Is There a (Viable) Crucial-Case Method?

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Case study researchers use diverse methods to select their cases, a matter that has elicited considerable comment and no little consternation. Of all these methods, perhaps the most controversial is the crucial-case method, first proposed by Harry Eckstein several decades ago. Since Eckstein's influential essay, the crucial-case approach has been used in a multitude of studies across several social science disciplines and has come to be recognized as a staple of the case study method. Yet the idea of any single case playing a crucial (or critical) role is not widely accepted. In this article, the method of the crucial case is explored, and a limited defense (somewhat less expansive than that envisioned by Eckstein) of that method is undertaken. A second method of case-selection, closely associated with the logic of the crucial case, is introduced: the pathway case.

Keywords: case study; pathway case; small N analysis; qualitative methods; crucial case

Case study researchers use diverse methods to select their cases, a matter that has elicited considerable comment and no little consternation (Achen & Snidal, 1989; Collier & Mahoney, 1996; Coppedge, 2002; Eckstein, 1975; Geddes, 1990; Levy, 2002; Lieberman, 2005; Lijphart, 1971, 1975; Rohlfing, 2004; Sekhon, 2004). Of all these methods, perhaps the most controversial is the crucial-case method, first proposed by Harry Eckstein several decades ago.

In his seminal essay, Eckstein (1975) describes the crucial case as one "that *must closely fit* a theory if one is to have confidence in the theory's validity, or, conversely, *must not fit* equally well any rule contrary to that proposed" (p. 118). A case is crucial if the facts of that case are central to the confirmation or disconfirmation of a theory. In my interpretation

(following closely on Eckstein's original treatment), there are several varieties. A case is crucial in the strongest sense when it can be explained precisely by a theory; no other theory can explain the facts of that case, and the theory is invariant (deterministic). A case is crucial in a somewhat weaker sense when it is most or least likely to fulfill a theoretical prediction. A most-likely case is one that, on all dimensions except the dimension of theoretical interest, is predicted to achieve a certain outcome and yet does not. It is therefore disconfirmatory. A least-likely case is one that, on all dimensions except the dimension of theoretical interest, is predicted not to achieve a certain outcome and yet does so. It is confirmatory.

In all formulations, the crucial case is a most difficult test for an argument and hence provides what is, arguably, the strongest sort of evidence possible in a nonexperimental, single-case setting. Since Eckstein's influential essay, the approach has been used in a multitude of studies across several social science disciplines (e.g., Desch, 2002; Goodin & Smitsman, 2000; Kemp, 1986; Reilly & Phillpot, 2003) and has come to be recognized as a staple of the case study method (e.g., George & Bennett, 2005; Levy, 2002; Stinchcombe, 1968). For Eckstein's followers, the crucial case is the most methodologically defensible approach to single-case analysis.

Even so, the idea of any single case playing a crucial (or critical) role is not widely accepted among methodologists. There is considerable doubt about the usefulness of research based on single cases or a small sample of cases in which the proposition of interest pertains to a much broader population (e.g., Sekhon, 2004). Even Eckstein harbored doubts. Indeed, he could find only few examples of this method at the time of writing, a fact that provides the occasion for several wry remarks on the conclusion of his influential essay. Has the crucial case vindicated Eckstein's hopes? What, precisely, is this method?

Two issues must be disentangled to shed light on this question. The first concerns the relative falsifiability of the theory that is being confirmed or disconfirmed.[1] To the extent that a theory is falsifiable—to the extent, that is, that it has a law-like structure—it is amenable to a crucial-case test. The second issue concerns the role of the case study, which may be enlisted as a stand-alone test in the absence of additional information or as an adjunct to a larger body of empirical evidence. Specifically, the more cross-case evidence is available, the more the status of the case study shifts from a focus on covariational facts (do X and Y covary in the predicted direction?) to causal mechanisms (what pathways lead from X to Y?).

The article begins with a discussion of the stand-alone crucial case: its definition, uses, and limitations. The following section introduces a new kind of case study in which the purpose of an intensive analysis of an individual case is to elucidate causal mechanisms (i.e., to clarify a theory) rather than to confirm or disconfirm a general theory. This will be referred to as a *pathway case*. The article concludes with some observations on the problem of representativeness (sample bias) in case-study research.

The Stand-Alone Crucial Case

Harry Eckstein looked to the crucial-case method for stand-alone confirmation or disconfirmation of general theories. I shall argue that this is a plausible use of the method only in certain relatively restrictive, and probably quite rare, circumstances. The key insight into Eckstein's argument and its limitations is that the crucialness of a case rests not only on the empirical properties of the case but also on the formal properties of the theory that is being tested. Broadly speaking, I shall argue that risky theories are amenable to crucial tests, whereas more open-ended theories are not. Because the latter tend to be characteristic of most theoretical formulations in the social sciences, our enthusiasm for the crucial-case method must be tempered.

The Confirmatory (Least Likely) Crucial Case

Let us begin with the confirmatory (aka least likely) crucial case. The implicit logic of this research design may be summarized as follows. Given a set of facts, we are asked to contemplate the probability that a given theory is true. Although the facts matter, to be sure, the effectiveness of this sort of research also rests on the formal properties of the theory in question. Specifically, the degree to which a theory is amenable to confirmation is contingent on how many predictions can be derived from the theory and on how risky each individual prediction is. In Popper's (1963) words,

> Confirmations should count only if they are the result of *risky predictions*; that is to say, if, unenlightened by the theory in question, we should have expected an event which was incompatible with the theory—and event which would have refuted the theory. Every 'good' scientific theory is a prohibition; it forbids certain things to happen. The more a theory forbids, the better it is. (p. 36)

A risky prediction is therefore one that is highly precise and determinate and therefore unlikely to be achieved by the product of other causal factors (external to the theory of interest) or through stochastic processes. A theory produces many such predictions if it is fully elaborated, issuing predictions not only on the central outcome of interest but also on specific causal mechanisms and if it is broad in purview. The notion of riskiness may also be conceptualized within the Popperian lexicon as degrees of falsifiability (Popper, 1934/1968).

These points may also be articulated in Bayesian terms. Colin Howson and Peter Urbach (1989) explain:

> The degree to which h [a hypothesis] is confirmed by e [a set of evidence] depends . . . on the extent to which $P(e|h)$ exceeds $P(e)$, that is, on how much more probable e is relative to the hypothesis and background assumptions than it is relative just to background assumptions. (p. 86)

Again, "confirmation is correlated with how much more probable the evidence is if the hypothesis is true than if it is false." Thus, the stranger the prediction offered by a theory—relative to what we would normally expect—the greater the degree of confirmation that will be afforded by the evidence. As an intuitive example, Howson and Urbach (1989) offer the following:

> If a soothsayer predicts that you will meet a dark stranger sometime and you do in fact, your faith in his powers of precognition would not be much enhanced: you would probably continue to think his predictions were just the result of guesswork. However, if the prediction also gave the correct number of hairs on the head of that stranger, your previous scepticism would no doubt be severely shaken. (p. 86)

Although these Popperian and Bayesian notions[2] are relevant to all empirical research designs, they are especially relevant to case study research designs; for in these settings, a single case (or at most, a small number of cases) is required to bear a heavy burden of proof. It should be no surprise, therefore, that Popper's idea of riskiness was appropriated by case-study researchers such as Harry Eckstein to validate the enterprise of single-case analysis. (Although Eckstein does not cite Popper, the intellectual lineage is clear.) Riskiness, here, is analogous to what is usually referred to as a *most-difficult* research design, which in a case study research design would be understood as a least likely case. Also note that the distinction between a must-fit case and a least likely case—that in the event actually does fit the terms of a theory—is a matter of degrees. Cases

are more or less crucial for confirming theories. The point is that, in some circumstances, a paucity of empirical evidence may be compensated by the riskiness of the theory.

The crucial-case research design is, perforce, a highly deductive enterprise; much depends on the quality of the theory under investigation. It follows that the theories most amenable to crucial-case analysis are those which are law-like in their precision, degree of elaboration, consistency, and scope. The more a theory attains the status of a causal law, the easier it will be to confirm or disconfirm with a single case. Indeed, risky predictions are common in natural science fields such as physics, which in turn served as the template for the deductive-nomological ("covering-law") model of science that influenced Eckstein and others in the postwar decades (e.g., Hempel, 1942).

A frequently cited example is the first important empirical demonstration of the theory of relativity, which took the form of a single-event prediction on the occasion of the May 29, 1919, solar eclipse. Stephen Van Evera (1997; see also Eckstein, 1975; Popper, 1963) describes the impact of this prediction on the validation of Einstein's theory:

> Einstein's theory predicted that gravity would bend the path of light toward a gravity source by a specific amount. Hence it predicted that during a solar eclipse stars near the sun would appear displaced—stars actually behind the sun would appear next to it, and stars lying next to the sun would appear farther from it—and it predicted the amount of apparent displacement. No other theory made these predictions. The passage of this one single-case-study test brought the theory wide acceptance because the tested predictions were unique—there was no plausible competing explanation for the predicted result—hence the passed test was very strong. (pp. 66-67)

The strength of this test is the extraordinary fit between the theory and a set of facts found in a single case and the corresponding lack of fit between all other theories and this set of facts. Einstein offered an explanation of a particular set of anomalous findings that no other existing theory could make sense of. Of course, one must assume that there was no—or limited—measurement error. And one must assume that the phenomenon of interest is largely invariant; light does not bend differently at different times and places (except in ways that can be understood through the theory of relativity). And one must assume, finally, that the theory itself makes sense on other grounds (other than the case of special interest); it is a plausible general theory. If one is willing to accept these a priori assumptions, then the 1919 case study provides a very strong confirmation of the theory. It is difficult

to imagine a stronger proof of the theory from within an observational (nonexperimental) setting.

In social science settings, by contrast, one does not commonly find single-case studies offering knock-out evidence for a theory. This is, in my view, largely a product of the looseness (the underspecification) of most social science theories. George and Bennett (2005) point out that although the thesis of the democratic peace is as close to a law as social science has yet seen, it cannot be confirmed (or refuted) by looking at specific causal mechanisms, because the causal pathways mandated by the theory are multiple and diverse. Under the circumstances, no single-case test can offer strong confirmation of the theory (although, as I shall discuss below, the theory may be disconfirmed with a single case).

However, if one adopts a softer version of the crucial case method—the least-likely (and most difficult) case—then possibilities abound. Indeed, I suspect that, implicitly, most case-study work that focuses on a single case and is not nested explicitly within a cross-case analysis relies largely on the logic of the least likely case. Rarely is this logic made explicit, except perhaps in a passing phrase or two. Yet the deductive logic of the risky prediction may in fact be central to the case-study enterprise. Whether a case study is convincing or not often rests on the reader's evaluation of how strong the evidence for an argument might be, and this in turn—wherever cross-case evidence is limited and no manipulated treatment can be devised—rests on an estimation of the degree of fit between a theory and the evidence at hand, as discussed.

Lily Tsai's (2007) investigation of governance at the village level in China uses several in-depth case studies of villages that are chosen (in part) because of their least likely status relative to the theory of interest. Tsai's hypothesis is that villages with greater social solidarity (based on pre-existing religious or familial networks) will develop a higher level of social trust and mutual obligation and, as a result, will experience better governance. Crucial cases, therefore, are villages that evidence a high level of social solidarity but which, along other dimensions, would be judged least likely to develop good governance (e.g., they are poor, isolated, and lack democratic institutions or accountability mechanisms from above). The *Li Settlement* in Fujian province is such a case. The fact that this impoverished village nonetheless boasts an impressive set of infrastructural accomplishments such as paved roads with drainage ditches (a rarity in rural China) suggests that something rather unusual is going on here. Because her case is carefully chosen to eliminate rival explanations, Tsai's conclusions about the special role of social solidarity are difficult to gainsay. How else is one

to explain this otherwise anomalous result? This is the strength of the least likely case, in which all other plausible causal factors for an outcome have been minimized.[3]

Jack Levy (2002) refers to this, evocatively, as a "Sinatra inference": If it can make it here, it can make it anywhere. Thus, if social solidarity has the hypothesized effect in *Li Settlement*, it should have the same effect in more propitious settings (e.g., where there is greater economic surplus). The same implicit logic informs many case-study analyses in which the intent of the study is to confirm a hypothesis on the basis of a single case without extensive cross-case analysis (e.g., Khong, 1992; Sagan, 1995; Shafer, 1988).

The Disconfirmatory (Most Likely) Crucial Case

A central Popperian insight is that it is easier to disconfirm an inference than to confirm that same inference. (Indeed, Popper doubted that any inference could be fully confirmed, and for this reason preferred the term *corroborate*.) This is particularly true of case-study research designs, in which evidence is limited to one or several cases. The key proviso is that the theory under investigation must take a consistent (aka invariant, deterministic) form, even if its predictions are not terrifically precise, well elaborated, or broad.

As it happens, there are a fair number of invariant propositions floating around the social science disciplines (Goertz & Levy, 2006; Goertz & Starr, 2003). For example, it used to be thought that long-standing political stability could occur only in countries that are relatively homogeneous or where existing heterogeneities are mitigated by cross-cutting cleavages (Almond, 1956; Bentley, 1908/1967; Lipset, 1960/1963; Truman, 1951). Arend Lijphart's (1968) study of the Netherlands, a peaceful country with reinforcing social cleavages, is commonly viewed as refuting this older theory on the basis of a single in-depth case analysis.[4]

Granted, it may be questioned whether presumed invariant theories are really invariant; perhaps they are better understood as probabilistic. Perhaps, that is, the theory of cross-cutting cleavages is still true, probabilistically, despite the Dutch exception. Or perhaps the theory is still true, deterministically, within a subset of cases that does not include the Netherlands. (This sort of claim seems unlikely in this particular instance, but it is quite plausible in many others.) Or perhaps the theory is in need of reframing; it is true, deterministically, but applies only to cross-cutting ethnic and racial cleavages, not to cleavages that are primarily religious. One can quibble

over what it means to disconfirm a theory. It is easy to get caught up in semantic debates that have little bearing on the progress of science. The important point is that the crucial case has, in all these scenarios, provided important updating of a theoretical prior. This—not its status as confirming, disconfirming, or reconceptualizing—ought to occupy our attention.

Heretofore, I have treated causal factors as dichotomous. Countries either have reinforcing or cross-cutting cleavages, and they have regimes that are either peaceful or conflictual. Evidently, these sorts of parameters are often matters of degree. In this reading of the theory, cases are more or less crucial. Accordingly, the most useful (i.e., most crucial) case for Lijphart's purpose is one that has the most segregated social groups and the most peaceful and democratic track record. In these respects, the Netherlands was a very good choice. Indeed, the degree of disconfirmation offered by this case study is probably greater than the degree of disconfirmation that might have been provided by other cases such as in India or Papua New Guinea—countries where social peace has not always been secure. The point is that where variables are continuous rather than dichotomous, it is possible to evaluate potential cases in terms of their degree of crucialness.

Note that when disconfirming a causal argument, background causal factors are irrelevant (except as they might affect the classification of the case within the population of an inference). It does not matter how the Netherlands, India, and Papua New Guinea score on other factors that affect democracy and social peace.

The Pathway Case

Now, let us suppose a somewhat different research scenario. Here, the broader cross-case relationship is known, either on the basis of explicit cross-case investigation or on the basis of strong deductive hunches. That is, we have reason to presume that a causal factor of interest (denoted X_1) is strongly associated with an outcome (Y), holding other factors (X_2) constant. In this context, the identification of a crucial case serves not to confirm or disconfirm a causal hypothesis (because that hypothesis is already well established) but rather to clarify a hypothesis. More specifically, the case study serves to elucidate causal mechanisms.[5]

In situations where a causal hypothesis is already established prior to case study investigation, researchers are well advised to focus on a case where the causal effect of X_1 on Y can be isolated from other potentially confounding factors (X_2). I call this a "pathway case" to indicate its uniquely

penetrating insight into causal mechanisms. Because this objective is quite different from that which is usually associated with the term *crucial case*, I enlist a new term for this technique.

To clarify, the pathway case exists only in circumstances in which cross-case covariational patterns are well studied and in which the mechanism linking X_1 and Y remains dim. Because the pathway case builds on prior cross-case analysis, the problem of case-selection must be situated within that sample. There is no stand-alone pathway case. Thus, the following discussion focuses on how to select one (or a few) cases from a cross-case sample.[6]

Cross-Case Technique with Binary Variables

The logic of the pathway case is clearest in situations of causal sufficiency—in which a causal factor of interest, X_1, is sufficient by itself (though perhaps not necessary) to account for a positive outcome ($Y = 1$).[7] The other causes of Y, about which we need make no assumptions, are designated as a vector X_2. Note that wherever various causal factors are substitutable for one another, each factor is conceptualized (individually) as sufficient (Braumoeller, 2003). Thus, situations of causal equifinality presume causal sufficiency on the part of each factor or set of conjoint factors.[8]

As a way of concretizing this discussion, let us consider several specific examples culled by Bear Braumoeller (2003) and drawn from diverse fields of political science. The decision to seek an alliance is motivated by the search for either autonomy or security (Morrow, 1991). Conquest is prevented either by deterrence or defense (Schelling, 1966). Civilian intervention in military affairs is caused by either political isolation or geographical encirclement (Posen, 1984). War is the product of miscalculation or loss of control (Levy, 1983). Nonvoting is caused by ignorance, indifference, dissatisfaction, or inactivity (Ragsdale & Rusk, 1993). Voting decisions are influenced by either high levels of information or by the use of candidate gender as a proxy for social information (McDermott, 1997). Democratization comes about through leadership-initiated reform, a controlled opening to opposition, or the collapse of an authoritarian regime (Colomer, 1991). These and many other social science arguments take the form of causal substitutability—multiple paths to a given outcome.

For heuristic purposes, it will be helpful to pursue one of these examples in greater detail. I shall focus on the latter exemplar: democratization. The literature, according to Braumoeller, identifies three main avenues of democratization (there may be more, but for present purposes, let us assume that the universe is limited to three). The case study format constrains us to analyze

one at a time, so let us limit our scope to the first one: leadership-initiated reform. So considered, a causal-pathway case would be one with the following features: (a) democratization, (b) leadership-initiated reform, (c) no controlled opening to the opposition, (d) no collapse of the previous authoritarian regime, and (e) no other extraneous factors that might affect the process of democratization. In a case of this type, the causal mechanisms by which leadership-initiated reform may lead to democratization will be easiest to study. Note that it is not necessary to assume that leadership-initiated reform always leads to democratization; it may or may not be a deterministic cause. But it is necessary to assume that leadership-initiated reform can sometimes lead to democratization. This covariational assumption about the relationship between X_1 and Y is presumably sustained by the cross-case evidence (if it is not, there is no justification for a pathway case study).

Now let us move from these examples to a general-purpose model. For heuristic purposes, let us presume that all variables in that model are dichotomous (coded as 0 or 1) and that the model is complete (all causes of Y are included). All causal relationships will be coded so as to be positive: X_1 and Y covary as do X_2 and Y. This allows us to visualize a range of possible combinations at a glance.

Recall that the pathway case is always focused, by definition, on a single causal factor, denoted X_1. (The researcher's focus may shift to other causal factors but may only focus on one causal factor at a time.) In this scenario, and regardless of how many additional causes of Y there might be (denoted X_2, a vector of controls), there are only eight relevant case-types, as illustrated in Table 1. Identifying these case types is a relatively simple matter and can be accomplished in a small N sample by the construction of a truth table (modeled after Table 1) or in a large N sample by the use of cross-tabs.

Note that the total number of combinations of values depends on the number of control variables, which we have represented with a single vector, X_2. If this vector consists of a single variable, then there are only eight case-types. If this vector consists of two variables (X_{2a}, X_{2b}), then the total number of possible combinations increases from 8 (or 2^3) to 16 (or 2^4). And so forth. However, none of these combinations is relevant for present purposes except those in which X_{2a} and X_{2b} have the same value (0 or 1). Mixed cases are not causal pathway cases, for reasons that should become clear.

The pathway case, following the logic of the crucial case, is one in which the causal factor of interest, X_1, correctly predicts a positive value for Y, whereas all other possible causes of Y (represented by the vector, X_2)

Table 1
Pathway Case with Binary Variables

Case Types	X_1	X_2	Y
A	1	1	1
B	0	0	0
C	0	1	1
D	0	0	1
E	1	0	0
F	1	1	0
G	0	1	0
H	1	0	1

Note: X_1 = the variable of theoretical interest. X_2 = a vector of controls (a score of 0 indicates that all control variables have a score of 0, whereas a score of 1 indicates that all control variables have a score of 1). Y = the outcome of interest. A through H = case types (the N for each case type is indeterminate). H = pathway case. Sample size = indeterminate. The assumptions are the following: (a) all variables can be coded dichotomously (a binary coding of the concept is valid); (b) all independent variables are positively correlated with Y in the general case; and (c) X_1 is (at least sometimes) a sufficient cause of Y.

make wrong predictions. If X_1 is—at least in some circumstances—a sufficient cause of Y, then it is these sorts of cases that should be most useful for tracing causal mechanisms. There is only one such case type in Table 1: H. In all other cases, the mechanism running from X_1 to Y would be difficult to discern for one of the following reasons: The outcome to be explained does not occur ($Y = 0$); X_1 and Y are not correlated in the usual way (violating the terms of our hypothesis); or other confounding factors (X_2) intrude. In Case A, for example, the positive value on Y could be a product of X_1 or X_2. An in-depth examination of this case is not likely to be very revealing.

Keep in mind that because we already know from our cross-case examination what the general causal relationships are, we know (prior to the case study investigation) what constitutes a correct or incorrect prediction. In the crucial case method, by contrast, these expectations are deductive rather than empirical. This is what differentiates the two methods. And this is why the causal pathway case is principally useful for elucidating causal mechanisms rather than verifying or falsifying general propositions (which are already more or less apparent from the cross-case evidence).

Now let us complicate matters a bit by imagining a slightly different scenario in which at least some of these substitutable causes are conjoint

(aka conjunctural). That is, several combinations of factors—$X_a + X_b$ or $X_c + X_d$—are sufficient to affect the outcome, Y. This is known in philosophical circles as an INUS condition[9] and is the pattern of causation assumed in most Qualitative Comparative Analysis models. Here, everything that has been said so far must be adjusted so that X_1 refers to a set of causes (e.g., $X_a + X_b$) and X_2 refers to a vector of sets (e.g., $X_c + X_d$, $X_e + X_f$, $X_g + X_h$ . . .). The scoring of all these variables makes matters more difficult than in the previous set of examples. However, the logical task is identical and can be accomplished in a similar fashion (i.e., in small N datasets with truth tables and in large N datasets with cross-tabs). Case type H now refers to a conjunction of causes, but it is still the only possible pathway case.

Cross-Case Technique with Continuous Variables

Finally, we must tackle the most complicated scenario—when all (or most) variables of concern to the model are continuous rather than dichotomous. Here, the job of case-selection is considerably more complex, for causal sufficiency (in the usual sense) cannot be invoked. It is no longer plausible to assume that a given cause can be entirely partitioned (i.e., rival factors eliminated). However, the search for a pathway case may still be viable.

What we are looking for in this scenario is a case that satisfies two criteria: (a) it is not an outlier (or at least not an extreme outlier) in the general model and (b) its score on the outcome Y is strongly influenced by the theoretical variable of interest X_1, taking all other factors into account (X_2). In this sort of case, it should be easiest to observe and interpret the causal mechanisms that lie between X_1 and Y.

In a large N sample, these two desiderata may be judged by a careful attention to the residuals attached to each case. Cases are more or less typical or deviant relative to the general model, as judged by the size of their residuals. It is easy enough to exclude cases with very high residuals (e.g., standardized residual > |2|). For cases that lie closer to their predicted value, small differences in the size of their residuals may not matter so much. But ceteris paribus, one would prefer a case that lies closer to the regression line.

Achieving the second desiderata requires a bit of manipulation. To determine which (nonoutlier) cases are most strongly affected by X_1, given all the other parameters in the model, one must compare the size of the residuals for each case in a reduced form model, $Y = \text{Constant} + X_2 + \text{Res}_{\text{reduced}}$, with the size of the residuals for each case in a full model, $Y = \text{Constant} + X_2 + X_1 + \text{Res}_{\text{full}}$. The pathway case is that case or set of cases which shows

the greatest difference between the residual for the reduced-form model and the full model (ΔResidual). Thus,

$$\text{Pathway} = |\text{Res}_{\text{reduced}} - \text{Res}_{\text{full}}|, \text{ if } |\text{Res}_{\text{reduced}}| > |\text{Res}_{\text{full}}| \qquad (1)$$

Note that the residual for a case must be smaller in the full model than in the reduced-form model; otherwise, the addition of the variable of interest (X_1) pulls the case away from the regression line. We want to find a case in which the addition of X_1 pushes the case toward the regression line (i.e., it helps to explain that case).

As an example, let us suppose that we are interested in exploring the effect of mineral wealth on the prospects for democracy in a society. According to a good deal of work on this subject, countries with a bounty of natural resources—particularly oil—are less likely to democratize or, once having undergone a democratic transition, are likely to revert to authoritarian rule (Barro, 1999; Humphreys, 2005; Ross, 2001). The cross-country evidence is robust. Yet as is often the case, the causal mechanisms remain rather obscure. Consider the following list of possible causal pathways, summarized by Michael Ross (2001):

> A 'rentier effect' . . . suggests that resource-rich governments use low tax rates and patronage to relieve pressures for greater accountability; a 'repression effect' . . . argues that resources wealth retards democratization by enabling governments to boost their funding for internal security; and a 'modernization effect' . . . holds that growth based on the export of oil and minerals fails to bring about the social and cultural changes that tend to produce democratic government. (pp. 327-328)

Are all three causal mechanisms at work? Are they present in all cases and to equal degrees? Although Ross valiantly attempts to test these factors in a large N cross-country setting, his answers remain rather speculative.[10] Let us see how this might be handled by a pathway-case approach.

The factor of theoretical interest, oil wealth, may be operationalized as per capita oil production (barrels of oil produced, divided by the total population of a country [derived from Humphreys, 2005]). Democracy is measured with a variable drawn from the *Polity IV* dataset (Polity2). Additional factors in the model include GDP per capita (logged), Muslims (as a percentage of the population), European language (percentage speaking a European language), and ethnic fractionalization (1 - likelihood of two randomly chosen individuals belonging to the same ethnic group).[11] These are

all regarded as background variables that may affect a country's propensity to democratize (X_2). The cross-case model, limited to 1995, is as follows:

$$\text{Polity2} = -3.71 \text{ Constant} + 1.258 \text{ GDP} + -.075 \text{ Muslim}$$
$$+ 1.843 \text{ European} + -2.093 \text{ Ethnic fract}$$
$$+ -7.662 \text{ Oil} \qquad (2)$$

For this model, R^2 adjusted $= .450$ and $N = 149$.

The reduced-form model is identical to the above except that the variable of theoretical interest, *Oil*, is removed.

$$\text{Polity2} = -.831 \text{ Constant} + .909 \text{ GDP} + -.086 \text{ Muslim}$$
$$+ 2.242 \text{ European} + -3.023 \text{ Ethnic fract} \qquad (3)$$

For this model, R^2 adjusted $= .428$ and $N = 149$.

What does a comparison of the residuals across Equations 2 and 3 reveal? Table 2 displays the highest ΔResidual cases. Several of these may be summarily removed from consideration by virtue of the fact that $|\text{Res}_{\text{reduced}}| < |\text{Res}_{\text{full}}|$. Thus, we see that the inclusion of oil increases the residual for Norway; this case is apparently better explained without the inclusion of the variable of theoretical interest. Needless to say, this is not a good case to explore if we wish to examine the causal mechanisms between natural resource wealth and democracy.

Among cases in which the residual declines from the reduced to the full model, several are clear-cut favorites as pathway cases. The United Arab Emirates (UAE) and Kuwait have the highest ΔResidual values and also have fairly modest residuals in the full model (Res_{full}), signifying that these cases are not extreme outliers. Indeed, UAE, with a residual approaching 0, may be regarded as a typical case according to the parameters of this model. The analysis suggests, therefore, that researchers seeking to explore the effect of oil wealth on regime type might do well to focus on these two cases, because their patterns of democracy cannot be well explained by other factors (e.g., economic development, religion, European influence, or ethnic fractionalization). The presence of oil wealth in these countries would appear to have a strong independent effect on the prospects for democratization of these cases, an effect that is well modeled by our general theory and by the available cross-case evidence.

It is worth noting that although I have restricted the discussion to cross-sectional models, the logic of the pathway case is even clearer in the context of time-series cross-section models, in which variation across space

Table 2
Possible Pathway Cases in Which Variables Are Scalar and
Assumptions Are Probabilistic

Country	$Res_{reduced}$	Res_{full}	ΔResidual
Iran	−0.282	−0.456	0.175
Turkmenistan	−1.220	−1.398	0.178
Mauritania	−0.076	−0.255	0.179
Turkey	2.261	2.069	0.192
Switzerland	0.177	−0.028	0.205
Venezuela	0.148	0.355	−0.207
Belgium	0.518	0.310	0.208
Morocco	−0.540	−0.776	0.236
Jordan	0.382	0.142	0.240
Djibouti	−0.451	−0.696	0.245
Bahrain	−1.411	−1.673	0.262
Luxembourg	0.559	0.291	0.269
Singapore	−1.593	−1.864	0.271
Oman	−1.270	−0.981	−0.289
Gabon	−1.743	−1.418	−0.325
Saudi Arabia	−1.681	−1.253	−0.428
Norway	0.315	1.285	−0.971
United Arab Emirates	−1.256	−0.081	−1.175
Kuwait	−1.007	0.925	−1.932

Note: $Res_{reduced}$ = the standardized residual for a case obtained from the reduced model (without Oil) – Equation 3; Res_{full} = the standardized residual for a case obtained from the full model (with Oil) – Equation 2; ΔResidual = $Res_{reduced}$ – Res_{full} (arranged in ascending order of absolute value).

and time may be exploited. Here, the obvious choice for a pathway case is a country (or unit) that undergoes variation in X_1 and Y through time, as predicted by the theory, whereas all other factors (X_2) hold constant. This sort of case exemplifies a natural experiment. The pathway case is, quite explicitly, designed to replicate the circumstances of a (successful) experiment— but not for purposes of validation. Rather, its purpose is to gain insight into causal mechanisms.

Of course, the choice of a pathway case is no guarantee that the researcher will gain insight into general causal mechanisms (e.g., by which oil leads to autocracy). Rarely are causal mechanisms observable in the literal sense of the term. (Social science is not a bit like billiards.) Invariably, causal assessment requires considerable interpretation on the part of the researcher. When oil was discovered in UAE and Kuwait, what behavioral patterns commenced, and why? To what purposes was the oil revenue put? What effect

did it have on the recipients of this largesse and on the country's currency? Many additional questions may be imagined. The obvious point is worth emphasis: Careful reconstruction of a case does not follow apodictically from the case-selection procedure. Considerable artifice is also required (George & Bennett, 2005).

Conclusions

A good deal of ground has been covered in this short essay. I have shown, first of all, that the crucial-case research design, as introduced by Harry Eckstein several decades ago, adopts several guises. In its strictest version, the crucial case builds on a risky prediction of a given phenomenon, thus leading to a decisive confirmation or disconfirmation of a general theory. The theory is very unlikely to be true (false), given the evidence adduced by the case. This version of the crucial case rarely appears in the annals of social science (though it may be more common in the natural sciences). A looser interpretation of the method relaxes the riskiness of the prediction relative to the case, thus assigning to the case study a less epic role. These are known as "least likely" or "most likely" cases, depending on whether the analyst is intending to confirm or disconfirm a causal proposition. The logic of the analysis remains the same, but the degree of certainty invested in the conclusion is vitiated. Most case studies in the social sciences that are classified as *crucial* take the latter form. Indeed, this is the implicit logic behind most single-case analyses, regardless of whether the author identifies them with Eckstein's label.

Second, I have shown that crucial cases may be usefully distinguished according to their principal goal: to confirm or disconfirm a given hypothesis. There are positive and negative styles of argument, and the intention of an author bears directly on the plausibility of the method. That is, it is almost always easier to disconfirm a theory than to confirm it with a single case. Indeed, a theory that is understood to be deterministic may be disconfirmed by a single case, properly chosen. By the same token, we are much less likely to accept a theory based on the results of a single case study. Positive arguments are harder.

A general theme of this discussion, one largely neglected in the literature, is that the degree to which crucial cases can provide decisive confirmation or disconfirmation of a theory is in large part a product of the structure of the theory to be investigated. It is a deductive rather than inductive matter. Risky theories—ones with broad scope, many precise predictions, and a

deterministic logic—are amenable to crucial-case tests; vague and ambiguous theories are not. In short, the more a theory approaches the status of a causal law, the more this particular case study format recommends itself. In this respect, a positivist orientation toward the work of social science militates toward a greater appreciation of the case study format, not a denigration of that format, as is usually supposed. Those who, with Eckstein, embrace the notion of covering-laws, are likely to be attracted to the idea of cases that are crucial. Those who, on the other hand, are impressed by the irregularity and complexity of social behavior are unlikely to be persuaded by crucial-case studies, except perhaps as a method of disconfirming absurdly rigid causal laws.

I have argued that another sort of crucial case lurks within the research design presented by Harry Eckstein. Here, the covariational pattern between a cause and an effect is already well known and presumably has been examined across a broad range of cases. However, the causal mechanisms leading from X_1 to Y—which is to say, the theory that accounts for the covariational relationship—remains ambiguous. In this circumstance, the case study, if properly designed, presents an opportunity to see X_1 and Y interact, in isolation from all other possible causes. Because the technique and the underlying purpose of this case study are quite different from what Eckstein originally envisioned, I have assigned a new name—*the pathway case*—to this research design.

The simplest sort of pathway case exists when the variables of theoretical interest are dichotomous and when causal sufficiency can be presumed: X_1 predicts a positive outcome, all other possible causes of Y (X_2) predict a negative outcome, and Y occurs. A case of this sort may offer uniquely penetrating insights into causal mechanisms, for the covariational evidence is likely to be easier to interpret.

Where the variables of interest are continuous rather than dichotomous, the logic of elimination is less plausible, for potentially confounding causal factors (X_2) cannot be neatly partitioned. Even so, the construction of a general model and a close look at the residuals generated by that model may identify a case or a set of cases in which the value for Y is strongly influenced by a particular theoretical variable of interest (X_1), holding other factors constant (X_2). This case is likely to offer greater insight into causal mechanisms than other cases (presuming of course that it is not an extreme outlier).

Thus, the crucial case method is usefully disaggregated into several types of analysis, each building on the investigation of a single case but with different goals and different case-selection techniques. Despite the technical nature of the discussion, it should be noted that when researchers refer to a

particular case as an example of a broader phenomenon, they are usually referring to a crucial or pathway case. This sort of case illustrates the causal relationship of interest in a particularly vivid manner.

Before quitting this subject, it is important to warn about several limitations, lest the author's arguments be extended beyond their proper purview. First, in many research contexts, there may be no crucial or pathway cases that meet the expectations of the foregoing methods. We have already noted that must-fit cases are rare. So are most likely and least likely cases (presumably); otherwise, we should see many more of them. Similarly, there will not always be an ideal pathway case for a given research problem. Sometimes, even where all variables in a model are dichotomous, there are no cases of Type H (in Table 1). This is known as the "empty cell" problem or (in a statistical context) a problem of severe multicollinearity. Where variables are continuous, an additional problem may arise in which a causal variable of interest (X_1) has only minimal effects on the outcome. That is, its role in the general model is quite minor (as judged by its standardized coefficient or by F tests comparing the reduced form model and the full model). In these situations, the only cases that are strongly affected by X_1—if there are any at all—may be extreme outliers, and these sorts of cases are not properly regarded as providing confirmatory evidence for a proposition.

Second, the methods explored in this article by no means exhaust the methods appropriate to case study research (for additional options, see Seawright & Gerring, 2006). Moreover, it is quite common to combine different approaches in a given study. Thus, a researcher who wishes to investigate the putative connection between oil wealth and autocracy, as discussed in the previous example, might also wish to conduct a most-similar analysis—two cases that demonstrate different outcomes and different scores on the variable of interest (oil wealth) but have similar characteristics along other dimensions. This analysis might or might not include the previously identified pathway cases (UAE and Kuwait). In short, it is not incumbent on an investigator to follow a pure case-study research design. Often, multiple methods are helpful.

Third, case-study methods inevitably raise questions about the representativeness of the chosen cases (Achen & Snidal, 1989; Collier & Mahoney, 1996; Geddes, 1990; King, Keohane, & Verba, 1994; Rohlfing, 2004; Sekhon, 2004). To be a case of something broader than itself, the chosen case must be similar (in some respects) to a larger population. Otherwise—if it is purely idiosyncratic (unique)—it is uninformative about anything lying outside the borders of the case itself. A study based on a nonrepresentative sample has no (or very little) external validity.

Fortunately, there is some safety in numbers. Insofar as case study evidence is combined with cross-case evidence, the issue of sample bias is mitigated. Indeed, the suspicion of case study work that one finds in the social sciences today may be a product of a too-literal interpretation of the case-study method. A case study *tout court* is thought to mean a case study *tout seul*. Insofar as case studies and cross-case studies can be enlisted within the same investigation (either in the same study or by reference to other studies in the same subfield), problems of representativeness are less worrisome. This is the virtue of cross-level work (aka triangulation). And it is one of the virtues of the pathway case, which explicitly combines cross-case and within-case evidence.

Harry Eckstein's expectations that a single case could provide useful evidence for (or against) a general causal proposition are vindicated. Even so, few (if any) theoretical arguments of interest to social scientists rest solely on the basis of a single case. The only circumstances in which a single case is likely to suffice to prove a general theory is where the argument is anodyne enough to obviate the collection of additional evidence or where additional evidence is, for one reason or another, unavailable. This points us to a broader conclusion: Case studies are best viewed in conjunction with cross-case studies. In most circumstances, there is no justification for a stand-alone case study. Usually, case studies are fruitfully combined with cross-case studies, either within the same work or within a body of cumulated work on a subject.

Importantly, to say that case study evidence is complementary to cross-case evidence is not to denigrate the former in preference for the latter. Indeed, there are few instances in the annals of social science in which cross-case evidence suffices in the total absence of case-study evidence.

Notes

1. For present purposes, no important distinction is made among the following near synonyms: *confirm*, *corroborate*, *demonstrate*, *prove*, and *verify*. Similarly, I do not distinguish between *disconfirm* and *falsify*.

2. A third position, which purports to be neither Popperian or Bayesian, has been articulated by Mayo (1996, chapter 6). From this perspective, the same idea is articulated as a matter of "severe tests."

3. It should be noted that Tsai's (2007) conclusions do not rest solely on this crucial case. Indeed, she uses a broad range of methodological tools, encompassing case-study and cross-case methods.

4. Also see the discussion in Eckstein (1975) and Lijphart (1969). (For additional examples of case studies disconfirming general propositions of a deterministic nature, see Allen, 1965; Dion, 1998; Lipset, Trow, and Coleman, 1956; Njolstad, 1990; Reilly, 2000; and Rogowski, 1995).

5. Granted, insofar as case-study analysis provides a window into causal mechanisms and causal mechanisms are integral to a given theory, a single case may be enlisted to confirm or disconfirm a proposition. However, if the case study upholds a posited pattern of *X* and *Y* covariation and finds fault only with the stipulated causal mechanism, it would be more accurate to say that the study forces a reformulation of a given theory rather than its confirmation or disconfirmation.

6. This portion of the article dovetails with other efforts to situate case-selection procedures within a large *N* cross-case sample (Coppedge, 2002; Lieberman, 2005; Seawright & Gerring, 2006).

7. This may be known as a unidirectional or asymmetric cause (Clark, 2006).

8. Qualitative Comparative Analysis (Ragin, 2000), for example, presumes causal sufficiency for each of the designated causal paths.

9. An INUS condition refers to an Insufficient but Necessary part of a condition, which is itself Unnecessary but Sufficient for a particular result. Thus, when one identifies a short-circuit as the cause of a fire, one is saying, in effect, that the fire was caused by a short-circuit in conjunction with some other background factors (e.g., oxygen) that were also necessary to that outcome. But one is not implying that a short-circuit was necessary to that fire, which might have been (under different circumstances) caused by other factors. See Mackie (1965/1993).

10. Ross tests these various causal mechanisms with cross-country data, using various proxies for these concepts in the benchmark model and observing the effect of these—presumably intermediary—effects on the main variable of interest (oil resources). This is a good example of how cross-case evidence can be mustered to shed light on causal mechanisms; one is not limited to case-study formats. Still, as Ross notes (2001), these tests are by no means definitive. Indeed, the coefficient on the key oil variable remains fairly constant, except in circumstances in which the sample is severely constrained.

11. GDPpc data are from World Bank (2003). Muslims and European languages are coded by the author. Ethnic fractionalization is drawn from Alesina, Devleeschauwer, Easterly, Kurlat, and Wacziarg (2003).

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