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Exogenous Shocks: Definitions, Types, and Causal Identification Issues*

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Abstract

The article systematically explores exogenous shocks in leadership and management research. It introduces a special issue of The Leadership Quarterly emphasizing how naturally occurring events like financial crises, pandemics, and regulatory changes can be used for empirical research. Then, it reviews various conceptualizations and ways of integrating exogenous shocks into empirical strategies. Finally, it categorizes exogenous shocks based on their extent, timescale, and granularity of intervention, highlighting challenges in causal identification.

Keywords: exogenous shocks; causal inference; natural experiments; LATE; SUTVA; taxonomy.

*This document was compiled using Prof. Donald Knut's type-setting system TEX.
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1 Introduction

Exogenous shocks play an important role in practice and research. In management and leadership practice, shocks, including financial crises, pandemics, and wars, can threaten organizations' existence and, thus, pose significant challenges to leaders who must navigate their organizations through the resulting crises. In management and leadership research, exogenous shocks are integral parts of researchers' theorizing, e.g., they are often theorized as triggers of organizational or societal change (Meyer 1982; Tost 2011), and relevant context factors, e.g., the crises that result from exogenous shocks, form a context that may change established relationships. Additionally, we witnessed a greater use of exogenous shocks for causal identification purposes in the last couple of years, e.g., in the context of natural experimental research (Sieweke and Santoni 2020).

Despite the relevance of exogenous shocks, we lack a systematic assessment of how to harness exogenous shocks in management and leadership research. This special issue in The Leadership Quarterly was initiated to address this gap. The idea for the special issue was born just weeks after one of the most impactful shocks of the last decades—the global pandemic caused by the novel coronavirus, SARS-CoV-2—began to affect our lives. Our goal with the special issue was twofold (Jacquart et al. 2020): first, we saw the special issue as an opportunity to address new shock-related topics and phenomena in the realm of management and leadership research and to deepen our understanding of management and leadership in the context of exogenous shocks. Second, the special issue was an opportunity to re-investigate topics that have already received much attention in management and leadership research, but without rigorous causal testing. Indeed, we believe that our collection of seven articles has achieved both goals. The seven articles in this issue provide key examples of how we can draw inferences about critical topics in leadership and management research by harnessing exogenous shocks. These articles address important topics in leadership within politics and business, employing diverse empirical strategies to leverage exogenous shocks for advancing management and leadership research. This special issue includes three studies utilizing key variants of difference-in-difference estimation methods combined with quasi-random exogenous shocks (Garretsen et al., in press. Mukherjee and Krammer, in press; Zhao, Zhong, and Chen, in press), two studies using RDDs to applied leadership and management research which allow for causal inference from being quasi-randomly "shocked" with a particular treatment (Arvate and Story, in press; Bastardoz, Jacquart, and

Antonakis, in press), one study implementing an event study design (Page et al., in press), and finally one study using event history analysis to examine policy reactions following an exogenous shock (Wang, Devine, and Molina-Sieiro, in press). Of course, we introduce the articles in more detail in the next section.

Besides introducing the collection of articles, this editorial has an additional objective. As argued above, one of our learnings as guest editors of the special issue was that despite the prominence of exogenous shocks in management and leadership research, we lack a systematic assessment of what constitutes an exogenous shock and how shocks can be differentiated and harnessed in empirical research. Of course, the ideas presented in this editorial are rather the first attempt toward a systematic assessment of exogenous shocks in management and leadership research. Nevertheless, we hope the editorial and the seven articles in the special issue will contribute to shock-based management and leadership research.

In what follows, we first introduce the collection of articles in this special issue and document the current state of exogenous shocks in management and leadership research. Next, we provide a review of shock-related leadership and management research that provides insights into how exogenous shocks have been harnessed in empirical research. Finally, we provide a taxonomy of exogenous shocks that may help researchers, referees, and editors assess the validity of empirical strategies based on exogenous shocks and discuss key challenges related to harnessing exogenous shocks.

2 Overview of the Special Issue Articles

The special issue on harnessing exogenous shocks consists of seven empirical articles. The articles harness several events, including close elections (Arvate and Story, in press), the COVID-19 pandemic (Garretsen et al., in press. Wang, Devine, and Molina-Sieiro, in press), terrorist attacks (Bastardoz, Jacquart, and Antonakis, in press), the Global Financial Crisis (Mukherjee and Krammer, in press), and government regulations (Page et al., in press; Zhao, Zhong, and Chen, in press), to causally address relevant research questions for management and leadership research. Below, we provide a summary of each article.

Leaders affect business creation: Evidence from mayoral elections, by Paulo Arvate and Joana Story. The study exemplifies how a natural, quasi-random election outcome can be

harnessed as an exogenous shock to evaluate the importance of leadership. The authors utilize a regression discontinuity design to study how political leaders affect business creation. Their approach highlights how leaders with specific policy objectives that quasi-randomly assume the mayor's office shape economic outcomes. The empirical analyses indicate that mayors who prioritize business creation as a key policy goal have a significant impact on business creation. The study also identifies a likely mechanism for this effect, namely, the implementation of actions related to business incubation.

Effect of crises on charisma signaling: A regression discontinuity design, by Nicolas Bastardoz, Philippe Jacquart and John Antonakis. This paper examines the effects of crises on charismatic leadership, focusing on changes in leaders' rhetoric and approval ratings following crisis events. Using a regression discontinuity design to analyze exogenous events such as terrorist attacks, the study creates a "quasi-experimental" framework to establish causality. The authors first provide a reanalysis of Bligh et al. (2004) showing that President George W. Bush's rhetoric after 9/11 included more references to charismatic themes and further apply their approach to analyze François Hollande's reactions to terrorist attacks in 2015 and 2016. The findings from both exogenous shocks indicate that crises result in increased charismatic signaling and higher approval ratings for political leaders.

The pandemic that shocked managers across the world: The impact of the COVID-19 crisis on leadership behavior, by Harry Garretsen, Janka I. Stoker, Dimitrios Soudis and Hein Wendt. The aim of this study was to investigate ether an unexpected, exogenous shock changes the level of directive leadership behavior exhibited by managers. The authors use a unique dataset covering monthly data for almost 27,000 managers across 48 countries and 32 sectors to study in a difference-in-differences design with heterogenous treatment intensity how the COVID-19 crisis affected leadership behavior. In line with the threat-rigidity hypothesis, the authors show that the (unexpected) first wave of the pandemic resulted in an increase of directive leadership, and more rigid and controlling actions among managers. The authors discuss why they consider the early phase of the COVID-19 crisis an interesting exogenous and unanticipated shock "to be harvested" and elaborate on how leadership behavior developed in later waves of the pandemic.

When the going gets tough: Board gender diversity in the wake of a major crisis, by

Shibashish Mukherjee and Sorin M.S. Krammer. This study explores the impact of major external disruptions on gender diversity within corporate boards. It specifically asks whether significant external shocks affect board gender diversity and whether the presence of female CEOs or strong institutional mechanisms such as quotas or corporate governance codes may mitigate such effects. Using a dataset of 10,181 unique firms from 21 countries, the study employs a two-way fixed effect difference-in-differences methodology to study the impact of the global financial crisis on board gender diversity. The analyses reveal a notable decline in board gender diversity following the global financial crisis. Surprisingly, the authors find no evidence that female CEOs or institutional mechanisms effectively counteract this reduction. Thereby, the authors reveal important limitations of current institutional environments in maintaining gender diversity during periods of crisis.

Regulation and the trickle-down effect of women in leadership roles, by Aaron Page, Ruth Sealy, Andrew Parker and Oliver Hauser. This research uses an event study design to understand the consequences of board gender diversity regulation. The exogenous "shock" in this study refers to a new regulation suddenly introduced for firms listed on the United Kingdom's FTSE 350 index that recommended (among other measures to increase female representation) a voluntary target of having twenty-five percent of board positions held by women. The key outcome of interest is a trickle-down effect of women in leadership roles (as proxied by a positive correlation between the share of females on a company board and the share of females in senior management, controlling for other firm fixed effects). While the percentage of women at board level modestly increased in periods after the introduction of the new policy (from 8.37% during 2007 to 9.35% during 2010), the authors highlight an important unintended consequence of the reform: a weakening of the trickle-down effect. While the association between women on boards and women in senior management was positive and statistically significant in the pre-regulation period (2007–2010) the magnitude of this relationship is substantially smaller (and no longer statistically significant) in the post-regulation period (2011–2018). As such, the reform may have also altered how effectively females in senior positions may serve as role models.

Democratic governors quicker to issue stay-at-home orders in response to COVID-19, by Gang Wang, Richard A. Devine and Gonzalo Molina-Sieiro. In contrast to the other studies included in this special issue, this research does not primarily use the COVID-19 crisis as an exogenous shock for causal empirical identification. Instead, it examines how different groups

respond to a shock affecting everyone simultaneously. The study focuses on whether governors' party affiliation influences the speed at which they respond to the crisis by issuing stay-at-home orders, which were advocated as a strong defense against the pandemic. The authors find that Democratic governors issued statewide stay-at-home orders approximately nine days sooner than Republican governors. They also demonstrate that governing discretion and governing demands intensified the relationship between governors' political partisanship and the timing of issuing stay-at-home orders. Additionally, the study reveals that governors' political affiliation was also linked to the timing of reopening plans, with governing discretion and demands moderating also the latter relationship.

Early-life experience and political leaders' policy preference: Evidence from China's Zhiqing officials, by Renjie Zhao, Shihu Zhong and Jie Chen. This study examines how early life experiences of leaders influence their behavior in political office. It leverages the unique Chinese political system and the quasi-experimental nature of a large-scale social movement in China, where about a third of Chinese urban youths were 're-educated' by working in rural areas to 'learn from the peasants' for aneaverage of 3.5 years during the 1960s-70s. These urban youths, commonly referred to as zhiqing (short for educated youth in Chinese), were sent to rural areas for this purpose. Using a two-way fixed effect panel data model within a Difference-in-Differences framework, the study considers the leadership turnover from a non-zhiqing leader to a zhiqing leader (or vice versa) as the treatment condition. The study finds that regions governed by zhiqing leaders implemented significantly more generous rural welfare programs. The association is stronger when these leaders spent more time in underdeveloped rural areas during their youth. Importantly, the authors highlight that their data shows no evidence for an influence of rustication experience on the likelihood of becoming a local leader in general or on the assignment of leaders to a particular region. Further, their results do not indicate that the early childhood experience is linked to any particular personal traits that might also impact a local leader's policy style.

The articles in this special issue show the great potential of harnessing exogenous shocks for management and leadership research. We hope that they serve as empirical role models for future management and leadership studies using exogenous shocks to address important research questions. In what follows, we present our ideas regarding a more systematic assessment of exogenous shocks in management and leadership research. We hope that these ideas serve as

a starting point for greater conceptual clarity and further contribute to harnessing exogenous shocks for management and leadership research.

3 What Is An Exogenous Shock?

3.1 Exogenous Shocks in Natural Experiments

The first aspect that requires greater clarity is what is an exogenous shock. The literature on natural experiments offers several elements to appreciate the concept of 'exogenous shock' (for an overview of the natural experiment design, see Craig et al. 2017; Dunning 2012; Keele and Titiunik 2016; Withers and Li 2021; for a review of the application of this design, see Rosenzweig and Wolpin 2000; Sekhon and Titiunik 2012; Sieweke and Santoni 2020). Mainly, the extant studies draw a line between the categories of 'exogenous shock' and 'naturally occurring event.' While one can observe diplomatic crises, institutional reforms, or terrorist attacks, exogenous shocks are situated in abstract models that illustrate how economic and social formations work in the real world (Morgan 2012). In other words, impactful naturally occurring events, such as the COVID-19 pandemic, could be challenging to fit within a model of interest and, therefore, do not lead to any exogenous shock. At the same time, a particular event could provide multiple models with an exogenous shock.[1] Figure 1 illustrates the idea that exogenous shocks emerge from purposive associations of naturally occurring events and research questions. The quality of these associations can be substantive—when the environmental variation becomes an integral part of a study's theorizing—, empirical—if one exploits the environmental variation to deal with endogeneity concerns—or comprise substantive and empirical elements.

The lack of *substantive relevance* is one of the most common concerns when using naturally occurring events as sources of randomization (Deaton 2009; Heckman and Urzúa 2010). To illustrate the idea, we focus on a now-common approach of turning a naturally occurring 'event,' in this case, rainfall, into a 'shock' with substantive relevance, to identify causal relationships of interest. For example,Miguel, Satyanath, and Sergenti's (2004) study of the effect of economic growth on civil wars in Africa. Thanks to the ingenious choice to consider rainfall data, the authors broaden the conversation on institutions and economic growth. Notably, the variation in

1. For example, the reunification of Eastern Germany and Western Germany has been exploited to address diverse research questions, including the impact of income on health (e.g., Frijters, Haisken-DeNew, and Shields 2004), the transmission of preferences for entrepreneurship from parents to children (e.g., Wyrwich 2015), or the legitimation of inequality (e.g., Haack and Sieweke 2018).

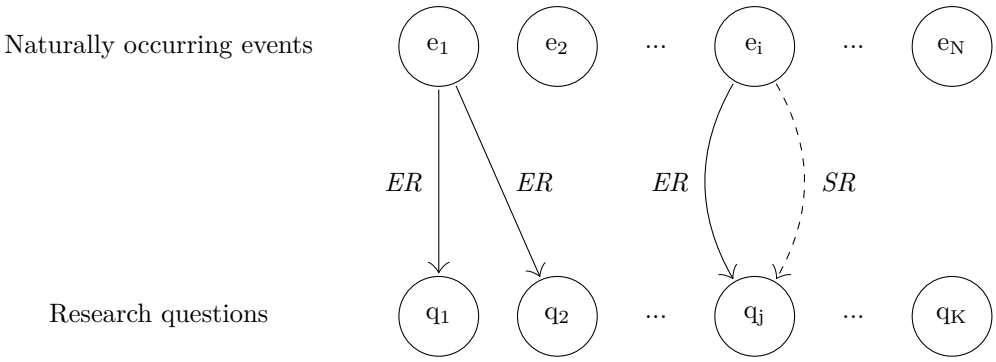

FIG. 1. — Exogenous shocks map naturally occurring events onto research questions via empirical and substantive relevance relationships. Notes. — The labels *ER* and *SR*, reported around the arrows connecting events to research questions, denote the empirical relevance and substantive relevance relationships; a naturally occurring event can be associated with one or multiple research questions or be isolated.

rainfall levels facilitates an IV design that copes with longstanding endogeneity issues regarding the co-evolution of institutions and macroeconomic factors. Hence, the authors can empirically investigate a new and essential theoretical relationship, namely, the effect of economic growth on the likelihood of civil war. Importantly, from an empirical perspective, rainfall may serve as an instrument for growth, if it is relevant for growth and influence the outcome of interest (here: conflict) only through its effect on the growth. While in principle both conditions may be fulfilled, Miguel and Satyanath (2011) show that instrument relevance may vary across time,[2] and Mellon (in press) discusses in detail the potential violations of exclusion-restriction for studies using weather data as an instrumental variable.

Regarding the *empirical relevance* of a naturally occurring event, the literature on natural experiments shows a strict view: an event qualifies as an exogenous shock if and only if it allows operating an empirical strategy with a control group (Cook, Campbell, and Shadish 2004). In other words, there should be an adequate time window[3] in which the intervention T emerging from the exogenous shock exclusively affects a fraction of a population's units only. Such a condition is the *sine qua non* to evaluate the impact of the intervention using Neyman's potential outcome framework (1923 (1990)), an unbiased estimator of the average causal effect $T - C$ that based on three quantities: (1) $\widehat{T}$, the average response if all subjects were assigned to treatment; (2) $\widehat{C}$, the average response if all subjects were assigned to control; and (3) the difference $\hat{T} - \widehat{C}$.

2. For instance, Miguel and Satyanath (2011) explicitly state that "first-stage relationship between rainfall and growth is weaker after 2000, suggesting that alternative instruments are needed when studying recent conflicts."
3. We discuss the temporal aspects of exogenous shocks' effects in Section 4 and Section 5.

The study of John Snow of London's cholera outbreak of 1853-54[4] emphasizes the importance of using exogenous shocks that heterogeneously affect the units of a population. In 1852, the Lambeth Waterworks company—one of the major utility companies supplying water to several parts of the city—relocated their waterworks from Hungerford Market to fifteen miles upstream in the Thames, thereby *"obtaining a supply of water quite free from the sewage of London"* (Snow, 1855 (1965), page 68). Contrarily, Southwark & Vauxhall, a company competing with Lambeth Waterworks in several districts of London, left its intake pipe downstream in the Thames at Battersea. Snow obtained records on cholera deaths in households throughout London, as well as information on the company that provided water to each household and the total number of houses served by each company. Figure 2 reports one of the most compelling pieces of empirical evidence included in the study: fatal attacks are compared before and after the exogenous shock—namely, Lambeth Waterworks moving their intake pipelines in 1952—and by water supply (see the column reported on the far-right hand section of the table). Consistently with Neyman's model, the analyses of Snow disentangle the 'true' effect of the exogenous shock on cholera communication from time-invariant attributes regarding the households served by different water suppliers and, perhaps more importantly, from the time-variant factors such as the state of the cholera outbreak at other points in time. Should the naturally occurring event have affected the totality of households in London, unlikely Snow's work would have addressed the problem of confounders convincingly.

A related but distinct aspect of *empirical relevance* concerns the 'exogenous' nature of the naturally occurring variation. The literature on natural experiments emphasizes that relevant events are not necessarily sudden, such as the death of a business leader because of heart attack (e.g., Nguyen and Nielsen 2010),[5] uncontrollable, such as earthquakes (e.g., Belloc, Drago, and Galbiati 2016), or random, such as lotteries (e.g., Poulos 2019). The extant studies show that legal changes and policy interventions can be purposefully used as exogenous shocks to address particular research questions (e.g., Beaman et al. 2012; Chauchard 2014; Matsa and

4. The project of Snow—aiming to prove that cholera did not transmit through the air, the so-called 'miasma hypothesis'—developed along two arms: he used geospatial visualizations to show that attacks clustered around Broad Street water pump in London's Soho district; then, he conducted the standard natural experiment briefly summarized in the main text.

5. The identification of sudden deaths poses definition issues (e.g., Azoulay, Graff Zivin, and Wang 2010; Oettl 2012). In the interest of consistency, Nguyen and Nielsen (2010) report they *"rely on the medical literature, which defines sudden death as an unexpected and non-traumatic death that occurs instantaneously or within a few hours of an abrupt change in the person's previous clinical state."* The causes of sudden deaths they consider are 'heart attack,' 'stroke,' and 'accident or murder.' In addition to such deaths, they also consider *"accidental and traumatic deaths that are unanticipated by the stock market and unrelated to firm conditions"* (page 553).

TABLE XII.

Sub-Districts.	Deaths from Cholera in 1849.	Deaths from Cholera in 1854.	Water Supply.
St. Saviour, Southwark	283	371	
St. Olave	157	161	
St. John, Horsleydown	192	148	
St. James, Bermondsey	249	362	
St. Mary Magdalen	259	244	
Leather Market	226	237	
Rotherhithe*	352	282	Southwark & Vauxhall Company only.
Wandsworth	97	59	
Battersea	111	171	
Putney	8	9	
Camberwell	235	240	
Peckham	92	174	
Christchurch, Southwark	256	113	
Kent Road	267	174	
Borough Road	312	270	
London Road	257	93	
Trinity, Newington	318	210	
St. Peter, Walworth	446	388	Lambeth Company, and Southwark and Vauxhall Compy.
St. Mary, Newington	143	92	
Waterloo Road (1st)	193	58	
Waterloo Road (2nd)	243	117	
Lambeth Church (1st)	215	49	
Lambeth Church (2nd)	544	193	
Kennington (1st)	187	303	
Kennington (2nd)	153	142	
Brixton	81	48	
Clapham	114	165	
St. George, Camberwell	176	132	
Norwood	2	10	
Streatham	154	15	Lambeth Company only.
Dulwich	1	—	
Sydenham	5	12	
First 12 sub-districts	2261	2458	Southwk. & Vauxhall.
Next 16 sub-districts	3905	2547	Both Companies.
Last 4 sub-districts	162	37	Lambeth Company.

FIG. 2. — An extract of the statistical analyses reported in the study of John Snow 'On the mode of communication of cholera' (1855 (1965)). Notes: The table, reported on page 90, considers both pretest and posttest data points (Lambeth Waterworks moved their intake pipes in 1952) for treated and control households.

Miller 2013). Dunning (2012, page 236) advances a three-step procedure to assess whether a naturally occurring event can be plausibly considered exogenous or 'as-if random.' First, researchers should investigate whether units had information that they would or would not receive the treatment. Second, researchers need to check whether units had incentives to self-select into the treatment or control group. Finally, researchers should analyze whether units had incentives and the capacity to self-select into a treatment status. For the assessment, Dunning (2012) suggests using both qualitative evidence (e.g., documents, interviews) and quantitative evidence (e.g., balance tests).

For example, Snow (1855 (1965)) presented various sorts of evidence to establish the pre-treatment equivalence of houses that were exposed to pure and to contaminated water supplies—this is a good example of a thorough qualitative analysis of the 'as-if randomness' of a treatment. For instance, Snow explains in detail the 'as-if random' nature of the water supply that is unaffected by confounders including resident characteristics (e.g., wealth) or house characteristics (e.g., location). Additionally, Snow (1855 (1965)) presented rich qualitative information on the context and the process of determining the water-supply source. For instance, he emphasized that absentee landlords decided which competing water companies would have served a particular address. Thus, many residents had limited opportunities to 'self-select' into a source of water supply — that is, confounding characteristics of residents appeared unlikely to explain the significant differences in death rates across the two suppliers (see). Moreover, the Lambeth Company committed to moving their intake pipe upstream on the Thames before the cholera outbreak of 1853-54, when existing knowledge did not link water sources to cholera risk. Such a supply choice implied that more than 300,000 people of all ages and social strata were "divided into two groups without their choice, and, in most cases, without their knowledge; one group being supplied with water containing the sewage of London, and, amongst it, whatever might have come from the cholera patients, the other group having water quite free from such impurity" (Snow, 1855 (1965), pages 74-75).

Drawing on the methodological insights included in Snow's study, Figure 3 illustrates that both events that are unknown or unknowable to units and events that are known to units can provide scholars with an exogenous variation suited to address the research question at hand. However, 'known events' may raise endogeneity concerns regarding the possibility of a unit affecting the direction and magnitude of a naturally occurring variation and self-select into the

treatment or control group. Hence, while we find many events that are referred to as 'exogenous shocks' or 'jolts' in the management and leadership literature,[6] not all of them may equally qualify to study a particular research question. Most importantly, we warn against using any naturally occurring event as an 'exogenous shock' (Clement 2024; Donelson et al. 2022).Instead, it is crucial for researchers to have a clear ex-ante definition of what constitutes an exogenous shock that fits within the model of interest, and that comprises substantive and empirical elements. Following this approach, we can (non-comprehensively) define an exogenous shock as an event (or a series of related events) outside a social system that is unanticipated by and not under the control of actors of interest (e.g., individuals, organizations) within the system. First, by originating outside the social system under investigation, the shock avoids any confounding effects of actors from within the system. Second, a shock should neither be under the control of actors with the system nor anticipated by the actors to rule out that actors can (precisely) manipulate if and when a shock occurs and whether they are affected by the shock. This prevents actors from sorting into treatment and control groups as well as from changing their behaviors, attitudes, or intentions in anticipation of the shock.

3.2 Exogenous Shocks in Leadership and Management Research

To understand how leadership and management scholars conceptualize and use exogenous shocks, we reviewed the literature. Specifically, we focused on the studies that assign the 'exogenous shock' concept to a core narrative role by placing it in the paper's title or abstract.[7] We considered the journals publishing empirical articles, which the ABS Journal Ranking 2021 rated as '4' or '4*' for 'entrepreneurship an small business management'(Entrepreneurship Theory and Practice, Journal of Business Venturing, and Strategic Entrepreneurship Journal), 'ethics, CSR, and management' (Academy of Management Journal, Administrative Science Quarterly, British Journal of Management, Business Ethics Quarterly, Journal of Management, and Journal of Management Studies), 'organization studies'(Human Relations, Leadership Quarterly, Organization Science, and Organization Studies), 'strategy' (Global Strategy Journal and Strate-

6. For instance, the papers published in this special issue refer to various exogenous shocks, including terrorist attacks (Bastardoz, Jacquart, and Antonakis, in press), the COVID-19 pandemic (Wang, Devine, and Molina-Sieiro, in press), the Global Financial Crisis (Mukherjee and Krammer, in press), government regulation (Page et al., in press), the Chinese rural rustication movement (Zhao, Zhong, and Chen, in press) and election results (Arvate and Story, in press).

7. Our purpose is not to provide a systematic review of the literature on the role of exogenous shocks for empirical identification (see Sieweke and Santoni 2020). Instead, we aim to uncover the views and uses of the exogenous shock concept. Retrieving the studies in which the bigram 'exogenous shock' appears once or a few times in the full text of the paper would have little value for us.

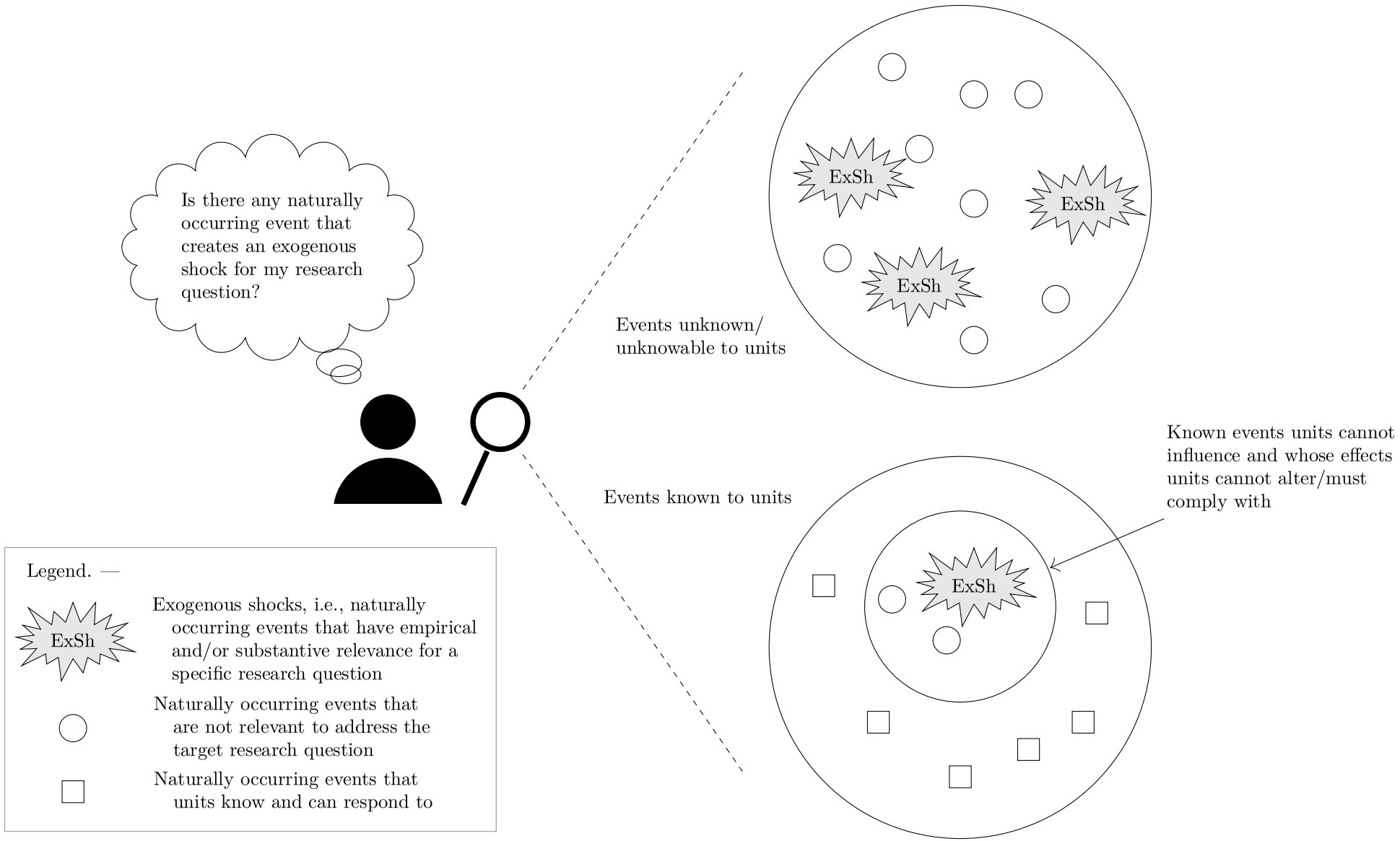

FIG. 3. — The interpretation of a naturally occurring event as an exogenous shock is contingent on the research question one wants to address and the intrinsic attributes of the event.

gic Management Journal), and 'work and organizational psychology/organizational behavior' (Journal of Applied Psychology, Journal of Occupational and Organizational Psychology, Journal of Occupational Health Psychology, Journal of Organizational Behavior, Journal of Vocational Behavior, Organizational Behavior and Human Decision Processes, Personnel Psychology, and Work and Stress). We also considered Management Science, ranked as '4*' for 'operation research and management science,' and Journal of Business Ethics, ranked as '3' for 'ethics, CSR, and management,' which is known to publish natural experiment papers. Using Scopus, we retrieved 71 articles published up until or available online on July 1, 2024, presenting the bi-gram 'exogenous shock*,' in the title, abstract, *or* set of author-generated keywords.

Considering the full manuscript of each retrieved article, we discarded 22 articles that did not fall within the reviews' remit. We excluded from the sample two studies in which the search token appears once and does not focus on or use the conceptual category of 'exogenous shock' (Kriauciunas and Kale 2006; Uzzi 1997); one study focusing on managers' cognitive representation of a shock (Barreto and Patient 2013); four non-empirical papers (e.g., McSweeney 2009); two qualitative studies (Glynn and Lounsbury 2005; Jenkins 2010); one field experiment (Cui, Zhang, and Bassamboo 2019); one computational experiment (Reikard 2005); 11 Management Science articles dealing with finance, marketing, or operations subjects (e.g., Tham, Sojli, and Skjeltorp 2018). Figure 4 illustrates the distribution of sample studies across journals.

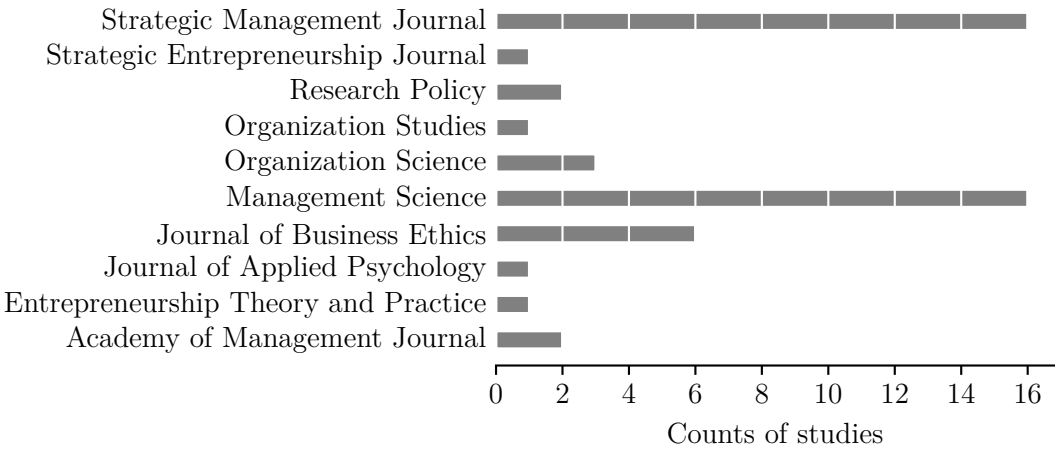

FIG. 4. — Distribution of exogenous shock studies across journals. Notes: N = 49; in the interest of consistency, we excluded 'exogenous shock' studies published in Management Science addressing finance, marketing, or operations subjects.

One of the guest editors coded the retained studies against the dimensions included in Figure 1,that is, (1) the exploited naturally occurring event (e.g., 9/11, Sarbane-Oxley Act); (2) the leading research question (e.g., 'how do changes in an employee's relational capital influence

mobility and entrepreneurship decisions?'); and (3) the relationship between (1) and (2), which can be substantive—when the exogenous shock is an integral part of the research question/plays a key role for theorizing—or empirical—when a study's authors claim to leverage a naturally occurring event to cope with the problem of confounders—or both. Having completed the independent analysis of sample studies, the two authors of this work merged their coding choices and reconciled their different views regarding the role of exogenous shocks in four papers.[8] Table I reports the outcome of our coding, including a summary of how the naturally occurring event qualifies as an exogenous shock (see the column 'Summary,' reported on the right-hand side of the table).

Regarding the first dimension of our coding, the most popular categories of events are 'legal change' (N = 14) and 'turnover' (N = 8) (see Figure 5). Concerning 'legal change,' scholars have relied on events such as the staggered passage of anti-takeover laws (Cabral, Francis, and Kumar 2021; Wang, Zhao, and He 2016), change in immigration rules (Choudhury and Kim 2019), the Garn-St. Germain Act (Haveman, Russo, and Meyer 2001), the Sarbane-Oxley Act (Gupta et al. 2020), SEC's regulation change (Jia, Gao, and Julian 2020), the change of inheritance, gift, and estate taxes (Kang and Kim 2020), the staggered adoption of the Inevitable Disclosure Doctrine in U.S. (Kang and Kim 2020), a revision of U.S. Higher Education Amendments (Krishnan and Wang 2019), reductions in import tariffs (Li and Zhan 2019), demonetization measures (Natarajan, Mahmood, and Mitchell 2019). Turnover events comprise sick leave episodes of key employees (Chen and Garg 2018; Chown and Liu 2015; Drexler and Schoar 2014), political leadership churn (Byun, Raffiee, and Ganco 2019; Gedefaw Birhanu and Wezel 2020), and executives' sudden death (He 2022; Ke et al. 2019) and retirement (He 2022). Other recurrent events include terrorist attacks (Bastardoz, Jacquart, and Antonakis, in press; Corbo, Corrado, and Ferriani 2016; Li and Zhan 2019; Vergne 2012), scandals (Cai and Shi 2019; Hilary and Huang 2023), change in financial analysts' coverage (Chatterji and Toffel 2010; Qian, Lu, and Yu 2019), and pandemics (Garretsen et al., in press. Jo, Harrison, and Gray 2021).

As shown in the Venn diagram in Figure 6, circa four cases out of five (N = 40) claim to use exogenous shocks with an empirical role. For instance, Krishnan and Wang (2019) use Survey of Consumer Finances data to address the research question 'does student debt

8. The coding spreadsheet is publicly available in the OSF project LQ SI on exogenous shocks—editorial.

TABLE I
SUMMARY OF STUDY EVENTS, RESEARCH QUESTIONS, AND EXOGENOUS SHOCKS

Study	Event	Research question	Relevance of the event		
			Empirical	Substantive	Summary
Allen & Wahid (2024)	California Senate Bill (SB) 826 on board gender composition	Do gender diversity quotas enhance firm value?	✓	×	California Senate Bill (SB) 826 creates an exogenous variation in board gender composition among California firms
Attig (2024)	Scattered adoption of anti-re-characterization laws in some U.S. states	How do financial constraints influence CSR activities?	✓	×	The promulgation of anti-characterization laws in seven U.S. states reduce the costs of debt financing and improve access to credit
Byun et al. (2019)	Change in a politician's committee and/or committee chair assignments.	How do changes in an employee's relational capital influence mobility and entrepreneurship decisions?	✓	✓	Lobbyists may experience a discontinuous shift in the value associated with a connection, if there are changes to a politician's committee and/or committee chair assignments. Then, the authors can investigate empirically the consequences of social capital change on lobbyists' career.
Cabral et al. (2021)	Staggered passage of anti-takeover laws in U.S.	Does managerial job security affect the adoption of innovative practices and structures?	✓	✓	Adopting an anti-takeover statute is a proxy of managerial job security, which changes across states and within individual states over time, and it is supposed to affect the propensity to create a CVC program.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event		
			Empirical	Substantive	Summary
Cai & Shi (2019)	The revelation of the sexual abuse of children by Catholic priests in U.S.	Does a firm's religious environment influence outside parties' perceptions in contracting with the firm?	✓	×	The revelation of the sexual abuse of children by Catholic priests is an exogenous shock to the religiosity of a region, which can influence the capital structure, credit rating, cost of debt, and covenants of local firms.
Chatterji & Fabrizio (2016)	Department of Justice investigation against the five largest U.S. orthopedic device makers.	How does an open innovation system affect the rate and direction of innovation?	✓	✓	Department of Justice investigation increases the friction in the market for ideas by regulating the interactions between physicians and the medical device firms under investigation.
Chatterji & Toffel (2010)	Change in the scope of KLD Database, a prominent source of CSR ratings.	How do managers react to poor corporate environmental ratings?	✓	×	The change in KLD's scope creates a subset of companies responding for the first time to a CSR rating, which allows the authors deal with mutual causality issues regarding a firm's CSR rating and CSR strategy.
Chen et al. (2024)	U.S. state-level changes to the enforceability of non-compete agreements	Does labour mobility help or hinder the adoption of new technologies at the organizational level?	✓	×	Non-compete agreements determine an exogenous variation in labour mobility extent and qualities

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event: Empirical	Relevance of the event: Substantive	Summary
Chen & Garg (2018)	Injuries occurred to star NBA players.	Does a star's temporary absence help the organization overcome myopia?	✓	✓	The absence of star players is presumed to impact the pattern of organizational routines at the team level.
Chen et al. (2023)	Data breach events concerning publicly listed companies	Do managers increase the amount of cybersecurity risk factor disclosures after experiencing data breaches?	×	✓	Data breaches are exogenous shocks to managers' assessment of their firm's cybersecurity risks occur.
Chen et al. (2023)	French government's intervention to impose a ceiling on trade credit duration (included in the Law on the Modernisation of the Economy)	How does trade credit impact operational decisions?	✓	×	By imposing a ceiling on credit duration, the French government creates an exogenous variation in trade credit, whose magnitude changes across sectors depending on conventional payment terms
Choudhury & Kim (2019)	Change in U.S. H1B employment visas.	How do migrant inventors influence knowledge production and reuse?	✓	×	The H1B quota change exempted universities and a selected list of other entities, creating heterogeneous effects in terms of the supply of first-generation ethnic migrant inventors and the rate of codification of knowledge previously locked within migrant inventors' home countries.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event		
			Empirical	Substantive	Summary
Chown & Liu (2015)	Turnover within U.S. Senate and 'iconoclastic' senators deviating from the institutionalized seating arrangement.	How does one's location in an organizational forum affect the likelihood of receiving peer support?	✓	×	Turnover within U.S. Senate and 'iconoclastic' senior senators create opportunities for freshman senators not to sit at the chamber's margins. These elements affect the dyadic distance between senators, a factor that is presumed to affect the likelihood of joint support.
Corbo et al. (2016)	9/11.	Does a major environmental shock affect the social structure of an organizational field?	×	✓	9/11 is supposed to affect the organization and functioning of civil aviation, which allows the authors to assess the extent to which network mechanisms shape the alliances connecting airline companies under different contingencies.
DesJardine et al. (2023) .	Mergers between financial institutions	a How does common ownership influence CSR performance?	✓	×	Mergers between financial institutions to generate exogenous variation in common ownership that is independent of firms' CSR.
Drexler & Schoar (2014) .	Sick leave episodes among loan officers.	How (much) does employee turnover affect organizational performance?	✓	✓	Loan officers' sick leaves alter economic and social exchange between the firm and its clients.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event		Summary
			Empirical	Substantive	
Fang et al. (2023)	Crackdown on corrupt Chinese officials beginning in 2012	How does corruption affect the allocation of research subsidies and firm innovative outcome?	✓	✓	The staggered removal of provincial heads on corruption charges during China's anti-corruption campaign and the unanticipated departures of local government officials responsible for innovation programs led to plausibly exogenous reductions in corruption
Gupta et al. (2020)	Sarbanes-Oxley Act (SOX) & Global Financial Crisis.	Does CFO gender influence the likelihood of financial misreporting?	✓	×	The authors expect: i) SOX to lead to a larger decrease in financial misreporting for male CFO firms than female-CFO firms; ii) firms to face greater pressure to report favorable earnings during crisis periods, which is more likely to influence male compared to female CFOs (based on the logic that female CFOs will be less likely to engage in fraud regardless of stakeholder pressure).
Han et al.(2024)	iOS7 jailbreak	How do innovators conduct knowledge search in response to an increased risk that their original ideas may be imitated?	✓	✓	The iOS7 jailbreak exogenously increases appropriability concerns for software developers.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event: Empirical	Relevance of the event: Substantive	Summary
Haveman et al. (2001) ..	California Legislature enactment of the nation's first comprehensive managed competition program, and Garn-St. Germain Act	How do organizations respond to discontinuous industry-level change?	×	✓	The authors use a series of regulatory changes to investigate how organizations respond to punctuated changes in the environment and with what performance consequences.
He (2022).....	Exogenous turnover (i.e., deaths and retirements) of business leaders.	Are central business leaders more likely to engage in financial misreporting?	✓	×	Exogenous turnover at the upper echelon level can attenuate the 'firm-manager' matching may drive the effect of an executive's network centrality on the occurrence of financial misreporting.
Hilary & Huang (2023) .	The revelation of the sexual abuse of children by Catholic priests in U.S.	Does generalized trust affect the power of CEO contracts?	✓	×	The revelation of the sexual abuse of children by Catholic priests reduces generalized trust for certain counties only, which helps to reveal the causal effect of generalized trust on the characteristics of executives' contracts.
Hsu et al. (2022)	Introduction of the Federal Trademark Dilution Act (FTDA)	Does greater trademark protection strengthens the predictability of new trademark registrations?	✓	×	The FTDA of 1995 introduced a major exogenous shock that enhanced trademark protection and therefore increased the value of trademark.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event: Empirical	Relevance of the event: Substantive	Summary
Jia et al. (2020)	2005 Regulation SHO by which SEC removes the uptick restriction for a set of randomly selected pilot firms.	Do managers use CSR to insure against stock price risk?	✓	×	SEC program changes stock risk price for pilot firms only, which helps to assess whether firms invest in CSR in response to greater stock price risk, and whether such investments provide intended insurance-like benefits.
Jo et al. (2021)	COVID-19 pandemic	How do individuals recalibrate their social ties to cope with the uncertainty and anxiety introduced by the pandemic shock?	×	✓	COVID-19 is an exogenous stressor affecting interpersonal ties maintenance in the workplace, that is, optimal matching theory's focus.
Kang & Kim (2020)	Staggered changes in inheritance, gift, and estate taxes in U.S. & sudden deaths of business owners.	Do family firms invest more in employee relations than non-family firms?	✓	×	Taxation changes provide family owners with incentives to continue their businesses, which helps to reveal the relationship between governance forms and investment in employee relations. The sudden death of family members alters a firm's status, which attenuates the concerns time-invariant characteristics jointly affect performance and the ability to implement employee-friendly policies.
Ke et al. (2019)	Sudden deaths and retirements of executives.	How do social connections among executive team members affect management forecast accuracy?	✓	×	Sudden turnover events alter the social connections within a team of executives, and, in turn, help to reveal the causal effect of social capital on decision-making quality.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event: Empirical	Relevance of the event: Substantive	Summary
Kini et al. (2024)	Mergers between financial institutions	Does common ownership improve firm product development and investments?	✓	✓	Mergers between financial institutions exogenously increase common ownership between product market competitors.
Koh et al. (2018)	Staggered adoption of the Inevitable Disclosure Doctrine (IDD). in U.S.	Are confident CEOs more likely to report R&D expenditures than cautious CEOs?	✓	×	The staggered U.S. state courts' verdict on the IDD helps to reveal the relationship between CEO confidence and R&D disclosure by attenuating market competition.
Krishnan & Wang (2019)	1992 and 1998 Higher Education Amendments (HEA)	How does student debt influence the propensity to start a firm?	✓	×	1998 HEA alters the cost of discharging student debt through bankruptcy—which increases the cost of entrepreneurship, that is, new venture failure—while it is unlikely to affect financing availability to start a venture. Hence, the authors can assess the causal relationship between student debt and the propensity to create a new venture. 1992 HEA affects the volume of student loans through the federal government. Students who spend more time in college during the post-1992 HEA regime will have more student loans. Hence, they will have a lower likelihood of starting a new venture.
Lai et al. (2024)	Staggered implementation of SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system	How does the adoption of a market major regulatory technology influence the cost of capital?	✓	✓	The implementation of EDGAR reduces the cost of accessing mandatory corporate filings

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event		Summary
			Empirical	Substantive	
Li & Tallman (2011)	9/11.	Does a sudden change in the environment influence the economic returns of international diversification?	×	✓	9/11 is a "reorienting disruptive change" that alters international business logic, particularly, the economic and finial returns of international diversification.
Li et al. (2023)	Terminal High Altitude Area Defense (THAAD) dispute between China and South Korea	Does country-of-origin agglomeration helo MNEs navigate an adverse institutional environment?	×	✓	THAAD increases the regulatory burden for South-Korean MNEs in the host country, namely, China.
Li & Zhan (2019)	Reductions in import tariffs initiated by U.S. authorities.	How do product market threats affect stock crash risk?	✓	×	Reduction in import tariffs increases competitive pressure, which aggravates executives' incentive to withhold negative information and increases and makes firms more prone to stock crashes.
Liu & Liu (2024)	Social credit system reform pilot in China	Does the level of integrity in a society affect stock price crash risk?	✓	✓	Firms located in 'pilot' cities sustain larger costs for undertaking 'promise-breaking behaviors.'

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event: Empirical	Relevance of the event: Substantive	Summary
Mahmood et al. (2017)	Global Financial Crisis.	How does the centralization of intragroup equity ties affect the performance of group affiliates?	$	✓	Global Financial Crisis creates environmental turbulence exogenously for Taiwanese firms, and, in turn, helps to appreciate the contingent role of equity tie centralization.
Natarjan et al. (2019) . .	Indian Government's demonetization measure.	How do middle managers influence resource allocation choices?	✓	×	The decision to withdraw almost 85% of banknotes in circulation (all 500-rupee and 1,000-rupee bills, the most common units of circulating currency) increased bank headquarters' control over ATM deployment, which resulted in tighter monitoring of middle managers' allocation decisions.
Nguyen et al. (2023)	Does institutional uncertainty affect a firm's likelihood to be a takeover target?	Sample of terrorist attacks	✓	✓	Firms located near terrorism-stricken areas deal with as-if random variations in institutional uncertainty.
Qian et al. (2019)	Brokerage house mergers and closures in U.S.	How do financial analysts influence managers' choices to invest in CSR?	✓	✓	The closure or merger regarding a brokerage house reduces financial analyst coverage for some firms only, which allows the authors to assess the causal relationship between the (change in the) extent of analyst coverage and CSR.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event: Empirical	Relevance of the event: Substantive	Summary
Ramirez & (2018).....	Price variation in the global copper industry.	How does the value appropriated by employees vary in response to an exogenous shock to the price of the firm's product?	✓	✓	Copper mines' size is homogeneous. Hence, price fluctuations in the global copper industry are exogenous variations for individual mines and can reveal the mechanisms behind value distribution within organizations.
Seebeck & Vetter (2022)	Brexit Referendum.	Does board gender diversity affect corporate risk disclosure?	✓	✓	The outcome of the Brexit Referendum increases the risk for all UK-based companies, which attenuates reverse causality concerns regarding board gender diversity on corporate and risk disclosure.
Shin et al. (2023).....	Exogenous exit and re-entry of rideshare platforms Uber and Lyft into a local market	How does the gig economy affect product quality in seemingly unrelated local industries through the labor market?	✓	✓	By leaving and re-entering the market, Uber and Lyft affect employee turnover among local restaurants, and, therefore, restaurant service quality.
Tan & Netessine (2014).	Adoption of a new staffing system.	How does workload impact worker productivity?	✓	×	The staggered adoption of a new computer-based scheduling system prescribes different staffing levels from those that managers might suggest because it uses more historical sales data than a manager can handle. Hence, authors can make cross-restaurant comparisons involving similar servers experiencing different workload levels.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event: Empirical	Relevance of the event: Substantive	Summary
Tong & Lee (2024).....	Staggered adoption of R&D tax credits policies at the state level	How does the knowledge of incumbent inventors in a hiring firm affect the post-hiring use of the hired inventor's knowledge?	✓	×	State R&D tax credits policies as exogenous shocks to the mix of generalist inventors at affected sites.
Vergne (2012).....	9/11.	Does straddling multiple product-market categories dilute stakeholder attention to the stigma of operating in the global army industry?	×	✓	Since attackers used commercial airlines hijacked by terrorists armed with kitchen knives, the definition of the weapons category was questioned in the post-9/11 period." Hence, 9/11 allows the author to test whether the salience of the category 'weapons' weakens 'the negative relationship between stigma dilution (i.e., the situation in which a diversified business also operates in a stigmatized sector, such as 'arms') and media disapproval.
Wang et al. (2016).....	Delaware's 1996 ruling against hostile takeovers.	Do takeover threats affect a firm's knowledge structure?	✓	×	A series of law cases make takeover less favorable for target firms incorporated in Delaware, allowing the authors to assess the impact of (an increase in) takeover protection on firm-level knowledge production.

TABLE I (CONT'D)

Study	Event	Research question	Relevance of the event		Summary
			Empirical	Substantive	
Zhang et al. (2020)	iOS 7 jailbreak.	Does a lapse in gatekeeping reduce knowledge sharing among developers?	✓	✓	The event is an exogenous shock to Apple's gatekeeping policy, aiming to orchestrate developers' value-creation activities in the AppStore. That allows scholars to appreciate the impact of platform governance on knowledge sharing among developers.
Zhao et al. (2024)	1998 flooding in China	Does military service influence entrepreneurship?	✓	✓	Childhood experience of the Chines floods in 1998 included the exposure to military involved in flood relief, which increases treated individuals' likelihood to join the military in adulthood to help disaster victims for
Zheng & Wang (n.d.) ...	2014 Google blockade in China.	How does Google's search engine influence the search process of inventors?	×	✓	The blockade of Google affects inventors' information processing and, in turn, innovation output.

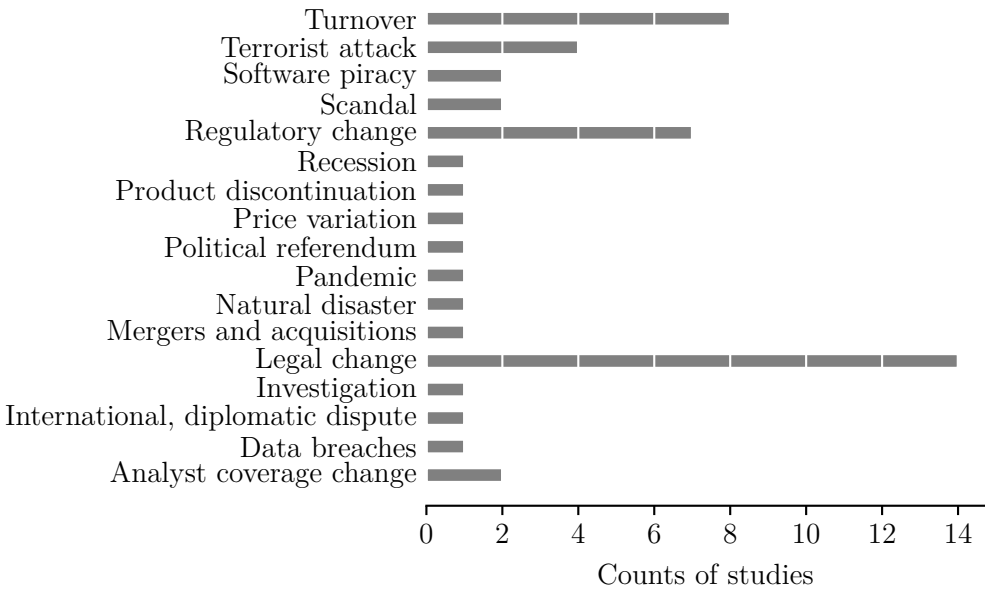

FIG. 5. — Classes of naturally occurring events presumed to create an exogenous shock. Notes: N = 49.

influence the propensity to start a firm?' The concept of exogenous shock is not essential for the scope of their work and does not inform the proposed theorizing. Still, one may study the relationship between student debt and business creation using a correlational approach. However, the authors are concerned about the causal interpretation of their empirical estimates *"there may be unobserved characteristics that may drive our results. For instance, individuals with wealthier families may have lower student debt as well as the financial means to start a firm. Such unobservable family effects may explain the negative relation between student debt and entrepreneurship. Alternatively, individuals from wealthier families may borrow more if they expect to be able to pay back the loans easily (and such individuals are more likely to be entrepreneurs)"* (page 4528). Hence, they use a legal change as an exogenous shock to the cost of business failures for individuals with greater levels of student loans

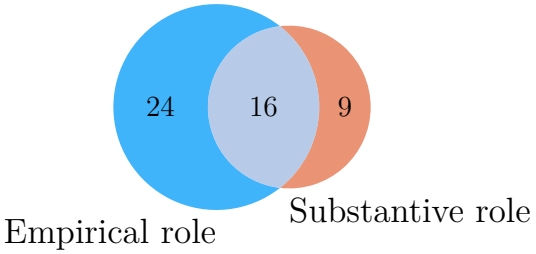

FIG. 6. — Role of the naturally occurring events presumed to create an exogenous shock.

About half of the studies (N = 25) assign a substantive role to exogenous shocks. For example, Haveman, Russo, and Meyer (2001) articulate a framework that links organizations'

responses to discontinuous industry-level regulatory change. The theoretical section of the study maps the phenomenon of regulatory change onto the General Punctuated Equilibrium Model and provides expectations about the multiple consequences of regulatory change for individual organizations. The substantive role of the shock is self-evident in the formulation of the hypotheses, e.g., *"Immediately following any regulatory punctuation, CEO succession rates will not rise; instead, CEO succession rates will rise gradually as time passes."* (page 259). It is worth notice the authors emphasize the 'exogenous' nature of the Garn-St. Germain Act—the example of regulatory change at the center of the paper —, but they do not discuss what it means for the study's empirical strategy, especially in terms of empirical identification.

We also found that one study out of three (N = 16) claims to use an exogenous with empirical and substantive relevance. For example, Byun, Raffaele, and Ganco (2019) propose a hypothesis set that connects 'discontinuous increases in the value of an employee's relational capital' with 'employee turnover' and 'spinout' formation. For example, their first hypothesis states *"discontinuous increases in the value of an employee's relational capital will be positively related to employee exit."* (page 1371). The authors can advance and test this and the other hypotheses thanks to naturally occurring events regarding the politicians connected to lobbyists (i.e., 'employees').Specifically, the authors exploit politicians' appointment to committee chair positions and Congress committees to assess changes in politicians' power. The series of political appointment decisions also play an empirical role, because changes in politicians' power is exogenous to their connection to lobbyists, as the authors explain in great detail (p. 1375).

Figure 7 illustrates the distribution of sample studies across empirical strategies and exogenous shocks' roles. One article out of four (N = 14) operates an empirical strategy without a control group (see panel A.). Within this group, we found eight articles that do not use the shock for empirical identification purposes. For example, Corbo, Ferriani, and Corrado (2016) use 9/11 as a *"major environmental shock"* (page 323), affecting the logic that shapes the formation of alliances in the airline industry. The impact of 9/11 on aviation companies is so immediate and pervasive to impede the identification of units that can form a control group even for a limited period. Although such a naturally occurring variation does not help the authors in terms of empirical identification, it is relevant from a substantive standpoint. For instance, the 9/11 terrorist attacks allow Corbo et al. (2016) to explore novel theoretical intuitions regarding the change in interorganizational networks as organizations' response to naturally occurring

events.

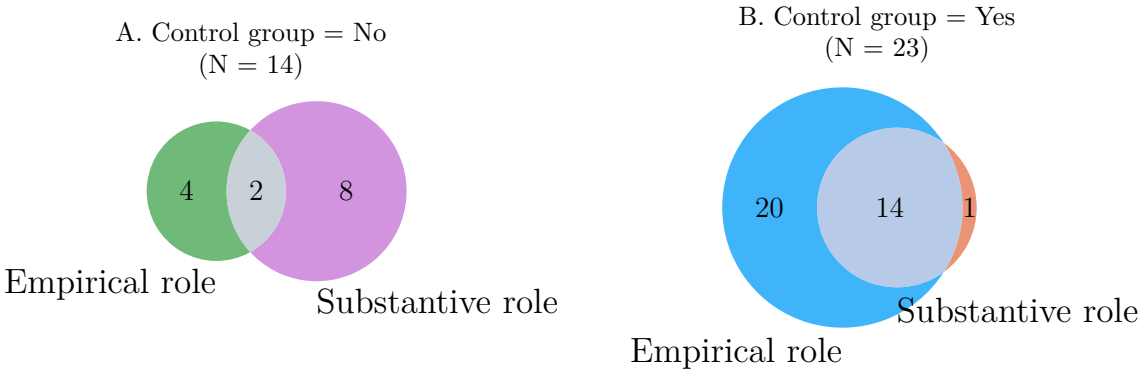

FIG. 7. — Distribution of studies across exogenous shocks' roles and empirical strategies (presence Vs. absence of a control group). Notes: A design lacking a control group has a pretest and posttest observations for one group only; a design with a control group has pretest and posttest both for units that are affected by the exogenous shock and those that are not.

The remaining six articles lacking a control group emphasize the empirical relevance of their naturally occurring events. Seebeck and Vetter (2022) investigate the relationship between gender board diversity and corporate risk disclosure. Their study uses the Brexit Referendum to create an intention-to-treat model (Angrist, Imbens, and Rubin 1996) where the future exit of the United Kingdom from the European Union is an exogenous shock on a firm's risk environment by which *"all firms face similar and tremendous risks related to the Brexit that need to be considered by public firms when preparing their annual reports according to the Financial Reporting Council (FRC 2016a, b) as well as section 414c(2)(b) of the companies act and section 4 of the UK corporate governance code."* (page 396).

However, Seebeck and Vetter's article does not rely on Neyman Potential Outcome Framework because the study sample only includes UK (FTSE 350) companies, which are all affected by the exogenous shock associated with the Brexit referendum.

Similar to Seebeck and Vetter's work, the study of Bastardotz, Jacquart, and Antonakis (in press) uses a naturally occurring event with immediate and pervasive consequences on organizational and social formations. Specifically, the study considers 9/11 and the 2015 and 2016 terrorist attacks in France as exogenous shocks to assess the causal effect of crises on political leaders' charismatic rhetoric. To cope with the lack of a ground-truth control group—i.e., cross-sectional variance in the treatment across units—Bastardoz and colleagues use the Regression Discontinuity in Time (RDiT) estimator (Hausman and Rapson 2018), which they present as a model that *"closely resembles event-studies or interrupted time series analyses in that they*

examine the effect of exogenous events on individual or organizational decisions." (page 2).

To attenuate the concern that the units (that is, political leaders' speeches) differ across the sides of the cutoff for reasons other than the exogenous shock, the authors perform sensitivity analyses by re-estimating their RDiT model using different time windows. The findings of the sensitivity analyses support their initial results and show their robustness.

4 Towards a Taxonomy of Exogenous Shocks

This section introduces a taxonomy of exogenous shocks that may help scholars evaluate a concrete shock's essential features and link them with salient empirical strategy challenges. In doing so, we take the relevance of a naturally occurring event 'for granted.' In other words, we assume the researcher has already shown the added value of the environmental variation in addressing a relevant research question.

As shown in Figure 8, the taxonomy builds on three dimensions of exogenous shocks: (1) the *extent of the intervention*, i.e., the fraction of a unit's population that is presumed to be treated; (2) the *the timescale of the intervention*, i.e., the amount of time an exogenous shock takes to treat units; (3) the *granularity of the intervention*, i.e., the different degrees with which an exogenous shock treats units.

The literature shows considerable variations regarding the first dimension, an *exogenous shock's extent of intervention*. At one extreme of the gamut, there are cases such as pilot or unique policies and rare naturalistic or social events that affect one unit only. For instance, Nathan (2020) evaluates the causal impact of a flagship UK technology cluster program that carries out an original 'light-touch,' market-oriented intervention. The policy under investigation—which the author presents in as an as-if random variation[9]— regards one cluster London solely (that is, 'Tech City'). The study of Abadie and Gardeazabal (2003) is another example of an exogenous shock affecting one unit only. The authors use the terrorist conflict in the Basque Country as a case study to investigate the effect of conflict on regional GDP. In other circumstances, exogenous shocks regard a fraction of the units included in the reference population. Typical cases are empirical strategies that consider the death of business or political leaders

9. Here is a passage from Nathan (2020) where the author describes the empirical identification strategy for the paper: *"By 2010 Ministers were claiming 'something special' for the Inner East London cluster (Cameron, 2010; Osborne and Schmidt, 2012). Other accounts depict policy origins as chaotic (Butcher, 2013; Nathan et al., 2019), and thus as good as random"* (page 5).

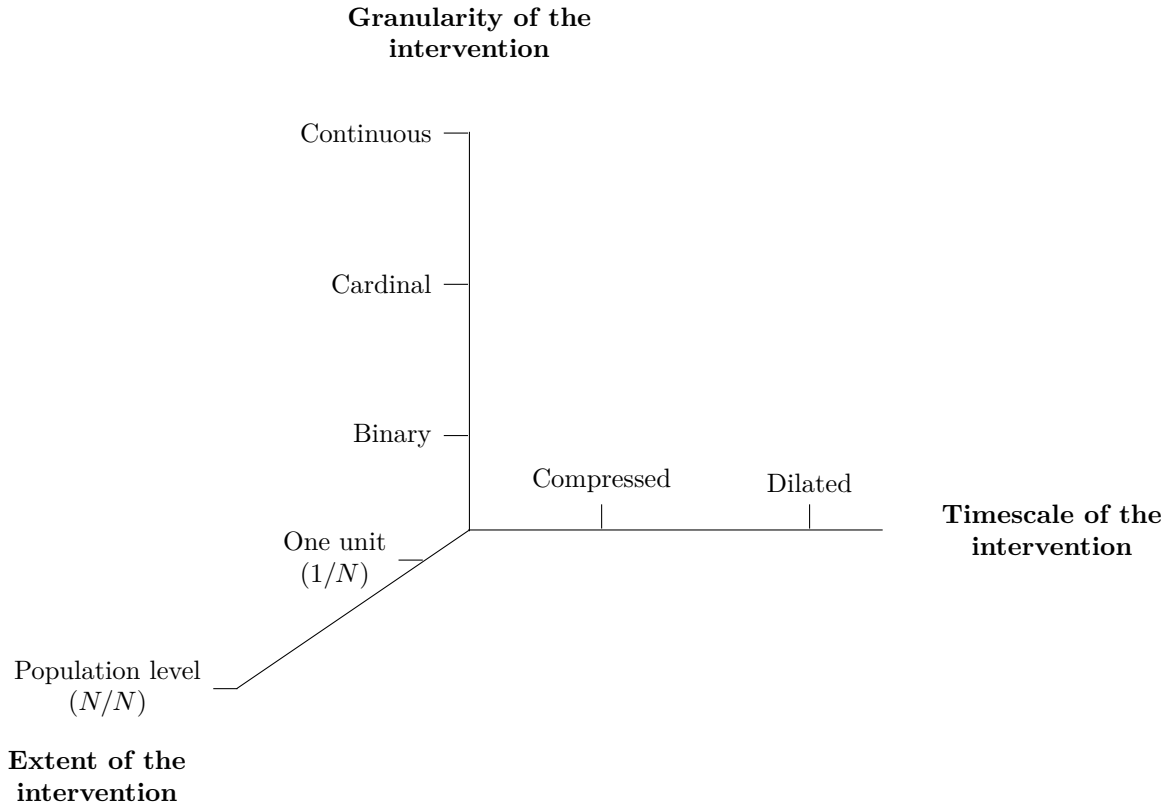

FIG. 8. — A taxonomy of exogenous shocks. Notes: The 'timescale of the intervention' axis is a continuum, which we annotated with reference points in the interest of interpretability; N denotes the study's population size.

(e.g., Bennedsen et al. 2007; Brown et al. 2017; Iyer 2010; Johnson et al. 1985; Jones and Olken 2005; Kang and Kim 2020; Ke et al. 2019; Lee, Kim, and Bae 2020; Nguyen and Nielsen 2010, 2014; Quigley, Crossland, and Campbell 2017). For instance, Iyer (2010) uses the heirless death of princes in the 19^{th} century India as a random variate accounting for the transition of a district from the 'indirect rule' to the 'direct rule,' in which British administrators collected taxes and administered local governance themselves. The descriptive evidence reported in Iyer's work indicates twenty districts out of 181 experience heirless death.[10] One of the studies included in our review (Jia, Gao, and Julian 2020) takes advantage of SEC's pilot study consisting in the exclusion of designated securities from the operation of the 'tick' test of Rule 10a-1(a) and any short sale price test rule of any exchange or national securities association. Such a temporary intervention resulted in a stock price risk surge for 512 firms belonging to the Russell 3000 Index.

The other extreme of the gamut regards exogenous shocks that interest the whole population of units. That could happen for different reasons. Sometimes, governments introduce legal changes in a non-staggered manner, making new laws binding simultaneously for all firms in the country. An example is Norway's gender quota policy, the shock central to the work of Matsa and Miller (2013) on the implications of gender composition in executive teams. According to the policy—released in 2006 —, Norwegian public limited companies had two years to comply with the requirement of having at least 40 percent representation from each sex on their board. According to the descriptive evidence reported in the study, *"nearly all firms complied by February 2008, and all did by April 2008"* (page 140). Exogenous shocks affecting the reference population can also emerge from significant catastrophes, pandemics, recessions, or global-scale terrorist attacks. Examples are Corbo et al. (2016) and Vergne (2012), which rely on the variance created by 9/11 to investigate the change of the airline industry and the boundaries of the global arm sector, respectively, and Gupta et al. (2020), which draws on the Global Financial Crisis as a source of pressures for CFOs to report favorable results.

The second dimension of our topology—*the timescale of the intervention*—emphasizes the timing with which an exogenous shock is presumed to affect a relationship or mechanism of interest. To clarify this dimension, let us focus on one class of exogenous shocks: the death

10. Iyer considers the twelve-year timespan (1848 - 1856) where the Governor-General of India, Lord Dalhousie, enacted the Doctrine of Lapse, according to which annexation would result from the death of a ruler without a natural heir.

of individuals occupying prominent positions in organizations or fields. The finance literature includes studies using sudden deaths amongst upper echelons to address the overarching question 'how do executives matter?' (e.g., Cho et al. 2016; Dedman and Lin 2002; Duchin and Sosyura 2013; Faccio and Parsley 2009; Falato, Kadyrzhanova, and Lel 2014; Fee, Hadlock, and Pierce 2013; Fracassi and Tate 2012; Johnson et al. 1985; Nguyen and Nielsen 2010, 2014; Salas 2010). The intuition behind this body of work is that analyst and market reactions to unanticipated executive turnover reveal the 'net contribution' of business leaders to shareholder value. Since analysts and markets factor in broad arrays of time-variant elements (e.g., the search costs a firm may incur to fill in the vacancy), it is important to pick up an appropriate time window within which stock prices foster a ceteris paribus, pre-post shock comparison. For instance, Nguyen and colleagues (2014) evaluate the impact of executives' sudden deaths using a short window (11 trading days) around the death of the executive. Essentially, the finance literature stresses two aspects. First, sudden executive deaths are essential sources of variance in estimating leaders' economic and financial impact. Second, and more importantly for our taxonomy, there is a relatively tight time frame where sudden executive deaths create exogenous shocks to address the question, '(how) do executives matter?' Essentially, the finance literature stresses two aspects. First, sudden executive deaths are essential sources of variance in estimating leaders' economic and financial impact. Second, and more importantly for our taxonomy, there is a relatively tight time frame where sudden executive deaths create exogenous shocks to address the question, 'how do executives matter?'

Another example for studies focusing on the death of key individuals can be found in the fields of economics and sociology of science. Studies in these fields highlight a different temporal pattern by which sudden deaths alter reference processes or mechanisms and, in turn, acquire relevance. Several articles Several articles (e.g., Aizenman and Kletzer 2011; Azoulay, Fons-Rosen, and Zivin 2019; Azoulay, Graff Zivin, and Wang 2010; Azoulay, Wahlen, and Sivan 2019; Khanna 2021; Oettl 2012) take advantage of the start scientists' premature death to estimate better the spill-overs that emanate from collaboration. For example, the study of Azoulay, Graff Zivin, and Wang (2010) quantifies these spill-overs in terms of a scientist's differential of publications and research grants when collaborative ties collapse because of the death of an alter star scientist. Unlike finance literature, where executive deaths can create 'instantaneous' change in expectations about a firm's future cash flows, Azoulay et al. (2010) consider a broad

timespan to reveal the effect of exogenous shock. The rationale seems twofold. On the one hand, spillovers can 'roll over' after the death of a superstar collaborator. On the other hand, a scientist's research can take substantial time to change. These elements seem to guide the authors' choice to evaluate the effects of the shock in a fifteen-year time window (see Figure 9).

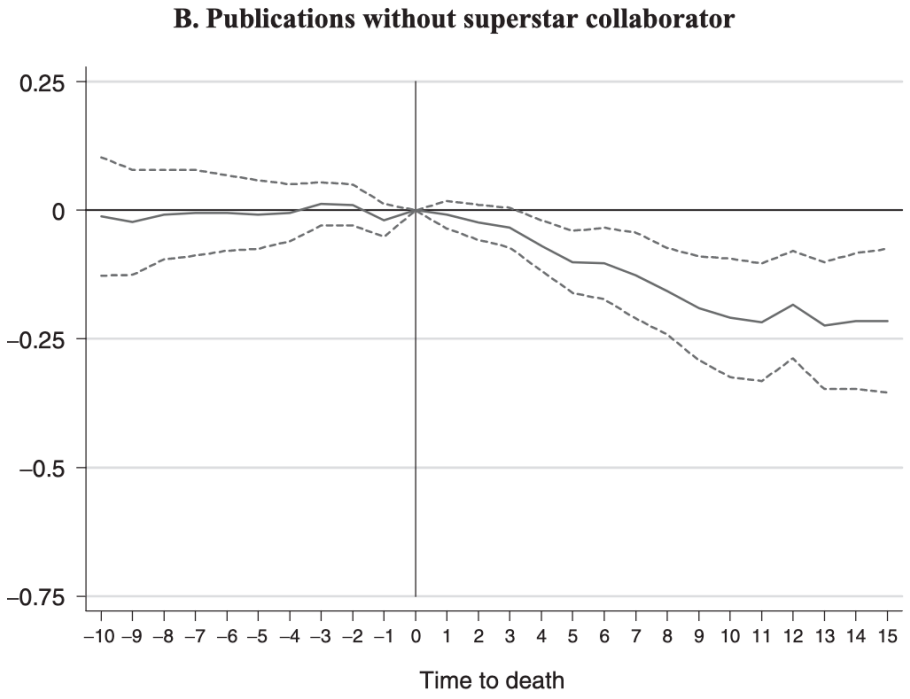

FIG. 9. — A visualization included in Azoulay et al. (2010) clarifying the timescale of the exogenous shock generated by the sudden death of a scientist's prominent collaborator. Notes: The figure, titled 'Dynamics of Treatment Effects,' is reported a page 569; here is the note describing the key aspects of the figure: *"The solid lines in the above plots correspond to coefficient estimates of conditional fixed effects quasi-maximum likelihood Poisson specifications in which the weighted publication output of a collaborator is regressed onto year effects, seventeen indicator variables corresponding to different age brackets, and interactions of the treatment effect with 27 indicator variables corresponding to eleven years before the year of death and prior, ten years before the year of death, nine years before the year of death, . . . , fourteen years after the year of death, and fifteen years after the year of death and above (the indicator variable for treatment status interacted with the year of death is omitted)."*

These two examples show the necessity of a thorough understanding of the context and intervention when making decisions about the timing with which an exogenous shock is presumed to affect a relationship or mechanism of interest. Researchers should familiarize with the context and intervention prior to their analysis. Additionally, when making a decision regarding the appropriate time window for their analysis, researchers need to find a balance between a narrow time window, which reduces the threat of confounding events or developments that may influence the relationship, and a wider time window, which increases the available sample size. Given that most decisions regarding the time window are rather arbitrary, we recommend running additional analyses with narrower and wide time windows to check the sensitivity of

the results.

The third element of our taxonomy regards the *granularity of the intervention* that stems from the exogenous shock. The minor granular intervention corresponds to a binary treatment that splits the statistical units into two experimental groups *á la* Snow (1855 (1965)). An intermediate level of granularity occurs when the exogenous shock is presumed to form more than two groups of units, each of which receives a certain amount of treatment. For instance, the study included in our review by Chen and Garg (2018) divides NBA teams into four strata: those not affected by a superstar injury (the control group) and those affected by a superstar injury implying 'short,' 'medium,' and 'long' absence. Finally, an exogenous shock may create a continuous treatment. An example is the study of Garretsen et al. (in press.), which deals with the impact of crises on managers' use of directive leadership behaviors. The authors draw on the exogenous shock emerging from the interaction between the early stages of COVID-19 pandemic and the cross-country variation in the number of COVID-19 deaths and fit a DID framework with a continuous treatment (i.e., heterogenous treatment intensity) to answer their research question

5 The Challenges of Harnessing Exogenous Shocks

This section emphasizes the empirical strategy challenges that are more likely to arise across exogenous shocks with different features. Mainly, we focus on three issues: (1) the scope of applicability of Neyman's Potential Outcome Framework; (2) the external validity of an average treatment effect; (3) interference between treated and control units, i.e., SUTVA violations. To do that, we map some ideal cases of exogenous shocks onto the taxonomy presented in the previous section (see Figure 10).

Let us consider case $A^{'}$, where a binary intervention influences a significant number of units by altering meaningful empirical relationships or theoretical mechanisms quickly. That would be the typical 'finance paper' drawing on the variance generated by the sudden death of executives. For instance, Nguyen and colleagues' (2014) paper considers 149 sudden death events whose effects are presumed to manifest in a relatively short period (i.e., eleven days). Such a case poses minimal concerns in terms of empirical strategy. First, the population of units contains a sufficient number of controls to approximate the unobservable counterfactual (e.g., how a stock price would have evolved absent the unanticipated executive turnover). Second,

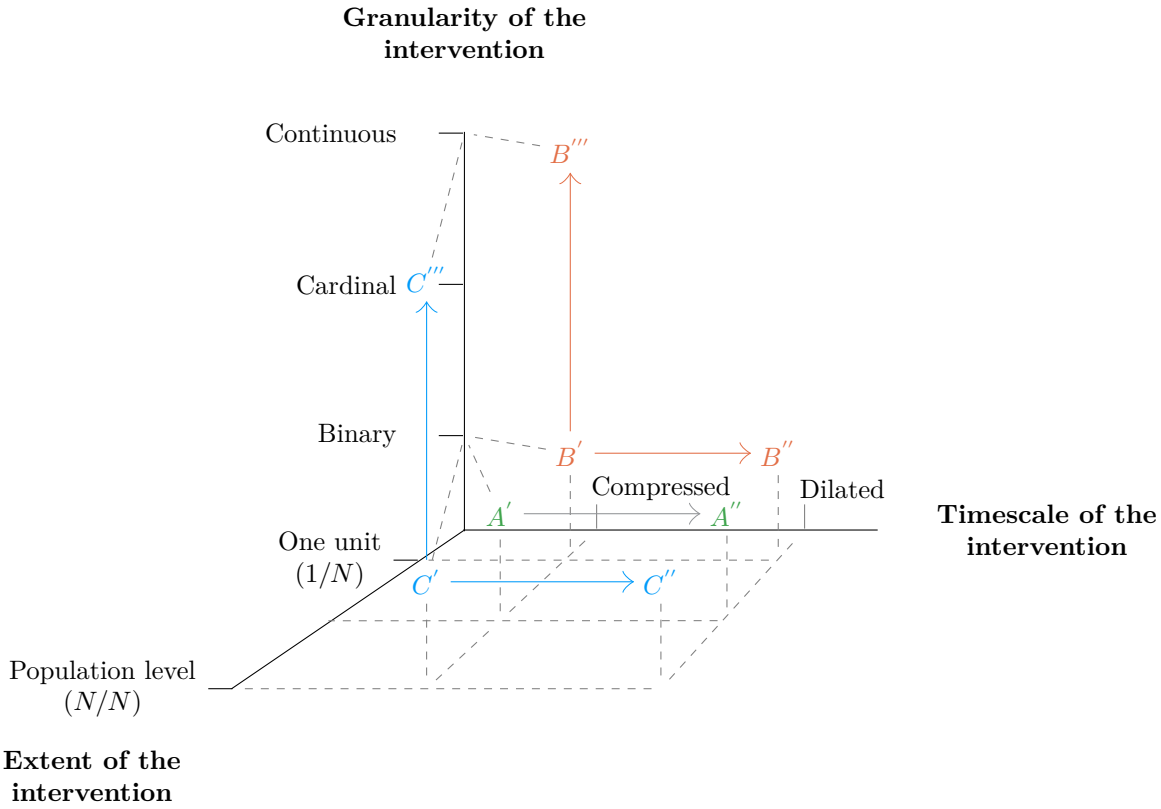

FIG. 10. — Comparative static comprising ideal cases of exogenous shocks. Notes: The key idea is that different cases present diverse degrees of concern about (1) the scope of applicability of Neyman's Potential Outcome Framework; (2) the external validity of an average treatment effect; (3) interference between treated and control units.

the binary intervention variable is 'well-behaved' and does not create range restriction issues threatening the external validity of the empirical estimates. Finally, the tight timescale of the intervention reduces the chances that control units will be unintentionally treated or affected by treated units' course of actions (that would be a vacancy chain at the executive level involving both treated and control companies, which is unlikely in a timespan such as the one Nguyen and colleagues (2014) consider).

Case A'' differs from A' because of the timescale of the intervention, which has a temporally dilated impact on the empirical relationships and/or theoretical mechanisms at the center of the study. Azoulay and colleagues' (2010) paper on 'superstar extinction' and knowledge spill-overs is consistent with this case. The author's dataset contains 112 sudden, premature ends of elite life scientists, whose effects on circa five thousand collaborators are modeled empirically over a fifteen-year timespan (see Figure 9). Similarly to A', chances are significant the population will contain suited control cases, and external validity concerns will be least. However, interference issues may arise because of the persisting impact of the shock. For instance, the effects of super-star extinction events may propagate over time through the social structure of collaboration affecting treated units' collaborators who belong to the control group. Azoulay et al. (2010) propose supplemental analysis to deal with possible SUTVA violations, which they present in terms of the *"problem of leakage through the coauthorship network"* (page 579).

In general, relying on an exogenous shock such as B' poses external validity concerns. Plausible causes are generic range restriction issues — i.e., a treatment group with little variance—and/or the presence of treated units showing idiosyncratic features. The former may appear in studies with few treated units (e.g., Aizenman and Kletzer 2011). The latter is common when naturally occurring events regard complex systems such as regions/countries (e.g., Abadie and Gardeazabal 2003), business platforms (e.g., Zhang, Li, and Tong 2020), or industrial clusters (e.g., Nathan 2020). As the population contains comparable control units, an empirical strategy can still produce causal evidence in such a scenario. However, the estimated effect is a local average treatment effect (LATE) (Imbens 2010) since it *"it only characterizes causal parameters for particular units"* (Dunning 2012, page 290). A 'cautious,' LATE interpretation of empirical estimates is—if possible—even more critical in case B_2, where the increased granularity in the treatment may exacerbate range restriction issues.[11] Alternatively,

11. The key idea is that the distribution of study variables conditional on a different level of the treatment may

the treated unit might lack a match in the control group. Then, 'Abadie's Comparative Case' method (Abadie 2021; Abadie, Diamond, and Hainmueller 2010, 2015; Abadie and Gardeazabal 2003) would be essential to create a synthetic counterfactual.[12]

Sometimes, a naturally occurring event's attributes and role *vis á vis* the target research question can impede the identification of a control group (see case C'). In our review, some studies take advantage of the variance created by 9/11 for theorizing (Corbo, Corrado, and Ferriani 2016) or measurement purposes (Vergne 2012). In contrast, none uses 9/11 to create an exogenous shock study in the sense of a natural experiment. In other circumstances, the existence of surrogate populations allows researchers to bypass the problem of a total-spectrum exogenous shock. The gender quota study of Matsa and Miller (2013) is one of the most representative examples. The government of Norway applied the '40% policy' in a non-staggered manner and made it mandatory for all public companies. The authors bypass the lack of counterfactuals by adjusting their empirical strategy in two ways. First, they consider two surrogate populations, namely Norwegian private firms and public firms located in Scandinavian countries (*ex-ante*, similar to Norway in terms of culture and institutions). Second, they use a triple Difference-in-Difference estimator to create a composite counterfactual that considers factors specific to the Norwegian economy and comparable public companies. Compared with C', cases C'' and C''' pose fewer constraints when identifying a control group. Under C'', scholars can exploit the cross-section variance created by the staggered introduction of a new policy or law, for example; C''' is consistent with studies using the variance generated by global events that, at least temporarily, have heterogeneous effects across regions or countries (e.g., Garretsen et al., in press.). This case could become increasingly popular as scholars use the COVID-19 pandemic as a source of variance in organizational practices (e.g., work from home). In Figure 11, we use a decision tree to summarize the intuitions presented in this paper section.

6 Conclusions

The aim of this editorial was twofold: first, we aimed at introducing a collection of seven articles that can serve as role models for future studies harnessing exogenous shocks in management

present significant sparsity.

12. As Abadie points out in his recent article (2021), the Synthetic Control Method was originally proposed *"with the aim to estimate the effects of aggregate interventions, that is, interventions that are implemented at an aggregate level affecting a small number of large units (such as cities, regions, or countries), on some aggregate outcome of interest" (page 392).*

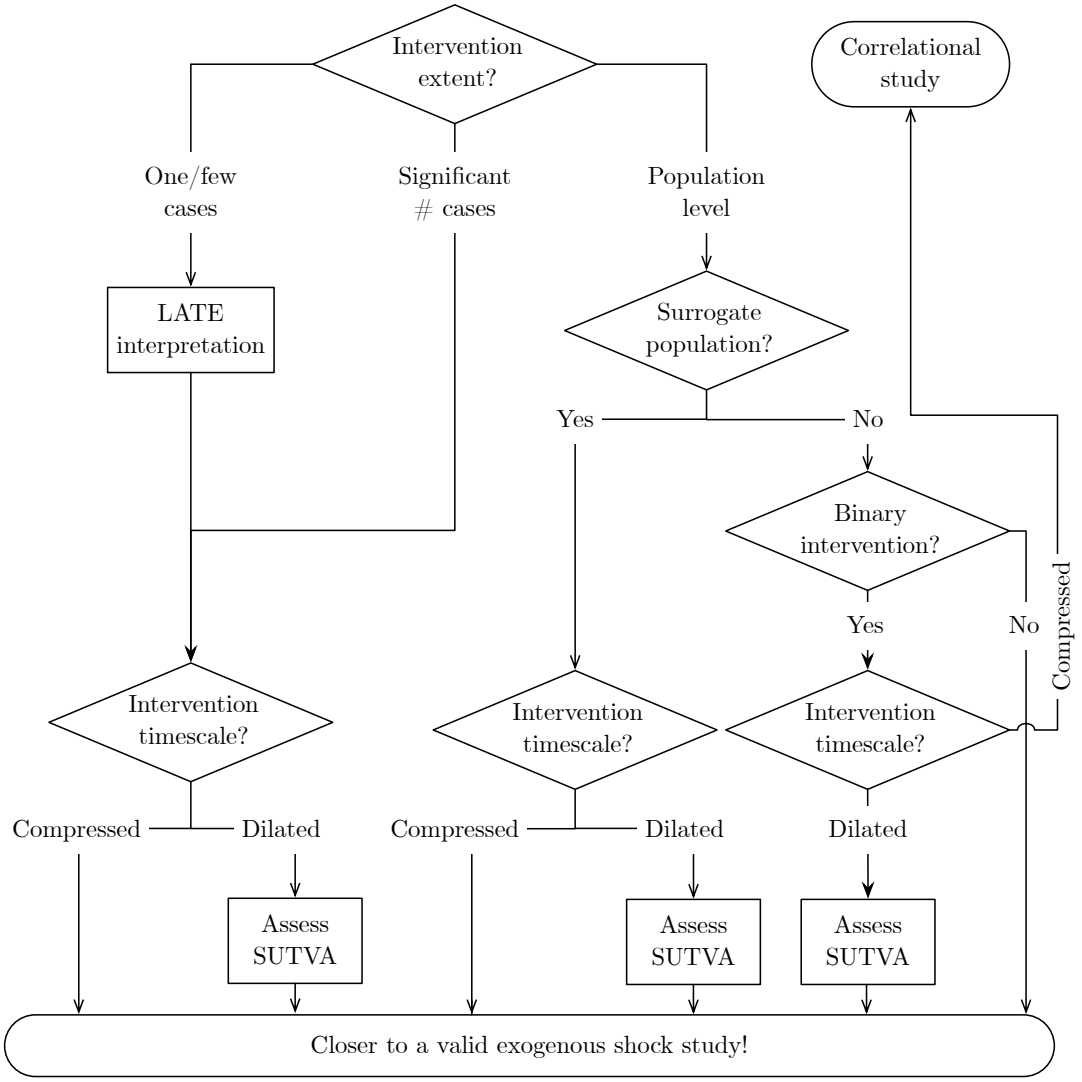

FIG. 11. — A decision tree to harness diverse exogenous shocks.

and leadership research. Second, we also aimed at contributing to a more systematic analysis of exogenous shocks. The editorial documented how the use of exogenous shocks has evolved in management and leadership research and clarified which types of exogenous shocks exist. In particular, we discussed boundaries of the exogenous shock concept and its ontological status. A key insight of our conceptualization of exogenous shocks is based on the idea that exogenous shocks do not simply exist. Rather, they emerge from the purposive association of naturally occurring events with precise research questions. As a corollary, it is not the intrinsic characteristics of a naturally occurring event that make an impactful exogenous shock study. In other words, 'relevant events' are not necessarily sudden, such as the death of a business leader because of a heart attack; uncontrollable, such as earthquakes; or random, such as lotteries. Instead, the relevance of a naturally occurring event is contingent on the empirical and theoretical problems being studied. Further, we have argued that not all exogenous shocks are born equal. Our original taxonomy highlights three key features that differentiate exogenous shocks and help scholars anticipate which empirical strategy challenges are more likely to arise conditional on the type of exogenous shock. Primarily, we have focused on three issues that have receive limited attention in leadership and management studies: the scope of applicability of Neyman's Potential Outcome Framework; the external validity of the average treatment effect estimate — i.e., the 'LATE' interpretation of statistical estimates; and the existence of treatment interference issues resulting in SUTVA violations. As such, we hope to provide useful insights for researchers, referees, and editors alike.

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