Zenger, 2009).
- **D2 Justification of decisions:** whether firms utilized data to inform their strategic initiatives (and if so, which types of data) and abductively formulated assumptions if data were missing (Felin and Zenger, 2009; Lafley et al., 2012; Zellweger and Zenger, 2021).
- **D3 Regular peer-review**: whether decision-making was embedded in routine top management meetings and connected strategy with implementation (Felin and Zenger, 2009).
- **D4 Effective peer-review**: whether decisions were considered in well-prepared, discussion-based strategy meetings (Lafley and Martin, 2013).

[4] Our discussion sequence of the practices deviates from the enumeration of the questions, since the discussion sequence follows Felin and Zenger, 2009, while the enumeration of questions reflects their sequence in the interviews. The sequence of questions in the interviews was set to naturally let questions build upon each other.

- **D5 Exploration of alternatives:** whether there was a routinized processes to "imagine possibilities" (Felin and Zenger, 2009) and ensure similar information on the feasibility, benefits, and initial assumptions/hypotheses of each alternative (Lafley et al., 2012).
- **D6 Peer-review of risk:** whether there were processes for executives to voice potential concerns on proposed decisions (Roberto 2005; Carroll and Mui, 2009).

Questions D1, D2 and D5 are closely related to ideas discussed in Felin and Zenger (2009). Question D1, "Initialization," scores whether managers proactively look for subtle cues[5] in the external competitive environment to initialize development of a new strategic theory, consistent with Felin and Zengers' view that novel theories are often based on few "observational or experiential fragments." We then capture in question D5 the "Exploration of alternatives," which according to Felin and Zenger makes executives "cognitively simulate and think counterfactually, thus allowing for the unique creation of possibilities."[6] Additionally, this practice dimension captures the "elaboration of possibilities" (Felin and Zenger, 2009), or "what would have to be true about the world for each possibility to be supported" (Lafley et al., 2012). Practice D2, "Justification of decisions," then captures to what degree decisions are evidence-based, if data can be collected (McElheran, Brynjofsson and Yang, 2022) and if data cannot be collected, whether CEOs abductively specify and document hypotheses or initial assumptions and their "conditions for success" (Lafley et al. 2012; Zellweger and Zenger, 2021).

Questions D3, D4 and D6 focus on practices of peer-review by the top management team, which supports scientific decision-making especially in more complex organizations. This is acknowledged to be crucial, even for entrepreneurial firms, as "an optimal collective process can create results of higher quality than those achievable by any one individual ... Individuals build off of each other's ideas and thoughts. They challenge and criticize ideas" (Felin and Zenger, 2009). In this spirit, question D6, "Peer-review of risk," measures whether the top management team systematically vets all strategic alternatives through the same, routinized process of risk evaluation, e.g., through the "devil's advocate" procedure of probing and criticizing assumptions (Roberto 2005; Carroll and Mui, 2009) or similar processes. In question D3, "Regular peer-

[5] The scoring emphasizes subtle cues and proactive behaviour, since obvious changes and reactive behaviour to commonly known industry trends are likely to be pursued by many other firms and are therefore unlikely to generate competitive advantage (Felin and Zenger, 2009; Barney, 1986).

[6] Lafley et al. (2012) view the generation of new hypotheses as "integral to the scientific method" and the related imagination of new strategies as the "ultimate creative act in business."

review," we measure whether peer review of strategy among top managers is embedded in their routines and whether such meetings regularly discuss strategy and implementation jointly. We deepen the measurement of strategy meetings in question D4, "Effective peer-review," where we measure whether the structure of meetings emphasizes discussion based on advance preparation and joint leadership by the CEO and operations managers, to ensure a dialogue between strategy design and operations (Lafley and Martin, 2013).

Beyond hypothesis development, hypothesis testing or "careful generation of custom-tailored tests" of theories is "integral to the scientific method" (Lafley et al., 2012). The survey instrument's treatment of Implementation focuses on five related areas:

- **I1 Implementation planning**: whether executives anticipated interdependencies across activities, and provided strategy-consistent targets and incentives (Gans et al., 2019; Pillai et al., 2020).
- **I2 Testing and follow-up**: whether the firm conducted regular reviews of their strategic decisions' outcomes and compared outcomes to initial assumptions and hypotheses (Pillai et al., 2020; Lafley et al., 2012; Zellweger and Zenger, 2021; Drucker, 1966).
- **I3 Validating causal mechanisms**: whether the firm collected evidence on mechanisms through which the strategy works, separated strategy design from luck, separated strategy development issues from implementation issues, and systematically learned from surprise outcomes about initial assumptions and hypotheses (Camuffo et al., 2020; Lafley et al., 2012; Pillai et al., 2020; Zellweger and Zenger, 2021).
- **I4 Strategy communication**: whether executives regularly communicated strategies to employees outside top management (Hirschman, 1970; Gadiesh and Gilbert, 2001; Kim and Mauborgne, 1998).
- **I5 Learning about resistance**: whether executives anticipated potential resistance to strategic decisions or changes outside of their firms' top management (Hirschman, 1970; Kim and Mauborgne, 1998).

I2 and I3 and focus on validating and revising strategic theories. Specifically, practice I2, "Testing and follow-up," measures the presence of systematic reviews of initial assumptions and hypotheses in light of strategy outcomes. We then provide a deeper measure of the extent of learning from strategy outcomes in question I3, "Validating causal mechanisms," including whether CEOs use "custom-tailored tests" of hypotheses (Lafley et al., 2012; Zellweger and Zenger, 2021), whether

they seek to understand the specific mechanisms by which individual strategy characteristics affect outcomes (Pillai et al., 2020), whether CEOs systematically separate intended strategy from luck (Camuffo et al., 2020), whether they separate issues with the strategic theory from implementation issues (Lee and Punaram, 2015), and whether lessons learned affect resource allocation and lead to strategy redesign (Camuffo et al., 2020; Pillai et al., 2020).

The practices I1, I4 and I5 focus on facilitating persuasion of and buy-in by employees outside top management. Question I1, "Implementation planning," scores the extent to which processes are in place to support the effective implementation of strategic decisions though assignment of responsibilities and complementary targets/milestones and incentives. But beyond such practices, scientific learning offers the opportunity to convince frontline employees and other important stakeholders to buy into a strategy based on logic and evidence instead of authority and incentives. This is well-recognized by Felin and Zenger (2009), who argue that "the manner in which ideas and theories are presented and discussed has much to do with whether there is large-scale buy in by others." Question I4 on "Strategy communication" measures to what degree firms regularly inform employees beyond top management about the content, rationale, and process used to arrive at strategic decisions (Gadiesh and Gilbert, 2001). Additionally, we score whether CEOs regularly provide opportunities for employees to voice their perspectives (Hirschman, 1970; Kim and Mauborgne, 1998), for example through town-hall style events. Question I5, "Learning about resistance," complements I4 by scoring whether top managers proactively identify potential resistance to new strategic ideas and their implementation by non-top-managers and elicit constructive criticism from potential resisters.

Figure 1 shows our detailed scoring grid for each question as well as the open-ended questions with which we started each part. On each item, each interview received a score from 1—reflecting a very informal, unstructured, reactive, and intuition-driven Strategy Practice—to 5—reflecting a highly formalized, consistent, proactive, and evidence-based practice.

2.3 Additional Data

Strategy Decisions: Number and Speed

In addition to the Strategy Practices discussed above, the survey captured data on strategic decision and implementation characteristics, as well as on the type of competitive advantage the company pursues. To measure how quickly each firm makes and implements strategic decisions,

we asked the respondent to estimate the average number of strategic decisions made over the previous five years as well as the time it took both to make and to implement strategic decisions for each of the three examples of strategic decisions the respondent mentioned.

Firm Characteristics

We collected data on several important firm characteristics at the end of the interviews. We asked interviewees to describe the ownership structure of their firms and the founding year of the firm, and where possible, we verified this information from third-party sources. Finally, we asked for the number of full-time employees at the respondent company. Importantly, we asked all of these questions at the end of the interview, lest any particular description of CEOs' firm characteristics bias any subsequent responses.

Separate from our survey, we obtained additional information on the American firms in our sample from two databases maintained by the US Census Bureau: the Longitudinal Business Database (LBD) and the Census of Manufactures (CMF). The LBD has two features that are particularly helpful for analyzing firms, their Strategy Practices, and their performance. First, the data come from IRS tax files, which are gathered independently from our survey. Associated performance data are therefore free of any survey bias in the reporting of performance. Second, both the reporting firms and the IRS have strong incentives for truthful reporting. In addition, the Census has invested deeply to maintain longitudinal links in the data, and this enables us to measure firm growth over time reliably. This panel dimension is important for separating firm effects from CEO effects of Strategy Practices. In contrast to the LBD, the CMF is cross-sectional, and it records data at the level of establishments (the location of a business, such as a plant or a store), not firms. The CMF data we use is linked to firm identifiers (Census "Alphas"), which ensures that we can reliably link establishments to firms for which we measure Strategy Practices. Despite only being a cross-section for 2017, the CMF data allows us to calculate markups/profitability, which is an important additional dimension of performance.

CEO Characteristics

To examine how various CEO characteristics might affect their strategic decision-making, we collected three measures that capture each CEO's respective level of experience: tenure at the company, tenure as CEO, and age. We did not directly ask for the respondent's age during the

interview in order to avoid any awkwardness. Instead, we used the following protocol to estimate respondent age from public sources. We searched for the CEO's LinkedIn page, recorded their college graduation year, and estimated age assuming that the CEO graduated at age 21. If there was no information on the college graduation year, we relied on the date of graduation from HBS for MBAs. Since HBS typically requires work experience before entering the MBA program, we assumed that HBS MBAs were 27 when they graduated. If neither of these steps yielded an approximate age, we reverted to the interviewer's initial guess of the respondent's age.[7]

Noise Controls and Interviewer Effects

We also recorded data that serve as possible interview noise controls, such as the time of day, interview duration, and interviewer scores of respondent expertise about strategy practices and respondent honesty. Since each interviewer conducted multiple interviews, we are able to control for interviewer fixed effects (none of which were significant in our models). Additionally, for a subset of our firms (approximately 23%), we interviewed other C-level executives instead of the CEO (such as the chief operating officer or chief financial officer) or board chairs, so we constructed a non-CEO dummy variable as an additional control variable and also confirmed that our main results were robust on the 77% data subset of CEOs.

2.4 Sampling Frame

Since we are interested in strategic decision making by the top decision makers within firms, our ideal interviewees are CEOs or equally senior managers. Our sampling frame was drawn from the population of alumni of Harvard Business School. While HBS alumni are not a representative sample of all managers, focusing on HBS alumni presents several benefits. First, the fact that two coauthors are affiliated with HBS helped us better reach and advertise the survey to a type of manager who is notoriously hard to engage in surveys. While response rates of around 10% are not unusual in CEO surveys (Ben-David, Graham and Harvey, 2013), focusing on HBS alumni allowed us to achieve a response rate of over 30%. Second, variation in Strategy Practices among managers who were exposed to a similar educational experience will likely represent a lower bound to the actual variation that exists in the general population of managers. Third, this

[7] Occasionally during interviews, CEOs would independently mention their own age, in which cases we would replace our age estimate with their own reported age.

sample enabled us to match the survey data with detailed information on the respondents' background and education (e.g. graduation year, MBA vs. Executive Education), which allowed us to study the impact of business school education on Strategy Practices, as we explain in more detail in Section 5.

For this study, we chose to focus on the U.S., Canadian, and U.K. manufacturing sectors in order to maximize the amount of performance-related data we would be able to obtain from the U.S. Census Bureau LBD, as we anticipated (correctly) that the majority of our CEO interviewees would work for privately-held firms with limited publicly-available performance data. To construct our sample, we started with a sample of 3,100+ HBS MBA and Executive Education alumni who were listed in the HBS alumni database as working in the manufacturing sector in the U.S., U.K., or Canada. From this list, we selected managers with the title of CEO or equivalent (e.g. president, managing director). As the information in the alumni database is self-reported, we took several steps to further vet and verify the data. First, we extensively researched each executive on our list using CapitalIQ, Factset, LinkedIn, and company websites to ensure that each individual was still employed at his or her respective firm, in the target role of CEO or other C-Suite officer (or equivalent). We required each executive to be employed at his or her respective firm for at least a year. Next, we collected information on each of the listed firms in the database in order to confirm that they were active in the manufacturing sector (e.g., a manufacturer of goods, as opposed to a distributor or retailer of manufactured goods). Our research on individual firms also allowed us to collect additional data on these respective firms, including six digits NAICS codes (from CapitalIQ and Orbis), as well as location and contact information. Ultimately, these selection criteria left us with a total of 863 CEOs and equivalent managers for our sampling frame. Of these, 63% were alumni of the HBS MBA program, and 37% were graduates of the handful of HBS executive education programs that grant alumni status.[8]

2.5 Collecting Accurate Responses

We followed a simple protocol to recruit executives to participate in our telephone-based interviews. We first sent each executive in our sampling frame a brief email message explaining the purpose of our research and inviting him or her to participate in an hour-long interview.

[8] Executive education participants at HBS can attain alumni status only if they have attended one of the so-called "comprehensive leadership programs." These are long programs, typically 8-12 weeks in duration.

Individuals who did not respond to our initial email received a follow-up request a week later. Next, we telephoned the remaining executives in our frame to invite them to participate in our study, following up again a week later if we did not receive a response. Executives who did not respond to our two rounds of emails and telephone calls were not contacted further. Ultimately, we were able to conduct interviews with 262 executives from our sample frame (a response rate of 30%).[9]

The survey was administered from Harvard Business School by a team of 6 interviewers and scorers, mostly Harvard MBA graduates, in late 2017 and through 2018. Interviewers received a total of 5 days of training, including several one-on-one practice sessions and mock interviews.

To ensure accurate responses, we explained to interviewees that we did not know what a "best practice" is and were interested in understanding the strategy processes of different companies. In particular, to avoid leading respondents and to reduce social desirability bias, we used almost exclusively open-ended questions throughout the survey. We took great care in balancing the scope and wording of questions to, on the one hand, be specific enough that we would get clear, accurate responses, but also, on the other hand, not be so specific as to risk "leading" interviewees to provide responses that were not reflective of their actual Strategy Practices.

We took several additional steps to reduce further any pressure to provide socially desirable answers. First, we assured interviewees that our conversations would be completely anonymous. Second, we informed interviewees that we would not ask for any performance-related information (to reduce any sense that interviewees might be assessed or judged according to their firms' performance during the interviews)[10] and that they were free to decline to answer any questions they deemed too sensitive. Third, to reduce any sense of assessment or judgment, the interviewees were not told that they were being scored during the interview. Additionally, we instructed the interviewers to be supportive and positive about any answers provided by interviewees, regardless of the nature of those responses or what they might reflect about a firm's performance. Finally, to

[9] Within our sampling frame, interviewed firms were slightly more likely to be based in the US (using a linear probability model in which the dependent variable is a dummy taking value=1 if the firm was ultimately interviewed, the coefficient on the US dummy is 0.085 with the base being firms based in the UK and Canada, standard error 0.045). We were able to gather employment data for 522 firms in the sampling frame, of which 170 were interviewed. In this subsample, we find that interviewed firms are smaller relative to non-interviewed firms (coefficient on log employment controlling for country of location and SIC2 dummies is -0.024, standard error 0.008).

[10] This tactic provided the added benefit of reducing potential bias in the scoring of our interviews, as interviewers and scorers were "blind" as to any potential connection between Strategy Practices and firm performance.

allow us to review the content of the interviews at a later date, we asked interviewees for permission to record our conversations. The vast majority of our executives agreed.

To minimize the risk that subjective interpretations of the interviewer were driving the scoring, two people—a main interviewer and a second listener—scored each interview independently. A potential drawback of open-ended questions is that individual interviewers must use judgment in scoring answers to such questions, but having a second listener present in every interview helped to reduce any errors in judgment or scoring. Throughout each interview, the interviewer and the second listener were connected through a chat program so the second listener could suggest clarification or follow-up questions in case a respondent's answers were vague or not sufficiently clear.[11] To minimize any potential biases or errors resulting from incorrect information recall if interviews were scored following the interview, answers to each question were scored "live" throughout the interview by both the interviewers and second listeners. After each interview, the interviewer and second listener compared their scoring, discussed and reconciled any differences, and recorded consensus scores which were used in our final analysis.

To gain additional information and accuracy of scoring during our interviews, we also used software-supported funneling of responses: responses that suggested structured strategy process automatically triggered follow-up questions on details of practices or specific examples. Appendix 2 discusses this practice in more detail.

2.6 Final Sample

Some features of our 262 interviewees and their firms are summarized in **Table 1, Panel A**. First, the average firm in our sample reports around 2,000 employees, and the average firm is more than 47 years old, which highlights that our sample is dominated by very large, mature, and successful firms.[12] These sample characteristics make our study especially attractive for generalizing the findings of the scientific approach to entrepreneurial strategy (Felin and Zenger, 2009; Lafley et al., 2012; Camuffo et al., 2020; Zellweger and Zenger, 2021; Yang et al., 2022) to

[11] As with the main questions in the interview, we instructed interviewers to word their follow-up carefully to prevent the asking of "leading" questions that might inadvertently pressure interviewees to provide a socially desirable response.

[12] Since it is well-known that firm-size distributions are very skewed and fat-tailed, one could also consider medians, which in our case reveals that the median firm size is 110 employees and median firm age is 36 years. Even by these medians, our sample of firms tends to be quite large and mature, compared to the nascent entrepreneurs analyzed in (Camuffo et al., 2020), the entrepreneurs in Novelli and Spina, 2022, which have on average 2 people and are 2.5 years old or the entrepreneurs in Yang et al., 2022 with a median employment of 3 and a median age of 7 years.

a broader set of firms. Additionally, the large reported standard deviations show that our sample exhibits a high degree of heterogeneity across firms, from large multinational enterprises to entrepreneurial start-ups. Second, ownership patterns are evenly distributed, with the largest fraction of firms owned by private companies.[13] Publicly listed companies constitute around 11% of the sample and are therefore strongly overrepresented compared to the U.S. economy.[14] None of the CEOs we interviewed work for a government-owned company, and 20% work in a family-owned (2nd generation or more) firm. Third, most firms in our sample sell at least some of their products or services to other businesses, while a large portion sell at least some of their products to consumers.

Among the executives we surveyed, 91 percent were male. The average respondent was 57 years old, had been with the same company for 17 years, and had been in his or her current position for nearly 14 years. Around 37 percent our interviewees reported having an undergraduate degree in either business or economics. Over 70 percent of respondents held an MBA from HBS, while the rest attended executive education courses at HBS.

3. Heterogeneity of Scientific Strategy Practices

In this section we characterize the overall distribution of Strategy Practices. We contrast within-industry heterogeneity in the degree of structured strategy process to across-industry heterogeneity.

3.1 Overall Distribution of Strategy Practices

Table 1, Panel B provides the summary statistics for the Strategy Practice scores. We use the 1-to-5 scale from Figure 1 and display the average across questions in each section for each CEO. Answers to all individual questions display the full range of possible values, highlighting that our survey instrument captures a realistic range of practices and that no practice had standards so very high that no company attained them.

[13] The five main types of ownership we observe are founder ownership, family ownership, other private ownership, ownership by other companies (such as venture capital or private equity firms), and the distributed ownership of a publicly traded company.

[14] There are over 7 million employer firms in the US and 4,000 publicly listed companies, so public companies represent less than 0.1% of all US employer firms.

To aggregate the separate questions into an overall score, we take a simple average across questions. To ensure the robustness of this method, we experimented with different ways to aggregate the data, such as principal component analysis and clustering and found that the results were very similar. We observe a minimum average Strategy Practice score of 1 and a maximum of 4. An average score of 1 typically means that strategic decision-making is entirely gut-driven and does not rely on *any* practices to formulate theories or test them empirically. In contrast, an average score of 4 means that a CEO is very much proactive in terms of explicitly formulating hypotheses and testing them, with some areas of less proactive adoption, for example in implementation planning or learning about resistance. We also constructed subscores for the areas of Formalization, Development, and Implementation and display them in Panel B of Table 1.

Even in our very selected sample of HBS alumni, Strategy Practices vary widely. Overall, Development scores display the greatest dispersion, followed by Implementation and Formalization. For additional clarity, **Figure 2** displays a histogram of the Strategy Practice score as well as histograms for the sub-scores. Our Strategy Practice scores are distributed widely along our scoring grid.

For further analysis and better interpretation of regressions, we first standardize the score on each of the 14 items shown in Figure 1 and then take the average of scores across all items. Finally, these constructed z-scores are standardized again for ease of interpretation.

To understand the potential relationships between different areas of Strategy Practices, we analyze correlations among the strategy sub-scores in **Appendix Table 2**. Development is strongly correlated with both Formalization and Implementation, while Formalization and Implementation are negatively and insignificantly correlated. This same pattern can be found at the level of individual questions: companies that are strongly structured on some dimensions can be relatively unstructured on other dimensions. This is in contrast to prior surveys (Bloom and Van Reenen, 2007), where different dimensions of management practices (e.g., operations and HR) tended to be highly correlated with each other. Our finding of differing correlations has at least two different interpretations. First, in contrast to the operational practices measured in the WMS, there may be less complementarity between different dimensions of strategic decision making. Alternatively, different aspects of strategic decision making may actually be complementary in principle (e.g., developing theories and testing them empirically), but executives might not have fully recognized these complementarities in practice. We show in Appendix 3 how to distinguish between these

two explanations empirically and provide preliminary evidence that Formalization and Implementation are not complementary.

3.2 Within- vs. Across-Industry Variation

A natural question to ask is, how important are industry differences for understanding differences in Strategy Practices? If industry differences explain a large part of the variation in Strategy Practices, then the different levels of scientific Strategy Practices we observe could be argued to be optimal contingent responses to differing competitive environments (Lawrence and Lorsch, 1967). However, it is well known that firms in the same narrow industry can deliver very different economic performance and that industry effects often play only a limited role in explaining performance differences (McGahan and Porter, 1997; Ruefli and Wiggins, 2003; Syverson, 2011; Gibbons and Henderson, 2012). One reason to think that the importance of industry effects might be rather limited in explaining the variation in Strategy Practices is that our targeted sample includes only manufacturing firms. On the other hand, the manufacturing sectors in our sample are very diverse, ranging from data-driven and IP-intensive industries such as pharmaceuticals and biotechnology to more traditional capital-intensive manufacturing industries such as industrial machinery and textile mills.

We find that industry effects have little explanatory power for the Strategy Practice scores. When we regress the Strategy Practice scores on three-digit NAICS industry fixed effects, industry effects have very low adjusted R^2s, such as -0.02 for the overall structured strategy score, -0.04 for the strategy formalization score, -0.01 for the strategy development score, and -0.00 for the strategy formalization score. Even at finer industry aggregations, such as 6-digit NAICS, the adjusted R^2 for the overall structured strategy score is only 0.0457, which is very low considering that we use 132 industry categories for a sample of over 260 firms.[15] This implies that there is considerable within-industry variation in strategic approaches: a CEO's specific industry environment appears to offer little explanatory power for the differences we observe in how much firms structure their strategic decision-making process. We therefore turn in the remainer of the paper to better understanding the cross-firm variation of scientific Strategy Practice scores.

[15] Generally, F-tests of the joint significance of industry dummies hovers around a value of 1 across specification, i.e. industry fixed effects are jointly insignificant.

4. Scientific Strategy Practices and Firm Performance

In this section we turn to two key questions about the general applicability of a scientific approach to business strategy beyond entrepreneurial ventures. Section 4.1 analyzes whether large firms differ in their adoption of scientific Strategy Practices. Section 4.2 then turns to the question of whether large and mature firms with scientific strategy practices tend to outperform their competitors.

4.1 How Do Strategy Practices Differ Across Small and Large Firms?

In this section we investigate whether larger firms adopt scientific Strategy Practices to a different degree than do small, entrepreneurial ventures. The basic measure of firm size we utilize in this section comes from the end of our survey, where we ask about the number of full-time employees at the respondent company. **Figure 3** shows the unconditional correlation between firm employment and our Strategy Practices score, and **Table 2**, column (1) provides statistical evidence that large firms tend to adopt scientific Strategy Practices at higher rates than small firms.[16] Columns (2) and (3) confirm that this relationship holds up when one controls for firm age and other firm and CEO characteristics. From the perspective of structured Management Practices as measured by Bloom and Van Reenen (2007) one might expect that larger firms tend to be more routinized are therefore also more likely to adopt scientific Strategy Practices in general and implementation-related practices in particular.

To understand which practices are adopted at higher rates by larger firms, we separate the overall Strategy Practice score into its main components of Formalization, Development and Implementation. As columns (4)-(6) show, all subcomponents are positively and significantly correlated with firm size. Additionally, column (7) includes all sub-components jointly in the regression to analyze whether the three sub-components contain variation independent of each other. This might for example be the case if some large firms exhibit higher Implementation scores, because they systematically test, validate and communicate their strategies but do not specify assumptions, develop theories or peer-review them and have therefore low Development scores. Interestingly, the results in column (7) indicate that theory Development and Implementation scores are strongly correlated, which is consistent with the view that Development and

[16] All specifications include noise controls (interviewer fixed effects, time of day, interview duration, ratings of interviewee expertise and interviewee reliability and non-CEO dummy) and industry fixed effects (3 digit NAICS dummies).

Implementation practices tend to be jointly adopted at higher rates by larger firms and that this pattern is driven by the theory Development. This finding aligns with recent evidence by Aggarwal et al. (2023), who use an RCT of Tanzanian farmers to show that theory development and hypothesis testing are complements for these entrepreneurs.

4.2 Do Firms with Scientific Strategy Practices Outperform their Peers?

4.2.1 The Number and Speed of Strategic Decisions

The outcome we examine here is, in essence, a management team's capacity to make and execute decisions. On a conceptual level, the idea that "getting things done" is a key task for effective executives can be traced back at least to Drucker (1966) and continues to be popular (Gibbons, Matoushek and Roberts, 2012). Indeed, authors such as Mankins and Steele (2006) have argued that the number of decisions made by an organization is a natural metric to evaluate the quality of any strategic decision-making process. The speed of decision-making and implementation matters for almost any context, and it is especially valuable in very competitive and fast-changing environments (D'Aveni, Dagnino and Smith, 2010).

This section sheds light on whether a more structured strategy process is positively or negatively correlated with executives' capacity to make and make decisions. Either is possible in theory. On the one hand, scientific learning may be an example of well-honed routines (Nelson and Winter, 1982) that allow management teams to work through a large number of decisions effectively and quickly. On the other hand, scientific learning may cause "paralysis by analysis" and delay strategic change (Peters, Waterman, and Jones, 1982; Lentz and Lyles, 1989). This is a major criticism of the traditional long-range strategic planning systems of the 1970s (Mintzberg, 1994). Intuitive decision-making, in contrast, may lead to almost immediate and surprisingly accurate decisions, as cognitive psychologists such as Klein (2004) and other researchers (Eisenhardt & Bingham, 2017) have argued.

Our analysis here reveals that more scientific Strategy Practices have both a positive and a negative effect on firms' ability to make decisions. In **Table 3**, we report that more scientific Strategy Practices are significantly and positively associated with the number of decisions made, but a higher score is also associated with a longer time spent in decision-making. All regressions include controls for the types of strategic decisions made and therefore only compare similar

strategic decisions (e.g. M&As or product innovations) with each other. (They also all include the basic firm, CEO, and noise controls included in Table 2; see the notes of **Table 3**.) A one standard deviation increase in the overall Strategy Practice score is associated with a 13% increase in the number of decisions made (with the results driven by the Implementation score) and 28% longer time required to reach a decision (driven by the Development score). Interestingly, we find that implementation speed is not significantly different for firms with high Strategy Practice scores.

These results suggest that firms with higher Strategy Practice scores experience countervailing effects. On the one hand, they are able to multi-task and pursue several strategic initiatives at the same time, but on the other hand, their deliberations are slower and take extra time. Once a decision is made, however, scientific learning does appear to delay implementation. These patterns can be an asset in some contexts and a liability in others. Specifically, longer decision times can lead to costly delays in very volatile environments, where decision speed is critical (Baum and Wally, 2003). At the same time, the ability to multi-task and work on many decisions simultaneously will tend to be especially beneficial in situations when taking account of many potential decisions and interdependencies across decisions is critical. In other words, multi-tasking is especially beneficial for situations of high strategic complexity (Rivkin, 2000).

There are at least two potential concerns with our analysis of the number and speed of strategic decisions, which both relate to the fact that the outcome data are based on memories and imperfect recall instead of being independently recorded as "administrative data," like our outcomes in the following sections. First, recalled data might be inaccurate and error prone. In this context, a long literature on eyewitness testimony has focused on whether a high fraction of objective facts can be reliability retrieved ("input-bound analysis"). The main finding of this research is that memories are imprecise and incomplete (Koriat et al., 2000). However, for the outcome variables in this section, the relevant question is whether the accuracy of recalled items is high ("output-bound analysis"). In this context, a recent field experiment by Diamond et al., (2020) has shown accuracy rates of over 93% for recalled data in an environment where real-world events were verifiable to researchers and in which respondents recalled events as far back as several years.

Second, even if respondents are able to accurately recall past strategic decisions, their responses might be biased, for example because of "consistency-seeking" bias, under which respondents who told us that they are pursuing very scientific practices also tell us that that they

take a long time to make decisions, since they think this is consistent with scientific decision-making. There are several reasons for why this bias is unlikely to affect our estimates in this section. The most important reason is that our double-blind survey design for the scientific Strategy Practice score implies that respondents do not know that they are scored and therefore do not know which responses "are consistent with scientific Strategy Practices." Additionally, any social desirability bias would induce respondents to uniformly downward bias their reported strategic decision and implementation times, and upward bias the reported number of strategic decisions, but is likely to leave the correlation between scientific Strategy Practices and decision/implementation speed and number of strategic decisions unaffected.

4.2.2 Firm Profitability in Administrative Data

In this section, we bring in administrative data from the IRS and the US Census Bureau to analyze whether firms with higher scientific Strategy Practices outperform their competitors in terms of profitability. This section serves at least two distinct purposes. On the one hand, correlating our scientific Strategy Practices measure with firm performance can be seen as a test of the validity of our survey measures. This is especially relevant in our context, as the current empirical literature has mostly focused on the benefits of scientific learning for small, entrepreneurial ventures (Camuffo et al, 2020; Yang et al., 2022). In contrast, our data oversamples mature and large companies, so any correlation between scientific Strategy Practices and firm performance at least rules out that these practices are irrelevant for large organizations, even though we cannot make any conclusive statements about whether scientific Strategy Practices cause better performance. On the other hand, the analysis of this section will be able to consider industry contexts for which scientific Strategy Practices might be especially beneficial. We show that in certain contexts, firms with more scientific Strategy Practices indeed tend to outperform their competitors.

We merged our survey with cross-sectional data from the Census of Manufactures (CMF) in 2017. The data merge successfully matched around 50 firms, which control around 100 establishments. (Firm and establishment counts have been rounded to preserve confidentiality.) Since firms can control multiple establishments, we cluster our standard errors at the firm level. Our main measure of profitability is markups, defined as sales revenue minus operating costs (cost of intermediate inputs and energy plus wage bill) divided by operating costs.

Columns (1) and (2) of **Table 4** show that firms with higher Strategy Practice scores also tend to be more profitable than other firms in the same industry. These results do not reflect differences in firm size or capital intensity and, if anything, become stronger if capital is controlled for, as shown in column (2). The quantitative implications are large. A one standard deviation increase in Strategy Practices is associated with a 15.5 percentage point higher markup as shown in column (1) of Table 4.

The CMF data also provide an opportunity to investigate more closely the mechanisms by which firms with higher Strategy Practice scores outperform their peers. Specifically, we construct measures of different industry characteristics on the 4-digit NAICS industry level, of which 17 industries are in-sample. We use the following specification:

$$y_i = \beta_1 \cdot \sigma_i + \beta_2 \cdot \phi_s + \beta_3 \cdot (\sigma_i \times \phi_s) + D_s + \epsilon_i \qquad (1)$$

where, y_i is establishment-level profitability, σ_i is the standardized measure of scientific Strategy Practices for establishment i, based on the Strategy Practice score of the underlying firm, ϕ_s is a characteristic for 4-digit NAICS industry s, and D_s are industry fixed effects.[17] The key parameter of interest in (1) is β_3, which captures whether firms with more scientific Strategy Practices outperform their competitors more in industries with higher industry characteristic ϕ_s.

We begin this analysis by considering strategic complexity, defined as average number of different types of strategic changes jointly pursued in the same strategic decision. A higher number of decision types indicates the need to manage more firm activities and take account of more interdependencies (Rivkin, 2000; Leiblein et al., 2018). Our measure of strategic decision complexity is based on the classification of each strategic change into multiple non-exclusive categories of strategic decisions by the interviewers, as described in section 2.2 and shown in Appendix 1. Since we ask CEOs to name three typical strategic changes, we average across all three and aggregate to the industry level by taking the median of complexity across firms. The theoretical literature on scientific learning recognizes complexity as a key contingency for strategic decision making. Zellweger and Zenger (2021) write that "[a] challenge for the entrepreneur is that product features are seldom simply additive in their capacity to solve a targeted problem, but

[17] Because of the industry fixed effects, the effect β_2 will not be separately identified and is therefore omitted from Table 4.

rather demonstrate complementarity in patterns unknown to the entrepreneur ex ante." Consistent with arguments by Zellwenger and Zenger (2021) as well as Agarwal et al. (2023b), we argue that scientific learning is likely to be especially important for making complex decisions well[18]—particularly for reasons related to practices captured in Development (D1,D2,D5) and Implementation (I2,I3) in our study. Specifically, strategic theories guide cumulative learning after falsification of predictions, by encouraging executives to think about which assumption is wrong and how to replace it (see also Felin and Zenger, 2017). Furthermore, practices to understand the underlying mechanisms of strategy outcomes motivate CEOs to sequentially isolate and test theories, while separating strategy effects from luck is captured in the Implementation part of our survey. These practices encourage simplification of theories to reduce overfitting and channel attention towards the most important potential mechanisms. Consistent with this view, column (3) of **Table 4** shows that firms with high Strategy Practice scores tend to outperform their industry peers even more in industries in which complexity is higher. This is consistent with our findings in section 4.2.1, where we showed that firms with higher scientific Strategy Practice scores tend to make more strategic decisions and are potentially better at multi-tasking decisions.

The second factor we analyze is uncertainty, as measured by the dispersion of forecast errors across establishments. The 2015 MOPS asks establishment managers of manufacturing establishments to forecast revenues for their establishment for the year 2016 and elicits subjective expectations about five possible scenarios from worst- to best-possible sales forecast, along with probability estimates for each scenario. Based on this information, we can construct expected sales growth from 2015 to 2016 for each manufacturing establishment as the probability-weighted average sales growth. At the same time, we have access to actual sales information in 2016, which then allows us to construct a forecast error for the sales growth of each establishment. Our measure of uncertainty is the dispersion (standard deviation) of sales growth forecast errors, with higher dispersion indicating that accurate forecasts of sales are more difficult and sales are therefore more uncertain.

In theory, scientific Strategy Practices could help or hurt a firm as it tries to cope with an uncertain environment. Research based on real options (McGrath, 1997) and referred to as "Discovery-driven Planning" (McGrath and Macmillan, 1995; McGrath and Macmillan, 2000)

[18] Our measure of scientific Strategy Practices and decision complexity (at the 4-digit NAICS level) are also significantly positively correlated when we regress the Strategy Practice score on decision complexity, with an estimated coefficient of 0.45 with standard error of 0.17.

suggests that firms with higher Strategy Practice scores might tend to outperform peers more in highly uncertain competitive environments. On the other hand, the structure that comes with scientific Strategy Practices may make it harder for a firm to adapt quickly in an uncertain environment (Mintzberg, 1994). Column (4) of **Table 4** gives evidence consistent with the latter view: firms with higher Strategy Practice scores tend to perform worse in industries with greater uncertainty. This finding is consistent with our results in section 4.2.1, where we showed that firms with higher Strategy Practice scores tend to take more time for their decisions.

The third factor under consideration is performance persistence (McGahan and Porter, 1997; Ruefli and Wiggins, 2003; Syverson, 2011; Gibbons and Henderson, 2012) quantified as autocorrelation of revenues, estimated with an AR(1) model across all establishments within the same 4-digit NAICS industry in the ASM. Column (5) of **Table 4** shows that firms with higher Strategy Practice scores especially outperform in industries with higher performance persistence. This finding is consistent with the result in column (4): Strategy Practices are especially associated with strong firm performance in relatively stable environments. The finding is also consistent with the results in section 4.2.1, where we found firms with higher Strategy Practice scores less able to make decisions quickly and therefore, presumably, better equipped for stable environments.

Two additional insights emerge in **Table 4**. First, although the various interaction effects across columns (3)-(6) point to important industry-level contingencies, note that across all columns in **Table 4**, the baseline association of Strategy Practices and establishment markup stays consistently positive and varies little in magnitude. Even though industry characteristics affect the outperformance of firms with high Strategy Practice scores, the baseline correlation of Strategy Practices and markups is robustly positive for all industries. Second, if we include all interactions between Strategy Practices and observable industry characteristics (as in column (7)), then all estimated effects remain similar in magnitude, even though two of the effects become statistically insignificant, potentially due to collinearity across the different interaction terms.

4.2.3 Firm Size/growth in Administrative Data

Our results in section 4.2.2 show that scientific Strategy Practices are potentially beneficial for the large and mature firms in our sample, but we cannot establish the causality of this relationship due to the cross-sectional nature of the survey and of the performance data. In this section we leverage a different administrative dataset from the US Census, the Longitudinal

Business Database (LBD), which provides panel data on employment and firm growth. Although this data does not enable us to fully establish causality in a credible way, it is helpful in ruling out at least some forms of endogeneity, such as reverse causality and assortative matching.[19]

The first column of **Table 5** reports the correlation results for firm size which correspond to similar regressions in **Table 2**. Compared to results using our survey-internal measures of firm size, effects remain significant but are somewhat smaller in magnitude, yet still economically important. According to column (1), a one-standard deviation increase in Strategy Practices is associated with a 1.58-fold ($= \exp(0.464)$) increase in firm size, which is only slightly smaller than the relationship we reported in Table 2.

We move next to investigate firm growth, and we find that more structured Strategy Practices are positively correlated with it. We measure firm growth in the LBD by using symmetric firm growth measures proposed by Davis, Haltiwanger and Schuh (1996), $g_t = 2 \cdot \left(\frac{x_t - x_{t-k}}{x_t + x_{t-k}}\right)$ for $k = \{1, 5\}$, where x is employment. Additionally, we control for initial firm size, to capture any mean-reversion effects in firm growth patterns (Dunne, Roberts and Samuelson, 1987; 1989) and use firm-level clustering for standard errors. Columns (2) and (3) of **Table 5** report the results. Column (2) displays short-run correlations of Strategy Practices and firm growth as measured in annual growth rates. These results are quantitatively and statistically significant. According to column (2), a one standard deviation increase in the Strategy Practices score is associated with a 4.7% increase in the annual growth rate. These results continue to hold for long-run growth rates, as measured by an overlapping 5-year growth rate measure in column (3). In the long-run growth analysis, a one standard deviation increase in the Strategy Practices score is associated with a 9.5% increase in the firm growth rate over a 5-year horizon—an economically important effect.

Although these associations of Strategy Practices and firm growth are suggestive, they cannot be interpreted as evidence of causality. In particular, more scientific Strategy Practices might mean that a CEO's style elevates a firm's performance, or high-ability CEOs might tend to join high-performance firms with highly structured Strategy Practices. In this case, a CEO's decision-making approach might reflect firm needs.

[19] Unfortunately, confidentiality considerations force us to drop some of the largest firms, and the current vintage of LBD data (which ends in 2016) limits our ability to match the very small and young (typically entrepreneurial) firms in our main sample in the Census data. Both of these factors are likely to reduce the overall variation in our data and might therefore plausibly attenuate our baseline results.

To differentiate between these two possible directions of causality, we use the following specification. We continue to use employment growth rates $g_{i,t}$, as on page 29. Let $A_{i,t}$ denote the CEO appointment dummy variable, with $A_{i,t} = 1$ for every year after the appointment to CEO and $A_{i,t} = 0$ for all years before. σ_i is the standardized measure of Strategy Practices for firm i, $\ln N_{i,t-1}$ is initial firm size, and D_s denotes industry fixed effects. The resulting specification is

$$g_{i,t} = \beta_1 \cdot A_{i,t} + \beta_2 \cdot \sigma_i + \beta_3 \cdot \left(A_{i,t} \times \sigma_i\right) + \ln N_{i,t-1} + D_s + \epsilon_{i,t} \qquad (2)$$

In this specification, there are two main coefficients of interest. First, β_2 captures whether firms with higher Strategy Practices scores exhibited high firm growth prior to the appointment of the CEO. Second, β_3 captures the effect of Strategy Practices on firm growth after the appointment of the CEO. To estimate (2), we use all available annual growth rates for the unbalanced sample of all firms we can match every year to the LBD.

Column (4) of **Table 5** shows that there were no significant growth pre-trends for firms with higher Strategy Practice scores. Indeed, the sign of β_2 indicates that if anything, firms with higher Strategy Practice scores tended to grow more slowly before the appointment of the focal CEO. Importantly, our estimates of β_3 indicate that firm growth accelerates for CEOs with high Strategy Practice scores *only after* their appointment. Together with our result on β_2, this rules out the hypothesis that CEOs learn more scientific Strategy Practices from high-performance firms. However, these results do not quite rule out the possibility of assortative matching in which boards of high-performance firms tend to hire high-ability CEOs in combination with a strategic mandate to pursue a pre-defined set of actions. Following arguments in Bandiera et al. (2019), we therefore investigate the timing of firm performance changes after the CEO appointments. Specifically, if assortative matching with a strategic mandate is driving our results, we would expect firm performance to have the strongest increase right after the hire, since the need for the new strategic actions is highest then. In other words, high-ability CEOs are likely to first pursue the highest-return strategic changes for which they were hired. Firm performance should then decelerate, as the pre-set strategy would eventually run into diminishing returns. We investigated the pattern of firm growth after CEO appointments in the Census LBD data, but confidentiality concerns prevented us from fully disclosing these results. However, Census personnel permitted us to disclose the following qualitative statement: "Estimates of β_3 tend to become larger in magnitude for regressions with employment growth over 2, 3, 4, 5 years as opposed to employment growth

over 1 year." The pattern we document here is the opposite of the expected performance pattern under assortative matching with a strategic mandate (that is, that we would observe performance differentials arising *prior* to or at the same time of CEO appointment), which casts doubt on this alternative hypothesis being the main driver for performance results in our sample.

To summarize, our analysis of panel data from the LBD suggests that the adoption of scientific Strategy Practices is not driven by CEO's decision-making approach reflecting firm needs. Instead, our results are consistent with CEOs bringing their own scientific Strategy Practice style to firms and learning how to apply this approach to the firms they lead over time. Our results suggests that the way CEOs adopt scientific practices strongly reflects their personal style (Bertrand and Schoar, 2003). This can explain the considerable differences in the use of Strategy Practices observed, even within highly selection sample of HBS alumni. Factors unique to each CEO, like their experience and educational background, differ significantly. These individual differences lead to a wide range of approaches in the adoption of scientific methods in strategic practices.

5. The Impact of Business Education on Strategic Decision Making

The results of section 4.2 show that firms whose CEOs use more scientific Strategy Practices systematically outperform their industry peers. Moreover, our evidence in 4.2.3 is consistent with the view that CEO styles are critical in this context. This begs the question: How can the adoption of scientific Strategy Practices by CEOs be facilitated? In this section, we examine one mechanism to boost the adoption of potentially beneficial scientific Strategy Practices: business education (Jung and Shin, 2018; Heshmati and Csaszar, 2023). To do so, we take advantage of the fact that our interviewees who obtained their MBA at HBS collectively experienced a sharp discontinuous change in the MBA strategy curriculum: the 1983 appointment of Michael Porter—a leading strategy academic —as head of the required HBS MBA strategy course.

We examine whether this change (or "shock") – which is plausibly exogenous to cohorts that joined HBS just before and just after Porter was appointed head of the strategy course – alters parts of the Strategy Practice score for which the curriculum change is likely to have been most consequential: Formalization and Implementation. In particular, we argue that Porter's strategy curriculum gave students a framework for analyzing the external competitive environment

systematically as they crafted strategy. However, with this new emphasis on strategy Formalization, other Strategy Practice areas—including areas that are crucial for scientific learning, such as Implementation, which includes testing/validation—might have been de-emphasized.

5.1 Institutional History

Some history of Harvard Business School is necessary to motivate our analysis. A longtime hallmark of the HBS MBA curriculum was the Business Policy course. Launched in 1912, only four years after the school's founding, the course emphasized from its earliest days features that would become central concepts in business strategy, such as a focus on "the intimate connection of [functional] groups" and "the substitution of careful, conscious analysis of managerial problems for unconscious analysis" (Harvard University, 1915: 35-36). Business Policy became a required course in 1920-21 and soon stretched across the entire second year of the MBA curriculum. In the 1950s and 1960s, professors such as C. Roland Christensen, Kenneth Andrews, and Edmund Learned used Business Policy to implant the term "strategy" in management education (Andrews, 1971). As Kiechel (2010) writes, the Business Policy course through the 1970s emphasized general managerial skills instead of analytic frameworks to understand the situation of a company.[20] Analysis in the course was careful and conscious, but it was hardly structured or systematic. Moreover, analysis focused more on the inside of a company than on its external environment.

While the course evolved gradually and incrementally over the decades, more fundamental changes happened to the course and its content in the late 1970 and early 1980s. In 1979, a desire to have an integrative course earlier in the MBA curriculum caused HBS faculty to split Business Policy into two separate courses (Porter and Siggelkow, 1999). Business Policy I would be taught in the second term of the MBA's first year and would emphasize the formulation of formal strategy. Business Policy II would remain in the second year and focus on strategy implementation.

[20] Kiechel, 2010 summarizes the philosophy behind the pre-Porter HBS "Business Policy" education as follows: "What Andrews and his colleagues in the Business Policy course resolutely refused to do—and the main reason his ideas largely disappear from the subsequent history of strategy—was to agree that there were standard frameworks or constructs that could be applied to analyzing a business and its competitive situation. Oh, they might allow one, perhaps because they had helped develop it: so-called SWOT analysis, which called for looking at the strengths, weaknesses, opportunities, and threats besetting an enterprise. But nothing more schematic and hard-edged than that. Individual companies and industries were just too idiosyncratic, and the ambitions and values of their managers too rich and varied to be mapped on any single template."

In 1983, Michael Porter became the head of Business Policy I in what traditionalists at HBS saw as a Dean-mandated takeover. He completely overhauled the curriculum and introduced new course content built upon his recent research in Industrial Organization, captured in his first book, *Competitive Strategy (*1980). Porter, a young upstart economist, had used deep contact with managers when teaching executive education courses, as well as an MBA elective, to pioneer insights on industry analysis (Porter, 1979) and to define the elements of strategic choice (Porter, 1985). In sharp contrast to the "fuzzier" notions of strategy historically taught in Business Policy, Porter offered a discrete, holistic framework to evaluate the attractiveness of an industry, drawing on insights from the literature on Structure-Conduct-Performance in Industrial Organization. A key innovation of this framework was that it took a broad view of potential sources of competition. Porter's course encouraged students to go beyond incumbent rivals and take into account firms that might not yet exist (potential entrants) or firms that offer different products but satisfy similar underlying needs (substitutes). Furthermore, while firms cooperate with upstream suppliers and downstream customers to create value, they also compete with suppliers and customers to claim value in the form of profits. Porter's version of Business Policy I, soon renamed Competition & Strategy, would go on to become one of the most influential courses at HBS and to be formative for an entire generation of CEOs.

Using material from the HBS archives, we sought to examine and confirm the nature of Porter's changes to the Business Policy I course curriculum over the full timespan when our MBA alumni interviewees attended HBS. **Appendix 4** compares the course description for the year prior to Porter's restructuring (1982) to the course description for his first year (1983). The contrast is striking. While the 1982 course pays little attention to a firm's external context ("competition or adverse circumstances"), the overhauled 1983 course devotes substantial attention to analyzing and understanding a firm's competitive environment as a determinant of its success and performance. While the 1982 course description places heavy emphasis on the importance of general management of the entire enterprise (i.e. "what needs to be done"), the 1983 course description clearly moves away from any deep focus on issues related to management, execution,

and implementation.[21] [22] This de-emphasis of implementation is relevant, especially in the context of the literature on scientific learning and experimentation (Felin and Zenger, 2009; Camuffo et al., 2020). Pillai et al., (2020) define "economic experiments" as a combination of trials that allow executives to learn about uncertain assumptions while requiring commitment and recognition of interdependencies as in Leiblein et al. (2018). They add that "As the outcome of most strategic decisions is uncertain, the implementation of strategic decisions is also an economic experiment." In this context, it is also important to recall that Implementation practices include the testing of theories (I2) and the validation of causal mechanisms (I3), which are critical for scientific Strategy Practices.

To investigate whether there were other, simultaneous curriculum changes that might affect our analysis, we reviewed the entire curriculum for all HBS MBA classes for the academic years 1982-83 and 1983-84.[23] This review revealed that eleven other courses were taught in both years. Those eleven courses were the same courses in both years. Ten of the eleven other courses had word-for-word identical course descriptions in both years. The remaining course had two words in its 1983-84 description that weren't in the 1982-83 description. Specifically, India and China were added to a list of countries that were studied. We can therefore rule out that any other, unobserved curriculum changes in the HBS MBA core program might drive our results.

5.2 Econometric specifications

We use this sudden, radical, and exogenous (to the students) change in the core strategy curriculum in 1983 at HBS as the source of a regression discontinuity that allows us to quantify the causal impact of MBA education on Formalization and Implementation. We use HBS MBA cohort years as the running variable for a regression discontinuity design (RDD). To fix ideas, let C_i be the MBA cohort year of CEO i and X_i different outcomes, such as strategic choices or a measure of strategy formalization. The econometric specification can be written as

[21] In order to confirm this de-emphasis of implementation topics in the curriculum, we also interviewed veteran faculty at HBS who confirmed that following Porter's changes to the course, discussions of implementation faded from the curriculum.

[22] The reduced emphasis on implementation can also be traced to Porter's writing, years later. Specifically, Porter (1996) argues that: "Constant improvement in operational effectiveness is necessary to achieve superior performance. However, it is not usually sufficient. Few companies have competed successfully on the basis of operational effectiveness over an extended period, and staying ahead of rivals gets harder every day."

[23] We would like to thank an anonymous referee to raising this issue.

$$X_i = f(C_i) + \beta_1 \cdot 1_{\{C_i \geq 1983\}} + \epsilon_i \quad (3)$$

where ϵ_i is a random error and $f()$ is a continuous function. The key identification assumption in this approach is that unobserved characteristics of MBAs entering HBS are continuous, while only the change in the HBS strategy curriculum is discontinuous. We use a step function $1_{\{C_i \geq 1983\}}$ to estimate the effect, both because it is less problematic in terms of potential model misspecification and because data requirements for estimation are less demanding, which is important for our application given our limited sample. Our baseline specification uses a local, non-parametric RDD using the optimal bandwidth selection procedure of Imbens and Kalyanaraman (2012), which in our case is 3 years before and after 1983. Additionally, we use a global or parametric approach to equation (3), which uses all 185 observations and specifies the functional form of $f(C_i)$ as either second order polynomial $f(C_i) = f_1 \cdot C_i + f_2 \cdot C_i^2$ or third order polynomial $f(C_i) = f_1 \cdot C_i + f_2 \cdot C_i^2 + f_3 \cdot C_i^3$. This increases the precision of our estimates at the expense of potential bias from the misspecification of the functional form for $f(C_i)$. Furthermore, more complex and flexible functional forms for $f(C_i)$ will lead to overfitting, thereby eventually rendering the estimates less precise again. In **Appendix 5**, we use different optimal bandwidth approaches as well as global parametric approaches to show estimates for all sub-questions.

5.3 Results

We start our results by reporting the distribution of the MBA subsample of CEOs across graduation years.[24] **Figure 4** shows the number of potential and realized MBA interviewees (within our target set of manufacturing industries) in the HBS alumni database by graduation year. Importantly, the response rates do not seem to differ significantly for the cohorts immediately before 1983 compared to the cohorts following 1983. This is reassuring, as it is consistent with the view that selection implies only continuous changes along unobservable dimensions.

We then estimate the effect of the HBS strategy curriculum restructuring on the two subsets of scientific Strategy Practices included in our survey that are most likely to have been affected by the curriculum change: Formalization and Implementation. Specifically, given the curriculum changes, one would expect Porter's influence to make aspects of strategy related to the scope of

[24] We restrict our sample for this analysis to only the MBA graduates in our sample because we are unable to collect data on and therefore observe and specify which, if any, comparable changes may have occurred in HBS's executive education programs.

the firm, competitive advantage, and strategic distinctiveness (captured in questions F2 and F3) more salient to managers, and implementation practices (captured in questions I1 to I5) less relevant to them.

The main results of this analysis are shown in **Table 6**, Panels A and B, which presents the RDD results. Starting with the top left of Panel A, we show that CEOs who were exposed to the restructured HBS MBA core curriculum were more likely to make deliberate, structured strategy scope choices and therefore had higher degrees of Formalization. This result is shown for two common non-parametric regression discontinuity estimators, plus a parametric estimator with quadratic and cubic polynomial controls. We also present the graphical analysis of the non-parametric RDD in **Figure 5**, in which the individual points are averages of observations for the different cohort years. Reassuringly, the results of **Table 6, Panel A** are apparent in the jump of the cohort averages at the cutoff at 1983. Importantly, these results show that changes in business education can be effective in influencing CEOs' decision-making styles on a persistent basis.

In Panel B of **Table 6** we investigate how Porter's changes to the curriculum affect implementation-related Strategy Practices, represented in questions I1-I5, as our observation of curriculum changes suggested the possibility of effects on Implementation. In line with the changes to the course curriculum described above, we find that the cohort of students first exposed to Porter's courses appear to have lower Implementation scores, which is significant for the non-parametric estimators but not for one of the parametric estimators. In other words, the apparent de-emphasis of implementation-related topics (including validation of theories) that we observe from the Business Policy/Strategy course descriptions appears to have reduced the adoption of the associated practices among the firms in our sample.[25] It is also worth emphasizing that our results on the impact of business education on decision-making even decades later is consistent with theories of "imprinting," which captures the idea that people are especially susceptible to formative lessons and experiences early in their educations and careers (Jung and Shin, 2018).

The combined evidence of the "Porter Effect" on CEO's Strategy Practices presents an interesting picture of countervailing effects with potentially substantial consequences understanding the adoption of scientific CEO styles. On the one hand, exposure to Porter's work appears to have caused an increase in Formalization practices, which made some forms of formalized theories more popular. On the other hand, that same exposure appears to have reduced

[25] We show the results for all the individual questions included in the survey in Appendix Table 2.

the adoption of firms' Implementation practices, including testing and validation, which are critical for scientific learning. These types of results are potentially consistent for example with limited attention of MBA students during their education. At the same time, these results suggest that once business education is completed, the associated changes in (scientific) CEO style will be highly persistent. Overall, this suggests that business education to teach scientific Strategy Practices should focus on few high-priority lessons instead of a large number of complex items.

5.4 RDD Robustness

In this section we briefly discuss three potential issues with our RDD approach and how we address these concerns. [26] The detailed empirical analysis for all the concerns can be found in **Appendix 5.2**. The first concern is that assignment of potential MBA students into cohorts before and after 1983 might not have been random. In **Appendix 5.2.1**, we follow Imbens and Lemieux (2008) and show that placebo outcomes that should be unaffected by the cutoff point around 1983 indeed do not exhibit any jumps. Among the placebo outcomes are several pre-determined characteristics, such as CEO gender, whether the CEO inherited the leadership of a family firm, and the CEO's undergraduate major.

The second concern is that potential MBA students might have systematically selected into different cohort years because they had private information about the quality of teaching from Michael Porter as well as about his appointment to head the MBA core strategy class. Based on the institutional history, we believe that this is unlikely, but we offer an analysis of the implications of such sorting. In **Appendix 5.2.2**, we follow McCrary (2008) and test for mass points in the distribution of MBA students across years. If there were systematic sorting, one would expect the cohorts shortly after 1983 to exhibit systematically more students and the cohorts shortly before 1983 to exhibit fewer students. We explore this implication not just in our small sample of 185 MBA students, but also with data of all HBS graduates in the BoardEx database (see Appendix 5.2.2), which allows us to increase the statistical power of these tests with sample sizes of around 1,000 and around 2,900, respectively. In all three samples, we fail to find any evidence of bunching, which is consistent with the absence of systematic selection of potential students across cohort years in anticipation of Michael Porter becoming head of the core strategy class.

[26] We would like to thank two anonymous referees for raising these concerns and suggesting parts of this analysis.

The third potential concern is that the year 1983 might be a problematic cutoff year: it is just after the 1981-1982 recession, which might affect selection into the HBS MBA program. To address this concern, we re-estimate our RDD for the years 1990, 1991 and 1992, which are years around the 1991 recession. If our results are driven by the 1981-1982 recession, we should find similar effects around 1991. **Appendix 5.2.3** re-runs our RDD estimation strategy for all years between 1990 and 1992 as placebo RDD cutoffs and fails to find any effects comparable to our results in Table 6.

6. Conclusion

A fundamental task of managers is to make decisions, and no decisions of top executives are more consequential than the decisions that set a firm's strategic direction. Yet prior empirical literature in strategy is largely silent on the question of how chief executives make strategic decisions, despite longstanding calls to answer it (Porter, 1991). In this paper, we have aimed to begin answering that question.

In seeking to answer this critical question, our paper makes several contributions. Our main contribution is to develop techniques to collect data systematically on the strategy-making processes of CEOs. Toward this end, we devised a novel survey instrument that examines the formalization, development, and implementation of strategy, heavily building on prior efforts to understand a scientific approach to strategic decision-making (Felin and Zenger, 2009; Lafley et al., 2012). We used open-ended questions and highly trained interviewers to gather data on how 262 HBS-educated chief executives make choices. In particular, we assessed the degree to which they use scientific Strategy Practices for developing and testing theories and supporting practices that facilitate top management peer-review and persuasion of employees beyond top management.

Our second contribution is to show that scientific Strategy Practices are adopted at higher rates by larger firms. This finding suggests that these practices are valued by decision-makers beyond—and perhaps especially beyond—the entrepreneurial ventures in which prior research has examined the practices.

Our third contribution is to show that, compared to their gut-driven counterparts, CEOs with higher scientific Strategy Practice scores lead firms that are more profitable and faster growing. We obtain these results in a sample of mature and large firms, thereby showing that benefits of scientific learning potentially apply more broadly than the context of small,

entrepreneurial firms that is the current focus of the literature on scientific learning (Felin and Zenger, 2009; Camuffo et al., 2020). Importantly, we show that growth effects are driven not by firms' needs for more scientific Strategy Practices, but by CEOs' decision-making styles being scientific. The profitability effects are especially large and positive in the face of strategic complexity, but not uncertainty—results consistent with our findings that Strategy Practices allow firms to handle more decisions but not to make fast decisions.

Our fourth contribution is to analyze the potential of business education to increase adoption of scientific Strategy Practices in the long run. Thanks to a unique aspect of our sample—its focus on Harvard Business School alumni—we have some causal evidence that business education can indeed boost adoption of Strategy Practices. In particular, CEOs exposed to a curriculum that emphasized systematic analysis of the external environment utilize a different set of Strategy Practices, making their strategy scope decisions more deliberately than do their predecessors who received a less analytical education. The data also show that the more intense focus on Formalization might have crowded out attention to practices related to Implementation, which includes validation of theories. Remarkably, the impact of this sudden change in HBS's curriculum on how CEOs make decisions can be discerned decades after the shift occurred, which suggests that business education can be effective in promoting scientific Strategy Practices.

Much remains to be learned about how chief executives make strategic decisions. Further investigation of executives' processes for making strategic decisions in other geographies, in other sectors of the economy, or among non-HBS graduates, for instance, will likely reveal additional insights on this important topic. Subsequent studies might aim for more causal evidence, of either the antecedents or the consequences of differences in decision-making processes. We hope this paper makes the case that follow-up work is worthwhile and clarifies how such work might be conducted.

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Appendix 1: Cognitive Testing and Piloting

This section describes the process we used to validate the survey questions as well as the scoring grid. We started with an early version of the survey in 2014, but for the first versions it was unclear whether executives would correctly interpret our questions and whether as a consequence, their answers would be too vague and unrelated to reliably classify the responses. We used a three-stage process to conduct cognitive testing of respondents or interviewers and to refine our survey instrument and interview process.

In the first stage of cognitive testing, we started by sharing the earliest versions of the survey instrument with a small number of retired executives at HBS and Berkeley-Haas to elicit feedback. During this stage of cognitive testing, we also used a focus group of current executives in HBS executive education programs in Spring 2015 to address two potential issues. First, we gathered information about which topics these executives thought are important when thinking about how they make strategic decisions. Second, for a few questions for which either the question phrasing or the scoring grid was unclear, we asked for responses to the open-ended questions to learn how executives interpreted the questions and compare their answers to our scoring grid.

In the second stage of cognitive testing, we started a process of running approximately 20 pilot interviews with alumni of HBS executive education programs. These pilot interviews, conducted during the summer and early fall of 2015 year, had several objectives. First, we wanted ensure that despite the use of open-ended questions, these questions were specific enough that executives would not talk about unrelated topics. Second, we used the pilots to make sure that the way we classified responses was realistic and that our classification captured the full range of executives' responses to our questions. Third, to make sure that the coverage of topics in the survey was comprehensive, we asked every pilot interviewee after the completion of their interview, whether they could think of any major issue for strategic decision making, that we might have missed. Fourth, the pilots allowed us to quantify the total interview length as well as the time taken for each question, which we then used to remove confusing or less important questions.

We then conducted the third stage of cognitive testing in 2016, which allowed us to test whether the survey instrument could be used to gather reliable information on strategic decision making during large scale data collection efforts. A key question in this context was whether we would be able to train interviewers with limited knowledge about business strategy to correctly score

executives' responses. We recruited five HBS second-year MBA students and generated training material describing the overall goals of our research, as well as mock interview scripts that we used to simulate the interview process. We also developed survey software that automated interview funneling, which we developed to systematically validate high interview scores as well as ease the cognitive burden for interviewers and double scorers. During this third cognitive testing phase, we conducted a larger pilot with 92 executives from two different HBS executive education programs. This pilot sample included CEOs or Presidents of small or medium-sized companies, as well as senior executives at large, publicly traded companies and had wide sectoral as well as international variation. During this large-scale pilot, we conducted additional cognitive testing to ensure that the MBA student interviewers understood the scoring grid and could easily and reliably use the survey software. We also gathered additional feedback on the questions, the scoring grid and the survey software in weekly meetings with the MBA student interviewers.

We used the data from this pilot to write a summary of some findings for Harvard Business Review (HBR) online, in Teti et al. (2017). The patterns reported in this summary are only tangentially related to our final scoring of the Strategy Practices grid. Beyond this HBR online piece, the data from the large-scale pilot have not been used.

Appendix 2: Software-supported Funneling of Responses

We extended the Bloom and Van Reenen methodology by introducing software-supported funneling of responses: responses that suggested structured strategy process automatically triggered follow-up questions on details of practices or specific examples. This interview practice was introduced to achieve two specific goals. First, to counter the tendency of respondents to let their Strategy Practices be more structured than they actually are (social desirability bias), we deliberately asked follow-ups on details or examples of practices, to ensure that more structured practices are indeed used. Second, the use of software-supported funneling also reduced the cognitive burden on interviewers, since it automatically displayed follow-up questions and specific responses to be recorded when needed, but hid those same questions when they were unnecessary.

We illustrate this interview practice in the **Figure A1**, which shows the beginning of funneling of responses for the first question of the strategy development section or (D1). The questions asks "What TYPICALLY prompts you to think about a strategic change?" As the figure shows, low scoring responses such as "Go with gut" or "React to performance drops", do not trigger any follow up questions. However, responses higher than "Look for widely reported, imminent shifts", will trigger the follow up question "What type of information do you use to inspire thinking about strategic changes?", which will be followed again by follow-ups about the detailed nature of information used, if and only if the respondent gives any response other than "Just intuition". As a result of this funneling practice, high scores for structured strategy process are less likely to be driven by respondents' desire to be perceived as rational decision makers but instead are more likely to capture an actual structured strategy process.

Appendix 3: Additional results

3.1 Correlation of sub-scores and complementarity

In this section we investigate the correlation of the sub-scores for Formalization, Development and Implementation and explore the potential mechanisms behind our findings.

Appendix Table 2 reports estimated coefficients of regressions of Strategy Practice sub-scores on each other. As might have been expected Development and Implementation are systematically positively correlation. However, more surprisingly, Formalization and Implementation are negatively correlated, even if this correlation is not statistically significant. To further investigate the relationship between Formalization and Implementation, we break out the three questions of Formalization and regress them on Development and Implementation in columns (3)-(5) of **Appendix Table 2**. These results show that the zero correlation between Formalization and Implementation is driven by the fact that F2 is in fact significantly negatively correlated with Implementation, while F3 is significantly positively correlated with Implementation.

As we mention in the main text the overall insignificant correlation between Formalization and Implementation could either be driven by the absence of complementarity between both categories of Strategy Practices. Or it could be driven by a failure to respond to an existing complementarity. One way to explore these two mechanisms is to estimate a "performance approach to complementarity" (Athey and Stern, 1998). The dependent variable in such a specification is firm

performance and the independent variables consist of the interaction terms between Formalization, Development and Implementation. If there is a positive effect on the interaction term of Formalization and Development, this could indicate that there is a failure to exploit complementarities. On the other hand, a zero or even negative effect would indicate the absence of any true complementarity in performance. However, we also caution that ideally this performance test would use at least three separate and non-collinear instruments alongside with two non-collinear interacted IVs and one non-collinear triple-interaction IV to correctly identify the causal effect of the interactions (Athey and Stern, 1998). Such an analysis is beyond the scope of this paper, which is why we only offer an exploratory analysis of an OLS performance regression here.

Appendix Table 3 shows that we fail to find evidence for an existing complementarity between Formalization and Implementation. At the same time, the interaction effect between Development and Implementation shows a large and significant positive effect. This positive effect is consistent with complementarity between Development and Implementation, which we think is natural given the interdependency of hypothesis development and hypothesis testing within scientific learning (Zellweger and Zenger, 2021). But, as mentioned before, our performance test of complementarity does not provide causal evidence to that effect, which we leave for future research.

3.2 Relationship Between Strategy Practices and CEO Tenure and Age

Executives can learn though trial and error and form adaptive expectations, as more experience increases the potential sample size of subjective data. As a result, very experienced CEOs might more reliably use their intuition or heuristics developed through experience instead of a structured strategy process. This section therefore explores whether reliance on structured strategy processes is systematically correlated with CEO (lack of) experience.

Appendix Table 4 reports our results from regressing our strategy scores on logged executive age as well as logged measures of tenure in the executive's current position or company. We provide two different proxies for CEO age. Academic CEO age is defined as years since MBA plus 27 or years since college plus 21 if the CEO did not have an MBA. Executive age is defined as academic age if available and otherwise age guess by interviewer. To reduce collinearity across measures, we compute relative position tenure as tenure at the current position divided by tenure at the current

company. Similarly, we define relative company tenure as tenure in the current company divided by executive age.

Columns (1) to (5) show that CEOs with more experience report systematically lower levels of scientific Strategy Practices. We find a negative association for both relative tenure in the CEO position and executive age, which is likely to proxy for overall work experience. This is consistent with the view that more experience might lead to more intuition or heuristics-based decision-making. A similar pattern emerges with academic CEO age, albeit a bit weaker which suggests that our measure of CEO age contains some valuable statistical signal. It is also consistent with the view that scientific learning is especially helpful for developing novel strategies that are not based on much experience, but instead on "observational fragments" (Felin and Zenger, 2009). Correspondingly, we find that the negative correlations between CEO position tenure and scientific Strategy Practices are strongest for the Development part of our survey, which focuses on theory development.

3.3 Firm ownership

We also considered the difference between public and private firms. Publicly traded companies are subject to a host of regulatory requirements and investor demands about transparency and comprehensibility of strategic choices. Consequently, scientific Strategy Practices can be beneficial, since they enhance the ability of managers to persuade outside stakeholders and shareholders of the strategic theory of the firm. Since we are most interested in public firms, we use all private firms as a baseline and only contrast public firms with family firms.

Column (5) of **Appendix Table 4** displays the results of our analysis of the relationship between Strategy Practices and firm ownership. Publicly traded firms adopt more scientific Strategy Practices than private firms, even when we include of number of employees as measure of firm size. One way to understand this correlation is that public firms are subject to a high demand for comprehensibility by professional investors and monitoring pressures which encourage firms to clearly explain the causal logic of their theories. In contrast, we find no significant difference between family firms and other privately owned organizations and firm age (unconditional on size).

Appendix 4: Changes in the HBS Strategy Curriculum*

Business Policy I Course Description (1982)	Business Policy I Course Description (1983)
Business Policy is the study of the **functions and responsibilities of general management** and the problems which affect the character and success of the total enterprise. The problems of policy in business have to do with the **choice of purposes**, the molding of **organizational character**, the definition of what needs to be done, and the **mobilization of resources** for the attainment of goals in the face of competition or adverse circumstances. In Business Policy, the problems considered and the point of view assumed in analyzing and dealing with them are those of the **chief executive officer or general manager** whose primary responsibility is the **enterprise as a whole**. Cases are drawn from companies of various sizes and industries. The purpose of instruction is to develop in students a **general management point of view** rather than a specialist or departmental orientation. Business Policy builds upon and integrates the total work of the school.	Business Policy I is a course about competition. It examines the **competitive forces in industries**, and the way in which companies can **create and sustain competitive advantage** through strategy. Reflecting a company's competencies, competitive strategy is a set of goals and integrated policies in each functional area that define how the company will compete in an industry, taking the point of view of the enterprise as a whole. A major theme of the Business Policy I is than **an acute understanding of competitive forces** will allow companies to shape competition in their favor. The primary focus of Business Policy I is on **competitive strategy in the industry environment, the primary arena in which competitive advantage is either won or lost**. Government's effect on competition is examined both domestically and internationally. The course also considers how competitive advantage may be enhanced through the combination of business units in a multibusiness company, an important task in corporate strategy. Cases are drawn from a wide variety of U.S. and global industries illustrating the range of competitive situations companies face. In its concern with how a **total enterprise can be related to its environment**, Business Policy I aims to integrate the work of other functional courses. …

***Emphasis Added**

Note: Following Porter's overhaul of the Business Policy I course in 1983, it was renamed "Competition and Strategy" in 1986.

Appendix 5: Robustness of RDD analysis

5.1 Different RDD Specifications for the Porter-RDD estimation

This appendix gives an overview of different approaches we used to estimate the regression discontinuity associated with MBA cohort years at HBS.

$$X_i = f(C_i) + \beta_1 \cdot 1_{\{C_i \geq 1983\}} + \epsilon_i$$

In all of these cases, the cutoff year chosen was 1983, none of the specifications use any additional control variables and we report all specifications for the strategy practice variables X_i.

Non-parametric or "local regression" estimates

In non-parametric approaches, the estimation strategy focuses on choosing a neighborhood of observations around the discontinuity point, where it is more plausible that the functional form is linear. The length of this neighborhood is also called the bandwidth. Once the bandwidth is chosen, the algorithm will estimate a local regression, which in our case will be a dummy regression.

There are two important steps in the implementation of this empirical strategy. First, the bandwidth choice matters, since smaller bandwidths will include less observations and will therefore produce noisier estimates, but also will be less biased as observations are closer to the discontinuity. (Imbens and Kalyanaraman, 2012) propose a procedure to optimally select bandwidths for local regressions of RDs based on MSE minimization and all of the algorithms we use, follow some implementation of their ideas.

Second, once the optimal bandwidth has been chosen, the estimation algorithm requires variance estimates to calculate standard errors. The first algorithm we use, follows (Calonico, Cattaneo and Titiunuk, 2017) (henceforth CCT) and offers two choices of the variance estimations. The first uses a k-Nearest Neighbor algorithm to estimate the variance of the estimators following (Abadie and Imbens, 2006). The second uses a "plug-in" or analytic formula for the variance estimation that is based on similar formulas for heteroscedasticity-robust least squares standard errors, see (MacKinnon, 2013). The first two columns of the **Appendix Table 5** below show the results, which are broadly consistent with each other.

Within the class of non-parametric local regressions, we also utilize an alternative algorithm by (Nichols, 2011), which is based on code by (Fuji, Imbens, and Kalyanaraman, 2009) and

implements another version of the optimal bandwith selection procedure by Imbens and Kalyanaraman, 2012. The results of this are displayed in the third column of **Appendix Table 5** and are broadly consistent with the code by Calonico, Cattaneo and Titiunuk, 2017.

Parametric or "global regression" estimates

This approach uses the entire sample instead of only focusing on a neighborhood around the discontinuity, but also assumes that the functional form for the regression is known. In particular, starting with the following regression:

$$X_i = f(C_i) + \beta_1 \cdot 1_{\{C_i \geq 1983\}} + \epsilon_i$$

the parametric approach specifies the function $f(C_i)$ as different continuous functions. This approach has the advantage of being more precise, as the whole data is used, but that comes at the cost of increased bias in the estimates, as observations that are far away from the discontinuity can still influence the estimates. Furthermore, the more complex and flexible the functional form of $f(C_i)$ is chosen, the more the noise in the data will influence the estimates, thereby eventually rendering the estimates less precise again and increasing the standard errors. For functional form of $f(C_i)$ we use either a second order, "quadratic" polynomial $f(C_i) = f_1 \cdot C_i + f_2 \cdot C_i^2$ or a third order "cubic" polynomial $f(C_i) = f_1 \cdot C_i + f_2 \cdot C_i^2 + f_3 \cdot C_i^3$

The last two columns of the **Appendix Table 5** report the results using the parametric specifications using robust standard errors. Generally, the signs of estimates are consistent with our baseline results, although some of the results are much weaker in the parametric specifications. An exception are the results on Formalization (F2+F3), which tend to be slightly stronger in the parametric specifications.

5.2 More Robustness of RDD

In this section, we follow best practices for checking the robustness of regression discontinuity designs, as outlined by Imbens and Lamieux, 2008. Specifically, we proceed in three steps

- Step 1: Analyze possible jumps in covariates that should not exhibit such jumps at the cutoff point (Imbens and Lamieux, 2008, section 7.1).
- Step 2: McCrary tests for possible discontinuities in the density of the forcing variable (Imbens and Lamieux, 2008, section 7.2).

- Step 3: Analyze possible jumps in main outcome variables at non-cutoff points (Imbens and Lamieux, 2008, section 7.3).

5.2.1 Placebo outcomes at cutoff point

The basic idea of this robustness check is that if the Porter event was truly unanticipated by HBS students and therefore did not lead to selection into the HBS MBA program, then characteristics determined before students enter business school should be unaffected by the RDD cutoff, see Imbens and Lamieux, 2008. Imbens and Lamieux, 2008 state that "Such tests are familiar from settings with identification based on unconfoundedness assumptions."

We choose a number of variables that are either predetermined or unlikely to be affected by the Porter RDD event, such as the CEO's gender, whether the CEO is part of the owning family at a family firm, whether the CEO's undergraduate degree was in engineering or business/econ and the CEO's tenure in the company or the current position. As **Appendix Table 6** shows, none of these outcomes is affected by the Porter RDD.

5.2.2 McCrary tests

McCrary, 2008 formalized the idea that manipulation of a RDD cutoff should imply measurable discontinuities in the density of values across the running variable in an RDD. In our context, the running variable is HBS MBA cohort and selection into the new Porter curriculum based on private information would imply that prospective MBA students might defer a year or two and join HBS later. As a result, one might expect bunching immediately after 1983 and fewer HBS MBA students right before 1983. The null hypothesis in the following test is that the density of students distributed over the HBS cohort years is the same before and after 1983. A rejection of this null hypothesis implies a violation of the "as-if randomization" and therefore existence of self-selection of MBA students into the new Porter curriculum, based on private information.

To conduct the McCrary tests, we follow Cattaneo, Jansson and Ma, 2018 and implement a test with local polynomials to approximate densities close to RDD cutoff point. Starting out as closely as possible to our empirical specification, we specify an optimal bandwidth of 3, which is the optimal bandwidth chosen by the Imbens, and Kalyanaraman, 2012 algorithm. The resulting test

statistic has a p-value of 0.77 and can therefore not reject the hypothesis that the distribution to the left and right of the 1983 cutoff point are identical. The corresponding local histogram and local density approximations are presented in **Panel A of Figure A2**.

It should be noted that this test is not very powerful, since the number of observations in the optimal bandwidth is only 36. We therefore move to a broader sample next.

The BoardEx sample is attractive for our purposes, since it provides us with many more observations than our core survey sample. We begin again with a somewhat restricted sample that resembles our survey sample and then generalize to the broadest possible sample.

The initial sample we use are HBS MBA graduates between 1980 and 1986, which is 3 years before and after the cutoff date of 1983. This corresponds to the 3-year optimal bandwidth we use in the non-parametric RDD approach of **Table 6**. With this restriction, we obtain a sample size of $N = 1{,}007$ observations. Again, the null hypothesis of no selection cannot be rejected with a p-value of 0.56. **Panel B of Figure A2** shows the corresponding local histogram and local density approximations.

We can also extend this sample in the BoardEx data. If we allow all HBS MBA graduate between 1973 and 1993, we the sample size to $N = 2899$. While this almost triples our sample size, the McCrary test still cannot reject the hypothesis of no bunching around 1983 with a p-value of 0.12. The resulting density plot is shown in **Panel C of Figure A2**.

5.2.3 Placebo cutoff around 1990-1991 recession

A possible concern in our baseline results in Table 6 is the occurrence of a recession in 1982 or in the year before Porter became head of the core strategy course at HBS. In particular, according to the official NBER business cycle dating website, the "Volcker" recession is between 1981 and 1982. Therefore, one might argue that the results in **Table 6** are potentially driven by the recession driving more analytically oriented prospective students into an HBS MBA.

One way to assess this hypothesis is to analyze another recession in our sample, during which no radical curriculum shift in the HBS strategy course was underway. This analysis is has the added benefit of showcasing RDD results for cohort graduation years for which we do not believe there

to be a comparable change in the HBS core strategy curriculum. The next official NBER recession is observed in 1990-1991. We therefore apply the same non-parametric RDD approach for each of the years 1990, 1991 and 1992. As can be seen in **Appendix Table 7**, none of these placebo dates generate results that are similar to our findings in **Table 6** of the main text.

Formalization

		1	3	5
F1	**Strategy Statement:** What is your company's strategy?	Respondent is unable to summarize	There is an informal statement, covering scope and possibly goals.	A formalized, concise statement exists, that summarizes: goals, scope and (competitive) advantage.
F2	**Deliberate scope and advantage:** What is your most important choice of "where to compete" in terms of products, geography or customers?	No priorities are set, regarding scope.	There are clear priorities, but reasons for these priorities are vague.	Clear priorities are related to internal advantage and external market opportunities.
F3	**Deliberate strategic distinctiveness:** If I asked your customers, how your company differs from the competition, either in the products/services you offer or in the way you provide them, what would they say?	The company is neither different in terms of products, nor in terms of business process or price, relative to the competition.	The company is different, in terms of products, processes or prices, relative to the competition. But information that ensures uniqueness is mostly informal (e.g. customer feedback).	The company is unique either in terms of in terms of products, processes or prices, relative to the competition. Data on customer feedback, and competitors is utilized to track how unique the company is.

Development

		1	3	5
D1	**Initialization:** How do you typically first come to consider changes to strategy?	We go with our gut to decide whether change is needed.	Change strategy before imminent performance changes. Qualitative and quantitative info from internal and external sources used, but no details are mentioned.	Proactively seek opportunities based on subtle shifts, using a broad range of quantitative and qualitative information on current and future external conditions to determine the need for change. Regular information updates combine internal and external sources.
D2	**Justification of decisions:** What type of information do you use to select a strategic change rather than its alternatives?	To decide on a strategic change, we don't use any information beyond our own intuition.	To select among alternatives, we use quantitative information on external conditions. But no details are provided. When we lack data, we make our best guess.	To select among alternatives, we use a broad range of quantitative and qualitative information on current and future external conditions. Regular information updates combine internal and external sources. When we lack data, we articulate initial assumptions/hypotheses for an alternative to be beneficial.
D3	**Regular peer-review:** How often do strategy development meetings take place? And why? Are there recurring themes across strategy development meetings?	We do not have regular meetings dedicated to strategy development.	Most strategic decisions are made in annual strategy exercises (strategy retreats, annual planning cycle of functional staff). Budgeting and compensation questions dominate.	Strategy development is embedded in regular formal and informal meetings, as strategy and implementation go together. Strategy discussions take priority.
D4	**Effective peer-review:** How are strategy development meetings prepared? What is the typical structure? Who participates? What is the role of the different participants?	We do not have regular meetings dedicated to strategy development.	Recurring meeting structure is dominated by presentations. Process is led by functional staff (strategy, finance..)	Recurring meeting structure is dominated by discussions, with detailed advance preparation. CEO and operating managers jointly lead the process.

Figure 1: Strategy Practices scoring grid

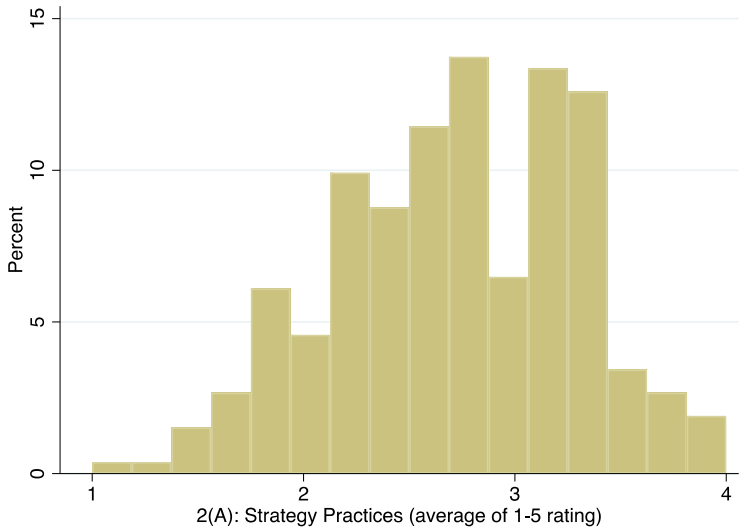
D5	**Exploration of alternatives:** Do you typically consider alternatives to given possible strategic change? How much information on these alternatives is there? How do you typically first come to consider these alternatives?	We know what we have to do and do it.	We consider mostly 1 alternative. But, alternatives are not regularly generated and there might be no vetting of alternatives.	We usually consider at least two realistic and feasible alternatives. We have a routinized process in place to explore feasible alternatives, even without immediate need. For each alternative, we specify initial assumptions/hypotheses if there is no data.
D6	**Peer-review of risk:** When you are considering a strategic change, when and how do people express potential concerns?	Concerns are expressed irregularly.	We have public discussions, but managers also express concerns in private. Public discussions are mostly done for ``important'' decisions only.	All concerns were voiced and debated, using a systematic process of criticism, risk evaluation and open discussion. All strategic changes and possible alternatives are vetted through the same process.

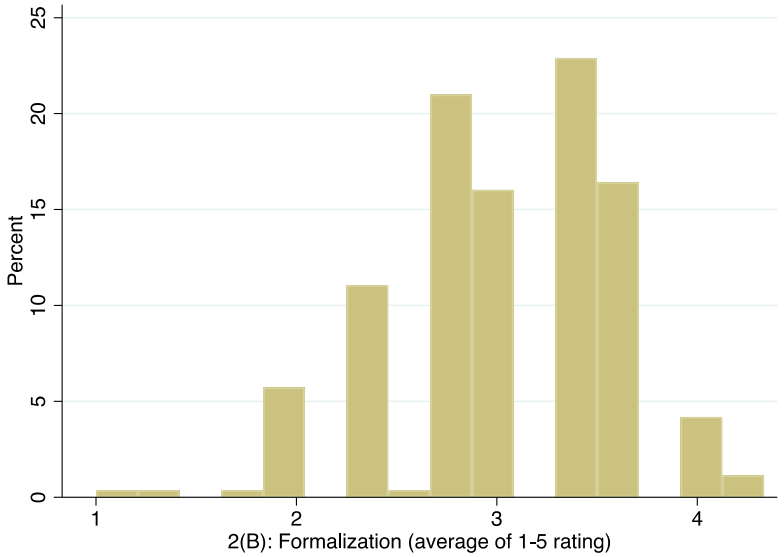
Implementation

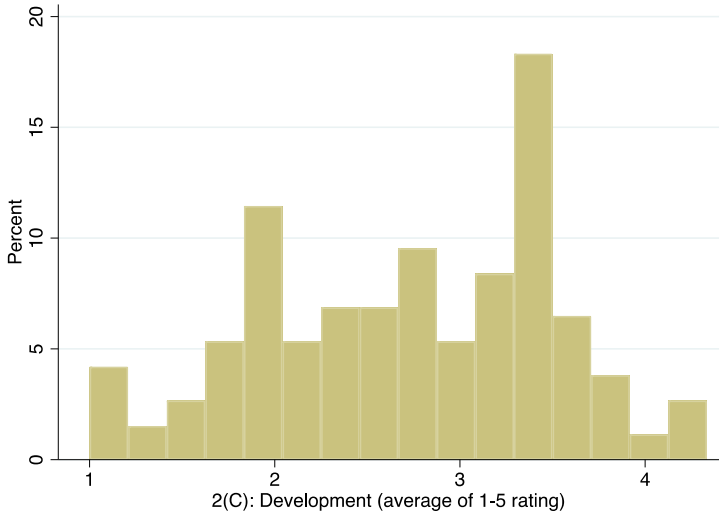
		1	3	5
I1	**Implementation planning:** When you make a strategic decision, which implementation details are clear and what remains to be figured out?	Steps to implement a strategy are typically not articulated at the time of the decision.	The most important steps for implementation are clearly defined for directly involved department heads Department targets reflect these steps. But no details on performance targets or incentives are clear.	Detailed steps and intermediate targets for all directly and indirectly involved departments and individuals are defined. Performance and compensation were tied to the completion of these steps at the individual and team level.
I2	**Testing and follow-up:** How do you review the progress of a strategic change?	No or irregular review.	Reviews discuss successes/failures and follow-up goals are usually stated. But either discussion minutes or follow-ups do not regularly exist.	Strategy review discussions discuss successes/failures, risks/opportunities and review of initial assumptions or hypotheses. Minutes document discussion and follow up plans with clear goals.
I3	**Validating causal mechanisms:** How would you typically know whether a strategic change has succeeded or failed? What happens if a strategic change does not meet your expectations, either positively or negatively?	We typically do not know whether a strategy succeeded or not.	We use performance in a targeted area to measure success but often do not know how strategy worked. Large surprises are reviewed but often no adjustment steps are taken or lessons for strategy discussed.	We judge success/failure relative to targeted effects using customized measures informative about the way strategy works and try to separate strategy design from luck and implementation issues. We investigate why outcome was surprising and have an ongoing detailed dialogue on surprise outcomes and their implications for operations and strategy.
I4	**Strategy communication:** When and how are employees outside top management typically informed about strategic changes?	As changes take place, ``word trickles out".	Official (CEO) memos go out in advance and announce the change. Employees mostly do not interact with superiors during communications.	Official statements go out in advance and inform employees through a variety of channels such as CEO statements, town-hall type Q&As, personal meetings throughout the organization. Communications include: what is done, why change was needed, how it affects employees.
I5	**Learning about resistance:** There might sometimes be individuals opposed to a strategic change? How do find out about them? Are you usually able to overcome their resistance? If so, how?	We do not identify resisters.	Before the decision, we identify resisters, as they voice opposition. Resisters are sidelined, neutralized or compliance is bought.	When preparing strategy considerations, we proactively identify influential individuals or groups, who might oppose the change. There is a routinized process to increase support for changes, elicit constructive criticism and keep management informed about potential implementation-issues from resistance.

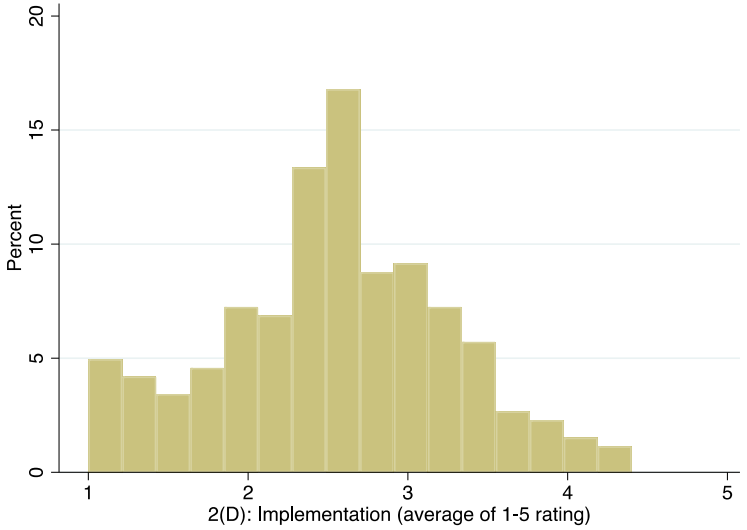
Figure 1 (continued): Strategy Practices scoring grid

Figure 2 Distribution of Strategy Practices



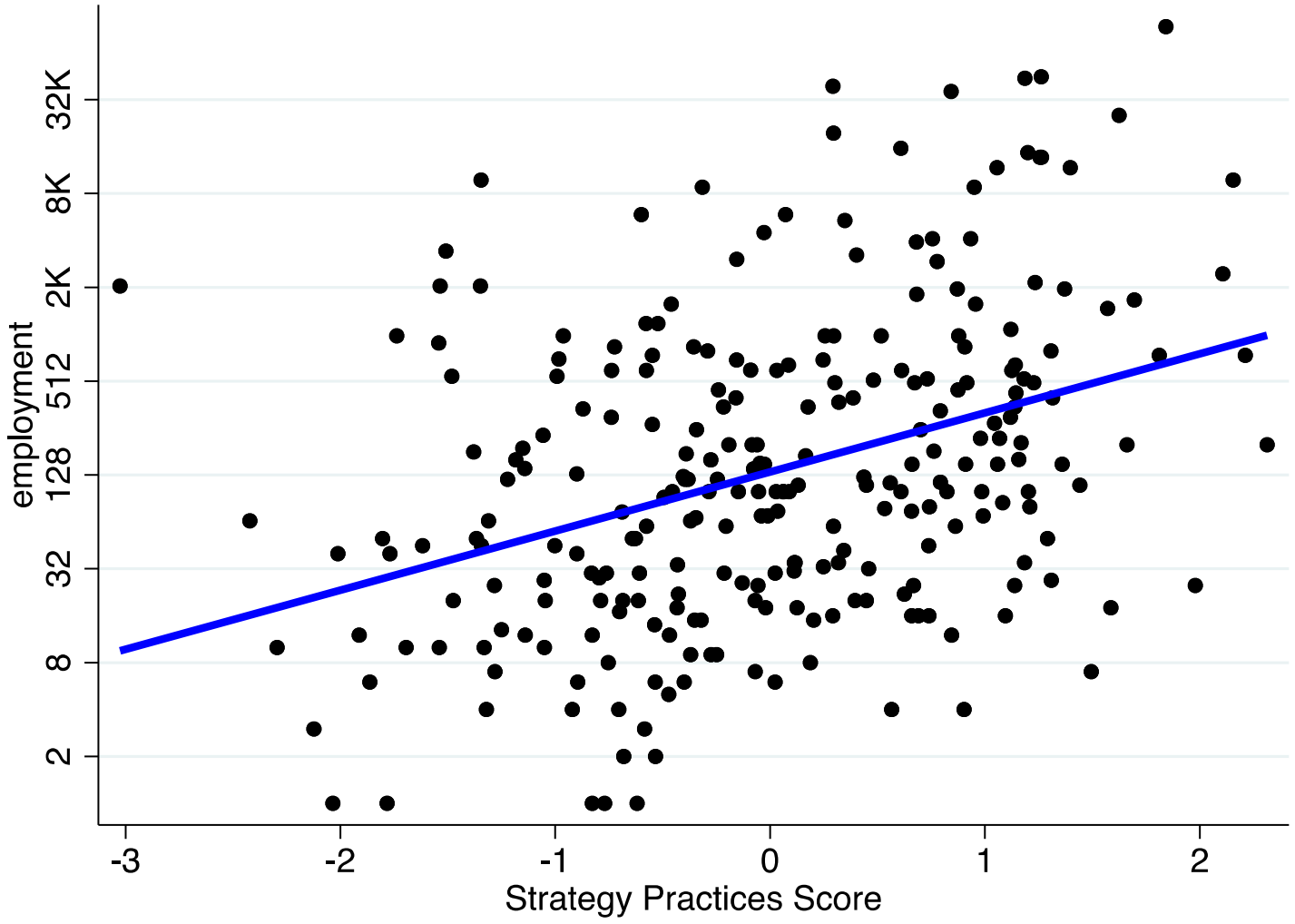






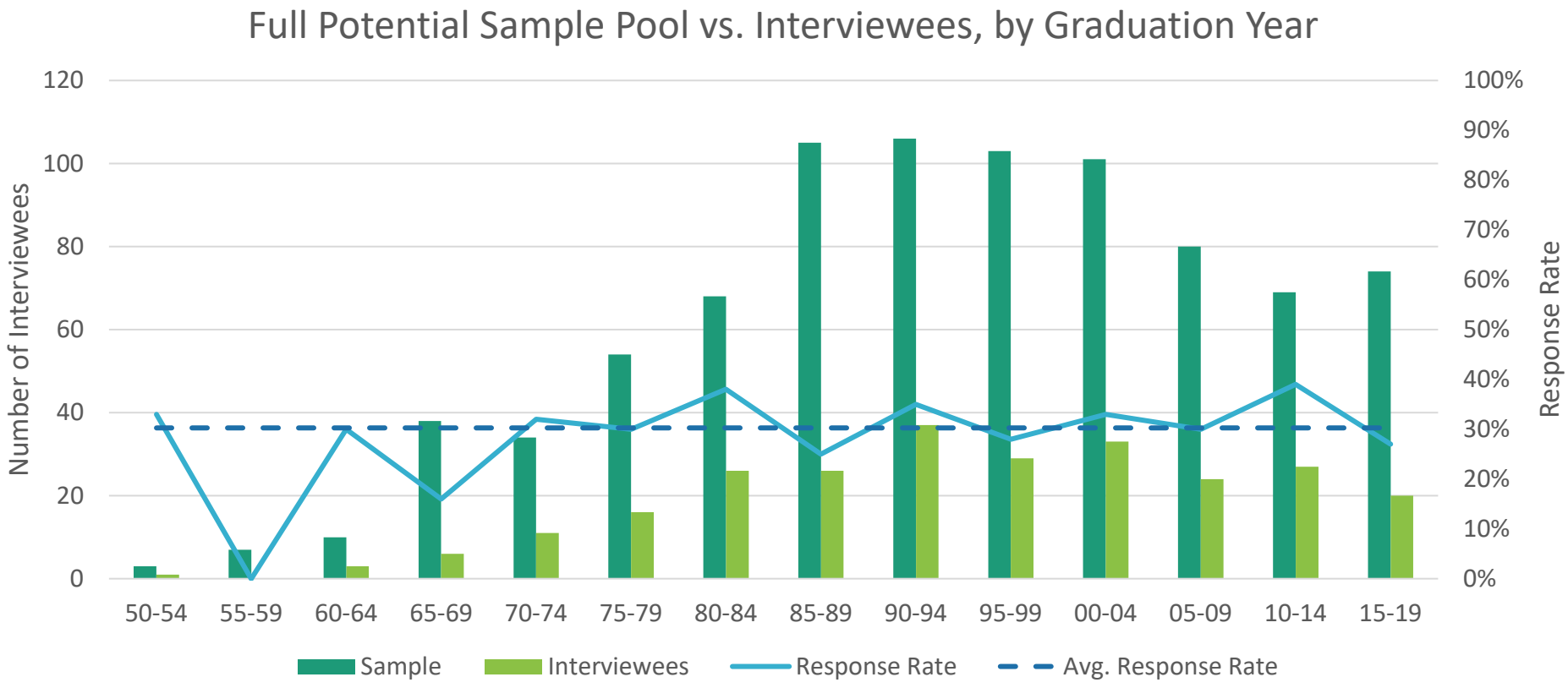
Note: The Strategy Practices score is an unweighted average of the score for each of the 14 strategy questions, where each question is normalized to have zero mean and standard deviation of one. The sub-scores consist of standardized, unweighted sums for questions (F1)-(F3) for Formalization, (D1)-(D6) for Development and (I1)-(I5) for Implementation.

Figure 3: Unconditional correlation of Strategy Practices and Firm Size



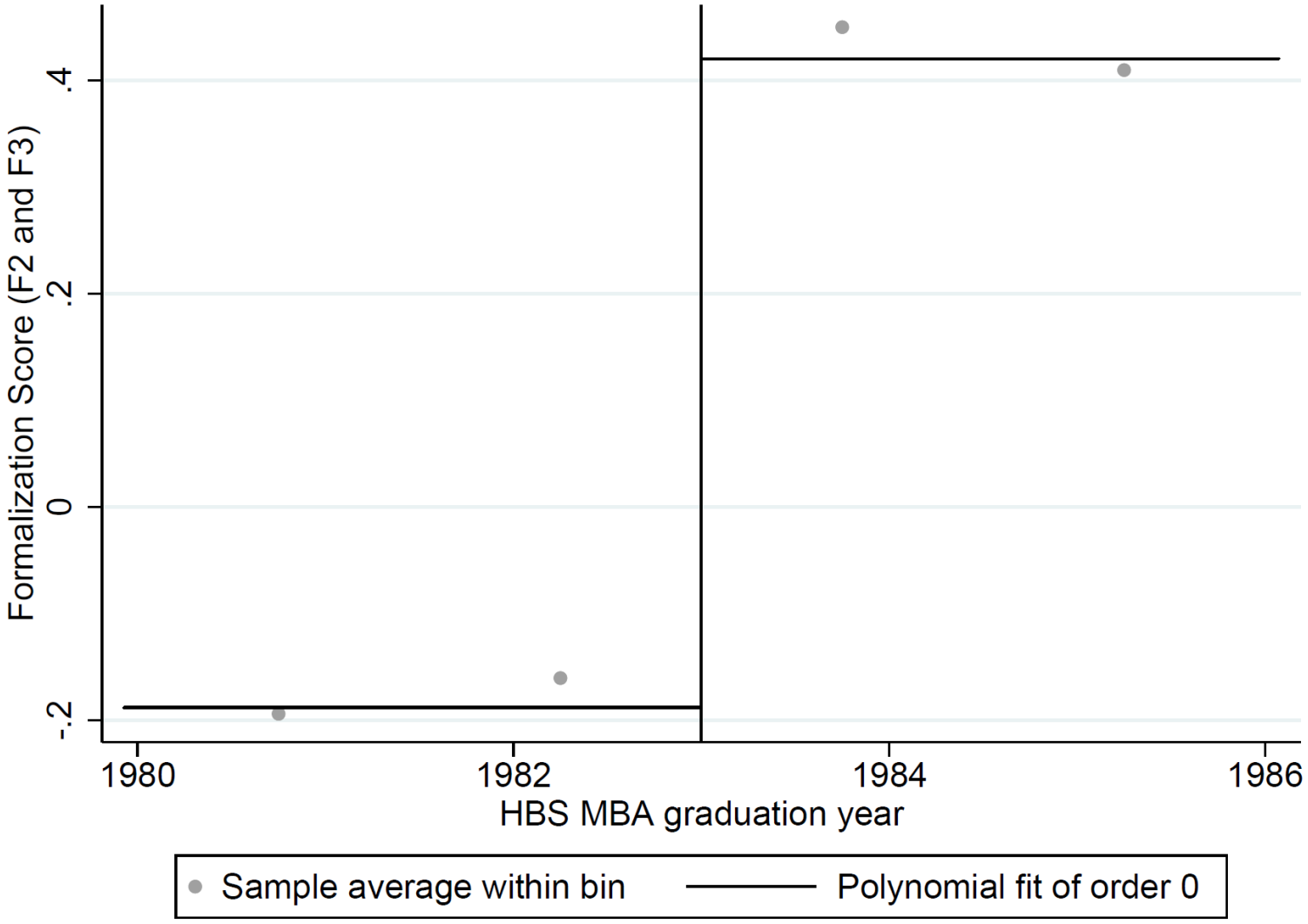
Note: The Strategy Practice score is an unweighted average of the score for each of the 14 strategy questions, where each question is normalized to have zero mean and standard deviation of one. Employment is measured as the number of full-time employees at the company.

Figure 4: Distribution of observations across graduation years



Note: The overall number of potential interviewees per year is measured by the number of alumni in the HBS alumni database with a degree from HBS, including MBA and executive education programs. The response rate has been calculated as ratio of number of executives who agreed to participate, relative to the number of executives that could successfully be contacted.

Figure 5: Regression discontinuity plot of the causal impact of the HBS core strategy course restructuring by Michael Porter on Formalization Score (F2 and F3)



Note: The dependent variable is the normalized version of the Formalization score (excluding Q1) with zero mean and standard deviation of one. The sample are all interviewed executives with an HBS MBA, within the optimal bandwidth of the local RDD regression.

Figure A1: Measurement of type of strategic decisions

What would be three examples of typical strategic decisions?

	Example 1	Example 2	Example 3
M&A: merger or acquisition	☐	☐	☐
geographic expansion	☐	☐	☐
new technology (including IT)	☐	☐	☐
large capital expenditure	☐	☐	☐
new product or business line	☐	☐	☐
new business process	☐	☐	☐
organizational restructuring	☐	☐	☐
focusing business (divestiture)	☐	☐	☐
outsourcing	☐	☐	☐
joint venture	☐	☐	☐
moving service in-house (vertical integration)	☐	☐	☐
Re-orientation of priorities (market/business lines)	☐	☐	☐
Supply chain re-orientation	☐	☐	☐
hiring	☐	☐	☐
IPO	☐	☐	☐
Significant change in funding sources	☐	☐	☐

Figure A2: Example of funneling of responses for question 4 in the survey, which corresponds to practices (D1) of the theory/strategy development part, discussed in section 3.1.

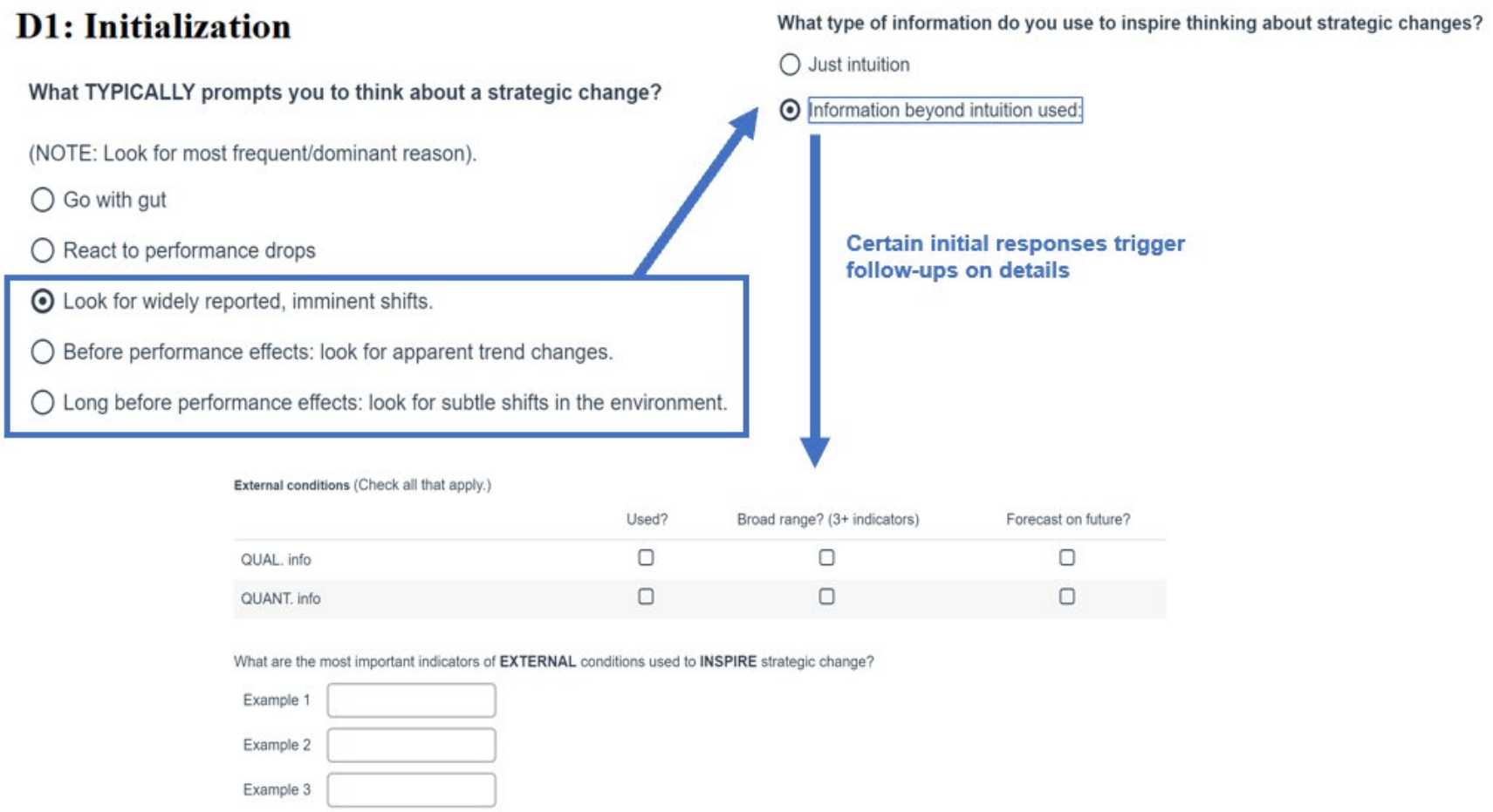
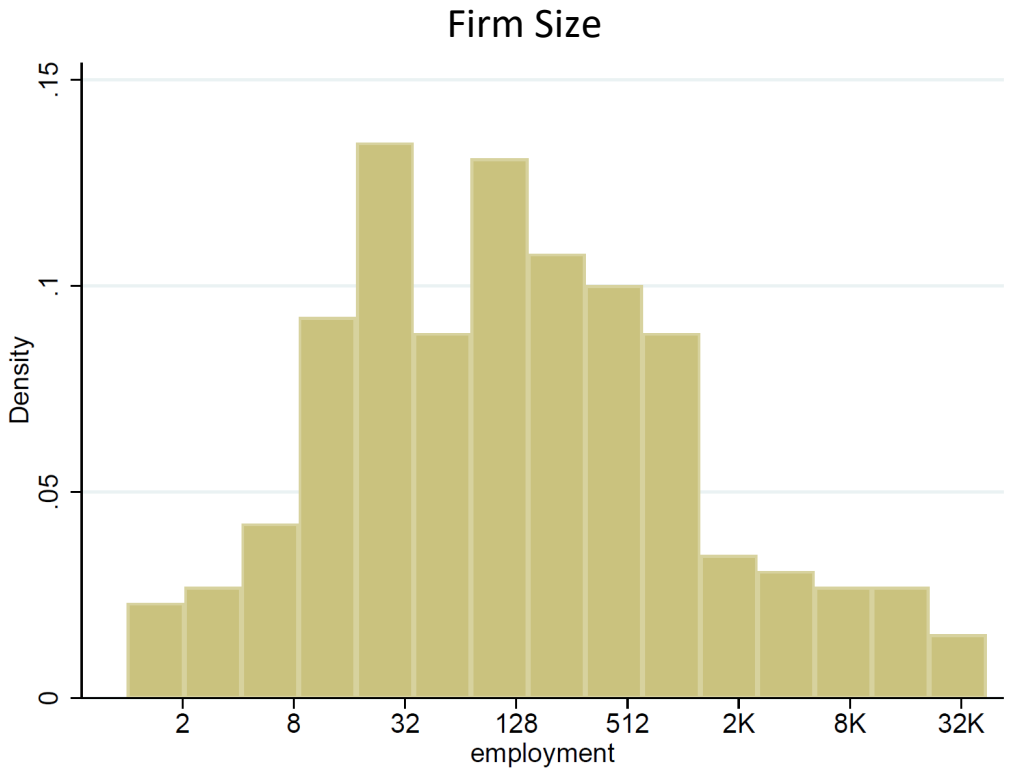


Figure A3: Firm characteristics in survey sample



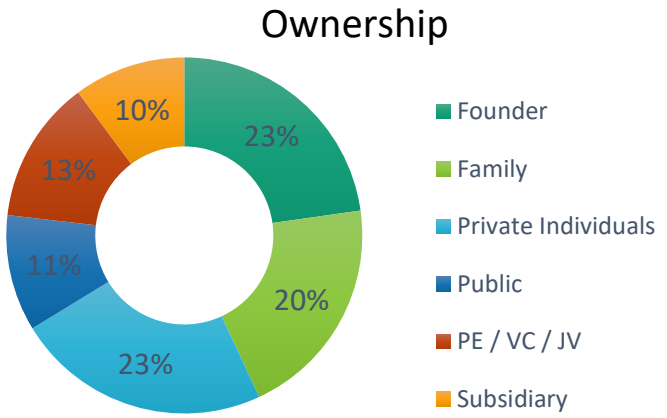
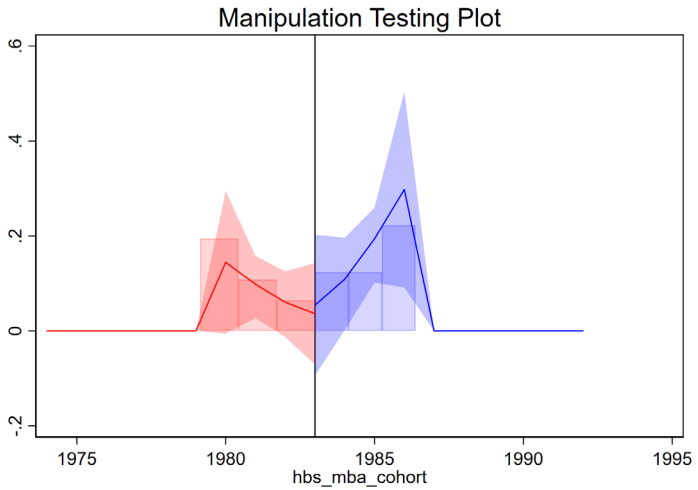
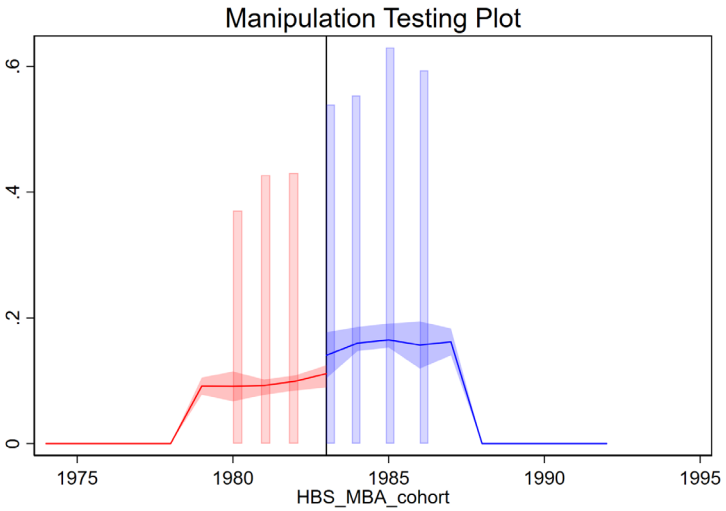


Figure A4: McCrary Tests

(A): HBS alumni 1979-1986 in Strategy Practices Survey Sample



(B): HBS alumni 1979-1986 in BoardEx Sample



(C): HBS alumni 1973-1993 in BoardEx Sample

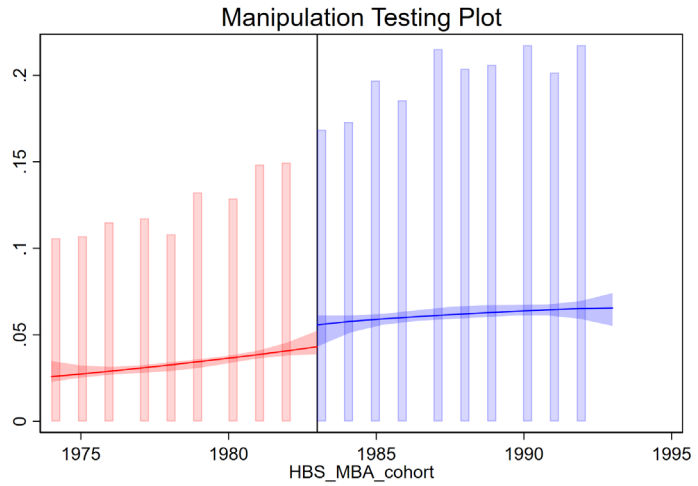


Table 1: Descriptive Statistics

	Obs	Mean	Standard Deviation	min	max
Panel A: Firm and Executive Characteristics					
Firm characteristics					
Number of employees	262	2088	8343	1	96500
Firm age	262	47.96	46.30	1	395
Public ownership	262	0.11	0.31	0	1
Family ownership	262	0.20	0.40	0	1
Executive characteristics					
Female	262	0.09	0.28	0	1
Age of executive	262	57.34	12.14	24	95
Tenure in position	262	13.86	11.31	0	51
Tenure in company	262	17.31	14.23	0	69
Bachelor degree in business or econ	262	0.37	0.36	0	1
Bachelor degree in engineering	262	0.04	0.15	0	1
MBA from HBS	262	0.71	0.45	0	1
Panel B: Strategy Practices	262	2.72	0.57	1.00	4.00
Formalization	262	3.02	0.57	1.00	4.33
F1: Strategy statement	262	2.51	0.71	1.00	5.00
F2: Deliberate scope and advantage	262	2.89	0.94	1.00	5.00
F3: Deliberate strategic distinctiveness	262	3.68	0.95	1.00	5.00
Development	262	2.72	0.81	1.00	4.33
D1: Initialization	262	2.63	0.86	1.00	5.00
D2: Justification of decisions	262	2.74	0.81	1.00	5.00
D3: Regular peer-review	262	2.60	1.33	1.00	5.00
D4: Effective peer-review	262	2.51	1.32	1.00	5.00
D5: Exploration of alternatives	262	2.98	1.34	1.00	5.00
D6: Peer-review of risk	262	2.85	1.23	1.00	5.00
Implementation	262	2.54	0.70	1.00	4.40
I1: Implementation planning	262	2.09	0.94	1.00	5.00
I2: Testing and follow-up	262	3.02	1.20	1.00	5.00
I3: Validating causal mechanisms	262	2.81	1.02	1.00	5.00
I4: Strategy communication	262	2.83	1.21	1.00	5.00
I5: Learning about resistance	262	1.94	0.86	1.00	5.00

Notes: Strategy questions are scored with values between 1-5. Strategy practices (all questions), Formalization (F1-F3), Development (D1-D6) and the Implementation (I1-I5) are averages of the underlying questions. Core practices for scientific learning are printed in bold, while support practices are in normal font. Missing observations are imputed at sample mean.

Table 2: Strategy and firm size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable				log employees			
Strategy Practices	0.980***	0.864***	0.692***				
	(0.141)	(0.126)	(0.132)				
Formalization				0.340***			0.256**
				(0.117)			(0.109)
Development					0.597***		0.501***
					(0.131)		(0.142)
Implementation						0.391***	0.162
						(0.134)	(0.145)
log firm age		1.109***	0.996***	1.103***	0.969***	1.056***	1.031***
		(0.119)	(0.146)	(0.151)	(0.149)	(0.150)	(0.149)
Noise controls	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Additional Firm and CEO controls	NO	NO	YES	YES	YES	YES	YES
Obs	262	262	262	262	262	262	262

Notes: Strategy Practices score is a normalized z-score with unit variance which is the sum of all 14 normalized strategy questions with mean zero and unit variance. Formalization (F1-F3), Development (D1-D6) and Implementation (I1-I5) are also z-scores with unit variance. Noise controls include interviewer fixed effects, time of day, interview duration, ratings of interviewee expertise and interviewee honesty and non-CEO dummy. Industry fixed effects are 3 digit NAICS dummies. Additional firm and CEO controls include: family ownership dummy, public ownership dummy, CEO age, CEO tenure in company, CEO tenure in position. Missing observations are imputed at sample means with imputation dummies included whenever observations are imputed. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.

Table 3: Strategy Practice Scores and strategic changes

	(1) log number of strategic changes	(2) log decision time (weeks)	(3) log implementation time (weeks)
Strategy Practices	0.132*	0.281***	0.103
	(0.067)	(0.107)	(0.079)
Formalization	-0.004	0.083	0.021
	(0.070)	(0.093)	(0.081)
Development	0.061	0.269**	0.104
	(0.065)	(0.107)	(0.078)
Implementation	0.190***	0.131	0.055
	(0.058)	(0.095)	(0.069)

Notes: Each coefficient corresponds to a different regression. Number of strategic changes is the estimated number of changes over a 5 year horizon. Strategy Practices score is a normalized z-score with unit variance which is the sum of all 14 normalized strategy questions with mean zero and unit variance. All columns include controls for noise controls (interviewer fixed effects, time of day, interview duration, ratings of interviewee expertise and interviewee honesty and non-CEO dummy), and firm and CEO controls (firm age, family ownership dummy, public ownership dummy, CEO age, CEO tenure in company, CEO tenure in position). All columns include controls for decision type fixed effects include dummies for 17 non-exclusive types of strategic changes pursued. All columns include controls for industry fixed effects, which are 3 digit NAICS dummies. Missing observations are imputed at sample means with imputation dummies included whenever observations are imputed. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.

Table 4: Strategy practices and profitability (Census of Manufacturing)

	(1)	(2)	(3)	(4)	(6)	(7)
Dependent variable	**markup/profitability**					
Strategy Practices	0.155**	0.180**	0.193***	0.223***	0.166***	0.211***
	(0.069)	(0.070)	(0.057)	(0.055)	(0.053)	(0.049)
Strategy Practices X Complexity			0.202***			0.177***
			(0.067)			(0.048)
Strategy Practices X Forecast Error Dispersion				-0.351***		-0.243
				(0.090)		(0.162)
Strategy Practices X Sales persistence					0.189**	0.109
					(0.089)	(0.071)
ln employment control	YES	YES	NO	NO	NO	NO
ln capital stock control	NO	YES	NO	NO	NO	NO
Noise controls	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES
Obs (rounded)	100	100	100	100	100	100
No of firms (rounded)	50	50	50	50	50	50

Notes: Strategy Practices score is a normalized z-score with unit variance which is the sum of all 14 normalized strategy questions with mean zero and unit variance. Environmental contingencies are calculated at the 4 digit NAICS level: Complexity is measured as the sum of different strategic decision types (e.g. product innovation and M&A and geographic expansion) among the 3 typical strategic decisions discussed by each respondent and aggregated to the industry level by taking the median. Forecast error dispersion is measured as standard deviation of forecast errors for sales across establishments, using the 2015 MOPS and the 2017 Census of Manufacturing. Sales persistence is measured as average AR(1) coefficient across establishments within the same 4-digit NAIC industries for 2006-2017. Markup is defined as sales minus operating costs (intermediate inputs, energy costs, wage bill) divided by operating costs. Noise controls include interviewer fixed effects, time of day, interview duration, ratings of interviewee expertise and interviewee honesty and non-CEO dummy. Column (6) additionally controls for the interaction of strategy practices and velocity, which measured as the median of the standard deviation of growth of ecommerce within establishment during 2006-2017. Industry fixed effects are 4 digit NAICS (17 industries in-sample). Missing observations are imputed at sample means with imputation dummies included whenever observations are imputed. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.

Table 5: Strategy practices and firm size / firm growth in Census data (LBD)

Dependent variable	(1) log employees	(2) 1-year firm growth	(3) 5-year firm growth	(4) 1-year firm growth
Strategy Practices	0.464**	0.047***	0.095**	-0.049
	(0.198)	(0.012)	(0.037)	(0.034)
log initial employees		-0.049***	-0.095***	-0.058***
		(0.007)	(0.019)	(0.009)
Strategy Practices **X** CEO Appointment				0.085**
				(0.041)
CEO Appointment				-0.061*
				(0.036)
Noise controls	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Obs (rounded)	200	2000	1300	2000
No of firms (rounded)	200	200	150	200

Notes: Results are based on merging the strategy practice data into the Longitudinal Business Database (LBD) and aggregating the data to the firm level. Strategy Practices score is a normalized z-score with unit variance which is the sum of all 14 normalized strategy questions with mean zero and unit variance. Growth rates are based Davis, Haltiwanger and Schuh (1996) formula. Industry fixed effects are 2 digit NAICS dummies. CEO Appointment is a dummy that is one from the first year of the CEO's tenure in this position onwards and zero prior to that year. Additional firm and CEO controls include: family ownership dummy, public ownership dummy, CEO age, CEO tenure in company, CEO tenure in position. Missing observations are imputed at sample means with imputation dummies included whenever observations are imputed. Significance levels are: *: 10%, **: 5%, ***: 1%. Robust standard errors are used for column (1), while all other columns have standard errors clustered at the firm-level. Standard errors are reported in parentheses.

Table 6: Porter RDD Effects on Strategy Practices

Panel A: Dependent Variable: Formalization

Estimator	Non-parametric: IK-NN	Non-parametric: IK-PI	Parametric: cubic control	Parametric: quadratic control
	(1)	(2)	(3)	(4)
Porter treatment	0.845**	0.832**	0.583*	0.582**
	(0.424)	(0.373)	(0.307)	(0.245)
Sample obs	185	185	185	185
Estimation obs	36	36	185	185

Panel B: Dependent Variable: Implementation

Estimator	Non-parametric: IK-NN	Non-parametric: IK-PI	Parametric: cubic control	Parametric: quadratic control
	(1)	(2)	(3)	(4)
Porter treatment	-1.216***	-1.270***	-0.601**	-0.126
	(0.312)	(0.332)	(0.279)	(0.229)
Sample obs	185	185	185	185
Estimation obs	36	36	185	185

Notes: Effects show the impact of MBA cohort year after the cutoff date of 1983. Formalization (F2-F3), Development (D1-D6) and the Implementation (I1-I5) are averages of the underlying questions, normalized to zero mean and unit variance. Columns (1) and (2) use non-parametric local regressions with optimal bandwidth selections and constant effect only. The baseline uses bandwidth selection by (Imbens, and Kalyanaraman, 2012) using a nearest-neighbor variance estimation, denoted by IK-NN and is implemented by (Calonico, Cattaneo and Titiunuk, 2017). IK-PI uses the same bandtwidth selection procedure with analytic heteroscedasticity-robust "plug-in" variance estimates as discussed by (MacKinnon , 2013) is implemented by (Calonico, Cattaneo and Titiunuk, 2017). Columns (3) and (4) use parametric approaches and assume different functional forms for the continuous function f(.). It is assumed to be either quadratic or cubic. Sample includes only HBS MBA alumni. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.

Appendix Table 1: Frequency of different Strategic Decisions

Type of Strategic Decision	Count	Mean	SD
New product or business	262	0.85	0.77
Large capital expenditure	262	0.60	0.76
New technology (incl. IT)	262	0.50	0.73
Reorientation of priorities (market or business)	262	0.50	0.70
New business process	262	0.44	0.66
Geographic expansion	262	0.37	0.54
M&A	262	0.34	0.58
Cooperation with other firms (e.g. joint venture, alliance)	262	0.26	0.51
Hiring	262	0.26	0.50
Change in distribution channels	262	0.18	0.43
Organizational restructuring	262	0.17	0.41
Outsourcing	262	0.15	0.36
Supply-chain reorientation	262	0.15	0.42
diversiture	262	0.14	0.37
Moving service in-house (in-sourching, vertical integration)	262	0.14	0.37
Significant change in funding sources	262	0.13	0.36
IPO	262	0.02	0.12

Notes: Tabulation of dummies that are one if this strategic decision was one of 3 examples given for typical strategic decisions. Types of strategic changes are not mutually exclusive, and all types of changes relevant to a particular decision, as described by an interviewee, were selected. For example, if a decision to enter a new product market required both vertical integration into new manufacturing processes and expenditure on new manufacturing equipment, we would categorize the strategic decision as involving (1) New product or business line, (2) Large capital expenditure, and (3) Moving service in-house.

Appendix Table 2: Correlation among strategy practice subscores

	(1) Formalization	(2) Development	(3) F1	(4) F2	(5) F3
Development	0.227**		0.131	0.127	0.195**
	(0.088)		(0.084)	(0.080)	(0.089)
Implementation	-0.032	0.486***	-0.048	-0.180**	0.155**
	(0.082)	(0.066)	(0.084)	(0.081)	(0.074)
Formalization		0.162***			
		(0.060)			
Noise controls	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
Obs	262	262	262	262	262

Notes: Formalization (F1-F3), Development (D1-D6) and Implementation (I1-I5) are also z-scores with unit variance. F1 is strategy statement, F2 is strategy scope and F3 is strategic differentiation. Noise controls include interviewer fixed effects, time of day, interview duration, ratings of interviewee expertise and interviewee honesty and non-CEO dummy. Industry fixed effects are 3 digit NAICS dummies. Missing observations are imputed at sample means with imputation dummies included whenever observations are imputed. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.

Appendix Table 3: Complementarity in Strategy Practices (Census of Manufacturing)

	(1)	(2)
Dependent variable	**Markup**	
Formalization X Development	-0.078	-0.065
	(0.089)	(0.069)
Formalization X Implementation	-0.06	0.002
	(0.078)	(0.063)
Development X Implementation	0.302**	0.277***
	(0.118)	(0.077)
Formalization X Development X Implementation	-0.067	-0.068
	(0.148)	(0.073)
Formalization	0.025	0.055
	(0.086)	(0.064)
Development	-0.121	0.061
	(0.154)	(0.088)
Implementation	-0.051	-0.005
	(0.143)	(0.063)
log number of employees		-0.459***
		(0.042)
log capital stock		0.152***
		(0.045)
Noise controls	YES	YES
Industry FE	YES	YES
Constant	YES	YES
Obs (rounded)	100	100
No of firms (rounded)	50	50

Notes: Strategy Practices score is a normalized z-score with unit variance which is the sum of all 14 normalized strategy questions with mean zero and unit variance. Formalization (F1-F3), Development (D1-D6) and Implementation (I1-I5) are also z-scores with unit variance. Markup is defined as sales minus operating costs (intermediate inputs, energy costs, wage bill) divided by operating costs. Noise controls include interviewer fixed effects, time of day, interview duration, ratings of interviewee expertise and interviewee honesty and non-CEO dummy. Industry fixed effects are 4 digit NAICS (17 industries in-sample). Missing observations are imputed at sample means with imputation dummies included whenever observations are imputed. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.

Appendix Table 4: Other Firm and CEO Correlates of the Strategy Score

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Strategy Practices						
log rel. tenure position	-0.272**						
	(0.117)						
log rel. tenure company		-0.101					
		(0.083)					
log executive age			-1.440***				
			(0.290)				
log academic CEO age				-1.219***			
				(0.387)			
Family ownership					-0.047		
					(0.156)		
Public firm						0.742***	
						(0.200)	
log firm age							0.095
							(0.069)
Noise controls	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Obs	262	262	262	262	262	262	262

Note: Strategy Practices score is a normalized z-score with unit variance which is the sum of all 14 normalized strategy questions with mean zero and unit variance. Relative position tenure is defined as tenure at the current position divided by tenure at the current company. Relative company tenure as tenure in the current company divided by executive age. Academic CEO age is defined as years since MBA plus 27 or years since college plus 21. Executive age is defined as academic age if available and otherwise age guess by interviewer. Industry fixed effects are at the 3-digit NAICS level. Missing observations are imputed at sample means with imputation dummies included whenever observations are imputed. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.

Appendix Table 5: Porter RDD estimates for all questions, with different RDD specifications

	Non-parametric, baseline (IK-NN)		Non-parametric, IK-PI		Non-parametric FIK		Parametric, quadratic		Parametric, cubic	
Dependent variable	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
F1: Strategy Statement	0.031	(0.244)	0.03	(0.239)	-0.26	(0.509)	0.153	(0.233)	-0.092	(0.304)
F2: Strategy Scope	0.601**	(0.304)	0.629**	(0.292)	1.444*	(0.772)	0.32	(0.251)	0.372	(0.306)
F3: Strategic Differentiation	0.37	(0.456)	0.379	(0.422)	0.47	(0.71)	0.545**	(0.259)	0.496	(0.345)
D1: Proactivity and External Focus	0.549	(0.406)	0.559	(0.387)	1.079	(0.737)	0.467*	(0.252)	0.478	(0.321)
D2: Information for Strategy Selection	0.056	(0.316)	0.057	(0.296)	0.022	(0.822)	-0.06	(0.234)	-0.045	(0.299)
D3: Strategy Meetings: Frequency	-0.144	(0.328)	-0.155	(0.315)	-0.964	(0.764)	0.298	(0.253)	0.078	(0.318)
D4: Strategy Meetings: Involvement	-0.398	(0.366)	-0.349	(0.332)	-1.254	(0.814)	0.249	(0.241)	-0.106	(0.314)
D5: Consideration of Alternatives	-0.225	(0.286)	-0.217	(0.287)	-0.66	(0.605)	-0.015	(0.239)	-0.24	(0.305)
D6: Structured Criticism	-0.073	(0.316)	-0.054	(0.318)	-1.223	(1.018)	0.04	(0.252)	-0.167	(0.32)
I1: Implementation Planning	-0.986**	(0.439)	-0.986**	(0.404)	-1.612**	(0.753)	0.026	(0.233)	-0.367	(0.285)
I2: Strategy review and Follow-ups	-1.565***	(0.416)	-1.560***	(0.372)	-2.475***	(0.499)	-0.063	(0.258)	-0.338	(0.328)
I3: Learning from Strategy Outcomes	-0.299	(0.318)	-0.299	(0.338)	-1.015*	(0.606)	0.187	(0.228)	0.065	(0.304)
I4: Strategy Communication	-0.929***	(0.288)	-0.969***	(0.302)	-2.274***	(0.677)	-0.277	(0.241)	-0.607**	(0.3)
I5: Resistance to Change	-0.562**	(0.275)	-0.569**	(0.254)	-0.672	(0.444)	-0.245	(0.221)	-0.735***	(0.267)
Formalization	0.845**	(0.424)	0.832**	(0.373)	1.257**	(0.635)	0.582**	(0.245)	0.583*	(0.307)
Development	-0.025	(0.25)	-0.004	(0.246)	-0.702	(0.545)	0.235	(0.222)	-0.001	(0.279)
Implementation	-1.165***	(0.302)	-1.269***	(0.332)	-2.402***	(0.573)	-0.126	(0.229)	-0.601**	(0.279)

Notes: Column headers display different RD specifications. Non-parametric estimates use local regressions with optimal bandwidth selections of 3 years, implying the use of 36 observations. The baseline uses bandwidth selection by (Imbens, and Kalyanaraman, 2012) using a nearest-neighbor variance estimation, denoted by IK-NN and is implemented by (Calonico, Cattaneo and Titiunuk, 2017). IK-PI uses the same bandtwidth selection procedure with analytic heteroscedasticity-robust "plug-in" variance estimates as discussed by (MacKinnon , 2013) is implemented by (Calonico, Cattaneo and Titiunuk, 2017). The FIK estimator uses an implementation of IK by (Nichols, 2011) and (Fuji, Imbens, and Kalyanaraman, 2009). Parametric approaches use the full sample of MBAs (185 observations) and assume different functional forms for the continuous function f(.). It is assumed to be either quadratic or cubic.

Appendix Table 6: Placebo Outcomes

Panel A

Dependent variable	Female		Family CEO	
Estimator	Non-parametric: IK-NN	Parametric: cubic control	Non-parametric: IK-NN	Parametric: cubic control
	(1)	(2)	(3)	(4)
Porter treatment	0.012	-0.007	-0.035	-0.122
	(0.012)	(0.059)	(0.099)	(0.122)
Sample obs	185	185	185	185
Estimation obs	50	185	50	185

Panel B

Dependent variable	BA/BS engineering		BA/BS business or econ	
Estimator	Non-parametric: IK-NN	Parametric: cubic control	Non-parametric: IK-NN	Parametric: cubic control
	(1)	(2)	(3)	(4)
Porter treatment	0.016	0.010	-0.108	-0.067
	(0.017)	(0.029)	(0.239)	(0.131)
Sample obs	185	185	185	185
Estimation obs	89	185	18	185

Panel C

Dependent variable	Tenure (company)		Tenure (position)	
Estimator	Non-parametric: IK-NN	Parametric: cubic control	Non-parametric: IK-NN	Parametric: cubic control
	(1)	(2)	(3)	(4)
Porter treatment	1.067	0.175	-0.640	-0.267
	(5.724)	(3.596)	(4.061)	(2.913)
Sample obs	185	185	185	185
Estimation obs	36	185	36	185

Notes: Effects show the impact of MBA cohort year after the cutoff date of 1983. Dependent variable are: dummy of whether the CEO is female, dummy of whether CEO is family member running a family firm, dummy of whether CEO has undergraduate degree in engineering, dummy of CEO having undergraduate degree in business or economics, tenure of CEO at company and tenure of CEO in current position. The non-parametric RDD estimator uses bandwidth selection by (Imbens, and Kalyanaraman, 2012) using a nearest-neighbor variance estimation, denoted by IK-NN and is implemented by (Calonico, Cattaneo and Titiunuk, 2017). Columns (2) and (4) use parametric approaches and assume different functional forms for the continuous function f(.), which is a 3rd-order (cubic) polynominal. Sample includes only HBS MBA alumni. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.

Appendix Table 7: 1990-1991 Recession Placebo

Panel A: Dependent Variable: Formalization

Cutoff year	1990	1991	1992
	(1)	(2)	(3)
Placebo treatment	0.050	0.253	0.129
	(0.425)	(0.502)	(0.391)
Sample obs	185	185	185
Estimation obs	45	37	43

Panel B: Dependent Variable: Implementation

Cutoff year	1990	1991	1992
	(1)	(2)	(3)
Placebo treatment	-0.250	0.077	0.610*
	(0.356)	(0.590)	(0.357)
Sample obs	185	185	185
Estimation obs	29	37	59

Notes: Effects show the impact of MBA cohort year after the cutoff date shown on top. Formalization (F2-F3), Development (D1-D6) and the Implementation (I1-I5) are averages of the underlying questions, normalized to zero mean and unit variance. Columns (1) and (2) use non-parametric local regressions with optimal bandwidth selections and constant effect only. The baseline uses bandwidth selection by (Imbens, and Kalyanaraman, 2012) using a nearest-neighbor variance estimation, and is implemented by (Calonico, Cattaneo and Titiunuk, 2017). Sample includes only HBS MBA alumni. Significance levels are: *: 10%, **: 5%, ***: 1% and robust standard errors are reported in parentheses.