

The Relevance of Business Techniques

ABSTRACT

Successive reviews of scholarship about the relevance of business-school scientific research provide three key insights. First, these reviews explain the forces bringing growing attention to the issue of scientific relevance. Second, they provide evidence that the very term “relevance” lacks a precise, agreed-upon definition. Third, they decry the virtual absence of theory-driven, empirically rigorous research investigating scientific relevance. In this article, we use two theories to derive and test hypotheses about the relevance of business-school research and “scientific coevolution” in the use of business techniques: the Performativity Theory of Financial Economic techniques and the Market Theory of Management techniques. Such coevolution occurs when scientific research bearing on business techniques both influences and is influenced by the diffusion of these techniques, rendering them beneficial and relevant to the organizations that use them. Our study examines the scientific coevolution of 23 business techniques from the business-school fields of Accounting, Financial Economics, Management, Marketing, Operations Research, and Information Technology. Our results support Market Coevolution theories, suggesting that the joint broadcast of the yearly number of scientific and non-scientific articles about business techniques correlates with business organizations’ use of these techniques. Our results also provide support for Performativity Coevolution-Theories, suggesting that the yearly number of *scientific* articles about business techniques *correlate* with these techniques’ use by organizations whereas, interestingly, *non-scientific* articles *do not*. Our study breaks new ground by providing scientifically rigorous, quantitative evidence consistent with theory-driven hypotheses about scientific coevolution that dovetails with case studies of scientific coevolution and relevance across different business-schools fields.

Kurt Lewin's pronouncement that “nothing is as practical as a good theory” (Lewin, 1951: 129) suggests that theory-based, business-school research should be relevant to business organizations, their stakeholders, and society (Davis, 2015). Yet, there exists a pervasive and long-standing belief among scholars that such research lacks relevance. Pfeffer and Fong (2002: 80), among others, note that: “...the impact of business school research, judged by a number of different criteria, appears to be quite small, and this is true even when research produced by business-school professors is compared with business research conducted by writers not in business schools.” (Bartunek & Rynes, 2014; Donaldson, 2002; Kieser, Nicolai, & Seidl, 2015; Pfeffer & Fong, 2002). Nicolai and Seidl (2010: 1259) add that despite the rapid increase in the volume of research, ironically, “...the number of critical voices complaining about the practical irrelevance of management science has dramatically increased, as our review of the relevance debate indicates. [...] the majority do not take issue with persons or institutions but with scientific publications, in particular the scientific article.”

Even articles suggesting how to enhance the relevance of business-school science have been accused of being irrelevant (Abrahamson & Eisenman, 2001). Such “second-order irrelevance,” or irrelevance of the relevance literature, occurs arguably for two reasons. First, as Kieser et al. (2015) conclude from their thorough review, the relevance literature is largely made up of oft-repeated, ad-hoc claims driven by normative expectations (See also, Augier & March, 2007; Bartunek & Rynes, 2014; Corley & Gioia, 2011). Noting the virtual absence of theory-driven, empirically rigorous research investigating general claims about scientific relevance, Kieser et al. join many scholars’ call for such research (e.g., Augier & March, 2007; Bartunek & Rynes, 2014; Corley & Gioia, 2011).

Second, Nicolai and Seidl’s (2010) exhaustive review of the relevance literature reveals that it lacks a precise, agreed-upon definition of the term “relevance.” The theories and case-study evidence we draw upon below suggest that scientific research bearing on business techniques can benefit organizations that use these techniques either substantively or symbolically (Nelson, 2004), indicating “substantive” and “symbolic” relevance respectively (Kieser et al., 2015). Organizations derive substantive benefits from the use of business techniques when they employ them successfully either to

conceptualize the business world or transform it. Such substantive benefits evidence substantive relevance (Nicolai & Seidl, 2010). Organizations can also derive symbolic benefits from using normatively appropriate business techniques when they communicate to their stakeholders that they have implemented these techniques. By communicating such technical symbols, organizations appear normally or legitimately managed to their stakeholders. These stakeholders, as a result, continue supporting these organizations in beneficial ways (e.g., Staw & Epstein, 2000). Such symbolic benefits evidence symbolic relevance (Bartunek & Rynes, 2014). Use and relevance are said to be only symbolic because organizations may have used these business techniques substantively little, if at all (e.g., Zbaracki, 1998).

We largely share these two main critiques of the relevance literature, with the following caveat. Quite a few single-case-studies provide evidence of the relevance of scientific research on business techniques (Abrahamson, Berkowitz, & Dumez, In Press). In this study, we use extant theorizing to derive and test quantitatively hypotheses the relevance of multiple business techniques. We examine whether our results dovetail with case-studies evidencing the relevance of single business techniques.

This article's first section responds to the call for theory-driven research about the relevance of business-school science. We begin with Ferraro et al.'s (2005: 8) observation that theorizing regarding relevance has "not often been operationalized in ways that facilitate the development of an empirical agenda exploring their consequences." To this end, we operationalize two theories: Market Theories of business techniques and Performativity Theories. Market Theories concern why the supply-side broadcast of scientific and non-scientific articles about business techniques jointly influence, and are influenced by, the diffusion of such techniques across demand-side business organizations, rendering these techniques beneficial and relevant (Abrahamson, 1996; Hirsch, 2000; Meyer, 2010; Peterson & Anand, 2004; Strang, David, & Akhlaghpour, 2015). Performativity Theories explain how the widespread use of techniques, grounded in a science, transform the world in a way that renders these techniques beneficial and their scientific grounding relevant (Callon, 1998; Callon, 2007; Ferraro,

Pfeffer, & Sutton, 2005). Both theories suggest a scientific “coevolution process”: a dynamic process wherein scientific relevance comes about as the result of the mutual influence of science and practice.

Next, we respond to the call for methodologically rigorous research. Using the best quantitative data available, we test whether our quantitative multiple-case-study results dovetail with single-case-study findings on relevance. We do so by studying quantitatively the coevolution of 23 business techniques from the fields of Accounting, Financial Economics, Management, Marketing, Operations Research, and Information Technology.

We next presents our results and then discuss them. Our results are consistent with Market Theories’ coevolution hypothesis and case-study evidence. The joint number of scientific and non-scientific articles about business techniques correlates with their reported use by organizations. As Pfeffer and Fong (2002) suggest, however, scientific publications’ relevance should not be judged absolutely, but rather comparatively to non-scientific publications’ relevance. Therefore, we also compare how scientific and non-scientific articles about business techniques coevolved with their organizational use. Our results suggest that scientific and non-scientific articles may coevolve differently. Our results are consistent with Performativity Theories’ hypotheses and case-study evidence of coevolution. The annual number of *scientific articles* about business techniques *does* correlate with the organizational use of these techniques. Interestingly, the number of *non-scientific* articles *does not*.

In our conclusion, we stress the limitations of our study’s quantitative data. We use these limitations to develop an agenda for future data collection and research that would further advance theory-driven, methodologically rigorous research that combines the results of single-case-study and multi-case-study qualitative and quantitative research. Studies that would not suffer from second-order irrelevance.

THEORIES OF THE COEVOLUTION OF BUSINESS TECHNIQUES

Some single-case-study evidence is relevant to business-school research on “business techniques.” We begin this section by explaining our definition of “business techniques.” The second part

uses Market and Performativity Theories to derive hypotheses that dovetail with single-case-study evidence about the coevolution and relevance of business techniques.

Business Techniques

We define business techniques as linguistic labels, such as the “Black Sholes Option-Pricing model” or “Total Quality Management,” that denote linguistic prescriptions for making or evaluating more beneficial business and social choices (Strang & Meyer, 1993). Our definition stresses the linguistic nature of business techniques for two reasons. First, Market Coevolution Theories suggest that it is the broadcast of articles’ language about business techniques that influences whether organizations use them. Second, language also plays a central role in how organizations use business techniques (Green, 2004). Strang and Meyer (1993), in particular, argue persuasively that business organizations cannot use business techniques simply because they find them to be substantively beneficial (Rogers, 2005). Moreover, they cannot use business techniques simply because the number or status of organizations using these techniques render them normatively appropriate and symbolically beneficial (Haunschild & Miner, 1997). Rather, organizations must use the linguistic labels and prescriptions of business techniques to name the techniques, describe them, and justify their use to themselves and to external organizational stakeholders (Meyer, 2010).

Business techniques are sometimes referred to as “management concepts” (Kieser, 1997; Nicolai & Dautwiz, 2009), “management ideas” (Clark, 2004; Gill & Whittle, 1993; Giroux, 2006), or “management techniques” (Abrahamson, 1996; Strang et al., 2015). We use the term “business” rather than “management” when referring to business techniques because there exists case-study evidence of coevolution in business techniques grounded not only in the field of Management, but also in Accounting (e.g., Carmona & Gutierrez, 1998), Financial Economics (e.g., MacKenzie & Millo, 2003), Marketing (e.g., Huczynski, 1993), Operations Research (Abrahamson & Fairchild, 1999), and Information Technology (e.g., Wang, 2010). We use the term business “techniques” because case-study evidence generally reveals coevolution between technical labels that denote not only concepts or ideas, but also prescriptions for achieving particular organizational objectives (Abrahamson & Eisenman, 2008).

Market theories of Coevolution

In management studies, Coevolution Theories generally assume the existence of a market for business techniques made up of supply-side publications that broadcast articles bearing on business techniques to demand-side business organizations that use them. Market Coevolution Theories of the diffusion of business techniques suggest that the supply-side broadcast of business techniques both influences and is influenced by the extent of these techniques' use by demand-side organizations (Abrahamson, 1996; Hirsch, 2000; Meyer, 2010; Peterson & Anand, 2004; Strang et al., 2015). Repeated cycles of the loop, depicted in Figure 1, animate coevolution.

Insert Figure 1 about here

In the top part of the Figure 1 loop, change in the number of articles about a business technique, broadcasted by scientific and non-scientific supply-side publications, influences the diffusion of this technique's use or disuse, by demand-side, business organizations. In the bottom part of the figure 1 loop, change in the diffusion of this business technique influences the number of scientific and non-scientific articles about this technique.

Joint scientific and non-scientific influence. Market theories distinguish scientific and non-scientific supply-side publications. What Pfeffer and Fong (2002) call "scientific publications" are organizations that broadcast articles written and peer-reviewed by accredited business-school scientists (Brindle & Stearns, 2001). Non-scientific publications, are the non-peer reviewed publications of consulting firms (e.g., Scarbrough, 2002), books publishing houses (e.g., Furusten, 1999), magazines and their publishers (e.g., Klineciewicz, 2006), professional associations (Greenwood, Suddaby, & Hinings, 2002), or guru-shops (Jackson, 2001).

Market Coevolution Theory suggests that because articles about business techniques, broadcasted by scientific and non-scientific publications, influence each other, they will *jointly* influence and be influenced by the use of these business techniques by organizations. Note, however, that Market Coevolution Theories and evidence tend to suggest that non-scientific articles may exert a greater

influence than scientific articles (Pfeffer & Fong, 2002). Abrahamson (1996: 268), for example, theorizes that “Scientific grounding, usually provided by citations or miscitations of business-school research, is sometimes added to give [articles] a patina of rationality.” (See also, Kieser et al., 2015). Research also indicates that the broadcast of scientific articles about business techniques tends to lag that of non-scientific articles (Abrahamson & Fairchild, 1999). Moreover, research also indicates that scientific articles’ tone tends, over time, to take on the tone of non-scientific ones, rather than vice versa (Barley, Meyer, & Gash, 1988; Schulz & Nicolai, In press). As Barley et al. (1988: 52) concluded, "the pragmatics of academic discourse came to resemble more closely that of the practitioners' subculture”.

Coevolution. There is no implication in Market Coevolution Theory that supply-side publications’ joint broadcast of scientific and non-scientific articles about business techniques imposes, unilaterally, the use of these business techniques on demand-side business organizations (Czarniawska & Sevon, 2005). Some business techniques broadcast by supply-side organizations never catch on among demand-side business organizations. So Market Coevolution Theory suggests that demand-side organizations also influence which of the many business techniques broadcast by supply-side organizations diffuse across these demand-side organizations (Abrahamson & Fairchild, 1999; Nijholt & Benders, 2007; Strang et al., 2015). Figure 1’s bipartite feedback loop depicts the co-evolutionary process wherein supply and demand mutually influence each other (Bourdieu, 1984; Peterson, 1976, 1979).

As shown in the top part of the Figure 1 loop, scientific and non-scientific publications jointly influence practice. These publications broadcast articles about business techniques (Abrahamson, 1996; Peterson & Anand, 2004). Such broadcasts can influence the diffusion of techniques, depending on whether demand-side organizations benefit from using them, whether symbolically or substantively. Supply-side organizations, however, do not know, a priori, whether demand-side organizations will benefit from using a technique and whether it will diffuse.

As shown in the bottom part of the Figure 1 loop, practice influences scientific and non-scientific publications. Supply-side publications discover which business techniques demand-side business organizations benefit from by observing the diffusion of different techniques among these organizations.

Supply-side publications broadcast more or less articles about business techniques depending on whether they are or are not diffusing, causing the further diffusion of their use or disuse (Bourdieu, 1984; Peterson, 1976). In sum, supply-side scientific and non-scientific publications' broadcast of articles about business techniques jointly influence and are influenced by the diffusion of these techniques among demand-side business organizations. We hypothesize, therefore, that:

Hypothesis 1: The total number of scientific and non-scientific articles about business techniques will correlate with the number of business organizations that report using these techniques.

Our study examines whether our multiple-case, quantitative studies coevolution hypotheses, including Hypothesis 1, dovetail with single-case-study evidence. These case studies measure the supply-side broadcast of business techniques by adding counts of academic and non-academic articles about these techniques. Some of these case studies explore the Market Coevolution Theory's Hypothesis 1 explicitly, and they tend to support it. Abrahamson and Fairchild (2000), for instance, explored and supported Market Coevolution Theory in the single case of Quality Circle (QC) business technique which organizations used in the United States between 1962 and 1996. Their single-case-study described a coevolutionary process punctuated by alternating periods. During some periods, Figure 1's top loop was in effect, such that the broadcast of QCs influenced their diffusion. During other periods, the diffusion of QCs influenced their broadcast (see also Abrahamson & Fairchild, 1999; Cole, 1999; Strang, 1997; Strang & Macy, 2001). Strang et al. (2015) also developed a computer simulation of coevolution and validated it with a single case study of the Business Process Reengineering business technique. However, Nijholt and Benders' (2007) single case study of the Self-Managed Team did not support the coevolution hypothesis. Finally, though they were not designed to test Hypothesis 1, some quantitative studies of single business techniques reached findings consistent with this hypothesis, including Total Quality Management (David & Strang, 2006; Giroux & Taylor, 2002), Benchmarking (Strang, 2010), and Matrix Management (Burns & Wholey, 1993).

The single case study's support of the market coevolution hypothesis does not indicate whether coevolution benefits and is therefore relevant to organizations. Nor does it indicate whether such benefits

are symbolic or substantive and, therefore, whether science is symbolically or substantively relevant. We review the single-case-study evidence bearing on these questions in the discussion section.

Non-scientific coevolution

Market coevolution theories make it possible to theorize why, jointly, scientific and non-scientific articles about business techniques would influence and be influenced by organizations' use of these techniques. With a few specifications, they also make it possible to hypothesize why non-scientific articles, independent of scientific articles, could influence and be influenced by organizational use.

First, as shown at the top of Figure 1, broadcast influences diffusion: The articles broadcast by non-scientific publications, such as business magazine and professional association journals, reach many business organizations. These broadcasts of business techniques influence their diffusion among business organizations. Second, as shown at the bottom of Figure 1, diffusion influences broadcast. Non-scientific publications' writers—business-magazine journalists or professional-association reporters—follow particular types of business techniques and focus on specific industries (see Nijholt, 2010, for a review). This puts these writers in close contact with many business organizations and the business techniques they are using, which in turn informs these writers about which techniques are diffusing and whether to broadcast more or fewer articles about which techniques. Recurrent cycles of Figure 1's broadcast-influences-diffusion and diffusion-influences-broadcast loop suggest that:

Hypothesis 2: The number of *non-scientific* publications' articles about business techniques will correlate with the number of business organizations that report using these techniques.

We could find only one single case study that used only counts of non-academic articles to measure the supply-side broadcast of a business technique. Though this study was not designed to test Hypothesis 2, its results support it: Haunschild and Beckman (1998) find a correlation between the broadcast of non-scientific articles concerning Acquisitions and organizations' use of this business technique.

Scientific coevolution

We derived Hypothesis 1 from Market Coevolution Theories' argument that scientific and non-scientific articles about business techniques would jointly influence and be influenced by organizations' use of these techniques. In Hypothesis 2, we suggest that non-scientific articles alone could coevolve with organizational use. Market Coevolution Theories, however, provide no clear explanation as to why scientific articles alone would coevolve (Abrahamson, 1996; Peterson & Anand, 2004; Strang et al., 2015). On the contrary, as we noted above, both Market Theory and research evidence suggest that scientific articles' influence might be relatively minor (Abrahamson, 1996; Abrahamson & Fairchild, 1999; Barley et al., 1988; Schulz & Nicolai, in press). Given that reviews of the literature on the relevance of business-school scientific articles tend to concur (Beyer & Trice, 1982; Kieser et al., 2015), it would follow that articles about business techniques would tend not to coevolve with organizations' use of these techniques.

Callon (1998) and Ferraro, Pfeffer, and Sutton (2005), however, advance more muscular Performative Theories of scientific coevolution (Cabantous & Gond, 2011; Kieser et al., 2015; Marti & Scherer, In Press). Abrahamson et al. (in press) extend performativity theory to business techniques using the bipartite coevolution loop depicted in Figure 2.

Insert Figure 2 about here

As shown at the top of the loop, the diffusion of scientifically grounded business techniques gradually transforms the business world in ways that increasingly render scientifically grounded techniques more beneficial to organizations. As a result, at the bottom of the loop, business techniques' greater substantive benefits increasingly confirm scientific research predicting these benefits. This confirmatory evidence encourages the growth of research that reveals these techniques' benefits, providing more evidence influencing organizations to use these techniques. Repeated cycles of this two-part loop suggest that:

Hypothesis 3: The number of *scientific* publications' articles about business techniques will correlate with the number of business organizations that report using these techniques.

Our study also examines whether our multiple-case, quantitative studies coevolution Hypothesis 2 dovetails with single-case-study evidence. Abrahamson et al. (in press) used the case of the Black-Scholes option-pricing technique (BST) studied by MacKenzie and Millo (2003) to illustrate Performative Theories of the coevolution of scientifically grounded business techniques. As shown at the top of Figure 2's loop, the diffusion of scientifically grounded business techniques gradually transforms the business world in ways that increasingly render scientifically grounded techniques more beneficial to organizations. The BST, based on a number of simplifying theoretical assumptions, originally made relatively inaccurate forecasts of option prices. The rapid diffusion of the BST, however, caused it to influence option prices, and the BST's inaccuracies began to disappear as traders exploited the arbitrage opportunities it revealed. In this manner, option prices gradually conformed to those predicted by the scientifically derived BST. In short, the BST's use transformed option markets in a way that enhanced the BST's benefits for option traders.

In the bottom part of Figure 2's loop, business techniques' greater substantive benefits increasingly confirm scientific research predicting these benefits. This confirmatory evidence encourages the growth of research that reveals these techniques' benefits, providing more evidence influencing organizations to use these techniques. Accordingly, the BST's enhanced forecasting power demonstrated not only its greater forecasting benefits for option traders, but also yielded scientific evidence increasingly confirming the scientific accuracy of the BST (Mackenzie, 2007), providing all the more justification for option traders to use the BST.

Repeated rounds of the two processes depicted in figure 2 cause techniques grounded in science to gradually enhance the relevance of the science in which they are grounded. This cycle increased both the benefits of the BST, grounded in Financial Economics, and the relevance of the Financials Economics in which the BST was grounded.

Single-case-study evidence supports Performativity Theories not only in the case of the BST, but also in the case of Modigliani and Miller's (1958) Irrelevant Capital Structure and Dividend Policy, to give another example from Financial Economics (MacKenzie, 2006). Moreover, Ferraro et al. (2005) lead in extending the implications of Performativity Theory from Financial Economic techniques to Management techniques (Abrahamson et al., In Press; Kieser et al., 2015; Marti & Scherer, in press). Single-case-study evidence of scientific coevolution now exists not only in Management, but also in Operations and Marketing techniques (e.g., Dumez & Jeunemaitre, 2010; MacKenzie, Muniesa, & Siu, 2007; Muniesa, 2014).

Major and limited coevolution of business techniques. An observation made by Pfeffer and Fong (2002) applies to both Market and Performativity Theories of scientific coevolution. They note that the question is not only *whether* business scholarship has an impact on business practice, but also *how much of* an impact it might have, both absolutely and relative to non-academic writings. In short, the number of scientific or non-scientific articles about business techniques might or might not correlate with the number of organizations that report making either significant or limited use of these techniques. This argument suggests the need to test two additional hypotheses:

Hypothesis 4: The number of *scientific* publications' articles about business techniques will correlate with the number of business organizations that report making either *major* or *limited* use of these techniques.

Hypothesis 5: The number of *non-scientific* publications' articles about business techniques will correlate with the number of business organizations that report making either *major* or *limited* use of these techniques.

METHODS

With respect to the second criterion of good relevance research, sound methodology, three types of data limitations have presented the biggest obstacles to testing generalizable coevolution hypotheses and their implications for scientific relevance. The data we developed for this study addresses three obstacles to testing generalizable coevolution hypotheses and their implications for scientific relevance.

First, Clark (2001) criticizes research bearing on coevolution for assuming that it occurs. In particular, he denounces researchers who use supply-side measures of the broadcast of business techniques—particularly counts of articles about such techniques—as measures of these techniques’ diffusion among demand-side organizations because they assume that both coevolve. Because such an approach assumes that broadcast coevolves with diffusion, it is impossible to test whether or not it does. Therefore, research testing coevolution hypotheses should use different data to measure techniques’ broadcast—articles about business techniques, in this study—and their organizational use—survey data of such use, in this study.

Second, when scholars find data about the number of articles about business techniques, these data often do not reflect whether scientific or non-scientific publications published these articles. This creates an obstacle in distinguishing joint scientific and non-scientific coevolution from scientific coevolution alone.

Third, as the reliance on single case studies of coevolution and relevance indicate, when researchers can find data that overcome the first two obstacles, as Strang and Soule (1998) note, these data generally exist for single rather than multiple business techniques. Data are hard to find not only for multiple Management techniques but particularly for techniques belonging to multiple fields of business. This data limitation creates an obstacle to testing hypotheses that could show whether single-case-study evidence about the coevolution and relevance of a single business technique from one business school or scientific field generalizes across multiple techniques and fields.

Data

Our data addresses the three data obstacles described above. First, it does not use the number of supply-side publications’ articles broadcasting techniques as measures of their demand-side use by business organizations. Rather, we measured broadcast using count of articles about business techniques in the ABI Inform database and organizational use of these techniques in the Bain & Company database.

Organizations’ reported use of business techniques. We used the Bain & Company survey of senior managers reporting their organizations’ major or limited use of business techniques (Rigby, 2001,

2003). Bain conducted the surveys on a yearly basis between 1993 and 2000 and then on a biyearly basis in 2002 and 2004.

To take into account variations in the number of survey respondents, we divided the number of survey responses by the total number of organizations surveyed. Bain surveys approximately 10,000 companies with an average response rate of over 3,000 firms per year (Rigby, 2001). To test Hypotheses 1, 2, and 3, regarding demand-side organizations' total reported use of business techniques, we added on major and limited use. We tested Hypotheses 4 and 5 using separate measures of major and limited use.

Articles about business techniques. Supply-side publications broadcast discourse about business techniques to demand-side organizations via a variety of media (See Benders, Nijholdt, & Heusinkveld, 2007 for a review). Studies find a high correlation in the broadcast of business techniques through books, articles, speeches, and seminars (Abrahamson & Fairchild, 2000; Benders & Van Bijsterveld, 2000; Spell, 2001; Strang, 2010). We use citation counts of articles because they have been used most extensively and offer the most plentiful, reliable, and valid measures of such techniques' supply-side broadcast (Benders et al., 2007).

The Proquest organization's ABI Inform database global (ABI) stores abstracts of articles from more than 2,000 publications covering business-related topics. As is customary in this type of research, to find articles about a business technique, we used the ABI's thesaurus to identify articles about different business techniques (c.f. Abrahamson & Fairchild, 1999; Ghaziani & Ventresca, 2005 ; Spell, 2001).

Scientific and non-scientific publications. We noted a second data obstacle. When scholars find data about the number of articles about business techniques, these data often do not reflect whether the articles were published by scientific or non-scientific publications. ABI Inform codes articles as scientific or non-scientific. Moreover, their data indicates that articles coded as scientific were peer reviewed, whereas as non-scientific articles were not. Hypothesis 1 did not distinguish between scientific and non-scientific articles. So, to test this hypothesis, we summed the number of scientific and

non-scientific articles. The remaining hypotheses distinguish between both types of articles, so to test these hypotheses we used separate measures of the number of scientific and non-scientific articles.

We carried out our analysis for the period between 1993 and 2004, as the number of articles indexed by ABI Inform remained high and increased at a stable rate during this period. We calculated three different measures of articles' influence: first, the yearly raw count of articles divided by the total number of articles ABI indexed that year; second, the unadjusted raw count of articles; and third, the normalized number of articles. Our results were virtually identical. We present the results for the first measure, as it is used habitually with article data (Benders et al., 2007).

Multiple business techniques from different fields. We noted a third data obstacle. Data typically exist about single business techniques, which creates an obstacle to testing hypotheses that could show whether single-case-study evidence about the coevolution and relevance of a single business technique from one business school or scientific field generalizes across multiple techniques and fields. To overcome this obstacle, we built our data set to measure business articles and organizational use for the 23 business techniques listed in Table 1. Table 1's first column lists each technique's scientific field, whereas the second and third column list the names, denoting each technique, in the ABI Inform and Bain & Company data respectively.

Insert Table 1 about here

Control variables. Typically, a small number of articles about a business technique appear for a protracted "latency period" before organizations start reporting using this technique (c.f. Abrahamson & Fairchild, 1999; Benders et al., 2007; Strang, 2010). To control for this latency period, we used counts of articles only when they exceeded 10 articles. We used what we call the "latency period variable" as the control variable in the first step of our two-step regressions. We tested our regressions for robustness using thresholds of 5 and 20 articles and found no changes in the overall pattern of our results. We used year fixed effects to control for overall time trends. Given the relatively small number of years in our

sample, we had to use only these two control variables. We could not control for macro-economic forces, but Carson, Lanier, Carson, and Guidry's (2000) study shows that these variables have a limited impact.

In sum, this article uses arguably the best available data to overcome three obstacles to testing generalizable coevolution hypotheses and their implications for scientific relevance. This does not mean that we avoided all data obstacles. We use our study's data limitations, in our conclusion section, to develop an agenda for future data collection and research that would further advance theory-driven, methodologically rigorous research that combines the results of single-case-study and multi-case-study qualitative and quantitative research.

Analysis

We used Papke and Wooldridge's (2008) technique for fractional response variables using panel data with endogenous explanatory variables. This technique requires balanced panel data. As some of the techniques were added to the Bain survey in later years, our data was unbalanced. Therefore, we used a log-odds transformation, $Y = \log(y/(1-y))$, because our data do not take the extreme 0 and 1 values. We used fixed-effect regressions to estimate β s using the equation:

$$\text{Log}(Y_{it}/(1-Y_{it})) = \beta_1 X_{1it} + \beta_2 X_{2it} + \dots + \epsilon_{it}$$

where Y_{it} is the fraction demand-side organizations that use labels denoting the 'i'th technique at time 't' and X_1, X_2, \dots , are the explanatory variables.

RESULTS

Table 2 presents the descriptive statistics and correlation coefficients for all the variables.

Insert Table 2 about here

Table 3 presents regression results consistent with the market-coevolution Hypothesis 1. The sum of the adjusted number of scientific and non-scientific articles about business techniques correlated with the adjusted number of business organizations that reported using these techniques.

Insert Table 3 about here

Table 3 presents the results Hypothesis 2 and 3 contrasting the effect of non-scientific and scientific articles. The results did not support Hypothesis 2; the adjusted number of *non-scientific articles* about business techniques *did not* correlate with the adjusted number of business organizations reporting using these techniques. The results *did* support Hypothesis 3: The adjusted number of *scientific articles* about techniques correlated with the adjusted number of organizations reporting using these techniques.

Table 4 presents the results for hypotheses 4 and 5 concerning the major versus limited use of business techniques by business organizations.

Insert Table 4 about here

In parallel to Hypothesis 2, the results did not support Hypothesis 5: The adjusted number of *non-scientific articles* about business techniques *did not* correlate with the adjusted number of business organizations reporting making either *major* or *limited* use of such techniques. In parallel to Hypothesis 3, the results provided support for Hypothesis 4: The adjusted number of *scientific articles* about business techniques correlated with the adjusted number of organizations that reported making either *major* or *limited* use of such techniques.

DISCUSSION

This study responds to the call for research that use extant theories to derive and rigorously test hypotheses about scientific coevolution and relevance that generalizes across cases. Our tests of our coevolution hypotheses were confirmed with the notable exception of the coevolution of non-scientific

articles about business techniques and their organizational use. Our results, therefore, are largely consistent with the single-case-study evidence of coevolution reviewed above. We discuss our results bearing on the Market Coevolution and Performative Coevolution respectively.

The Market Coevolution Hypothesis

Market coevolution theories explain why supply-side scientific and non-scientific articles about business techniques would jointly influence and be influenced by the diffusion of these techniques among demand-side business organizations. We hypothesized and found support for Hypothesis 1, that the total number of scientific and non-scientific articles broadcasting business techniques correlated with the number of business organizations that report using these techniques. We noted above that the market-coevolution Hypothesis 1, and therefore our results supporting this hypothesis, are consistent with single case studies of market coevolution (Abrahamson & Fairchild, 1999; Abrahamson & Fairchild, 2000; Burns, 1982; Burns & Wholey, 1993; David & Strang, 2006; Strang, 2010; Strang et al., 2015). We noted, however, that the case studies we reviewed did not bear on whether coevolution benefits organizations. Nor did they indicate whether such benefits, if they occur, are symbolic or substantive, and therefore whether scientific coevolution is symbolically or substantively relevant. We next examine whether our quantitative results testing hypotheses using data about multiple business techniques dovetail with single case studies about substantive and symbolic benefits and relevance.

Single-case-study evidence bearing on the market coevolution of business techniques indicates that organizations generally benefit from using these techniques. However, this case-study evidence is split over whether these benefits are symbolic or substantive and whether, therefore, they constitute evidence symbolic or substantive relevance. The evidence is too extensive to review here. However, Total Quality Management (TQM), the business technique studied the most thoroughly, is illustrative of the general pattern of findings in the market Coevolution literature. TQM is grounded primarily in the business-school scientific discipline of Operations Management (Cole, 1999; Hackman & Wageman, 1995) and was broadcast broadly by supply-side scientific and non-scientific publications (Abrahamson & Fairchild, 1999; David & Strang, 2006).

Some case studies suggest that organizations used TQM largely symbolically. That is, they communicated to their stakeholders that they used TQM substantively, even if they had done so little or not at all. Westphal, Gulati, and Shortell (1997) studied 2,700 hospitals that used TQM and found that its use was largely symbolic. Additionally, case studies at the organizational level of analysis indicate that the TQM label was used symbolically to communicate TQM success stories to stakeholders (De Cock & Hipkin, 1997; Zbaracki, 1998). If organizations used TQM largely symbolically, then it is not surprising that Westphal, Gulati, and Shortell (1997) found that early consumers of TQM displayed few performance increases, whereas later consumers tended to experience none and to use these techniques only to obtain their stakeholders' support. Staw and Epstein's (2000) quantitative study of the use of TQM also indicates that it had virtually no financial-performance effects. They did find, however, that CEOs received higher salaries when they used TQM symbolically to communicate to internal stakeholders—board compensation committees—these techniques' implementation. CEOs' symbolic use of the TQM label to communicate its use to external stakeholders also enhanced their organizations' reputations.

In sum, the TQM case study specifically and market coevolution single case studies of other business techniques more generally suggest that business organizations use techniques broadcast by scientific and non-scientific publications largely symbolically. Moreover, these single case studies suggest that market coevolution results in symbolic benefits for business organizations and that the business-school fields these techniques belong to are largely symbolically relevant.

Market-coevolution research, however, has reached different conclusions when it has studied the organizational benefits of the broadcast of not just one but a succession of business techniques from the same field of business. Abrahamson and Eisenman's (2008) study of a succession of short-lived business techniques from the field of Management between 1971 and 2001 showed that they cumulated into major changes in what managers said and did. Cole (1999) also showed that over this time period, a series of business techniques from the field of Operations Research—including Quality Circles, TQM, and Six Sigma—gradually lifted the quality of U.S. products up to global standards from their nadir in the early

1980s. It follows that market coevolution of single techniques from one business field may have major symbolic but minor substantive benefits in the shorter term. The market coevolution of multiple business techniques belonging to that field, however, can accumulate over the longer term into major substantive benefits for many organizations using these techniques. These longer-term benefits provide evidence of the substantive longer-term relevance of the business-school scientific field undergirding techniques from that field (Abrahamson et al., In Press).

The Performativity Coevolution Hypothesis

Performative Coevolution Theories theorize why supply-side scientific articles about business techniques would jointly influence and be influenced by the diffusion of these techniques among business organizations. We hypothesized, therefore, and found support for our hypotheses that the number of scientific articles about business techniques correlated with the number of business organizations that reported using these techniques; interestingly, however, the number of non-scientific articles did not. We noted above that our performativity coevolution hypotheses, and therefore this study's results, are generally consistent with single-case-study research on performative coevolution (Abrahamson et al., In Press; Dumez & Jeunemaitre, 2010; MacKenzie, 2006; MacKenzie & Millo, 2003; MacKenzie et al., 2007; Muniesa, 2014). We turn now to the case-study evidence on whether and how performative coevolution might benefit and be relevant to organizations.

Single-case-study evidence bearing on the performative coevolution of business techniques indicates that organizations generally benefit from using these techniques. However, in the case of Performativity Theory, it is the theory itself that is split over whether these benefits are symbolic or substantive and whether, therefore, they evidence symbolic or substantive relevance. Abrahamson et al. (in press) note that Callon's (2007) version of Performativity Theory suggests that scientific coevolution renders science-based business techniques substantively beneficial, whereas Ferraro et al's (2005) version suggests that it can render them either substantively or symbolically beneficial. The distinction is not insignificant, as it relates to whether business-school science is symbolically or substantively relevant.

According to Ferraro et al. (2005: 8), theories undergirding business techniques “can ‘win’ in the marketplace for ideas, independent of their empirical validity, to the extent their assumptions and language become taken for granted and normatively valued, therefore creating conditions that make them come ‘true.’” This argument rests largely on case-study evidence indicating that the use of business techniques can render them symbolically relevant, leading in turn to their greater use. Callon (2007) rejects this thesis by pointing out that not all business practices coevolve scientifically. MacKenzie (2007), for example, provides a rare case study illustrating an instance of “counterperformativity”; that is, one wherein a science-based technique could not enact the business world that rendered this technique substantively beneficial, thereby validating the relevance of the science undergirding it.

Generalizability

In summary, our study breaks new ground by providing scientifically rigorous, quantitative evidence consistent with theory-driven hypotheses and single case studies of scientific coevolution and relevance. Moreover, we tested these hypotheses using data that allows us to explore whether single-case-study evidence bearing on scientific coevolution and relevance generalizes across cases. In particular, we tested these hypotheses using data on 23 business techniques from the fields of Accounting, Financial Economics, Management, Marketing, Operations Research, and Information Technology.

Although our results supporting coevolution hypotheses are consistent with case studies bearing on single business techniques’ coevolution and relevance, this study’s results must still be interpreted very conservatively. Due to insurmountable data limitations, our study could explore only certain questions bearing on the relevance of business-school research about business techniques. In concluding, we stress the questions that our study’s quantitative data could not address. We use these data limitation to develop an agenda for future data collection and research that would further advance theory-driven, methodologically rigorous research that combines the results of single-case-study and multi-case-study qualitative and quantitative research.

CONCLUSION

A strength of this article is that it brings together research using quantitative methods and inferential statistics with single case studies to test coevolution hypotheses. Given the nature and amount of data available, this study, alone, could not ascertain quantitatively the direction of causality between business-school scholarship—the number of scientific articles about business techniques—and business practice—the number of organizations reporting using these business techniques. To make causal claims about coevolution, we had to illustrate how our quantitative multiple-case-study results dovetail with single-case-study evidence.

We found that our quantitative multiple-case-study results do dovetail with single-case-study evidence. We found that Market and Performativity Theories bearing on scientific coevolution and relevance, as well as case study evidence, suggest that business-school scholarship and practice influence each other dynamically. Still, this study's data, *alone*, did not allow us to test empirically whether the causal relation between business science and practice is bidirectional coevolution or unidirectional influence. This still leaves open two unidirectional possibilities: either that only business-school scholarship influences business practices or that only business practices influence business scholarship; not both. Testing, quantitatively, how business-school science and business practice are causally related would require longer time series, firm-level data. As these data are not being collected currently, it is likely that for the foreseeable future, studies like this one will have to exploit the complementarities between single-case-study and multi-case data to address issues of causation.

Our study could not address whether business school science is symbolically or substantively relevant. We noted that theories and single-case-study evidence support the notion that business science and practice bearing on business techniques coevolve in ways that render business techniques more beneficial and science more relevant. We noted, however, that Performativity and Market Theories' single-case-study evidence of coevolution provide different explanations for how coevolution occurs. Moreover, both these theories and case-study evidence supporting them disagree on whether and when

technical benefits and scientific relevance is substantive or symbolic. For instance, Performativity Theory's single-case-studies focus on single Financial Economic techniques. These studies tends to suggest that coevolution, technical use, and relevance are substantive rather than symbolic (MacKenzie, 2007). However, theorists disagree on whether the performativity of business techniques is generally substantive (e.g., MacKenzie, 2007) or can be symbolic as well as substantive (Ferraro et al., 2005). Likewise, Market Theory single-case-study research has largely been carried out on Management and Operations Management techniques. Single-case-study evidence indicating that the substantive relevance of Financial Economics, Management, and Operations sciences may depend on whether one examines the shorter- or longer-term benefits of the coevolution of one or multiple business techniques (Abrahamson et al., in press). Finally, regardless of whether business-school science about business techniques coevolves with their substantive or symbolic use by organizations, another question remains: Who benefits from these substantive or symbolic outcomes: organizations, their stakeholders, society? Davis (2015), for instance, argues that the purpose of business research, and by extension business techniques, goes beyond serving just organizations or their managers to serving organizational stakeholders and society. Answering these questions will require more multi-case-study data providing measures of the symbolic and substantive benefits of business techniques to different organizational and societal stakeholders.

A strength of this study is that it provides results concerning scientific coevolution that generalize across business-school disciplines. However, we lacked sufficient quantitative data to resolve key questions, such as whether scientific coevolution occurred differently, results in greater or lesser benefits, and is more substantively or symbolically relevant in different disciplines. Answering these questions will require data about more than the 23 business techniques we could explore in this study.

We end with a question. How relevant is this business-school study in suggesting how to render business-school studies more relevant? Market and Performativity Theories, single case studies, and this multi-case-study's supporting evidence converge on the same answer: Business-school science about business techniques can be relevant. Therefore, we should do it.

TABLE 1**Bain and ABI labels**

Technique #	Functional Area	Bain labels	ABI/Inform labels
1	Accounting	Activity Based Management	Activity Based Management
2	Management	Balanced Scorecard	Balanced Scorecard
3	Management	Benchmarking	Benchmarking
4	Operations	Business Process Reengineering	Business Process Reengineering
5	Management	Change Management Program	Management of change
6	Management	Core Competencies	Core Competencies
7	Management	Corporate Ethics	Corporate Ethics
8	Marketing	Customer Relationship Management	Customer Relationship Management
9	Marketing	Customer Retention	Customer Retention
10	Marketing	Customer Service Management	Customer Satisfaction
11	Management	Downsizing	Downsizing
12	Accounting	Economic Value Added	Economic Value Added
13	Information Technology	Group Ware	Group Ware
14	Management	Knowledge Management	Knowledge Management
15	Management	Outsourcing	Outsourcing
16	Management	Pay for Performance	Pay for Performance
17	Management	Portfolio Analysis	Portfolio Management
18	Management	Self-Directed Work Teams	Self-Directed Work Teams
19	Finance	Stock Buy Back	Stock Buy Back
20	Management	Strategic Alliance	Alliances
21	Management	Strategic Planning	Strategic Planning
22	Operations	Supply Chain Integration	Supply Chain Management
23	Operations	Total Quality Management	Quality Management

TABLE 2
Descriptive Statistics and Correlation Coefficients^a

Variable ^b	Mean	s.d.	1	2	3	4	5	6
1. Total number of articles	143	449						
2. Number of non-scientific articles	114.2	372.4	0.995					
3. Number of scientific articles	29.16	85.02	0.913	0.872				
4. Reported use of business techniques	0.585	0.150	0.358	0.346	0.389			
5. Reported major use of business techniques	0.253	0.105	0.541	0.523	0.581	0.853		
6. Reported limited use of business techniques	0.332	0.082	-0.039	-0.039	-0.035	0.738	0.278	
7. Latency period	8.486	7.209	0.445	0.426	0.475	0.217	0.387	-0.096

^a Correlations with an absolute value of 0.04 or above are statistically significant at $p < 0.5$; $n = 107$.

^b The first five variables are yearly and adjusted, the sixth is total adjusted.

TABLE 3**Articles about Business Techniques and Business Organizations' Use of These Techniques**

Variables	All supply-side organizations	Non- scientific supply- side organizations	Scientific supply-side organizations
Yearly adjusted number of articles	.0001649* (8.83e-05)	.0001586 (.000104)	.0015069*** (.000466)
Latency period	.00584 (.0127)	.00537 (.012822)	.00508 (.0120506)
Constant	.410*** (.148)	.427*** (.149)	.378*** (.139)
N	107	107	107
Adjusted R-squared	0.605	0.611	0.372
Number of Business Techniques	23	23	23

Robust standard errors are in parentheses.

* p < 0.1

** p < 0.05

*** p < 0.01

TABLE 4

Articles about Business Techniques and Business Organizations' Limited and Major Use of These Techniques

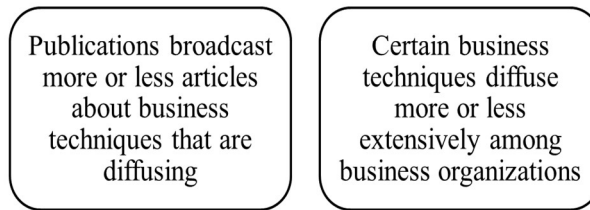
Variables	<u>Major Use</u>		<u>Limited Use</u>	
	Non-scientific	Scientific	Non-scientific	Scientific
Yearly adjusted number of articles	.000227 (.000105)	.00180*** (.000461)	4.56e-05 (5.79e-05)	.000522** (.000266)
Latency period	.0313 (.0128)	.0302** (.0119)	-.00738 (.00711)	-.00729 (.00688)
Constant	-1.411*** (.150)	1.451*** (.137)	-.596*** (.083)	-.618*** (.0793)
Observations	107	107	107	107
Adjusted R-squared		0.551		0.209
Number of Business Techniques	23	23	23	23

Robust standard errors are in parentheses.

- * p < 0.1
- ** p < 0.05
- *** p < 0.01

Figure 1
Classical Coevolution

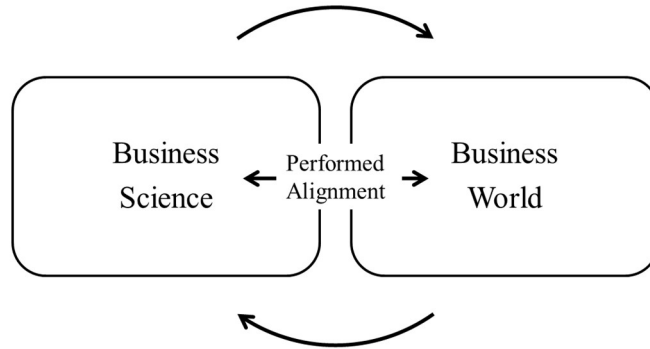
Publications' article make business organizations aware of innovative of certain business techniques they might need



Publications increase their broadcast of business techniques that are diffusing

Figure 2
Performative Coevolution

Broadcasts of a business technique
whose use by business organizations transforms the world



The transformed world provides evidence supporting
the scientific evidence undergirding the technique

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