Journal of Regulatory Economics (2024) 66:1–51
https://doi.org/10.1007/s11149-024-09483-4

ORIGINAL ARTICLE

Rules for the rulemakers: asymmetric information and the political economy of benefit-cost analysis

David Besanko[1] · **Avner A. Kreps**[2] · **Clair Yang**[3]

Accepted: 8 July 2024 / Published online: 24 July 2024
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Abstract
This paper presents a model of an executive administration that decides whether to mandate benefit-cost analysis (BCA) of newly proposed regulations. A regulator has private information about the social benefit of a new rule but may differ from the executive's preferences for regulation. BCA, which provides a noisy signal of the rule's social benefit, is most valuable when the executive is regulation neutral. Extremely regulation-averse administrations may be harmed by BCA unless they can bias it. Our results are consistent with use of BCA by U.S. presidential administrations since Reagan.

Keywords Benefit-cost analysis · Rule-making process · Environmental regulation · Asymmetric information · Information supplementation in signaling games

JEL Classification D82 · H11 · K20

1 Introduction

In developed countries around the world, regulatory rule making is a key function of a government's executive branch. The drafting of new regulations and their subsequent implementation is usually delegated to independent regulatory agencies that possess the expertise to develop new rules and assess their potential effects. These regulatory agencies are typically given wide latitude to formulate new rules consistent with prior legislative mandates. And to some extent, they are insulated from politics because

We would like to thank Michael Livermore, Nicola Persico, and David Sappington for their helpful comments and suggestions.

✉ David Besanko
d-besanko@kellogg.northwestern.edu

[1] Department of Strategy, Kellogg School of Management, Northwestern University, Evanston, USA

[2] Department of Economics, Northwestern University, Evanston, USA

[3] Henry M. Jackson School of International Studies, University of Washington, Seattle, USA

governments in most developed countries do not routinely subject new regulations to legislative review or popular vote. This is despite the sizable impact that regulations have on the economy. For example, just one set of rules, those implemented pursuant to the 1990 Clean Air Act amendment, accounted for estimated benefits of nearly $2 trillion in 2020, roughly 10 percent of U.S. GDP.[1]

While a country's executive leadership can influence the rule-making process by appointing members of regulatory bodies and courts, there is an additional, very direct way, in which a government's executive branch can affect the rule making process: the existence of a formal "gatekeeper." Such gatekeepers have the power to (a) review (and possibly disapprove) new regulations before they take effect and (b) determine how to structure the review process, e.g., what information regulatory agencies are required to provide when seeking approval to issue new regulations. In the United States, the agency with this gatekeeping responsibility is the Office of Information and Regulatory Affairs (OIRA). Other OECD countries have similar offices, such as the Treasury Board of Canada Secretariat, the Office of Best Practice Regulation in Australia, and the Secrétariat Général du Gouvernement in France.

Many of these gatekeepers require that a new regulation be subjected to regulatory impact analysis (RIA), essentially an analysis of the likely effect of the regulation on the economy. The most sophisticated RIA involves the use of benefit-cost analysis (BCA), and in some countries such as the U.S., the executive branch gatekeeper mandates the use of BCA for sufficiently large rules.

The presence of a gatekeeper can be considered an institutional arrangement that helps resolve an agency problem between the executive administration and independent regulatory agencies. The gatekeeper acts as a check on arbitrary administrative actions. It also can block new regulations that are at odds with the executive administration's policy priorities. Some scholars have argued that mandated use of BCA also helps resolve this agency problem (Sunstein, 2002; Mannix, 2016; Shapiro, 2020; Dudley, 2021). To be sure, by providing additional information about the costs and benefits of a new regulation, BCA can enhance the ability of the executive administration to monitor and influence the rulemaking process. What is less clear, though, is whether the potential gains from using BCA are the same for an executive administration irrespective of its ideological leaning. In the U.S., when the Reagan administration mandated the use of BCA for new regulations issued by independent agencies and cabinet departments in 1981, it was widely believed that BCA would serve a conservative policy agenda. But all subsequent center-left administrations (Clinton, Obama, Biden) have continued to mandate BCA (though with some modifications to required methodology), and some scholars have argued that BCA serves center-left policy priorities (Revesz & Livermore, 2008). Indeed, in the U.S., it was a staunchly right-wing administration—the Trump administration—that departed most conspicuously from generally accepted practices for benefit-cost analysis in evaluating new regulations.

This paper studies a model of regulatory rulemaking in an environment in which there is divergence of the policy preferences of an executive administration and the regulatory agency responsible for developing new regulations. Our main goal is to identify

[1] Environmental Protection Agency, "The Benefits and Costs of the Clean Air Act from 1990 to 2020," available https://www.epa.gov/sites/default/files/2015-07/documents/summaryreport.pdf (accessed November 27, 2023).

under what circumstances the executive administration would prefer to mandate the use of BCA in the rulemaking process. In the model, a new rule is developed and proposed by independent regulatory agency—the *regulator*—who has private information about the net social benefit of the proposed regulation. Consistent with practice in many OECD countries, the executive branch contains a gatekeeping office—the *executive*—who can approve the proposed rule or block it. We model the agency problem as a divergence between the regulator and the executive in the weight they give to the net social benefit of the regulation relative to the compliance costs. To deal with this information asymmetry and potentially shape the rulemaking process to best serve its policy priorities, the executive can mandate that any proposed regulation must be accompanied by a BCA that provides a noisy signal of the net social benefit.

It would seem straightforward that the executive administration would never hurt, and sometimes help, its interests by mandating the use of BCA. However, this is not the case. Specifically, we show that if the executive is sufficiently regulation averse (i.e., its welfare weight on net social benefit is sufficiently low), it would strictly prefer *not* to mandate BCA in the regulatory process even if (as we assume throughout) there is no cost of conducting BCA.[2] The intuition is that implementing BCA unavoidably makes the executive "softer" towards new rules, which lowers the overall quality of rules the regulator proposes.

We further show that BCA can be valuable to administrations across the ideological spectrum, with both regulation-averse and regulation-sympathetic administrations potentially benefitting from mandated BCA. However, the value from BCA is not distributed symmetrically across the ideological spectrum: more types of regulation-sympathetic administrations derive value from BCA than regulation-averse administrations, and the value of BCA is maximal for a regulation-neutral administration, one that is just indifferent between approving and not approving a new regulation based on its prior beliefs. BCA increases the probability that regulations are proposed or enacted if and only if the administration is regulation averse. BCA also is not useful to a sufficiently regulation-sympathetic executive, formalizing a "horseshoe theory": rather than the previously-accepted intuition that BCA benefits more conservative administrations, far-left and far-right executives have attitudes towards BCA more similar to each other than to moderate executives on either side. Throughout, we provide intuition by decomposing the impact of BCA into its effects on type 1 errors, type 2 errors, and the quality and quantity of proposed rules.

Because the outcome of BCA can depend on a host of choices (e.g., the discount rate, whether to include measures of co-benefits in the analysis), we explore what happens when the executive can commit to a BCA methodology that biases the measurement of benefits either upward or downward. When the executive has discretion in how it uses the BCA in its approval decision, a commitment to bias changes nothing: the executive simply de-biases the signals it receives from the BCA when deciding on a proposed rule. However, biasing the signal can have significant value to the executive when the executive also commits to a strict benefit-cost standard in which a rule is approved if and only if measured benefits exceed costs. We show that an executive

[2] We formally define regulation averse (as well as regulation sympathetic and regulation neutral) when setting forth the formal model in the next section.

with a higher welfare weight will choose to bias benefits upwards to a greater extent than an executive with a lower welfare weight. For plausible parameter values, the range of welfare weights in which the executive would prefer not to bias the benefit measure—i.e., to employ a strict and unbiased benefit-cost standard—is quite wide and would include both moderately regulation-averse administrations and regulation-sympathetic ones. However, a highly regulation-averse executive always prefers to bias the benefit measurement downward—to such an extent, in fact, that any proposed regulation would fail the benefit-cost standard.

After the analysis of the formal model, we provide a case study of the use of BCA in the U.S., from before the time it was first mandated in 1981 by the Reagan administration up to the present with the Biden administration. We recount the institutional context of BCA and discuss how BCA was implemented by different presidential administrations. We argue that the implications of our model are consistent with how presidential administrations from Reagan through Biden have deployed BCA in the rulemaking process.

Our paper is related to a variety of literatures. In addition to the papers mentioned above on the use of BCA to resolve the agency problem between executive administrations and regulatory agencies, our paper relates to a literature that takes a normative perspective on the virtues or drawbacks of benefit-cost analysis; see, for example, Adler and Posner (2006). Two important books in this literature are Revesz and Livermore (2008) and Livermore and Revesz (2020). These books not only contain valuable factual information about how BCA has been used in the U.S. since the Reagan administration, but they also argue that pro-regulation activists should welcome the use of BCA. Our findings that more types of regulation-sympathetic administrations derive positive value from a BCA mandate than regulation-averse ones, and that BCA increases the probability of regulations being enacted under regulation-averse administrations, are consistent with this argument.

A distinct literature focuses on the political economy of BCA and includes papers by Nyborg and Spangen (2000); Posner (2001), Adler and Posner (2006), and Cole (2012). Of these papers, Posner's is most closely related to ours in that it studies a game-theoretic interaction between an executive and regulator with different ideal points in policy space. Our model differs from Posner's in some superficial ways; for example, he assumes that the regulator can propose a level of regulation, whereas we assume the regulator has a binary choice. But a more important difference between our model and his is how BCA is modeled. Posner assumes that BCA perfectly reveals the regulator's private information and that the executive must reject any proposed regulation that is socially inefficient. By contrast, we assume that the BCA is noisy and that the executive can react strategically to it, which greatly enriches our analysis and creates more complex trade-offs for the executive. Our model also presents a full equilibrium analysis of the design of the regulatory process, enabling us to show how different arrangements governing the use of BCA depend on key parameters of the model.

Because our model involves an uninformed "receiver" (the executive) having the ability to obtain additional information about an informed "sender's" (the regulator's) type, our model is related to recent papers that explore information supplementation in signaling models. Bester et al. (2021) study an education signaling model in which employers can chose to audit the productivities of prospective employees after observing their education choices. Stahl and Strauz (2017) study a model in which price can signal a seller's private information about product quality, but where upon observing price, the buyer or the seller can decide to certify product quality. Our model differs in two important ways from these papers. First, in our model the decision to mandate or prohibit BCA, or make it voluntary is an *ex ante* commitment made by the executive, not an *ex post* choice upon receiving a proposed rule from an agency. This structure better reflects the institutional reality of regulatory decision making in which BCA is completed before a new rule is submitted to the executive branch for vetting. Second, the audit (in Bester, Lang, and Li) or quality certification (in Stahl and Strauz) is assumed to be perfectly informative of the sender's private information, while in our model the BCA is only imperfectly informative. This has important effects on the sender's equilibrium behavior, as well as on the gains and losses to the receiver from the use of additional information in the signalling game.

Closer to our paper is Daley and Green (2014) who study an education signalling model in which employers can observe a stochastic grade that provides statistical information about the workers type. The BCA in our model serves the same function that the grade plays in Daley and Green. However, Daley and Green do not focus on the *ex ante* decision to mandate the provision of grades in the first place. Moreover, the details of the labor market signaling context are different from the context of an agency problem between an executive and a regulator in ways that affect results. For example, in the education signaling model the uninformed receiver always earns zero surplus and thus can never be worse off when the grade is used. Our model takes place outside a market context, and we show that the uninformed receiver (the executive) can be worse off when the noisy measure of the sender's type is utilized in the game. As another example, Daley and Green find that a high-type worker is better off if the noisy grade is used by employers. In our model, by contrast, a regulator of either type may be better off or worse off if BCA is used, depending on the welfare weight of the executive.

Our model is also broadly related to a class of principal-agent models in which a principal must elicit information from a better-informed agent with misaligned incentives (Crawford & Sobel, 1982; Dessein, 2002; Krishna & Morgan, 2008). Unlike these papers, our agent (the regulator) has the power of agency—the regulator must propose a rule for the executive to approve it—which better aligns our model with the institutional context of BCA.

Our model also connects to analyses of principal-agent models in which more information can potentially hurt the principal (Prat, 2005; Dewatripont et al., 1999; Holmstrom, 1999; and Crémer, 1995). Our paper differs from these in two important ways. First, these papers consider principal-agent models in which the principal and agent are symmetrically uninformed about a payoff-relevant state. Our paper, on the other hand, finds a negative value of information for the principal can arise when the agent has hidden information, a setting in which one might expect that additional information would be especially valuable to the principal. Second, unlike these papers which present contracting models, in our model the principal responds to the actions of the agent, rather than committing to a contract. This means that the mechanism underlying the negative value of information in our model differs from the mechanisms in these models. The mechanism closest to that in our paper arises in Crémer (1995), where monitoring the ability of the agent can make it more difficult for the principal to commit not to renegotiate a contract in a two-period setting. Our model, of course, does not involve renegotiation, but like Crémer, giving the principal (i.e., the executive) noisy information about the agent's type "softens" the principal's response to the agent to the principal's detriment.

Finally, given the divergence between the executive and regulator's preferences for regulation in our model, our paper relates to the literature on endogenous bias of agents in models of decision making in bureaucracies (e.g., Prendergast (2007)). The paper in this literature closest to ours is Bubb and Warren (2014) which, like our paper, studies a setting in which a regulatory agency can propose a new rule that is subject to review by an executive branch gatekeeper. Unlike our paper, Bubb and Warren do not explicitly consider the use of BCA by the gatekeeper. But pertinent to our model, Bubb and Warren's analysis rationalizes why the executive might prefer to have new rules proposed by an agency that is more pro-regulation than the executive.

The remainder of this paper is organized as follows. Section 2 describes the basic model, and Sect. 3 analyzes the equilibrium in the regulatory proposal subgame for each of the executive's three possible stances on benefit-cost analysis. Section 4 explores under what circumstances the executive can profit from instituting biased BCA methodologies. Section 5 presents our case study on the use of BCA by the U.S. federal government and argues that the key implications of our model are consistent with the differences and similarities in how BCA has been used by different presidential administrations over the last 40 years. Section 6 summarizes and concludes. Unless indicated otherwise, proofs of lemmas and propositions are in the Appendix. The Online Appendix contains additional results pertinent to the robustness of our analysis to modeling choices.

2 Model

We analyze a game between the executive branch of government (the *executive*) and a representative regulatory agency (the *regulator*). The executive establishes the framework for regulatory procedure and acts as the gatekeeper that must approve or reject any proposed rule. The regulator is the nexus of expertise about circumstances that may warrant new regulatory rules and sets the agenda for rulemaking by deciding whether to propose new rules.

Figure 1 illustrates the game between the executive and the regulator. It begins with the executive choosing a framework on the use of BCA. The executive can either mandate the use of BCA by the regulator, allow the regulator to voluntarily use BCA when it submits a proposal, or prohibit the use of BCA altogether. The payoffs from the executive's decisions depend on the executive's continuation values EU_i^E, $i \in \{n, v, m\}$ determined in the regulatory proposal subgame, where the subscript n denotes prohibited BCA, v denotes voluntary BCA, and m denotes mandatory BCA.

Once it determines the framework, the regulator decides whether to develop and propose new rules. We focus on the choice of whether to develop one new rule.[3] The

[3] We do not believe much is lost by ignoring dynamic considerations and focusing attention on one rule at a time. In the U.S., for example, there are typically few economically significant rules proposed each

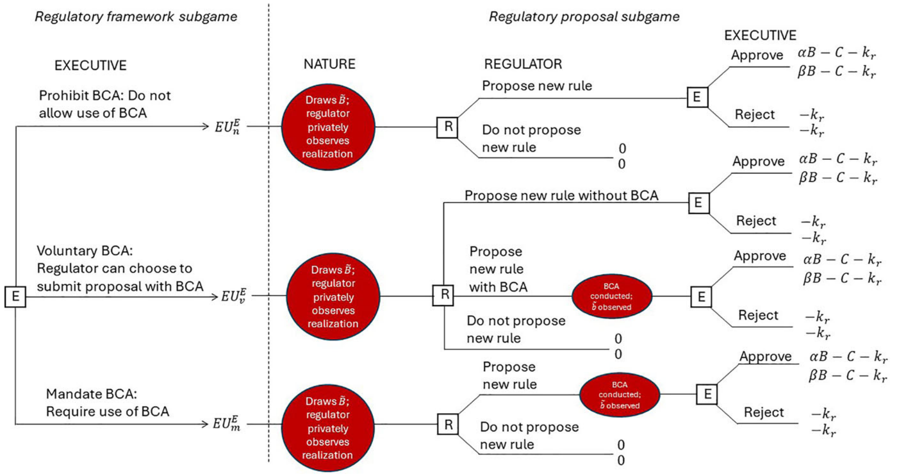

Fig. 1 The game between the regulator and executive consists of two subgames—the regulatory framework subgame and the regulatory proposal subgame. (In the latter subgame, the first payoff listed is the executive's payoff and the second is the regulator's)

rule has a present value of future net social benefits (future benefits minus future costs) B which, reflecting the regulator's subject matter expertise, is known by the regulator but not the executive.[4] Throughout, we refer to B as the *benefit* of the regulation. The regulation also has an up-front compliance cost (the *cost*) $C > 0$, which is known to both parties. The executive views the social benefit as a random variable $\widetilde{B}$ with support $\mathcal{B} = \{B^L, B^H\}$, where $B^H > C > B^L > 0$, and $\Pr(\widetilde{B} = B^H) = p$, $p \in (0, 1)$.[5] We let $B_0 = E[\widetilde{B}]$ denote the executive's prior expectation of the benefit. We refer to a regulator who knows the prospective regulation has benefit B^H as a *high-benefit regulator*; otherwise, it is a *low-benefit regulator*.

Reflecting the direct cost of developing a rule (e.g., formulating a legal rationale, drafting the language of the rule), as well as the opportunity cost to the proposing agency from devoting attention on the new rule instead of concentrating on other aspects of the agency's mission such as data gathering or enforcement, the regulator incurs a proposal cost $k_r > 0$ that is also internalized by the executive. Choosing not to develop a rule is terminal and results in a payoff of 0 for both parties. Note

Footnote3 contiuned

year by a given agency. For example, the Environmental Protection Agency has averaged approximately five economically significant rules per year since 1981. See Regulatory Studies Center, "Economically Significant Rules by Agency," https://regulatorystudies.columbian.gwu.edu/economically-significant-rules-agency. More generally, executive administrations in developed countries around the world turn over regularly, e.g., once every four or eight years in the U.S. As such, dynamic interactions between gatekeepers and regulatory agencies have a finite horizon, limiting dynamic incentives.

[4] An equivalent formulation would be that neither the regulator nor the executive knows the present value of future benefits less future costs, but the regulator knows the mean of the distribution of this present value. In this alternative formulation B is this mean.

[5] The Online Appendix analyzes a model with a continuum of types. Through a combination of formal results and computations, we show that the insights provided by the continuous-type model are largely the same as those we obtain in the two-type model.

that k_r is sunk once the regulator proposes a new rule. Therefore, while it may affect the executive's decision of regulatory regimes, which is decided before the regulator chooses whether or not to propose, it will not affect the executive's decision to approve or reject a proposed rule.

The rule is submitted with a BCA if the executive mandates BCA, or if the executive makes BCA voluntary and the regulator chooses to do so. BCA provides the executive a verifiable and informative *measured benefit* $\widetilde{b} \in \{b^H, b^L\}$, where $\Pr(\widetilde{b} = b^H | \widetilde{B} = B^H) = \Pr(\widetilde{b} = b^L | \widetilde{B} = B^L) = q \in (0.5, 1)$.[6] Developing a BCA entails no additional cost.[7] Though not necessary, it is intuitive to think of b^H and b^L taking on the values B^H and B^L, respectively.

If the regulator proposes a new rule, the executive then decides whether to accept or reject it.[8] The incremental payoff of approving the proposal for the executive is $\alpha B - C$, while the incremental payoff of having the rule approved for the regulator is $\beta B - C$, where α and β are the welfare weights of the executive and the regulator respectively.[9] The welfare weights represent how each side trades off future benefits of regulation against the compliance costs. If the executive could act only on the basis of prior information, it would prefer (resp. oppose) a new regulation whenever $\alpha B_0 - C > 0$ (resp. < 0). Accordingly, we say that an executive as *regulation neutral/averse/sympathetic* if $\alpha = / < / > \frac{C}{B_0}$. Similarly, we say that the regulator is regulation neutral/averse/sympathetic if $\beta = / < / > \frac{C+k_r}{B_0}$.[10] The incremental payoff of rejecting a rule is 0 for both sides.

The executive conditions its approval decision on all the information it has available in a subgame. When BCA is prohibited, this is simply that a new regulation has been proposed. When BCA is used, the executive can also condition its decision on the measured benefit b. And when BCA is voluntary, the executive can additionally condition on whether a proposal is submitted with a BCA or not.[11]

6 Our formulation assumes that the BCA signal is symmetrically informative. In the Online Appendix, we discuss the implications of asymmetrically biased signals, where the probability that the measured benefit is correctly identifies the true benefit depends on the underlying benefit itself.

7 Our justfication is that any additional cost of a BCA is likely to be small in comparison to k_r or C. In the Online Appendix we study a model in which a BCA has an additional cost. That cost plays virtually no role in the analysis.

8 In practice, OIRA sometimes requires revision of rules that it approves. In many cases these revisions are minor but not always (Congressional Research Service, 2011) To reflect the possibility of approval of revised rules, we can interpret the approval probability in our model (to be introduced shortly) as the scale or severity of a regulation. We show that in equilibrium this probability may be strictly between 0 and 1, which can be interpreted as a rule that is accepted by the regulator but scaled back in its severity.

9 We assume that the appointees to OIRA that actually accept or reject the proposed regulation have the same beliefs as the President, i.e., the executive is a faithful agent of the presidential administration's preferences.

10 The regulator's definition of regulation aversion contains k_r because the regulator can choose to forego the proposal cost k_r by not proposing a regulation. The executive cannot forego k_r because when it receives a proposal this cost is sunk.

11 In theory, in any subgame the regulator could also submit a message $\mu(B)$ that depends on its type, and the executive could take this message into account in its acceptance decision. However, in the Online Appendix, we show that there is no equilibrium in any subgame in which the executive conditions its acceptance decision on a message by the regulator. That is, we do not have a "cheap talk" equilibrium in the sense of Crawford and Sobel (1982).

Fixing a value of B, the ideal outcome of each actor falls in the binary set {*regulation proposed and enacted*, *regulation not proposed*}. If $\alpha \neq \beta$, there will be states of B in which the parties' ideal outcomes differ. Thus, a divergence between α and β reflects an agency problem between the executive (the principal) and the regulator (the agent). One might imagine that the executive would use its appointment power to staff a regulatory agency that is fully aligned with its welfare weight, thereby eliminating the agency problem. In practice, a combination of statutory limits (e.g., appointment terms to regulatory bodies that often overlap administrations) and civil service rules (that prevent an administration from replacing the professional staffs of regulatory agencies) make full alignment difficult to achieve. Using personnel records and voter registration files, Spenkuch et al. (2023) find that "At any given point in time... a significant number of rank-and-file bureaucrats are ideologically misaligned with their political superiors." (p. 1173). Even if an executive administration could appoint ideological allies to key leadership positions in regulatory agencies, these allies may face informational disadvantages relative to career civil servants (Moe & Wilson, 1994). In addition, as Bubb and Warren (2014) show, it may be in the executive branch's interest for the agency proposing regulations to be more pro-regulation than the executive branch.[12] Divergence between the executive's preference for regulation and the regulator's is thus likely to be the norm than the exception.

Throughout our analysis, we make the following two assumptions:

Assumption 1 $\alpha \in (\frac{C}{B^H}, \frac{C}{B^L})$.

Assumption 2 $\beta > \frac{C+\frac{k_r}{1-q}}{B^L}$

Assumption 1 makes the proposal subgame non-degenerate. If it did not hold, the executive would either approve or reject every rule, regardless of the signals provided by the regulator's proposal decision or the BCA. There are multiple ways of interpreting Assumption 2. One of its implications, $\beta > \frac{C+k_r}{B^L}$, together with Assumption 1, implies there is a meaningful agency problem between the executive and regulator. When BCA is not used, it is straightforward to prove that this rules out an equilibrium in which the regulator proposes a new rule if and only if $\widetilde{B} = B^H$ and the executive accepts any rule with probability one. Assumption 2 is slightly stronger, and can be thought of as a requirement on the support of $\widetilde{B}$ relative to the precision of the BCA, q that has the following interpretation. Suppose the executive followed a strict benefit-cost standard, accepting a proposal for a new rule with certainty if and only if it has a high measured benefit. Assumption 2 implies that if the BCA is sufficiently imprecise relative to B^L and/or that the regulator is sufficiently regulation sympathetic, a low-benefit regulator would be willing to take the gamble and propose. We view this as a realistic assumption because BCA is an inexact science that necessarily involves judgment calls about how to account for benefits and costs that may sway the final

[12] In Bubb and Warren's model, an agency that is more pro-regulation than the executive works harder to identify new regulations than one whose policy preferences are aligned with the executive's. By biasing the agency, the executive ensures less shirking by the agency in idemtifying new regulatory opportunities. In a different setting and for different reasons than Bubb and Warren (2014), Besanko and Spulber (1993) show that a presidential administration may prefer to have a divergence in welfare weights between itself and an agency with enforcement responsibilities.

measured benefit in either direction. However, we weaken this assumption in Sect. 3.4 and find that most takeaways from our analysis are maintained.

Throughout, we use as our solution concept (weak) perfect Bayesian equilibrium equipped with the D1 refinement (Banks & Sobel, 1987). The D1 refinement ensures that proposal of some kind of regulation is on path. Thus, in the BCA prohibited and BCA mandated subgames, the executive′s equilibrium beliefs upon receiving a proposed rule are directly calculable from Bayes's rule, and therefore we do not refer to beliefs when we define and discuss equilibria in these subgames.[13]

3 Regulatory proposal subgames

3.1 Prohibited BCA

The regulatory proposal subgame with BCA prohibited is a screening game, where the executive can only induce better rules by reducing its approval probability. To characterize the equilibrium in this game, let $\phi_n \in [0, 1]$ denote the probability the executive approves a proposed regulation, and let $\rho_n = \big(\rho_n(B^H), \rho_n(B^L)\big) \in [0, 1] \times [0, 1]$ denote the probability the regulator proposes a new regulation as a function of the type of regulation. Letting $\overline{\alpha}_n \equiv \frac{C}{B_0}$ denote the welfare weight at which the executive is regulation neutral, the form of the equilibrium depends on whether the executive is regulation averse (i.e., $\alpha < \overline{\alpha}_n$) or regulation sympathetic (i.e., $\alpha > \overline{\alpha}_n$).

Proposition 1 *Suppose Assumptions 1 and 2 hold. An equilibrium in the proposal subgame when BCA is prohibited exists, and if $\alpha \neq \overline{\alpha}_n$, the equilibrium is unique.*

(1) If $\alpha < \overline{\alpha}_n$, then the unique equilibrium is

$$\rho_n^* = \left(1, \frac{p(\alpha B^H - C)}{(1-p)(C - \alpha B^L)}\right),$$
$$\phi_n^* = \frac{k_r}{\beta B^L - C}.$$

(2) If $\alpha > \overline{\alpha}_n$, then the unique equilibrium is $\rho_n^* = (1, 1)$, $\phi_n^* = 1$.

(3) If $\alpha = \overline{\alpha}_n$, then there are infinitely many equilibria. In all such equilibria, $\rho_n^* = (1, 1)$ while $\phi_n^* \in [\frac{k_r}{\beta B^L - C}, 1]$.

Proposition 1 tells us that if the executive is regulation sympathetic, a pooling equilibrium arises in which both a high-benefit regulator and a low-benefit regulator propose with certainty, and the executive accepts with certainty. Under this equilibrium outcome, the executive essentially foregoes its gatekeeping power, ceding control over screening new regulations to the regulator.

[13] Without the D1 refinement, there would always be an equilibrium in which the executive believes all proposed rules have a low benefit, and the regulator does not propose any rules. D1 refines away all such equilibria because there are strictly more executive strategies that would entice a high-benefit regulator to propose than a low-benefit regulator. Thus, D1 requires that the executive's belief upon being surprised by a proposal is $\widetilde{B} = B^H$ with probability one, and the executive would like to approve such a rule by Assumption 1.

By contrast, if the executive is regulation averse, we have a semi-separating equilibrium in which a high-benefit regulator proposes with certainty, but a low-benefit regulator mixes between proposing and not proposing. The executive's equilibrium approval probability (which is less than one given Assumption 2) makes a low-benefit regulator just indifferent between proposing and not proposing a new regulation. In equilibrium, the low-benefit regulator proposes with precisely the probability $\rho_n^*(B^L)$ that makes the executive break even given its posterior expectation, i.e., $\alpha E[\widetilde{B}|\rho_n^*] = C$, where

$$E[\widetilde{B}|\rho_n^*] = \frac{p}{p + (1-p)\rho_n^*(B^L)} B^H + \frac{(1-p)\rho_n^*(B^L)}{p + (1-p)\rho_n^*(B^L)} B^L. \tag{1}$$

This makes the executive indifferent among approval probabilities and thus willing to approve a new regulation with probability $\phi_n^* = \frac{k_r}{\beta B^L - C}$.

The executive's *ex ante* expected payoff from the prohibited BCA subgame is

$$\begin{aligned} EU_n^E = {} & \phi_n^*\Big(p(\alpha B^H - C) + (1-p)\rho_n^*(B^L)(\alpha B^L - C)\Big) \\ & -(p + (1-p)\rho_n^*(B^L))k_r. \end{aligned} \tag{2}$$

Using the expressions from Proposition 1, (2) becomes:

$$EU_n^E = \begin{cases} p\left[\alpha B^H - C\right] - (1-p)\left[C - \alpha B^L\right] - k_r & \alpha > \overline{\alpha}_n \\ -pk_r\left(1 + \frac{\alpha B^H - C}{C - \alpha B^L}\right) & \alpha < \overline{\alpha}_n \end{cases}. \tag{3}$$

When $\alpha < \overline{\alpha}_n$, even though the regulator's proposal strategy ensures the executive is indifferent between accepting and rejecting a proposal, the regulator still incurs proposal costs that the executive prefers it did not. As such, the executive's expected *ex ante* payoff in this case is negative. Because the proposal cost is sunk when the executive gets to make a decision, the executive cannot credibly commit to a lower approval probability to induce the regulator to propose fewer low-benefit regulations.

To benchmark the executive's payoff from the prohibited BCA subgame, we briefly discuss the outcome in the symmetric information case—i.e., if the executive knew the realization of $\widetilde{B}$ along with the regulator. In this case, the executive will approve the rule if and only if $\widetilde{B} = B^H$. Given this, the regulator will propose the rule if and only if $\widetilde{B} = B^H$. As such, the executive's *ex ante* expected payoff is $EU_f^E = p(\alpha B^H - C - k_r)$.

The deadweight loss to the executive relative to the symmetric information case consists of three components:

$$DWL^E = EU_f^E - EU_n^E = DWL_1^E + DWL_2^E + DWL_3^E,$$

where

$$DWL_1^E = (1 - \phi_n^*)p(\alpha B^H - C), \tag{4}$$

$$DWL_2^E = \phi_n^*(1-p)\rho_n^*(B^L)(C-\alpha B^L), \tag{5}$$
$$DWL_3^E = (1-p)\rho_n^*(B^L)k_r, \tag{6}$$

which can also be written explicitly depending on the type of equilibrium:

	$\alpha > \overline{\alpha}_n$	$\alpha < \overline{\alpha}_n$
DWL_1^E	0	$\left(1 - \frac{k_r}{\beta B^L - C}\right) p(\alpha B^H - C)$
DWL_2^E	$(1-p)(C-\alpha B^L)$	$(1-p)\frac{k_r}{\beta B^L - C}(C-\alpha B^L)$
DWL_3^E	$(1-p)k_r$	$(1-p)\frac{k_r}{\beta B^L - C}k_r$

The objects DWL_1^E, DWL_2^E, and DWL_3^E represent, respectively, the *ex ante* welfare loss to the executive from three distinct distortions: type 1 error, type 2 error, and excess proposal cost. A type 1 error occurs when the executive rejects a high-benefit rule, forgoing welfare $\alpha B^H - C$. A type 2 error occurs if the regulator proposes a low-benefit rule—contrary to the executive's preferences—and the executive accepts it, imposing a loss $C - \alpha B^L$ on the executive. An excess proposal cost arises when the regulator proposes a low-benefit rule and in the process incurs cost k_r.

In the equilibrium stated in Proposition 1, a regulation-sympathetic executive does not face a type 1 error because it always approves a high-benefit regulation. However, it faces both a type 2 error and excess proposal cost stemming from the regulator proposing, and the executive approving, a low-benefit regulation. When the executive is regulation averse, the portions of the deadweight loss from a type 2 error and excess proposal cost are lower than they are when the executive is regulation sympathetic. This is due to a lower approval probability and a lower probability that a low-benefit regulation is proposed at all. However, with the lower approval probability, the regulation-averse executive opens itself up to type 1 error by rejecting a high-type rule with positive probability.

3.2 Mandated BCA

When BCA is mandated, the executive can condition its approval decision on the measured benefit $\widetilde{b}$. The executive chooses $\phi_m : [0,1]^2 \times \{b^H, b^L\} \rightrightarrows [0,1]$, where $\phi_m(\rho_m, b^j)$ is the executive's approval decision when it conjectures the regulator's proposal strategy is $\rho_m = (\rho_m(B^H), \rho_m(B^L))$ and the executive receives signal b^j from the BCA. If the executive receives signal b^H and faces a regulator it believes has proposal behavior ρ_m, it will update its conjectured expectation of $\widetilde{B}$ to be

$$E[\widetilde{B}|\rho_m, b^H] = \frac{pq\rho_m(B^H)B^H + (1-p)(1-q)\rho_m(B^L)B^L}{pq\rho_m(B^H) + (1-p)(1-q)\rho_m(B^L)}, \tag{7}$$

while if it receives signal b^L, its posterior expectation is

$$E[\widetilde{B}|\rho_m, b^L] = \frac{p(1-q)\rho_m(B^H)B^H + (1-p)q\rho_m(B^L)B^L}{p(1-q)\rho_m(B^H) + (1-p)q\rho_m(B^L)}. \tag{8}$$

The executive's best response correspondence $\phi_m(\rho_m, b^j)$ is:

$$\phi_m(\rho_m, b^j) = \begin{cases} 0 & \text{if } E[\widetilde{B}|\rho_m, b^j] < \frac{C}{\alpha} \\ \in [0,1] & \text{if } E[\widetilde{B}|\rho_m, b^j] = \frac{C}{\alpha} \\ 1 & \text{if } E[\widetilde{B}|\rho_m, b^j] > \frac{C}{\alpha} \end{cases}, \quad j = H, L. \tag{9}$$

Because $q \in (0.5, 1)$, it follows that $E[\widetilde{B}|\rho_m, b^H] \geq E[\widetilde{B}|\rho_m, b^L]$, with strict inequality if $\rho_m(B^H) > 0$ and $\rho_m(B^L) > 0$. In other words, the executive's expectation will be weakly higher if the measured benefit is b^H than if it is b^L, and strictly higher if the regulator's proposal behavior implies a positive probability of each type of regulation being proposed. As such, we have that $\phi_m(\rho_m, b^L) = 1$ implies $\phi_m(\rho_m, b^H) = 1$, and $\phi_m(\rho_m, b^H) = 0$ implies $\phi_m(\rho_m, b^L) = 0$.

The regulator's optimal proposal behavior takes the form $\rho_m : [0,1]^2 \times \{B^H, B^L\} \rightrightarrows [0,1]$, where $\rho_m(\phi_m(b^H), \phi_m(b^L), B^j)$ is a type-j regulator's best response when the executive is conjectured to approve regulations with probability $\phi_m(b^H)$ when receiving signal b^H and with probability $\phi_m(b^L)$ when receiving signal b^L. Given $\widetilde{B} = B^H$ and the executive's approval behavior $\phi_m(b^H)$ and $\phi_m(b^L)$, the regulator's expectation of the approval probability is

$$E[\phi_m|\widetilde{B} = B^H] = q\phi_m(b^H) + (1-q)\phi_m(b^L), \tag{10}$$

while if $\widetilde{B} = B^L$, the expected approval probability becomes

$$E[\phi_m|\widetilde{B} = B^L] = (1-q)\phi_m(b^H) + q\phi_m(b^L). \tag{11}$$

The regulator's best response given an approval strategy $\phi_m(\cdot)$ by the regulator is given by:

$$\rho_m(\phi_m, B^j) = \begin{cases} 1 & \text{if } \frac{C}{\beta} + \frac{k_r}{\beta E[\phi_m|\widetilde{B}=B^j]} < B^j \\ \in [0,1] & \text{if } \frac{C}{\beta} + \frac{k_r}{\beta E[\phi_m|\widetilde{B}=B^j]} = B^j \\ 0 & \text{if } \frac{C}{\beta} + \frac{k_r}{\beta E[\phi_m|\widetilde{B}=B^j]} > B^j \end{cases}, \quad j = H, L. \tag{12}$$

Whenever $\phi_m(b^H) \geq \phi_m(b^L)$, as we showed above will be the case, we have $E[\phi_m|\widetilde{B} = B^H] \geq E[\phi_m|\widetilde{B} = B^L]$ because $q \in (0.5, 1)$. Therefore $\rho_m(\phi_m, B^H) \geq \rho_m(\phi_m, B^L)$. Further, in this case, a high-benefit regulator would propose a new regulation with certainty whenever a low-benefit regulator would propose with positive probability. A low-benefit regulator would never propose a new regulation whenever a high-benefit regulator would propose with a probability below one. That is, $\rho_m(\phi_m, B^L) > 0$ implies $\rho_m(\phi_m, B^H) = 1$ and $\rho_m(\phi_m, B^H) < 1$ implies $\rho_m(\phi_m, B^L) = 0$.

An equilibrium in the mandatory BCA subgame is a pair $\{\rho_m^*, \phi_m^*\} = \{(\rho_m^*(B^H), \rho_m^*(B^L)), (\phi_m^*(b^H), \phi_m^*(b^L))\}$ such that $\rho_m^*(B^j) = \rho_m(\phi_m^*, B^j)$ and $\phi_m^*(b^j) = \phi_m(\rho_m^*, b^j)$ for each $j \in \{H, L\}$.

We now turn to deriving an equilibrium. Let $E[\widetilde{B}|\widetilde{b} = b^j]$ be the executive's expected benefit from BCA if the executive does not take into account the regulator's proposal behavior and receives signal b^j from the BCA. That is,

$$E[\widetilde{B}|\widetilde{b} = b^H] = \frac{pqB^H + (1-p)(1-q)B^L}{pq + (1-p)(1-q)}. \tag{13}$$

$$E[\widetilde{B}|\widetilde{b} = b^L] = \frac{p(1-q)B^H + (1-p)qB^L}{p(1-q) + (1-p)q}. \tag{14}$$

Because $q \in (0.5, 1)$, $E[\widetilde{B}|\widetilde{b} = b^H] > E[\widetilde{B}|\widetilde{b} = b^L]$. We can also define $\overline{\alpha}_m(b^j)$ as the welfare weight that makes the executive indifferent between approving and rejecting a rule with a BCA signal b^j, without taking the regulator's proposal behavior into account:

$$\overline{\alpha}_m(b^j) = \frac{C}{E[\widetilde{B}|\widetilde{b} = b^j]}, \quad j = H, L,$$

where $\overline{\alpha}_m(b^L) > \overline{\alpha}_n > \overline{\alpha}_m(b^H)$. To be willing to approve a regulation with a low measured benefit from the BCA, the executive must therefore have a higher welfare weight than it would need to be willing to approve a regulation with a high measured benefit.

The nature of the equilibrium depends on α in relation to $\overline{\alpha}_m(b^H)$ and $\overline{\alpha}_m(b^L)$. Similar to the prohibited BCA case, as the following proposition shows, an equilibrium in the mandated BCA subgame exists and, barring knife's-edge equalities among parameters, is unique.

Proposition 2 *Suppose Assumptions 1 and 2 hold. There exists an equilibrium in the regulatory proposal subgame. Assuming that equality conditions between parameters are not satisfied, this equilibrium is unique.*[14]

1. If $\alpha \geq \overline{\alpha}_m(b^L)$, then the equilibrium is $\rho_m^* = (1, 1)$, $\phi_m^* = (1, 1)$.
2. If $\alpha \in [\overline{\alpha}_m(b^H), \overline{\alpha}_m(b^L)]$, then the equilibrium is $\rho_m^* = (1, 1)$, $\phi_m^* = (1, 0)$.
3. If $\alpha \leq \overline{\alpha}_m(b^H)$, then the equilibrium is $\rho_m^* = (1, \rho_m^*(B^L))$, $\phi_m^* = (\phi_m^*(b^H), 0)$, with

$$\rho_m^*(B^L) = \frac{pq(\alpha B^H - C)}{(1-p)(1-q)(C - \alpha B^L)} \in (0, 1], \tag{15}$$

$$\phi_m^*(b^H) = \frac{k_r}{(1-q)(\beta B^L - C)} \in (0, 1]. \tag{16}$$

[14] If any of the below weak inequalities are satisfied with equality, we get multiple equilibria.

Proposition 2 indicates that the equilibrium takes three distinct forms depending on α, with each corresponding to the executive trading off the possibility of type 1 errors against type 2 errors differently. In scenario 1, the executive is highly regulation sympathetic, and therefore chooses to eliminate completely the possibility of type 1 error at the cost of accepting the highest amount of type 2 error possible by not taking into consideration the informational content of the BCA and simply approving all rules. In scenario 2, as in scenario 1, both a high-benefit regulator and a low-benefit regulator propose a new regulation with certainty. But because the executive is neither overwhelmingly regulation sympathetic nor overwhelmingly regulation averse, BCA turns out to be a sufficiently effective screening mechanism for balancing the likelihood of type 1 and type 2 errors. Consequently, the executive accepts a proposed rule with certainty if it has a high measured benefit, and it rejects a proposal with certainty if it has a low measured benefit. Finally, in scenario 3, the executive is so regulation averse that BCA is not tough enough for the executive—it encourages a low-benefit regulator to propose a new regulation too frequently, thereby inducing too high a probability of type 2 errors. The executive thus rejects with positive probability rules that have a high measured benefit. This increases the rate of type 1 error, but it moderates type 2 error somewhat, and it disciplines a low-benefit regulator into proposing with a lower probability.

The executive's *ex ante* expected payoff EU_m^E in this subgame is

$$\begin{aligned} EU_m^E = p\bigg(\Big(q\phi_m^*(b^H) + (1-q)\phi_m^*(b^L)\Big)\Big(\alpha B^H - C\Big) - k_r\bigg) \\ + (1-p)\rho_m^*(B^L)\bigg(\Big(q\phi_m^*(b^L) + (1-q)\phi_m^*(b^H)\Big)\Big(\alpha B^L - C\Big) - k_r\bigg) \end{aligned}$$

which, given Proposition 2, can be written as

$$EU_m^E = \begin{cases} p(\alpha B^H - C) - (1-p)(C - \alpha B^L) - k_r & \alpha \in [\overline{\alpha}_m(b^L), \frac{C}{B^L}) \\ pq(\alpha B^H - C) - (1-p)(1-q)(C - \alpha B^L) - k_r & \alpha \in [\overline{\alpha}_m(b^H), \overline{\alpha}_m(b^L)] \\ -k_r p\left(1 + \frac{q(\alpha B^H - C)}{(1-q)(C - \alpha B^L)}\right) & \alpha \in \left(\frac{C}{B_H}, \overline{\alpha}_m(b^H)\right] \end{cases}. \tag{17}$$

3.3 The value of mandating BCA

Before turning to the subgame in which the executive opts for voluntary BCA, we explore the value to the executive from mandating BCA. The gain to the executive from mandating BCA relative to a BCA-prohibition baseline is:

$$\begin{aligned} \Delta^E(\alpha) \equiv EU_m^E - EU_n^E = p\bigg(\Big(q\phi_m^*(b^H) + (1-q)\phi_m^*(b^L) - \phi_n^*\Big)\Big(\alpha B^H - C\Big)\bigg) \\ + (1-p)(\rho_m^*(B^L) - \rho_n^*(B^L))\bigg(\Big(q\phi_m^*(b^L) + (1-q)\phi_m^*(b^H) - \phi_n^*\Big)\Big(\alpha B^L - C\Big) - k_r\bigg). \end{aligned}$$

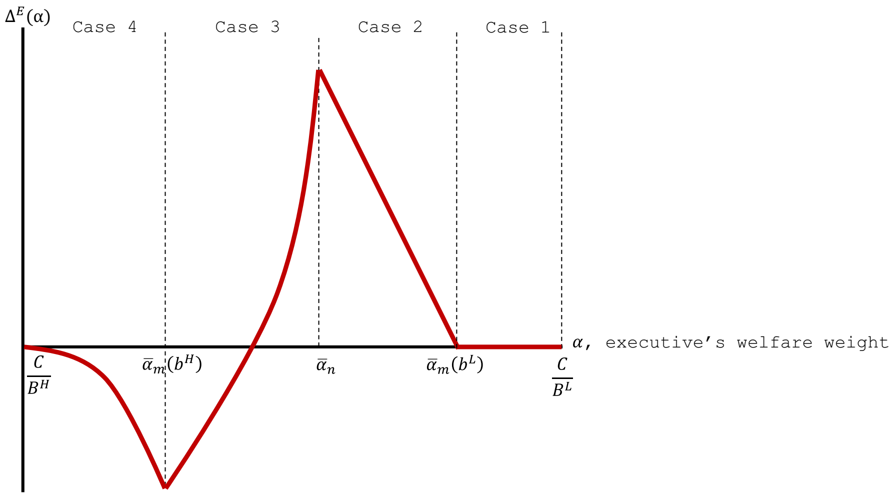

Fig. 2 The different cases implied by the expression for $\Delta^E(\alpha)$

Using (3) and (17), we can see that the expression for $\Delta^E(\alpha)$ gives rises to four distinct cases, illustrated by the graph of $\Delta^E(\alpha)$ in Fig. 2 and given by the expression in (18) below:[15]

$$\Delta^E(\alpha) = \begin{cases} 0 & \alpha \in [\overline{\alpha}_m(b^L), \frac{C}{B^L}) \\ (1-p)q(C-\alpha B^L) - p(1-q)(\alpha B^H - C) & \alpha \in \left[\overline{\alpha}_n, \overline{\alpha}_m(b^L)\right] \\ pq(\alpha B^H - C) - (1-p)(1-q)(C-\alpha B^L) + (1-p)\left[\frac{p(\alpha B^H - C)}{(1-p)(C-\alpha B^L)} - 1\right]k_r & \alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_n\right] \\ -p\left(\frac{2q-1}{q}\right)\left(\frac{\alpha B^H - C}{C-\alpha B^L}\right)k_r & \alpha \in \left(\frac{C}{B_H}, \overline{\alpha}_m(b^H)\right] \end{cases} \tag{18}$$

It is straightforward to establish that $\Delta^E(\alpha)$ is (i) continuous in α; (ii) strictly decreasing in α for $\alpha \in \left(\frac{C}{B_H}, \overline{\alpha}_m(b^H)\right]$ and $\alpha \in \left[\overline{\alpha}_n, \overline{\alpha}_m(b^L)\right]$; and (iii) strictly increasing in α for $\alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_n\right]$. Because there is no direct cost of conducting a BCA, $\Delta^E(\alpha)$ represents the executive's *maximum willingness to pay for BCA.*

Each case represents an archetypal executive administration. Case 1, $\alpha \in (\overline{\alpha}_m(b^L), \frac{C}{B^L})$, is a highly regulation-sympathetic administration. It would approve any proposed regulation both with and without BCA. Consequently, a BCA mandate does not change the proposal behavior of the regulator: with or without BCA, a low-benefit regulator and a high-benefit regulator propose a new regulation no matter what. As we can see from (18) and Fig. 2, there is neither a gain nor a loss from using BCA (though if BCA had even a small direct cost a highly regulation-sympathetic administration would prefer not to mandate it).

[15] These expressions are derived from straightforward but tedious algebraic manipulation of the expressions found by taking the difference between (17) and (3).

Case 2, $\alpha \in \left[\overline{\alpha}_n, \overline{\alpha}_m(b^L)\right]$, is a somewhat regulation-sympathetic administration. Without BCA, it would approve any proposed regulation, and the regulator would propose a low-benefit and high-benefit regulation no matter what. By contrast, with BCA the proposal behavior of the regulator is unchanged ($\rho_m^* = \rho_n^*$), but with a BCA mandate instead of accepting any proposal with certainty, the executive will accept only those proposals for which the measured benefit is high. In essence, the equilibrium behavior of the administration is observationally identical to a strict benefit-cost standard, and a BCA mandate effectively induces the executive to become more selective in the proposed regulations it accepts.

Case 3, $\alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_n\right]$, is a somewhat regulation-averse administration. In the absence of BCA, this administration would approve a proposed regulation with a positive probability $\frac{k_r}{\beta B^L - C}$, and a low-benefit-regulation would be proposed with less than probability one, while a high benefit regulation would be proposed with probability one. With a BCA mandate, the outcome for this administration is the same as that for a somewhat regulation-sympathetic administration: a proposal with a high measured benefit is accepted, and a proposal with a low measured benefit is rejected. This induces both a high-benefit regulator and a low-benefit regulator to propose with probability one. Given how the executive conditions on BCA in equilibrium, the expected approval probability when a low-benefit regulation is proposed is $1 - q$ and the expected approval probability when a high-benefit regulation is proposed is q. With the significant agency problem embodied in Assumption 2, both these approval probabilities exceed the equilibrium approval probability without BCA. Consequently, the BCA mandate tends to make a somewhat regulation-averse administration less selective than it would otherwise be.

Case 4, $\alpha \in \left(\frac{C}{B_H}, \overline{\alpha}_m(b^H)\right]$, is a highly regulation-averse administration. In the absence of BCA, this administration would achieve the same equilibrium as the somewhat regulation-averse administration. However, with a BCA mandate, it always rejects a proposal with a low measured benefit, and it sometimes even rejects proposals with a high measured benefit. As we discussed above, this deters a low-benefit regulator from proposing with too high a probability.

To further understand these archetypes, we decompose $\Delta^E(\alpha)$ into three components representing, respectively, the extent to which BCA reduces or increases the executive's welfare loss from type 1 error, type 2 error, and excess proposal cost:

$$\Delta^E(\alpha) = \Delta_1 + \Delta_2 + \Delta_3,$$

where

$$\Delta_1 = p(q\phi_m^*(b^H) + (1-q)\phi_m^*(b^L) - \phi_n^*)(\alpha B^H - C). \tag{19}$$

$$\Delta_2 = (1-p)\big(\phi_n^*\rho_n^*(B^L) - \big[(1-q)\phi_m^*(b^H) + q\phi_m^*(b^L)\big]\rho_m^*(B^L)\big)(C - \alpha B^L). \tag{20}$$

$$\Delta_3 = (1-p)(\rho_n^*(B^L) - \rho_m^*(B^L))k_r. \tag{21}$$

Table 1 Signs of Δ_1, Δ_2, and Δ_3

Case	Executive's regulatory preference?	Δ_1	Δ_2	Δ_3	Selection?
1	Highly regulation sympathetic	0	0	0	BCA does not change selection
2	Somewhat regulation sympathetic	$-$	$+$	0	BCA does not change selection
3	Somewhat regulation averse	$+$	$-$	$-$	BCA worsens selection
4	Highly regulation averse	$+$	$-$	$-$	BCA worsens selection

In the Appendix, we identify the signs of the decomposition terms for each of the four cases, and Table 1 summarizes this analysis.[16] The final column in the table ("Selection?") refers to whether BCA results in a lower probability that a low-benefit rule is proposed, i.e., $\rho_m^*(B^L) < \rho_n^*(B^L)$.

Four things are noteworthy about the results summarized in Table 1. First, observe from (19) that $\Delta_1 > 0$ if and only if the use of BCA increases the probability that the executive approves a socially beneficial regulation. Since Table 1 shows that $\Delta_1 > 0$ for regulation-averse administrations, our model suggests that, contrary to a view held by some advocates of more aggressive regulation, BCA can make it more likely that "good" regulations are approved. Our model thus formalizes one of the key themes in Revesz and Livermore (2008) who argued that environmental, safety, and consumer advocacy groups should welcome the use of BCA, not oppose it, when it is utilized by a conservative administration. These advocates fail to take into account the counterfactual of prohibiting BCA under a conservative administration: that such administrations would optimally crack down on regulation they are *ex ante* opposed to.

Second, BCA reduces the probability of enacting regulations of either type only when the executive is somewhat regulation-sympathetic (case 2). This qualifies our support for the thesis of Revesz and Livermore, and suggests that pro-regulation activists should focus on removing BCA only for center-left administrations, in which the executive is *ex ante* inclined to approve regulations but is not so regulation sympathetic that it would approve rules a BCA deems to be of low quality.

Third, except when utilized by a highly regulation-sympathetic administration, BCA creates a trade-off for the executive between controlling welfare losses from type 1 errors, on the one hand and welfare losses from type 2 errors and excess proposal costs on the other. For the regulation-sympathetic executive in case 2, BCA worsens the welfare loss from a type 1 error, while reducing the welfare losses from a type 2 error and expected proposal costs. For the regulation-averse executives in cases 3 and 4, BCA reduces the welfare loss from a type 1 error, while increasing the welfare loss

[16] A positive sign indicates that BCA reduces a welfare loss, and a negative sign indicates that it exacerbates a welfare loss.

from a type 2 error and expected proposal costs. There is no value of α for which BCA unambiguously reduces all three sources of welfare loss.

Fourth, Table 1 illustrates that BCA never improves selection, and when the executive is regulation averse, it worsens it. This finding is reminiscent of the conclusion in Posner (2001) that use of BCA can result in more regulation being proposed and enacted. In his model, that is because BCA perfectly reveals regulator's private information, but in our model the mechanism is different. BCA gives the executive flexibility that it does not have without BCA: it can condition the approval decision on the measured benefit. When the executive is regulation averse this "softens" the executive's approval incentives.

To see why, consider an arbitrary proposal strategy by the regulator $\rho = (1, \rho(B^L))$ in which a high-benefit regulator proposes with probability one and a low-benefit regulator proposes with probability $\rho(B^L)$. (As part of the proofs of Propositions 1 and 2, we establish that any equilibrium has this form.) With BCA prohibited, the executive's *willingness to accept a proposal* (WTA) when it conjectures the regulator's strategy is ρ is

$$WTA(\rho(B^L)) \equiv \alpha E[\widetilde{B}|\rho(B^L)] - C = \alpha \frac{pB^H + (1-p)\rho(B^L)B^L}{p + (1-p)\rho(B^L)} - C,$$

From (7) and (8), the executive's WTA with BCA when the measured benefits are b^H and b^L, respectively are

$$\begin{aligned}
&WTA^H(\rho(B^L)) \\
&\equiv \alpha E[\widetilde{B}|\rho(B^L), b^H] - C = \alpha \frac{pqB^H + (1-p)(1-q)\rho(B^L)B^L}{pq + (1-p)(1-q)\rho(B^L)} - C. \\
&WTA^L(\rho(B^L)) \\
&\equiv \alpha E[\widetilde{B}|\rho(B^L), b^L] - C = \alpha \frac{p(1-q)B^H + (1-p)q\rho(B^L)B^L}{p(1-q) + (1-p)q\rho(B^L)} - C.
\end{aligned}$$

It is straightforward to show that (i) $WTA(0) = WTA^H(0) = WTA^L(0) = \alpha B^H - C$, and because $q > \frac{1}{2}$, for $\rho(B^L) \in (0, 1]$,

$$WTA^H(\rho(B^L)) > WTA(\rho(B^L)) > WTA^L(\rho(B^L)).$$

That is, *holding the regulator's proposal strategy fixed*, the executive's WTA with a high measured benefit under BCA is greater than its (unconditional) WTA without a BCA. So, for example, if a regulation-averse executive conjectured that the regulator's proposal strategy was equal to its equilibrium proposal strategy without BCA, i.e., $\rho = \rho_n^* = \left(1, \frac{p(\alpha B^H - C)}{(1-p)(C-\alpha B^L)}\right)$, we would have $WTA^H(\rho_n^*(B^L)) > WTA(\rho_n^*(B^L)) = 0 > WTA^L(\rho_n^*(B^L))$, and the executive would approve a proposal with a high measured benefit and reject a proposed regulation with a low measured benefit. This implies that the expected approval probability facing a low-benefit regulator would be $1-q$, and given Assumption 2, this exceeds the equilibrium approval probability

$\phi_n^* = \frac{k_r}{\beta B^L - C}$ when there is no BCA. Thus, starting from the no-BCA equilibrium, the BCA mandate induces a regulation-averse executive to behave in a way that results in a low-benefit regulator facing a higher approval probability than it would have had BCA not been used. This, in turn, makes it more attractive for a low-benefit regulator to propose, which in equilibrium worsens selection. The upshot of this analysis is that by enabling the executive to condition its approval decision on the outcome of the BCA, when the measured benefit is high, the executive's WTA shifts upward relative to its unconditional WTA when BCA is not used. When the agency problem between the regulator and executive is sufficiently severe in the sense implied by Assumptions 1 and 2, this can have the counterproductive effect of making a low-benefit regulator more motivated to propose a new regulation.

The worsening of selection directly increases the welfare loss from excess proposal costs for a regulation-averse executive, and it also contributes to an increase in the welfare loss from a type 2 error which, as Table 1 illustrates, occurs for a regulation-averse executive. Although BCA helps reduce welfare losses from type 1 errors for a regulation-averse executive, the latter is less valuable for an executive with a sufficiently low α. Indeed, if α is sufficiently low, the additional welfare losses from type 2 errors and excess proposals costs brought about by a BCA mandate can more than offset the reduction in the welfare loss from type 1 errors, leading the executive to prefer not to mandate BCA even though BCA has no direct cost.

Proposition 3 $\Delta^E(\alpha) < 0$ *for* $\alpha \in \left(\frac{C}{B^H}, \overline{\alpha}_m(b^H)\right]$. *Moreover, there exists* $\overline{\alpha}_{nm} \in \left(\overline{\alpha}_m(b^H), \overline{\alpha}_n\right)$ *such that* $\Delta^E(\alpha) < 0$ *for* $\alpha \in \left(\overline{\alpha}_m(b^H), \overline{\alpha}_{nm}\right)$. *That is, an executive who is highly regulation averse or even somewhat regulation averse would prefer not to mandate BCA.*

It may seem counterintuitive that the executive could be harmed by employing BCA even if it has no direct cost. One might expect that BCA would always make the executive better off *ex ante* because it gives the executive greater flexibility in responding to a proposal for a new rule than it has when BCA is prohibited. However, as just discussed, when the agency problem between the executive and regulator is sufficiently severe in the sense implied by Assumptions 1 and 2, the flexibility provided by BCA can be disadvantageous for the executive: it can increase (relative to the setting in which BCA is prohibited) the likelihood that the executive approves a low-benefit proposal, and in equilibrium, this can worsen selection.

When the executive is highly regulation averse, i.e., $\alpha \in \left(\frac{C}{B^H}, \overline{\alpha}_m(b^H)\right]$ equilibrium selection is so much worse than it is in the absence of the BCA that even a proposal with a high measured benefit becomes "suspect," and as we pointed out above the executive rejects such proposals with positive probability, while rejecting a proposal with a low measured benefit with certainty. Despite this "tough" stance by the executive, the expected approval probability conditional on $\widetilde{B} = B^H$, $q\phi_m^*(b^H) + (1-q)\phi_m^*(b^L)$, exceeds the expected approval probability ϕ_n^* when BCA is not used, thus reducing the welfare loss to the executive from a type 1 error.[17] But a highly regulation-averse executive gains relatively little from a reduction in type 1 errors—after all, $\alpha B^H - C$ is quite low, and as α approaches the lower bound of its range, it goes to zero—and thus the deterioration in selection relative to the no-BCA case implies that the welfare losses to the executive from type 2 errors and excess proposal costs more than offsets this gain. For a sufficiently regulation-averse executive, abjuring the use of BCA is a way to tie its hands *ex ante* so that it is less inclined to accept proposed regulations.

The finding that a principal can be hurt by more information arises in other papers in the principal-agent literature such as Prat (2005); Dewatripont et al. (1999); Holmstrom (1999), and Crémer (1995). Our model is quite different from the models in these papers, though the mechanism in our model somewhat resembles that in Crémer (1995) which shows that monitoring an agent's ability can undermine the principal's ability to commit not to renegotiate its initial contract with the agent.

Though a BCA mandate may not necessarily be valuable for an extremely regulation-averse executive, it is valuable for a regulation-neutral executive, for a somewhat regulation-sympathetic executive, and for a somewhat-regulation averse executive, provided that the latter's welfare weight is not "too low."

Proposition 4 *(a) $\Delta^E(\alpha)$ attains its maximum value at $\alpha = \overline{\alpha}_n$, and $\Delta^E(\overline{\alpha}_n) > 0$. That is, an executive that is regulation neutral obtains the highest value from a BCA mandate and that value is positive; (b) $\Delta^E(\alpha) > 0$ for $\alpha \in (\overline{\alpha}_n, \overline{\alpha}_m(b^L))$. That is, any somewhat regulation-sympathetic executive would prefer to mandate BCA; (c) There exists $\overline{\alpha}_{nm} \in \left(\overline{\alpha}_m(b^H), \overline{\alpha}_n\right)$ such that $\Delta^E(\alpha) > 0$ for $\alpha \in (\overline{\alpha}_{nm}, \overline{\alpha}_n)$. That is, an executive who is somewhat, but not too, regulation-averse would prefer to mandate BCA.*

To see why Proposition 4 holds, consider a somewhat regulation-sympathetic executive. From Propositions 1 and 2, we see that as the executive's welfare weight changes in the interval $(\overline{\alpha}_n, \overline{\alpha}_m(b^L))$, selection is unaffected by a BCA mandate: $\rho_n^* = \rho_m^* = (1, 1)$. However, BCA makes the executive "choosier" in accepting proposals: it only accepts proposals with a high measured benefit, whereas it would accept any proposal when BCA is not used. As a result, the BCA mandate creates a welfare loss from a type 1 error that did not arise without BCA, and this welfare loss is more costly to an executive with a higher α. The maximum willingness to pay for BCA $\Delta^E(\alpha)$ thus decreases as α increases above $\overline{\alpha}_n$.

Consider, next, a somewhat regulation-averse executive. From Propositions 1 and 2, without a BCA mandate, such an executive rejects a proposed regulation with positive probability, and the probability that a low-benefit regulation is proposed is less than one. Mandating BCA worsens selection, moving it from $\rho_n^* = \left(1, \frac{p(\alpha B^H - C)}{(1-p)(C-\alpha B^L)}\right)$ to $\rho_m^* = (1, 1)$, worsening the welfare loss from a type 2 error and excess proposal costs.

[17] From Proposition 2 and (16),

$$q\phi_m^*(b^H) + (1-q)\phi_m^*(b^L) = q\frac{k_r}{(1-q)(\beta B^L - C)} > \frac{k_r}{(\beta B^L - C)} = \phi_n^*,$$

when $\alpha \in \left(\frac{C}{B^H}, \overline{\alpha}_m(b^H)\right]$ because $q > \frac{1}{2}$.

At the same time, executive accepts proposals with a high measured benefit and rejects those with a low measured benefit. The net effect of this is to change the probability of acceptance of a high-benefit regulation from $\phi_n^* = \frac{k_r}{\beta B^L - C}$ to $E[\phi_m^* | \widetilde{B} = B^H] = q\phi_m^*(b^H) + (1-q)\phi_m^*(b^L) = q$, and given Assumption 2 and $q > \frac{1}{2}$, this change is positive.[18] Thus, a BCA mandate for a somewhat regulation-averse executive creates a trade-off: a worse welfare loss from a type 2 error and excess proposal costs in exchange for a reduced welfare loss from a type 1 error. As α decreases below $\overline{\alpha}_n$, this trade-off becomes more unfavorable. As the executive becomes more regulation averse, the gain from reducing type 1 errors diminishes and the cost of increasing type 2 errors grows.

Proposition 4 establishes that the ideological spectrum along which an executive would favor mandating BCA is broad: ranging from a center-right regulation-averse administration to a center-left regulation-sympathetic administration. Notably, taking Propositions 3 and 4 together, we see that this ideological spectrum is asymmetric. Any somewhat regulation-sympathetic administration favors a BCA mandate, but some executives within the somewhat regulation-averse set would not favor it. Moreover, a highly regulation-averse executive would not favor a BCA mandate, while a highly regulation-sympathetic executive is indifferent between the use and non-use of BCA.

Before concluding this section it is also useful to categorize the impact of BCA on the regulator. Let $\Delta^R(\alpha, B^j)$ denote the gain or loss to a regulator of type B^j from a BCA mandate relative to a BCA prohibition. Using the properties of the equilibrium characterized in Propositions 1 and 2 it is straightforward to derive:

$$\Delta^R(\alpha, B^L) = \begin{cases} 0 & \alpha \in (\overline{\alpha}_m(b^L), \frac{C}{B^L}) \\ -q\left(\beta B^L - C\right) < 0 & \alpha \in \left[\overline{\alpha}_n, \overline{\alpha}_m(b^L)\right] \\ (1-q)(\beta B^L - C) - k_r > 0 & \alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_n\right] \\ 0 & \alpha \in \left(\frac{C}{B_H}, \overline{\alpha}_m(b^H)\right] \end{cases} . \quad (22)$$

$$\Delta^R(\alpha, B^H) = \begin{cases} 0 & \alpha \in (\overline{\alpha}_m(b^L), \frac{C}{B^L}) \\ -(1-q)\left(\beta B^H - C\right) < 0 & \alpha \in \left[\overline{\alpha}_n, \overline{\alpha}_m(b^L)\right] \\ (\beta B^H - C)\left[q - \frac{k_r}{\beta B^L - C}\right] > 0 & \alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_n\right] \\ \left(\frac{q}{1-q} - 1\right)\left[\frac{\beta B^H - C}{\beta B^L - C}\right] k_r > 0 & \alpha \in \left(\frac{C}{B_H}, \overline{\alpha}_m(b^H)\right] \end{cases} , \quad (23)$$

where the inequalities for the case $\alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_n\right]$ follow from Assumption 2 and $q > \frac{1}{2}$. Comparing (22) and (23) to (18), we see that a BCA mandate represents a Pareto improvement for a mildly regulation-averse administration, i.e., α just below $\overline{\alpha}_n$. On the other hand, a somewhat regulation-sympathetic administration ($\alpha \in \left[\overline{\alpha}_n, \overline{\alpha}_m(b^L)\right]$) would favor a BCA mandate, while a regulator of either type would oppose it. This is because the BCA mandate in this case increases the likelihood that a proposed regulation is rejected. To the extent that a regulator's preferences reflect external constituencies who are aligned with the regulator's mission, we would

[18] Assumption 2 implies $(1-q)(\beta B^L - C) > k_r$. Because $q > \frac{1}{2}$, we have $q > 1-q$, and thus $q(\beta B^L - C) > k_r$, or $q > \frac{k_r}{\beta B^L - C}$.

expect that mandatory BCA would be politically unpopular with these constituencies. This is what we observe in the U.S. (Revesz & Livermore, 2008).

3.4 What happens if the executive and regulator are more fully aligned?

Assumption 2 implies that the agency problem between the executive and regulator is significant in that the regulator is willing to take a risk of proposing in the hope that the outcome of the BCA is favorable. In this section, we explore what happens if the misalignment between the executive and the regulator is less severe. In particular, we replace Assumption 2 with

Assumption 3 $\beta \in \left(\frac{C+k_r}{B^L}, \frac{C+\frac{k_r}{1-q}}{B^L} \right)$

With this assumption, an agency problem still exists between the executive and the regulator in that when BCA is not used, a low-benefit regulator would be willing to propose if it believed the executive would approve a proposal with certainty. However, the agency problem is less severe than is implied by Assumption 2 enabling BCA to do a better job deterring a low-benefit regulator from proposing. In particular, when BCA is used a low-benefit regulator would be deterred from proposing if the executive rejected a proposal with a low measured benefit with certainty while accepting one with a high measured benefit with certainty.

The proof of Proposition 1 immediately implies that the equilibrium in the BCA prohibition subgame is the same as that characterized in that proposition. Moreover, when $\alpha \geq \overline{\alpha}_m(b^L)$, the equilibrium in the BCA mandate subgame is the same as that stated in Proposition 2: $\rho_m^* = (1, 1)$, $\phi_m^* = (1, 1)$. But if $\alpha \leq \overline{\alpha}_m(b^L)$, the equilibrium in the BCA mandate differs from Proposition 2; it is $\rho_m^* = (1, \rho_m^*(B^L))$, $\phi_m^* = (1, \phi_m^*(b^L))$, where[19]

$$\rho_m^*(B^L) = \frac{p(1-q)(\alpha B^H - C)}{(1-p)q(C - \alpha B^L)} \in (0, 1], \tag{24}$$

$$\phi_m^*(b^L) = \frac{k_r}{q(\beta B^L - C)} - \frac{1-q}{q} \in (0, 1]. \tag{25}$$

With a less severe agency problem, any executive other than a highly regulation-sympathetic one accepts a proposal with a high measured benefit with certainty and accepts a proposal with a low measured benefit with positive probability. Moreover, comparing $\rho_m^*(B^L)$ in (24) to $\rho_n^*(B^L)$ in Proposition 1, we see that BCA improves selection both when the executive is regulation averse and regulation neutral.

Assumption 3 gives rise to the following maximum willingness to pay for a BCA mandate:

[19] We derive this equilibrium in the Online Appendix.

$$\Delta^E(\alpha) = \begin{cases} 0 & \alpha \in [\overline{\alpha}_m(b^L), \frac{C}{B^L}) \\ (1-p)\left[1 - \frac{(1-q)p}{q(1-p)}\left(\frac{\alpha B^H - C}{C - \alpha B^L}\right)\right]\left[C - \alpha B^L + k_r\right] & \alpha \in [\overline{\alpha}_n, \overline{\alpha}_m(b^L)] \\ p\left[\frac{2q-1}{q}\left(\frac{\alpha B^H - C}{C - \alpha B^L}\right)\right]\left[C - \alpha B^L + k_r\right] & \alpha \in (\frac{C}{B^H}, \overline{\alpha}_n] \end{cases} . \tag{26}$$

It is straightforward to show that as when Assumption 2 holds, $\Delta^E(\alpha)$ is continuous, and it is maximized at $\alpha = \overline{\alpha}_n$. Thus, no matter the assumed severity of the agency problem, the maximal benefit of a BCA mandate accrues to regulation-neutral executive. The key difference is that the expression for $\Delta^E(\alpha)$ in (26) is strictly positive for $\alpha \in (\frac{C}{B^H}, \overline{\alpha}_m(b^L))$, with $\lim_{\alpha \to \frac{C}{B^H}} \Delta^E(\alpha) = 0$. That is, in contrast to the case in which the agency problem is severe, a BCA always has positive value to an executive, even one that is highly regulation-averse, although that value diminishes as regulation aversion increases. Indeed, we can also show that for any $\alpha \in (\frac{C}{B^H}, \overline{\alpha}_m(b^L)]$, $\Delta^E(\alpha)$ when Assumption 3 holds is greater than $\Delta^E(\alpha)$ when Assumption 2 holds. The implication of this subsection is that BCA is more valuable to the executive when the agency problem between the executive and regulator is less severe. Making that problem less severe is certainly something the executive can control to some extent, but as we discuss below in the case study of the use of BCA in the United States, there are limits to how much an executive administration can do this.

3.5 Voluntary BCA

We now consider the middle branch of the game portrayed in Fig. 1, in which the regulator may choose whether to conduct a BCA or not when submitting a rule. We begin with the observation that voluntary BCA can only result in a different outcome from a BCA prohibition or a BCA mandate if it gives rise to a *maximally separating* equilibrium, in which at least one type of regulator places positive probability weight on the option "Propose with a BCA" and at least one type (which could in principle be the same type) places positive weight on "Propose without a BCA." The set of non-maximally separating equilibrium outcomes—i.e., those in which the regulator chooses to either never propose with a BCA or never propose without a BCA—is a subset of the set of all equilibrium outcomes in the BCA mandated and BCA proposed equilibria, because there are strictly more conditions on both the regulator's strategy and the executive's beliefs. For example, proposing without a BCA not only must be better for the regulator than not proposing (as it was before), but it now must also be better than proposing with a BCA. Therefore, we confine our search to the set of maximally separating equilibria.

It is straightforward to rule out several types of maximally separating equilibria. For example, we can rule out any type of maximally separating equilibrium in which the low-benefit regulator proposes in a way that the high-benefit regulator does not, because the executive would optimally reject any proposal coming from the way the low-benefit regulator proposes, and the low-benefit regulator would be better off not proposing. We also cannot have the low-benefit regulator never propose (as then the executive would optimally approve all proposals, enticing the low-benefit regulator to propose). Nor can we have an equilibrium in which both the low- and high-benefit regulators do not propose with positive probability (as the conditions under which it is optimal for the low-benefit regulator to not propose imply that it is suboptimal for the high-benefit regulator to not propose).

We can continue with this logic to eliminate every type of maximally separating equilibrium besides the following three:

1. A high-benefit regulator mixes over {"Propose with a BCA", "Propose without a BCA"}; a low-benefit regulator mixes over { "Propose without a BCA", "Do not propose"}.
2. A high-benefit regulator mixes over {"Propose with a BCA", "Propose without a BCA"}; a low-benefit regulator also mixes over {"Propose with a BCA", "Propose without a BCA"}.
3. A high-benefit regulator mixes over {"Propose with a BCA", "Propose without a BCA"}; a low-benefit regulator mixes over { "Propose with a BCA", "Propose without a BCA", "Do not propose"}.

As it turns out, none of these are supportable as maximally separating equilibria.

Lemma 1 *A maximally separating equilibrium does not exist.*

As the next proposition illustrates, Lemma 1 is not an artifact of our two-type specification.

Proposition 5 *Consider a model with a general distribution of benefit types.*[20] *Then any maximally separating equilibrium is outcome-equivalent to an equilibrium in which BCA is prohibited.*

The intuition is that if the executive tries to use the signal provided by a proposal with a BCA to differentially condition on good and bad signals, then the regulator will only propose sufficiently high-benefit rules with a BCA. In this case, the executive will approve all proposals accompanied by a BCA, enticing any type of regulator to propose with a BCA. In fact, to sustain an equilibrium, the executive's approval probability needs to be constant in the BCA outcome and equal to the approval probability without a BCA, which is outcome-equivalent to a prohibited-BCA equilibrium.

Overall, then, as the structure of the game does not allow the regulator to credibly signal the quality of the regulation with its choice of whether to propose with a BCA or not, giving the regulator the option to propose with a BCA does not result in any meaningful improvements for the executive. Thus, our model rationalizes why executive administrations generally do not give regulators the freedom to choose whether to conduct a BCA when they propose a rule.

[20] In such a model, the executive views the social benefit as a random variable $\widetilde{B}$ with distribution function $F_0(B)$ defined on a support $\mathcal{B}$ that could be finite or continuous. A BCA reveals a possibly noisy signal $\widetilde{b}$ whose conditional probability distribution $G(\cdot|B)$ possibly depends on B and is defined on a support $\mathcal{T}(B)$. This support could either be finite or continuous. The benefit and signal $(\widetilde{B}, \widetilde{b})$ are affiliated, reflecting the idea that a better BCA signal is seen as "good news" for the likely effects of the rule. This general specification encompasses our two-type specification, a specification with multiple discrete types, or a continuum of types.

4 Introducing bias and commitment to BCA

The analysis above presumes a fixed information structure for the BCA. However, in practice, the executive could possibly set the parameters of the BCA to change the probability of receiving a good or bad signal, or the available menu of signals. In this section, we explore whether it would benefit the executive to do so.

4.1 Discretionary BCA with bias

Conducting a BCA typically requires making a host of choices about how to measure, discount, and categorize benefits and costs. One example pertinent to environmental regulations is whether the benefits from a new rule should include co-benefits, i.e., benefits that arise indirectly as a result of the enactment of the rule. For example, in the BCA done to support the original Mercury and Air Toxics standards issued in 2011, only a small fraction of benefits came from the reduction of emissions of mercury and other toxic metals; most came from other sources, such as reduction in carbon emissions. Another prominent example is how to measure the social cost of carbon. In the Obama administration, an inter-agency task force developed the administration's initial \$43 per ton estimate of the social cost of carbon by employing models that assessed the damage from carbon emissions on a global basis. Most economists use this approach. But the social cost of carbon is much lower when assessed only based on the impact of climate change on the U.S. economy. The Trump administration adopted this approach to justify a social cost of carbon between \$1 and \$7 (Friedman, 2020). Finally, executive administrations must decide how to discount benefits to future generations. The Biden administration, in the new regulatory review guidelines published in November 2023, announced that it would use a separate and lower discount rate for regulations that have benefits well into the future.[21]

The choices the agencies face in interpreting empirical evidence that go into a BCA or the theoretical foundations of benefit and cost measurement opens the door to the possibility that the executive makes strategic methodological choices so that BCA is more likely to support outcomes it prefers. One way to think about bias is that the executive commits to a methodology such that

$$\widetilde{b}_a = \widetilde{b} + A,$$

where $\widetilde{b}$ is the true measured benefit, and A is the degree of bias in the measurement of net benefits. When $A = 0$, we have the model analyzed in the previous section. When $A > 0$ (< 0) the measurement of net benefits is biased upward (downward).

However, as long as the executive has discretion in how to condition its approval decision on the measured benefit—which is what we assumed in the preceding analysis and what we now refer to as *discretionary BCA*—this form of bias has no effect on the outcome. This is trivially true in the two-type model: the information structure $\{b^H + A, b^L + A\}$ with probabilities $\{q, 1-q\}$ (probabilities $\{1-q, q\}$) if $B = B^H$

[21] See Office of Management and Budget, "Circular No. A-4," November 9, 2023, available at https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf.

(if $B = B^L$) is no different than the information structure in which the realizations are $\{b^H, b^L\}$. But the insight is true for any distribution of $\widetilde{b}$ and prior beliefs. This is because when faced with a proposal, the executive will simply "de-bias" $\widetilde{b}_a$ when computing its posterior expectation conditional on the regulator having submitted a proposal.[22] That is, as long as the executive has discretion in how to act on a biased measured benefit $\widetilde{b}_a$, the executive will act on $\widetilde{b}_a$ the same way it would act on $\widetilde{b}$ because the informational content of the two signals when it comes to the underlying social benefit B is the same.[23]

4.2 Strict BCA standard with bias

The preceding analysis suggests that biasing BCA can only be useful to the executive to the extent that it can also commit itself to a standard for how it is used. A natural standard to consider would be a commitment to approve a proposed regulation if and only if its measured benefits exceeded costs, where the executive can, as in the previous section, mandate a measurement methodology that can bias the measurement of net social benefits upward or downward. We call this case *strict BCA with bias*. A strict BCA standard can be thought of as a literal interpretation of BCA mandates requiring that rules be implemented if measured benefits exceed costs.[24]

Accordingly, we assume the executive commits to accepting a proposed rule if and only if $\widetilde{b}_a \geq C$, or equivalently $\widetilde{b} \geq C - A$, where $\widetilde{b}$ is an unbiased BCA. The executive's approval decision is $\phi_s(\widetilde{b}) = 1$ if $\widetilde{b} + A > C$, and $\phi_s(\widetilde{b}) = 0$ otherwise. Recalling that $B^L < C < B^H$, the executive then has three meaningful choices for A. If it chooses $A > C - B^L > 0$, any proposed regulation would pass the strict benefit-cost standard. It chooses $A < C - B^H < 0$, then a proposed regulation could not satisfy the strict benefit-cost standard, and if $A \in [C - B^H, C - B^L]$ (and in particular, $A = 0$), then the regulation satisfies the standard if $\widetilde{b} = B^H$ but not if $\widetilde{b} = B^L$.

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22 In a model where $\widetilde{b} \sim G(\cdot|B)$, with associated density function $g(\cdot|B)$, the executive's posterior distribution conditioned on any realization b of $\widetilde{b}$ is $f(B|b) = \frac{g(b|B)f_0(B)}{\int_{\mathcal{B}} g(b|x)f_0(x)dx}$. Letting $f_a(B|b_a)$ denote the executive's posterior distribution conditioned on a realized value of $\widetilde{b}_a = \widetilde{b} + A$, it is straightforward to establish that $f_a(B|b_a) = f(B|b)$. Thus the informational content of $\widetilde{b}_a$ is no different from that of $\widetilde{b}$.

23 The Online Appendix presents an analysis of an alternative model of bias in which the executive can commit to methodologies that change the information structure of the BCA signal. In particular, in that model the executive can commit to increasing or decreasing the probability of a high measured benefit by a given amount. This form of bias creates an asymmetry by making the informativeness of the signal $\widetilde{b}$ dependent on the underlying state B. We show that when the executive has discretion, a commitment to this form of bias can meaningfully affect the equilibrium in the regulatory proposal subgame.

24 For example, Executive Order 12291 in the U.S. One might wonder how a strict benefit-cost standard comports with statutory language that requires regulators to consider only the benefits of proposed regulations. For example, the Clean Air Act requires that in formulating National Ambient Air Quality Standards the Environmental Protection Agency consider only the protection of public health with an adequete margin of safety. However, this statutory language notwithstanding, the Enviromental Protection Agency was still bound by Executive Order 12291 and later 12866. Congressional Research Service (2017). Moreover, in our model, the regulator is certainly free, if it wishes, to incorporate compliance costs C in its own welfare function $\beta B^j - C - k_r$. And as $\beta \to \infty$, the regulator increasingly considers only the benefits of a regulation and not costs.

Hereafter, it is useful to denote the executive's choice set upon choosing a level of bias as $\mathcal{A} = \{A^-, 0, A^+\}$, where $A = A^+$ represents an a fixed positive number greater than $C - B^L$ and $A = A^-$ corresponds to a fixed negative number less than $C - B^H$. Letting $EU_s^E(A, \alpha)$ denote the executive's expected welfare, the executive's problem is

$$\max_{A \in \mathcal{A}} EU_s^E(A, \alpha).$$

To derive the expression for $EU_s^E(A, \alpha)$, we need to see how A affects the regulator's behavior. If $A = A^-$, no type of regulator would propose. If $A = A^+$, a regulation of either type would satisfy the strict benefit-cost standard, and a regulator of either type would propose a new rule. (In particular, Assumption 2 implies that a low-benefit regulator would propose.) If $A = 0$, $E[\phi_s(\widetilde{b})|B^H] = q$ and $E[\phi_s(\widetilde{b})|B^L] = 1 - q$. Because $(1-q)\,[\beta B^L - C] - k_r \geq 0$ from Assumption 2, a low-benefit regulator would propose a new regulation. And since $q > 1 - q$ and $B^H > B^L$, a high-benefit regulator would also propose when $A = 0$. Given the regulator's proposal behavior, we have[25]

$$EU_s^E(A, \alpha) = \begin{cases} p\left[\alpha B^H - C\right] - (1-p)\left[C - \alpha B^L\right] - k_r & \text{if } A = A^+ \\ pq\left[\alpha B^H - C\right] - (1-p)(1-q)[C - \alpha B^L] - k_r & \text{if } A = 0 \\ 0 & \text{if } A = A^- \end{cases}. \tag{27}$$

It is useful to establish

Lemma 2 *$EU_s^E(A, \alpha)$ is supermodular in (A, α).*

Topkis (1978) then immediately implies:

Proposition 6 *$A^*(\alpha)$ is weakly increasing in α.*[26]

The intuition is straightforward. The higher its welfare weight, the more concerned the executive will be about reducing type 1 errors and the less concerned about type 2 errors and proposal costs. Increasing the (positive) bias trades off reductions in the former for increases in the latter.

We note three distinctive properties of the solution to the executive's optimization problem. First, there must exists a value $\overline{\alpha}_s$ such that $A^*(\alpha) = A^-$ for all $\alpha \in \left(\frac{C}{B^H}, \overline{\alpha}_s\right)$, and thus $EU_s^E(\alpha) = EU_s^E(A^*(\alpha), \alpha) = 0$.[27] Because (from (3))

[25] This expression presumes Assumptions 1 and 2 hold. If instead Assumptions 1 and 3 held, the expression for $EU_s^E(A, \alpha)$ is the same when $A = A^+$: and $A = A^-$, but when A = 0, it becomes $EU_s^E(A, \alpha) = pq\left[\alpha B^H - C\right] - pk_r$. All of the results proved below also hold when Assumptions 1 and 3 held, although some details in Proposition 7 are different, as noted below.

[26] In the alternative model of bias with executive discretion analyzed in the Online Appendix, we obtain a result that is analogous to this proposition: a regulation-sympathetic executive's optimal bias in the probability of a high signal is at least as large as that for a regulation-neutral or regulation-averse executive.

[27] This follows directly from the expressions in (27) which imply $EU_s^E(0, \frac{C}{B^H}) = -(1-p)(1-q)\frac{C}{B^H}[B^H - B^L] - k_r < 0$, and $EU_s^E(A^+, \frac{C}{B^H}) = -(1-p)\frac{C}{B^H}\left[B^H - B^L\right] - k_r < 0$.

$\lim_{\alpha \to \frac{C}{B^H}} EU_n^E = -pk_r$ and (from (17)) $\lim_{\alpha \to \frac{C}{B^H}} EU_m^E = -pk_r$, a sufficiently regulation-averse administration would prefer to mandate BCA with a strict benefit-cost standard, along with a methodology that biases downward the measured benefit, than to either prohibit BCA or to mandate it with discretion.

A second noteworthy property is that the executive may have a polarized preference for bias, i.e., either $A^*(\alpha) = A^+$ or $A^*(\alpha) = A^-$ for all $\alpha \in \left(\frac{C}{B^H}, \frac{C}{B^L}\right)$. For example, if $k_r > pq\left(\frac{C}{B^L}\right)[B^H - B^L]$, and $\overline{\alpha}_n + \frac{k_r}{B_0} > \overline{\alpha}_m(b^L)$, then $A^*(\alpha) = A^+$ for $\alpha \geq \overline{\alpha}_n + \frac{k_r}{B_0}$ and $A^*(\alpha) = A^-$ for $\alpha \leq \overline{\alpha}_n + \frac{k_r}{B_0}$. Note that under these circumstances, even a somewhat regulation-sympathetic administration might prefer to bias the measured benefit downward to choke off a proposal by the regulator.

However, this polarized preference for bias will not arise if k_r is sufficiently small relative to C. In that normal case, as α increases, $A^*(\alpha)$ steps from A^- to 0 to A^+. This brings us to the third property. Under plausible conditions—in particular, the proposal cost k_r is small compared to the compliance cost C—the range of α over which $A^*(\alpha) = 0$ is quite "wide," including a range below $\overline{\alpha}_n$ and a range above it.

Proposition 7 *Suppose Assumptions 1 and 2 hold, and* $\frac{k_r}{C} < p(1-p)(2q-1)\frac{B^H - B^L}{B_0}$. *Then* $A^*(\alpha) = 0$ *if* $\alpha \in \left[\widehat{\alpha}_s, \overline{\alpha}_m(b^L)\right]$, *where* $\widehat{\alpha}_s = \overline{\alpha}_m(b^H) + \frac{k_r}{pqB^H + (1-p)(1-q)B^L} \in (\overline{\alpha}_m(b^H), \overline{\alpha}_n)$. *That is, conditional on a strict benefit-cost standard being used, regulation-neutral, moderately regulation-sympathetic, and (some) moderately regulation-averse executives prefer not to use biased benefit measurement.*[28]

The significance of the proposition is that only a highly regulation-averse administration would prefer to bias a strict benefit-cost standard. Thus, like when the executive has discretion and does not bias BCA, we would expect that the methodological frameworks for BCA used by a center-right administration would be closer to the frameworks used by a center-left administration than to a highly regulation-averse right-wing administration. As we discuss in more detail below, this has been the case in the U.S. over the last forty years.

We can also draw conclusions about other types of administrations. Recall for $\alpha \in [\overline{\alpha}_m(b^H), \overline{\alpha}_m(b^L)]$ the equilibrium under discretionary BCA involves rejecting with probability one a proposed regulation with a low measured benefit and accepting with probability one a proposed regulation with a high measured benefit. Hence, the equilibrium with discretionary BCA is equivalent to the outcome under a strict BCA standard with unbiased benefit measurement. Because unbiased benefit measurement is optimal for $\alpha \in \left[\widehat{\alpha}_s, \overline{\alpha}_m(b^L)\right]$ conditional on a strict BCA standard having been chosen, and since administrations with $\alpha \in (\overline{\alpha}_{nm}, \overline{\alpha}_m(b^L))$, where $\overline{\alpha}_{nm} \in (\overline{\alpha}_m(b^H), \overline{\alpha}_n)$

[28] If Assumption 3 replaces Assumption 2, a closely related version of this proposition holds: If $\frac{k_r}{C} < \frac{1}{2}(1-p)\frac{B^H - B^L}{B_0}$, and then $A^*(\alpha) = 0$ if $\alpha \in \left[\frac{C + \frac{k_r}{q}}{B^H}, \widehat{\alpha}_s\right]$, where $\widehat{\alpha}_s = \frac{[p(1-q)+(1-p)]C}{p(1-q)B^H + (1-p)B^L} + \frac{(1-p)k_r}{p(1-q)B^H + (1-p)B^L} > \overline{\alpha}_m(b^L) > \overline{\alpha}_n$ and $\frac{C + \frac{k_r}{q}}{B^H} < \overline{\alpha}_n$. The implication of the same: if an executive used a strict benefit-cost standard and is regulation-neutral, moderately regulation averse, or regulation sympathetic, it will prefer not to used a biased benefit measurement.

strictly prefer discretionary BCA to BCA prohibition, we conclude that there is a set of administration types ranging from somewhat regulation averse to somewhat regulation sympathetic that are at least as well off mandating BCA by means of a strict benefit-cost standard and unbiased measurement methodologies.

For a highly-regulation sympathetic administration $\alpha \in (\overline{\alpha}_m(b^L), \frac{C}{B^L})$, from (3) and (17), we have $EU_n^E = EU_m^E = p\left[\alpha B^H - C\right] - (1-p)\left[C - \alpha B^L\right] - k_r$, which in turn equals $EU_s^E(A^+, \alpha)$. It is straightforward to show that given the sufficient condition in Proposition 7, there will exist a range of α sufficiently close to $\frac{C}{B^L}$ for which $A^*(\alpha) = A^+$.[29] Accordingly, a sufficiently highly regulation sympathetic administration can do no worse than mandate BCA with a strict benefit-cost standard and benefit measurement that is biased upward.

4.3 Optimal BCA if the executive has commitment power

A limitation of the executive in our model is that it cannot commit *ex ante* to an approval rule; it must act sequentially rationally upon receiving a proposal. While it is clear that BCA, even when the executive can commit to a strict BCA standard with a level of bias, does not replicate the executive's first-best outcome of symmetric information, it is worth exploring whether discretionary BCA or strict BCA with bias can replicate the executive's second-best outcome of BCA with full commitment.

We present the derivation of the full-commitment outcome in the Online Appendix. It is optimal for the executive to commit to an approval rule so that the low-benefit regulator never proposes. However, for this to be incentive compatible, the executive sets the approval probability of a proposed regulation with a low measured benefit to zero, and it also reduces the approval probability of a proposal with a high measured benefit below one. Therefore, full commitment does not replicate the first-best symmetric information outcome, in which the executive accepts a proposal with certainty if and only if $\widetilde{B} = B^H$ and thus only a high-benefit regulator proposes. However, as we show in the Online Appendix, the full-commitment solution produces a strictly higher payoff for the executive than discretionary BCA (the executive has no commitment power). It also yields a higher payoff than strict BCA with bias except when α is sufficiently close to zero.

[29] Proof: The necessary and sufficient conditions for $A^*(\alpha) = A^+$ are

$$\begin{aligned} & p\left[\alpha B^H - C\right] - (1-p)\left[C - \alpha B^L\right] - k_r \\ & \geq pq\left[\alpha B^H - C\right] - (1-p)(1-q)[C - \alpha B^L] - k_r \end{aligned}$$

and $p\left[\alpha B^H - C\right] - (1-p)\left[C - \alpha B^L\right] - k_r \geq 0$. The first condition is equivalent to $\alpha \geq \overline{\alpha}_m(b^L)$ which is satisfied by assumption. The second condition is equivalent to $\alpha \geq \overline{\alpha}_n + \frac{k_r}{B_0}$. For there to be a solution on $(\overline{\alpha}_m(b^L), \frac{C}{B^L})$, it is necessary that $\overline{\alpha}_n + \frac{k_r}{B_0} < \frac{C}{B^L}$. Rearranging terms and using $B_0 = pB^H + (1-p)B^L$, this is equivalent to $\frac{k_r}{C} < p\frac{B^H - B^L}{B^L}$. Because $1 - p < 1$, $2q - 1 \leq 1$, and $B_0 > B^L$, it follows that $p(1-p)(2q-1)\frac{B^H - B^L}{B_0} < p\frac{B^H - B^L}{B^L}$, so if the sufficient condition in Proposition 7 holds, it follows that there is a range of α sufficiently close to $\frac{C}{B^L}$ that would bias the measured benefit upward if it adopted a strict BCA standard.

5 Benefit-cost analysis in the U.S., 1981-present

The results in Sects. 3.3 and 4 can be summarized as follows. A highly regulation-averse executive is strictly worse off under a (discretionary) BCA mandate than with a BCA prohibition. An administration that is somewhat regulation averse, regulation neutral, or somewhat regulation sympathetic benefits from mandating discretionary BCA as opposed to prohibiting it, although for different reasons. A somewhat regulation-averse administration benefits from BCA because it reduces the welfare loss from type 1 errors by enough to offset the increased welfare loss from type 2 errors and excess proposal costs. A somewhat regulation-sympathetic administration, by contrast, benefits from BCA because it reduces the welfare loss from type 2 errors and excess proposal costs, at the expense of greater welfare loss from type 1 errors. Increasing α above $\overline{\alpha}_n$ makes this welfare trade-off less attractive for regulation-sympathetic administrations, and decreasing α below $\overline{\alpha}_n$ makes the corresponding welfare trade-off less attractive for regulation-averse administrations. Accordingly, the value of the BCA mandate is highest for a regulation-neutral administration ($\alpha = \overline{\alpha}_n$).

For an extremely regulation-averse administration, mandating BCA with a strict benefit-cost standard is strictly better than a BCA prohibition or a mandate for discretionary BCA. Under plausible conditions, for a wide range of α embracing modest degrees of regulation aversion and regulation sympathy (and thus regulation neutrality as well), an administration can do no worse than to mandate BCA, utilize a strict benefit-cost standard, and adopt BCA methodologies that are unbiased. A sufficiently regulation-sympathetic administration is indifferent among a BCA prohibition, a mandate for discretionary BCA, or a mandate for BCA with a strict benefit-cost standard with methodologies that bias measured benefits upward.

These implications suggest that administrations whose policy preferences range from right wing, to center right to center left would all be willing to mandate the use of BCA through a strict benefit-cost standard. That is, it would not be surprising for a BCA mandate to endure across administrations, nor would it be surprising to see the formalization of a strict benefit-cost standard in the decrees mandating the use of BCA. The key distinction that we would expect to observe across administrations would be the way administrations mandate methodologies for measuring benefits, with a right-wing administration adopting approaches that tend to bias measured benefits downward, while center-right and center-left administrations adopt conventional measurement approaches that generally do not impart systematic bias either upward or downward. As we discuss below, these implications are consistent with the U.S. experience between the early 1980s and the present.

5.1 Background and overview

In 1981, the Reagan administration issued Executive Order 12291 (subsequently replaced by Executive Order 12866 during the first year of the Clinton administration) requiring that independent agencies and cabinet departments in the U.S., as part of a process of centralized executive branch regulatory review, use benefit-cost analysis (BCA) to evaluate the economic impact of major proposed regulations.[30] Although BCA had been used occasionally by U.S. government agencies to evaluate water resources projects (most notably by the Army Corps of Engineers; Pearce (1983), Jiang and Margraff (2021)), it was not systematically used for evaluation of environmental, health, and safety regulations prior to Executive Order 12291. Indeed, it was not until 1969 that economists and policy analysts in the U.S. federal government began to recognize that the same BCA methodology used for public works projects could also be applied to the evaluation of new social regulations (Tozzi, 2011; Center for Regulatory Effectiveness, 2019).

Centralized executive branch review of new regulations in the U.S. can be traced back to the administrations of Presidents Richard Nixon, Gerald Ford, and Jimmy Carter in the 1970s (Tozzi, 2011; Office of Management and Budget, 1997). Each administration established processes by which the Executive Office of the President could review new regulations proposed by agencies such as the Environmental Protection Agency (EPA). Each of these processes stressed the importance of assessing the benefits and costs of proposed regulations, although given the still nascent analytical capabilities of BCA in the 1970s, quantitative BCA was not as central to these processes as it would become in the wake of Executive Order 12991.

Four notable features of the rule-making process in the U.S. emerged in the wake of Executive Order 12291. First, building on the precedent for centralized review established in the Nixon, Ford, and Carter administrations, Executive Order 12291 created an important gatekeeping role for a little-known executive branch agency, the Office of Information and Regulatory Affairs (OIRA), housed within the Office of Management and Budget (OMB). OIRA was created by the Paperwork Reduction Act of 1980, but Executive Order 12291 infused it with its current authority. Independent agencies and cabinet departments are required to submit proposed regulations to OIRA for review at two stages: the initial proposal stage (before the public comment phase) and the final rule-making stage (after the rules have been reformulated in light of public comments). OIRA reviews all proposed rules, but if the proposed rule is "economically significant" (a $100 million or more impact on the economy), OIRA has the authority also to review the economic analysis on which the rule is based. At both points in its review process, OIRA either (1) certifies that the proposed rule is consistent with Executive Order 12866 (with possible changes to the rule); (2) returns the rule to the agency for modification; or (3) requests that the agency withdraw the rule. (Agencies also occasionally withdraw rules during the OIRA review.) Though OIRA does not have the formal authority to approve or disapprove rules *per se*, very rarely will an

[30] Independent agencies and cabinet departments are agencies whose heads serve at the pleasure of the president. Examples include the Department of Energy, the Environmental Protection Agency, the Social Security Administration, and the General Services Administration. Such agencies should be distinguished from independent regulatory agencies (a category created by the Paperwork Reduction Act of 1980) whose heads are nominated by the president and confirmed by Congress but can only be fired for cause. Some of these agencies are also required to use benefit-cost analysis when they issue rules under certain statutes. For example, when the Consumer Product Safety Commission issues rules under the Consumer Product Safety Act, the Federal Hazardous Substances Act, or the Flammable Fabrics Act, it is required by these statutes to conduct a benefit-cost analysis. However, many independent regulatory agencies do not conduct benefit-cost analyses when they are not required to do so under statute. "Major" or "economically significant" rules are those with a projected impact on the U.S. economy of over $100 million annually.

agency proceed with a proposed rule that OIRA has returned to it. Congressional Research Service (2011). OIRA seems to be a stricter gatekeeper during Republican presidential administrations than Democratic administrations (Copeland, 2009). For example, Dudley (2021) notes that the second Bush administration's OIRA director implemented Executive Order 12866 "more aggressively than his predecessors, for the first time returning draft regulations to agencies for reconsideration pursuant to Sec. 6(b)(3) and sending 'prompt letters' that suggested priority actions agencies could take to improve their regulations."

Second, both Executive Order 12291 and Executive Order 12866 clearly articulated a "benefit-greater-than-cost" standard for new regulations. Executive Order 12291 required that regulation be adopted only if "the potential benefits to society for the regulation outweigh the potential costs to society," while Executive Order 12866 specified that regulations be adopted only if there was a "reasoned determination that the benefits of the intended regulation justify its costs." Congressional Research Service (2011). Though the language of the two executive orders was different, Sunstein (2018) has characterized their underlying philosophy as substantively the same: "Executive Order 12866, called Regulatory Planning and Review, affirmed the essentials of Reagan's own. True, it was a lot longer, and it has many more details. But its 'regulatory philosophy' was close to what Reagan had embraced. Indeed, it could have been written by Reagan's White House." (p. 15)

Third, agencies are required to conduct BCA within the constraints of standardized requirements determined by OIRA. For example, until the Biden administration, OIRA required that when the present value of benefits and costs are calculated, a discount rate of 7 percent must be used as the base case for analysis (but with results reported for 3 percent as well).[31] While a commitment to standard methodologies is perhaps necessary to give BCA analytical legitimacy, both OIRA's requirements and the standard methodologies adopted by agencies could systematically bias the outcomes of BCA. A relatively high discount rate such as 7 percent, for example, biases the present value of benefits downward when benefits extend far out into the future while costs are more immediate.

Fourth, choices of benefit-cost methodologies are determined through administrative processes that are influenced by both technical expertise and politics. Revesz and Livermore (2008) provide a compelling description of the administrative and political context of BCA:

> It is important to keep in mind that in the administrative apparatus of Washington D.C., major decisions are often made through accumulation. Big decisions are subdivided into smaller decisions, which are then further subdivided until each is manageable. Information is gathered and processed, formal and informal meetings are held, and the views and perspectives of various actors are vetted and considered. These small decisions—made in hallways, by the authors

[31] Office of Information and Regulatory Affairs, "Circular A-4: Regulatory Analysis" (September 17, 2003), http://www.whitehouse.gov/sites/default/files/omb/assets/regulatory_matters_pdf/a-4.pdf. In April 2023, the Biden administration proposed reducing the baseline discount rate to 1.7 percent. Office of Information and Regulatory Affairs, "Draft Circular A-4" (April 6, 2023), https://www.whitehouse.gov/wp-content/uploads/2023/04/DraftCircularA-4.pdf

> of agency white papers, by analysts reviewing the testimony of agency officials to be given before empty congressional hearings—accumulate over time, until, sometimes before anybody realizes, the big decision emerges. It is often then, after the weight of all those little decisions has piled up, that the public gets involved. At that point, the inertia can be impossible to overcome. (…) The methodological choices that go into cost-benefit analysis can have a major impact on outcomes; regulations that are justified under one set of assumptions may be unjustified under another. The biases toward or against regulation that are built into the methodology of cost-benefit analysis play out over and over again in the administrative process, significantly shaping our regulatory regimes. (pp. 32–33)

This suggests that while administrations could not ignore the "benefit-greater-than-cost" standard embedded in Executive Orders 12291 and 12866, they did have latitude in shaping methodologies used to conduct BCA. This latitude was not infinite—there are established approaches to conducting BCA grounded in the economics literature that administrations would have to be respectful of—but depending on an administration's regulatory policy goals, it could bend the parameters to potentially suit its needs.

5.2 The political economy of BCA from Reagan to Biden

When assuming office in 1981, Ronald Reagan and his White House team could almost certainly be characterized as regulation averse. Reagan appointed heads of executive departments and regulatory agencies who were also, in most cases, regulation averse. This is epitomized by the appointment of Anne Gorsuch to head the EPA.[32] Gorsuch cut the EPA's budget and de-emphasized enforcement activity. Still, Gorsuch's ability to align EPA decision making fully with the Reagan administration's policy priorities was limited to some extent. Environmental and consumer advocacy groups had reached the apex of their political power in the late 1970s during the Carter administration (Pearlstein, 2020). The House of Representatives remained under Democratic control. And many decisions continued to be made by career appointees at the EPA, who often clashed with Gorsuch. Moreover, Gorsuch was eventually replaced two years into the administration's first term by William Ruckelshaus, who was the first head of the EPA when it was created in 1970. It is fair to say that despite the administration's appointments, the EPA was less regulation averse than the Reagan White House. The same could be said for other independent agencies that had been active in rulemaking during the Carter administration, such as the National Highway Traffic Safety Administration (NHTSA) and the Occupational Safety and Health Administration (OSHA). Overall, the regulatory policy environment was probably one in which the Reagan White House faced a meaningful agency problem with respect to its regulatory bodies.

At the same time, while the Reagan administration was regulation averse, that regulation aversion had its limits. For example, Decker (2019) points out that efforts

32 The remainder of this paragraph draws from Dennis and Mooney (2017).

by some administration lawyers to declare large swaths of environmental and social regulations unconstitutional were blocked by senior administration officials. He further argues that the Trump administration was far more hostile to environmental and social regulation than the Reagan administration was. And the Reagan administration cleared the way for the enactment of several significant environmental and social regulations. In 1982, the EPA, with the Reagan White House's consent, promulgated a new rule that tightened existing limits on the content of lead in gasoline (Newell & Rogers, 2003). This set the stage later in the 1980s for even more stringent standards that eventually phased out tetraethyl lead as a motor fuel additive. Taking all this into consideration, our analysis suggests that an administration with the policy preferences of the Reagan administration, facing the regulatory landscape that it did, would have been a natural candidate to mandate BCA.

A related but somewhat different assessment could be made of the George W. Bush administration. The Bush White House was also regulation averse. It was notably less open to environmental initiatives than its predecessor, the Clinton administration (Cohen, 2004). However, although it scaled back or abandoned many new initiatives that had been in the EPA's pipeline in the early 2000s, it was not unalterably opposed all new environmental rules, as suggested by its Clear Skies air pollution initiative or its endorsement of the tighter standard for arsenic in drinking water that was in development in the final years of the Clinton administration. By time the second President Bush entered office, the political power of environmental and consumer advocacy groups had waned, so all else equal, the typical Bush II-era regulatory agency led by administration appointees might have been expected to be less regulation sympathetic than it would have been during the Reagan-Bush I administrations and possibly even aligned with the White House's right-leaning regulatory policy priorities. But with respect to environmental regulation, the alignment was not perfect. Bush's appointee to head the EPA, former New Jersey governor Christine Todd Whitman, was an (unsuccessful) internal advocate for more forceful regulatory policy on climate change. Moreover, the behavior of the second Bush administration was inconsistent with a policy landscape of alignment between the executive branch and its regulatory agencies. An administration that is sufficiently aligned with its regulatory agencies in the sense of $\beta < \frac{C+k_r}{B^L}$ (a violation of Assumption 2) would not need BCA. Under those circumstances, it is straightforward to show that the administration would approve any new rule put forward by an agency, and only a high-benefit regulator would propose. This did not happen in the George W. Bush administration. It not only continued Executive Order 12866, but it also "reinvigorated the review process, sending back to the agencies more rules during the first year of the Bush administration than were returned during the entire eight years of the Clinton administration" (Dudley (2005), p. 1). This history is consistent with a regulation-averse administration that faced an agency problem with its key social and environmental regulators. The implications of our model are consistent with the second Bush administration continuing the Clinton administration's BCA mandate.

Why would the administrations of Clinton, Obama, and Biden have also continued to mandate the use of BCA for rulemaking, given that these administrations were generally more regulation sympathetic than the post-1980 GOP administrations? Part of the answer is each of these administrations was likely sensitive to the possibility that regulatory agencies could overreach, perhaps as result of the political influence of pro-regulation advocacy groups or the influence of career civil servants in the agencies. As Grossman and Hopkins (2015) point out: “The Republican Party is best viewed as the agent of an ideological movement whose members are united by a common devotion to the principle of limited government.... In contrast, the Democratic Party is properly understood as a coalition of social groups whose interests are served by various forms of government activity. Most Democrats are committed less to the abstract cause of liberalism than to specific policies designed to benefit particular groups.” Thus, even with their ability to appoint allies to staff key regulatory agencies, it is plausible that the policy priorities of these administrations were not necessarily aligned with key regulatory agencies inasmuch as the latter would be subject to influence by progressive activist groups. Cass Sunstein, Obama’s first director of OIRA, provides indirect evidence of this, writing “If the Obama administration publicly embraced cost-benefit analysis, progressive groups, including environmental, labor, and consumer organizations, would be quite unhappy, even angry” (Sunstein (2018), pp. 18–19). As our analysis in Sect. 3.3 illustrates, a somewhat regulation-sympathetic administration—$\overline{\alpha}_n < \alpha < \overline{\alpha}_m(b^L)$—facing modest misalignment would still benefit from mandating BCA.

Our model implies that the use of BCA by a somewhat regulation-sympathetic administration would make the administration behave more selectively than it would without BCA. Recall that in particular when BCA is not used, a regulation-sympathetic administration would approve any proposed regulation, effectively delegating responsibility for screening proposed regulations to the regulatory agencies, not the administrations “gatekeeping” office. The enthusiasm with which the Clinton, Obama, and Biden administration endorsed BCA, when it would have been politically beneficial (by shoring up support among progressive groups) to let the regulatory agencies decide which regulations to propose and forego the gatekeeping role played by OIRA, suggests that these administrations benefited from the greater selectivity of new regulations that BCA would have fostered.

Our model is also consistent with the continuity across Republican and Democratic administrations in the basic approach they took to conducting BCA. Though the Obama administration tended to give more emphasis to difficult-to-measure benefits from regulation, while the second Bush administration tended to give more weight to the costs regulation imposed on business (Fraas & Morgenstern, 2014), nevertheless both administrations were committed to conventional BCA methodology. In the guidelines to administrative agencies on how to conduct such analyses, both administrations emphasized that BCAs should endeavor to incorporate all identifiable incremental benefits and costs, including co-benefits or co-costs that arise indirectly as a result of compliance with proposed regulations (e.g., carbon emission reductions arising from compliance with a rule mandating electric power plants to reduce mercury emissions, or the increased safety risks from the production of lighter-weight vehicles to comply with fuel economy standards). This is consistent with the implication of our model that across a range of α including somewhat regulation-averse and somewhat regulation-sympathetic administrations, the executive would prefer not to systematically bias benefit measurement.

By contrast, the posture of the Trump administration toward BCA represented a marked break with the practices of the preceding administrations. The Trump administration was almost certainly highly regulation averse. By the time Donald Trump was elected president in 2016, public opinion on environmental policy, especially anything related to climate change, had become more polarized, and regulatory policy related to the environmental issues had become another front in the "culture wars." Grassroots Republicans, conservative-leaning think tanks, and GOP elected public officials had become even more regulation averse than they had been sixteen years before. Upon taking office in January 2017, President Trump issued Executive Order 13771 directing agencies to offset the cost of any new regulation by eliminating two existing regulations. It also required the director of OMB to establish a cap on the overall incremental costs of new regulations issued by independent agencies and cabinet departments over the course of a fiscal year (Executive Order 13771, 2017). The administration's regulatory budget framework forced decision makers in OIRA to place virtually no weight on the benefits of regulation and nearly all the weight on costs. Executive Order 13771 is suggestive of an administration that was extremely regulation averse, with α very close to $\frac{C}{B^H}$. Given Proposition 3, an administration that is that regulation averse would have preferred not to mandate discretionary BCA.

However, the Trump administration did not rescind Executive Order 12866. This is consistent with our finding that a sufficiently regulation-averse administration would prefer to mandate a strict BCA standard and then adopt methodological approaches to bias measured benefits downward. Consistent with this, when agencies did utilize BCA, the Trump administration sought to limit the extent to which co-benefits could be incorporated into the analysis. For example, in a new rule finalized in 2020, the EPA mandated that in any BCA of a new regulation, the agency had to distinguish between health benefits arising directly from the proposed rule and any co-benefits arising indirectly due to compliance with the rule. (In 2021, the Biden administration rescinded this rule.) More generally, Livermore and Revesz (2020) identify many examples of the Trump administration adopting BCA methodologies that were at odds with the conventional practices employed by the Bush and Obama administrations. In all these examples, methodologies were adopted that resulted in understatement of benefits or overstatement of costs. To take one such example, the Trump administration sought to reverse decades of conventional practice in the measurement of the costs of pollutants (and thus the benefit of reducing them) by adopting models that assumed that pollutants cause harm only after a certain threshold of exposure was reached. This was at odds with practices under the Obama, Bush, and Clinton administrations that assumed any exposure, however small, to cancer-causing pollutants, as well as the six "criteria" air pollutants subject to Clean Air Act regulation (ground-level ozone, particulate matter, carbon monoxide, lead, sulfur dioxide, and nitrogen dioxide), could cause health damage. This approach affected several new regulations proposed by the Trump administration including the Affordable Clean Energy rule which was devised to replace the Obama administration's Clean Power Plan rule that limited greenhouse gas emissions from existing electric power plants. As Livermore and Revesz (2020) wrote "The effort to reinvigorate threshold modeling for environmental regulation is a thinly disguised attempt to undermine cost-benefit justified regulation and aid the industry at the expense of public health" (p. 144).

6 Conclusion

This paper presents a model in which a presidential administration decides whether and how to incorporate BCA into the rulemaking process and then acts as a “gatekeeper” that either approves or disapproves a proposal for a new regulation. It chooses one of three process options: prohibiting BCA, mandating BCA, or making BCA voluntary. In the regulatory proposal subgame, the regulator has private information about the net social benefits of the proposed rule. When the regulator and executive are well-aligned on how to trade off the benefits and costs of regulation, the regulator can play a valuable screening role, but when they are misaligned, the executive faces an agency problem: the regulator would like to propose a wider range of rules than the executive would like to approve. Without BCA, the only tool the executive has to discipline the regulator is rejecting rules with a higher probability, which will cause the regulator to propose higher-benefit rules and reduce the probability of type 2 error at the cost of a higher probability of type 1 error.

We model BCA as a noisy signal of the net social benefits of the regulator’s proposed rule. By mandating BCA, the executive can potentially reduce the welfare losses that arise when BCA is not used. The signal from BCA can help the executive separate high-benefit rules it would like to approve from low-benefit rules it would not, potentially reducing type 1 and type 2 errors. However, the noisiness of a BCA leads rise to situations in which mandating it hurts the executive. This situation can arise when the executive is highly regulation averse. In this case, the use of BCA can make the executive a “softer” gatekeeper by creating the possibility that a proposal has a high measured benefit that the executive finds sequentially optimal to accept.

When BCA is voluntary, the executive gains information both from the results of the BCA, when used, and on whether the rule was proposed with or without a BCA. A maximally separating equilibrium in which different types of regulators opt to propose with a BCA and without a BCA does not arise. This result holds for our two-type model, but it also generalizes to arbitrary distributions of regulator types.

We then consider whether the executive can profitably commit to the use of BCA methodologies that bias the measurement of benefits. If the executive has discretion in how it incorporates BCA into its approval decision making, a biased BCA changes nothing because the executive simply de-biases the signal it receives. Bias is valuable only if the executive can also commit in advance to how it will make decisions. A natural commitment in our context is to a strict benefit-cost standard, where the executive commits to accepting proposals if and only if the measured benefits (however biased they may be) exceed costs. We then study the executive’s optimal bias problem, and we show that the optimal level of bias is non-decreasing in the executive’s regulation sympathy. We further show that executives near the middle of the regulatory preference spectrum, including those who are regulation averse and regulation sympathetic, adopt benefit measurement methodologies that are more similar than those that would be adopted by strongly regulation-averse administrations, who typically opt to bias the benefit measurement downward to such an extent that it ensures no new rule would ever be approved under a strict benefit-cost standard. Indeed, our analysis actually suggests a “horseshoe theory” of regulatory gatekeeping and regulatory impact analysis. It implies that far-left and far-right administrations would have a stance on BCA that is more similar to each other than to center-left or center-right administrations. A far-left administration can do no worse than to mandate strict BCA and bias the benefit measurement upward. A far-right administration, as just noted, benefits by mandating strict BCA and biasing the benefit measurement downward. Both types of administrations would therefore appear to be using BCA for "political purposes," in contrast to center-left and center-right administrations for whom methodological choices about how to conduct BCA would appear "conventional" and "technocratic."

Finally, we point out that our analysis is broadly consistent with how BCA has been used by presidential administrations in the U.S. since 1981. It is consistent with the persistence of a BCA mandate across both Republican and Democratic administrations, and it is consistent with that mandate taking the form of a strict-benefit cost standard. Our analysis also explains why the Trump administration was such an outlier in comparison to its predecessors and successor in its use of BCA, a central point made by Livermore and Revesz (2020). And though our analysis suggests that discretionary BCA is likely to be most valuable to moderately conservative administrations or administrations near the center of the political spectrum, while instituting biased BCA methodologies to the extent possible is most valuable to extremely conservative administrations, our analysis also provides insights consistent with Revesz and Livermore's (2008) thesis that use of BCA by center-right administrations can be valuable for advocates of greater regulation because it makes it more likely that decision makers will accept high-benefit proposals.

We believe our analysis can be extended in several fruitful directions. First, in our model, the executive and the regulator are risk-neutral. A potentially important difference between an executive and a regulator besides their welfare weights is their risk preferences. One might imagine that career regulators would be risk neutral, whereas an executive facing political pressure would be risk-averse. Introducing risk preferences to the model would therefore be useful.

Second, our model presumes that the regulator's informational advantage relative to the executive is exogenous. A recent literature has explored cognitive games in which a first mover in a game of (potentially) asymmetric information can chose the information structure that governs the play of the game in subsequent stages (Tirole, 2016; Pavan & Tirole, 2022). A natural application of this literature to our context would focus on the regulator's incentives to develop private expertise about net social benefits of rules it might propose and how the availability of BCA would in turn affect the regulator's preferences over information structures.

Third, in our model, we treat bias as a methodological commitment by the executive. However, considering that the regulator is the party actually doing the BCA, it seems plausible that a regulator could also bias a BCA to suit their own welfare weight, and that the executive would not be able to de-bias their result in a similar manner because they would not be able to directly observe the level of bias.

Finally, it would be useful to pursue the empirical implications of the model. For example, in the U.S., there is heterogeneous adoption of BCA across states. These data, if combined with data on the relative partisan leanings of state executives and regulators (with legislatures as a possible proxy for regulators) could possibly be used to test some of the predictions of the model. Alternatively, our model could be used for structural estimation of the welfare weights of executive administrations, either at the national or state level.

7 Proofs and derivations

Proof of Proposition 1 We begin by establishing the following result:

Claim Suppose Assumptions 1 and 2 hold. In any equilibrium, $\rho_n^* = (1, \rho_n^*(B^L))$ where $\rho_n^*(B^L) \in (0, 1]$.

Proof of claim: Suppose towards a contradiction that $\rho_n^*(B^H) < 1$. The regulator's best response correspondence $\rho_n(\phi_n, B^j)$ is given by

$$\rho_n(\phi_n, B^j) = \begin{cases} 1 & \text{if } \frac{C}{\beta} + \frac{k_r}{\beta\phi_n} < B^j \\ \in [0,1] & \text{if } \frac{C}{\beta} + \frac{k_r}{\beta\phi_n} = B^j \\ 0 & \text{if } \frac{C}{\beta} + \frac{k_r}{\beta\phi_n} > B^j \end{cases}, \quad j = H, L. \tag{28}$$

Let $\rho_n(\phi_n) \equiv (\rho_n(\phi_n, B^H), \rho_n(\phi_n, B^L))$.

Observing the cases of $\rho_n(\phi_n, B^H)$ where $\rho_n^*(B^H) < 1$ is possible, we see that it must be the case that $\rho_n^*(B^L) = 0$. Now Assumption 2 implies $\beta B^L > C + \frac{k_r}{1-q} > C + k_r$, so $\beta B^H > C + k_r$. It cannot, then, be the case that $\rho_n^* = (0, 0)$. It follows that $E[\widetilde{B}|\rho_n^*] = B^H > \frac{C}{\alpha}$, with the inequality due to Assumption 1. Therefore, $\phi_n(\rho_n^*) = 1$. But Assumption 2 implies $\beta B^L > C + k_r$, so $\rho_n(\phi_n^*) = (1, 1)$, contradicting that $\rho_n^*(B^H) < 1$. By the same logic, if $\rho_n^*(B^L) = 0$, then in any equilibrium the executive will accept with certainty, in which case proposing when $\widetilde{B} = B^L$ is the best response for the regulator. It follows then that $\rho_n^*(B^L) > 0$. □

Turning to the proof of the proposition, let us begin by noting that the executive's best response approval probability as a function of the regulator's proposal probabilities, $\phi_n : [0, 1]^2 \rightrightarrows [0, 1]$, is[33]:

$$\phi_n(\rho_n) = \begin{cases} 0 & \text{if } E[\widetilde{B}|\rho_n] < \frac{C}{\alpha} \\ \in [0,1] & \text{if } E[\widetilde{B}|\rho_n] = \frac{C}{\alpha} \\ 1 & \text{if } E[\widetilde{B}|\rho_n] > \frac{C}{\alpha} \end{cases}. \tag{29}$$

To establish part (1) note that $\alpha < \overline{\alpha}_n$ implies that $\phi_n(1, 1) = 0$. Therefore, there can be no equilibrium where $\rho_n(B^L) = 1$. Given that plus the claim we just established, the only other possible candidate for an equilibrium involves $\rho_n(B^L) \in (0, 1)$. In any such equilibrium, for the regulator to be best responding, it must be the case that $\frac{C}{\beta} + \frac{k_r}{\beta\phi_n} = B^L$, implying the executive's approval rule $\phi_n^* = \frac{k_r}{\beta B^L - C}$. Assumption 2 implies this is strictly between 0 and 1.

[33] Note that the executive does not take the proposal cost k_r into account in its decision-making because it is sunk after the executive has already proposed. Also note that if $\rho_n = (0, 0)$, i.e., the executive believes the regulator never proposes, then the executive's best response is not well-defined. We say that any approval probability is a best response for the executive in this case.

For the executive's approval rule to be $\phi_n^* \in (0, 1)$, it must be the case that $E[\widetilde{B}|\rho_n^*] = \frac{C}{\alpha}$. Because we established in the claim above $\rho_n^*(B^H) = 1$, this equation can be written as:

$$E[\widetilde{B}|(1, \rho_n^*(B^L))] = \frac{p}{p + (1-p)\rho_n^*(B^L)} B^H + \frac{(1-p)\rho_n^*(B^L)}{p + (1-p)\rho_n^*(B^L)} B^L = \frac{C}{\alpha}. \tag{30}$$

Solving (30) for $\rho_n^*(B^L)$, we get $\rho_n^*(B^L) = \frac{p(\alpha B^H - C)}{(1-p)(C - \alpha B^L)}$. We know that this is strictly between 0 and 1 by Assumption 1 (which guarantees that the numerator and denominator are both positive) and because we are in the case where $\alpha < \overline{\alpha}_n$ (which guarantees that the denominator is larger than the numerator). As such, this is an equilibrium, and since we have exhausted all other possibilities with $\rho_n^* \neq (0, 0)$, we know it is unique among that class of equilibria.

To establish part (2) of the proposition, first we note that $\alpha > \overline{\alpha}_n$ implies that $\phi_n(1, 1) = 1 = \phi_n^*$. Recalling that Assumption 2 implies $\beta B^L > C + k_r$, it follows that $\rho_n(1) = (1, 1) = \rho_n^*$. As such, this is an equilibrium, and the fact that the executive's best response is unique implies that it is the only possible equilibrium with $\rho_n^*(B^L) = 1$. Second, we note that all of the above logic implies that in any equilibrium with $\rho_n^*(B^L) < 1$, $\phi_n^* = \frac{k_r}{\beta B^L - C} < 1$, but for any such $\rho_n^*(B^L)$, $E[\widetilde{B}|(1, \rho_n^*(B^L))] > E[\widetilde{B}|(1, 1)] > \frac{C}{\alpha}$. Therefore, regardless of $\rho_n^*(B^L)$, the unique best response for the executive is $\phi_n = 1$. The unique best response to that from the regulator is $\rho_n(B^L) = 1$. As such, no equilibrium with $\rho_n(B^L) < 1$ exists.

Finally, to establish part (3) of the proposition, notice first that the logic of part (2) still applies—for any putative equilibrium with $\rho_n^*(B^L) < 1$, the unique best response for the executive is $\phi_n = 1$, but the unique best response for the regulator to that is $\rho_n(B^L) = 1$. As such, the equilibrium features $\rho_n^*(B^L) = 1$. It therefore must be the case that $\phi_n^* \geq \frac{k_r}{\beta B^L - C}$; otherwise $\rho_n(B^L) = 0$ is the unique best response. However, if $\rho_n^*(B^L) = 1$, then $\frac{k_r}{\beta B^L - C} \in [0, 1] = \phi_n(\rho_n^*)$, and $(1, 1) \in \rho_n(\frac{k_r}{\beta B^L - C}) = \{(1, \rho_n(B^L)) : \rho_n(B^L) \in [0, 1]\}$. Therefore, $\phi_n^* = \frac{k_r}{\beta B^L - C}$, $\rho_n^* = (1, 1)$ is an equilibrium. Also, if we fix $\phi_n^* \in (\frac{k_r}{\beta B^L - C}, 1]$, then $\phi_n^* \in \phi_n(\rho_n^*) = [0, 1]$, and $(1, 1) = \rho_n(\phi_n^*)$ because $\frac{C}{\beta} + \frac{k_r}{\beta \phi_n^*} > B^L$. Therefore, these also constitute equilibria. ■

Proof of Proposition 2 We begin by establishing the following claim.

Claim Suppose Assumptions 1 and 2 hold. In any equilibrium, $\rho_m^* = (1, \rho_m^*(B^L))$ where $\rho_m^*(B^L) \in (0, 1]$.

Proof of claim: As discussed above, $E[\widetilde{B}|\rho_m, b^H] \geq E[\widetilde{B}|\rho_m, b^L]$. This implies that $\phi_m(\rho_m, b^H) \geq \phi_m(\rho_m, b^L)$ unless possibly $E[\widetilde{B}|\rho_m, b^H] = E[\widetilde{B}|\rho_m, b^L] = \frac{C}{\alpha}$. However, since $B^H > B^L$, the only way for $E[\widetilde{B}|\rho_m, b^H] = E[\widetilde{B}|\rho_m, b^L]$ is if $\rho_m(B^H) = 0$ or $\rho_m(B^L) = 0$. However, in this case, then $E[\widetilde{B}|\rho_m, b^j] \in \{B^H, B^L\}$, and Assumption 1 thus guarantees that $E[\widetilde{B}|\rho_m, b^j] \neq \frac{C}{\alpha}$. Thus,

$\phi_m(\rho_m, b^H) \geq \phi_m(\rho_m, b^L)$. Our analysis of $\rho_m(\cdot)$ therefore guarantees that $\rho_m(\phi_m(b^H), \phi_m(b^L), B^L) > 0$ implies $\rho_m(\phi_m(b^H), \phi_m(b^L), B^H) = 1$ and $\rho_m(\phi_m(b^H), \phi_m(b^L), B^H) < 1$ implies $\rho_m(\phi_m(b^H), \phi_m(b^L), B^L) = 0$ for all relevant values of $\phi_m(b^H)$ and $\phi_m(b^L)$.

The rest of the proof follows analogously to the proof of the claim within Proposition 1's proof. Suppose towards a contradiction $\rho_m^*(B^H) < 1$. This guarantees $\rho_m^*(B^L) = 0$ by the analysis above. However, if $\rho_m^*(B^L) = 0$, then because $\rho_m^* \neq (0, 0)$, it follows that $E[\widetilde{B}|\rho_m^*, b^j] = B^H > \frac{C}{\alpha}$ for both $j \in \{H, L\}$, where the last inequality is implied by Assumption 1. Therefore, in any such case, $\phi_m^* = (1, 1)$. However, Assumption 2 then implies that $\rho_m(1, 1, B^H) = 1$, contradicting that $\rho_m^*(B^H) < 1$ is part of an equilibrium. By the same logic, if $\rho_m^*(B^L) = 0$, then $\phi_m^*(b^j) = 1$ for $j \in \{H, L\}$. Because Assumption 2 implies $\beta B^L - C > k_r$, we would then have $\rho_m(1, 1, B^L) = 1$, contradicting that $\rho_m^*(B^L) = 0$ in equilibrium.

□

Turning to the proof of the proposition, we state necessary and sufficient conditions for each kind of equilibrium below, and show that they are mutually exclusive (except for when equalities between certain parameters hold), and they cover the entire parameter space consistent with Assumption 1 and Assumption 2.

First, $\rho_m^* = (1, 1)$, $\phi_m^* = (1, 1)$ is an equilibrium if and only if

$$E[\widetilde{B}|(1, 1), b^L] \geq \frac{C}{\alpha}. \tag{31}$$

Note that (31) implies that $E[\widetilde{B}|(1, 1), b^H] \geq \frac{C}{\alpha}$, and Assumption 2—which implies $\beta B^L > C + k_r$—ensures the regulator is responding optimally in this case. Rearranging (31) gives us the α cutoff in part (1) of the proposition.

Second, $\rho_m^* = (1, 1)$, $\phi_m^* = (1, 0)$ is an equilibrium if and only if

$$\frac{C}{\beta} + \frac{k_r}{\beta(1-q)} \leq B^L, \tag{32}$$

$$\frac{p(1-q)}{p(1-q) + q(1-p)} B^H + \frac{(1-p)q}{p(1-q) + q(1-p)} B^L \leq \frac{C}{\alpha}, \tag{33}$$

$$\frac{pq}{pq + (1-p)(1-q)} B^H + \frac{(1-p)(1-q)}{pq + (1-p)(1-q)} B^L \geq \frac{C}{\alpha}. \tag{34}$$

Assumption 2 implies (32) and the α cutoffs in part (2) are equivalent to (33) and (34).

Third and finally, $\rho_m^* = (1, \rho_m^*(B^L))$, $\phi_m^* = (\phi_m^*(b^H), 0)$ with $\rho_m^*(B^L), \phi_m^*(b^H) \in (0, 1]$ is an equilibrium if and only if

$$\frac{C}{\beta} + \frac{k_r}{\beta(1-q)\phi_m^*(b^H)} = B^L, \tag{35}$$

$$E[\widetilde{B}|(1, \rho_m^*(B^L)), b^H] = \left\{ \begin{array}{l} \frac{pq}{pq+(1-p)(1-q)\rho_m^*(B^L)} B^H \\ +\frac{(1-p)(1-q)\rho_m^*(B^L)}{pq+(1-p)(1-q)\rho_m^*(B^L)} B^L \end{array} \right\} = \frac{C}{\alpha}. \tag{36}$$

Now,

$$\lim_{\phi_m(b^H)\to 1} \frac{C}{\beta} + \frac{k_r}{\beta(1-q)\phi_m(b^H)} = \frac{C}{\beta} + \frac{k_r}{\beta(1-q)} < B^L. \tag{37}$$

$$\lim_{\rho_m(B^L)\to 1} E[\widetilde{B}|(1,\rho_m(B^L)), b^H] = \left\{ \begin{array}{l} \frac{pq}{pq+(1-p)(1-q)} B^H \\ +\frac{(1-p)(1-q)}{pq+(1-p)(1-q)} B^L \end{array} \right\} \leq \frac{C}{\alpha} \tag{38}$$

where the inequality in (37) follows from Assumption 2, and the inequality in (38) follows from the cutoff $\alpha \leq \overline{\alpha}_m(b^H)$ defining this part of the proposition. Further

$$\lim_{\phi_m(b^H)\to 0} \frac{C}{\beta} + \frac{k_r}{\beta(1-q)\phi_m(b^H)} = \infty > B^L. \tag{39}$$

$$\lim_{\rho_m(B^L)\to 0} E[\widetilde{B}|(1,\rho_m(B^L)), b^H] = B^H > \frac{C}{\alpha}. \tag{40}$$

Together, (37)–(40) imply that there exist values $\phi_m^*(b^H) \in (0, 1)$ and $\rho_m^*(B^L) \in (0, 1)$ that make the equalities (35) and (36) hold. Solving (35) and (36) gives us the expressions (15) and (16).

To conclude, unless $\alpha = E[\widetilde{B}|(1, 1), b^L]$ or $\alpha = E[\widetilde{B}|(1, 1), b^H]$, then the parameter values are such that at most only one of these three sets of conditions hold. Because the union of these conditions is the entire parameter space consistent with Assumptions 1 and 2, at least one of these three sets of conditions hold. Therefore, we have proven that unless $\alpha = E[\widetilde{B}|(1, 1), b^L]$, $\alpha = E[\widetilde{B}|(1, 1), b^H]$, or $\beta = \frac{C}{B^L} + \frac{k_r}{B^L(1-q)}$, there is exactly one equilibrium. ∎

Derivation of signs of Δ_1, Δ_2, **and** Δ_3.

Case 1: $\alpha \in (\overline{\alpha}_m(b^L), \frac{C}{B^L})$. In this case, we have $\rho_n^* = (1, 1), \phi_n^* = 1$, $\rho_m^* = (1, 1), \phi_m^* = (1, 1)$. It is straightforward to see from (19), (20), and (21) that $\Delta_1 = \Delta_2 = \Delta_3 = 0$.

Case 2: $\alpha \in \left[\overline{\alpha}_n, \overline{\alpha}_m(b^L)\right]$. In this case we have $\rho_n^* = (1, 1)$, $\phi_n^* = 1$, $\rho_m^* = (1, 1)$, $\phi_m^* = (1, 0)$. Thus, (19) implies $\Delta_1 = p(q-1)(\alpha B^H - C) < 0$: (20) implies $\Delta_2 = (1-p)q(C - \alpha B^L) > 0$, and (21) implies $\Delta_3 = (1-p)(1-1)k_r = 0$.

Case 3: $\alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_n\right]$. Here we have $\rho_n^* = \left(1, \frac{p(\alpha B^H - C)}{(1-p)(C-\alpha B^L)}\right), \phi_n^* = \frac{k_r}{\beta B^L - C}$, $\rho_m^* = (1, 1)$, $\phi_m^* = (1, 0)$. Therefore from (19), we have

$$\Delta_1 = p(q - \frac{k_r}{\beta B^L - C})(\alpha B^H - C).$$

Given Assumption 2, $\beta B^L - C \geq \frac{k_r}{1-q}$. This latter inequality can be written

$$1 - q \geq \frac{k_r}{\beta B^L - C}. \tag{41}$$

Now because $q > \frac{1}{2}$, it follows that $q > 1-q$, and thus from (41), $q > \frac{k_r}{\beta B^L - C}$, which establishes $\Delta_1 > 0$.

Turning to Δ_2, we first note that $\rho_n^*(B^L) < \rho_m^*(B^L) = 1$ in this case, so BCA worsens selection. In addition, $\phi_n^* - \left[(1-q)\phi_m^*(b^H) + q\phi_m^*(b^L)\right] = \frac{k_r}{\beta B^L - C} - (1-q) \leq 0$, as indicated in (41). Given (20), it follows that $\Delta_2 < 0$. And since we just indicated that $\rho_n^*(B^L) < \rho_m^*(B^L)$, it follows that $\Delta_3 < 0$.

Case 4: $\alpha \in \left(\frac{C}{B_H}, \overline{\alpha}_m(b^H)\right]$. In this case we have, $\rho_n^* = \left(1, \frac{p(\alpha B^H - C)}{(1-p)(C-\alpha B^L)}\right)$, $\phi_n^* = \frac{k_r}{\beta B^L - C}$, $\rho_m^* = (1, \frac{pq(\alpha B^H - C)}{(1-p)(1-q)(C-\alpha B^L)})$, $\phi_m^* = (\frac{k_r}{(1-q)(\beta B^L - C)}, 0)$. Consider first Δ_1:

$$\begin{aligned}\Delta_1 &= p\left(\frac{q}{1-q}\frac{k_r}{(\beta B^L - C)} - \frac{k_r}{\beta B^L - C}\right)(\alpha B^H - C)\\ &= p\left(\frac{2q-1}{1-q}\right)\left(\frac{\alpha B^H - C}{\beta B^L - C}\right)k_r > 0,\end{aligned}$$

where inequality holds because $q > \frac{1}{2}$. To evaluate Δ_2, first note that

$$\begin{aligned}&\rho_n^*(B^L) - \rho_m^*(B^L)\\ &= -\frac{p}{(1-p)}\left(\frac{2q-1}{1-q}\right)\left(\frac{\alpha B^H - C}{\beta B^L - C}\right) < 0.\end{aligned} \tag{42}$$

Next, note that

$$\begin{aligned}&\phi_n^* - \left[(1-q)\phi_m^*(b^H) + q\phi_m^*(b^L)\right]\\ &= \frac{k_r}{\beta B^L - C} - \left[(1-q)\frac{k_r}{(1-q)(\beta B^L - C)}\right]\\ &= 0.\end{aligned} \tag{43}$$

Given (20), it follows from (42) and (43) that $\Delta_2 < 0$ and from (21) and (42), we have that $\Delta_3 < 0$. ■

Proof of Proposition 3 The first part of the proposition, pertaining to $\alpha \in \left(\frac{C}{B^H}, \overline{\alpha}_m(b^H)\right]$, follows directly from (18) and the assumption that $q > \frac{1}{2}$. Now consider $\alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_n\right]$. When $\alpha = \overline{\alpha}_m(b^H) < \overline{\alpha}_n$, $pq(\alpha B^H - C) - (1-p)(1-q)(C - \alpha B^L) = 0$, and $p(\alpha B^H - C) - (1-p)(C - \alpha B^L) < 0$. Thus, $\Delta^E(\overline{\alpha}_m(b^H)) < 0$. By contrast, when $\alpha = \overline{\alpha}_n > \overline{\alpha}_m(b^H)$, $p(\alpha B^H - C) - (1-p)(C - \alpha B^L) = 0$ and $pq(\alpha B^H - C) - (1-p)(1-q)(C - \alpha B^L) > 0$, so $\Delta^E(\overline{\alpha}_n) > 0$. Thus, by the intermediate value theorem, there exists some $\alpha \in (\overline{\alpha}_m(b^H), \overline{\alpha}_n)$ at which $\Delta^E(\alpha) = 0$. And from (18) we can see that $\Delta^E(\alpha)$ is increasing in α when $\alpha \in \left(\overline{\alpha}_m(b^H), \overline{\alpha}_n\right)$, so the value of α at which $\Delta^E(\alpha) = 0$, which we denote by $\overline{\alpha}_{nm}$, is unique. Thus, $\Delta^E(\alpha) < 0$ for $\alpha \in \left[\overline{\alpha}_m(b^H), \overline{\alpha}_{nm}\right)$. ■

Proof of Proposition 4 To establish part (a), consider the expression for $\Delta^E(\alpha)$ for $\alpha \in [\overline{\alpha}_m(b^H), \overline{\alpha}_n]$. $\frac{\partial \Delta^E(\alpha,\beta)}{\partial \alpha} = pqB^H + (1-p)(1-q)B^L + p\frac{\partial\left[\frac{\alpha B^H - C}{C - \alpha B^L}\right]}{\partial \alpha}k_r > 0$. For $\alpha \in [\overline{\alpha}_n, \overline{\alpha}_m(b^L)]$ we have $\frac{\partial \Delta^E(\alpha,\beta)}{\partial \alpha} = -(1-p)qB^L - p(1-q)B^H < 0$. Evaluating $\Delta^E(\alpha)$ at $\overline{\alpha}_n$ for either case gives us $\Delta^E(\overline{\alpha}_n) = (1-p)(C - \overline{\alpha}_n B^L)(2q-1) > 0$ since $q > \frac{1}{2}$. Thus, $\Delta^E(\alpha)$ is maximized at $\alpha = \overline{\alpha}_n$, and its maximal value is positive. Parts (b) and (c) follow immediately from the continuity of $\Delta^E(\alpha)$, with part (b) relying on $\Delta^E(\alpha) = 0$ for $\alpha \geq \overline{\alpha}_m(b^L)$, and part (c) relying on part (a) of this proposition and Proposition 3. ■

Proof of Lemma 1 Let ϕ_v denote the executive's approval probability for a proposal without BCA and $\left(\phi_v(b^H), \phi_v(b^L)\right)$ be the approval probabilities for a proposal with a BCA and measured benefits b^H and b^L. Consider, first, an equilibrium of form 1. In such an equilibrium, the executive would infer that a proposal with a BCA came from a type-B^H regulator. Accordingly, it would have to be the case that $\phi_v(b^H) = \phi_v(b^L) = 1$. Because a type-$B^H$ regulator is mixing over {"Propose with a BCA", "Propose without a BCA"}, it must be the case that $\beta B^H - C - k_r = \phi_v\left[\beta B^H - C\right] - k_r$, which implies $\phi_v = 1$. Because a type-B^L regulator mixes over {"Propose without a BCA", "Do not propose"}, it must be the case that $\phi_v\left[\beta B^L - C\right] - k_r = 0$ or since $\phi_v = 1$, $\beta B^L - C - k_r = 0$, which violates Assumption 2.

Consider, next, a separating equilibrium of the second form. Necessary conditions are

$$E\left[\phi_v(\widetilde{b})|B^H\right]\left[\beta B^H - C\right] - k_r = \phi_v\left[\beta B^H - C\right] - k_r > 0, \tag{44}$$

$$E\left[\phi_v(\widetilde{b})|B^L\right]\left[\beta B^L - C\right] - k_r = \phi_v\left[\beta B^L - C\right] - k_r > 0. \tag{45}$$

The condition $\phi_v\left[\beta B^H - C\right] - k_r > 0$ implies $\phi_v > 0$. Thus, in this equilibrium, the executive must be willing to approve a proposal without a BCA with positive probability. Moreover, rearranging (44), we have $E\left[\phi_v(\widetilde{b})|B^H\right] = \phi_v > 0$ and $E\left[\phi_v(\widetilde{b})|B^L\right] = \phi_v > 0$. This implies that either $\phi_v(b^H) > 0$ or $\phi_v(b^L) > 0$ or both must be positive, so the executive must approve a proposal with a measured benefit b^H or b^L or both. Suppose that this equilibrium involved $\phi_v = 1$. Then neither (44) nor (45) could hold. Hence, we must have $\phi_v \in (0, 1)$.

Now consider the executive's incentives. Let $\tau_v = \left(\tau_v(B^H), \tau_v(B^L)\right)$, be the probabilities with which the regulator proposes with a BCA, then conditional on a proposal having been made without a BCA the executive's expected welfare is

$$\alpha E\left[\widetilde{B}|\tau_v\right] - C = \frac{p\tau_v(B^H)\left[\alpha B^H - C\right] - (1-p)\tau_v(B^L)\left[C - \alpha B^L\right]}{p\tau_v(B^H) + (1-p)\tau_v(B^L)}.$$

Since $\phi_v \in (0, 1)$, we must have $\alpha E\left[\widetilde{B}|\tau_v\right] - C = 0$, which implies

$$\frac{\tau_v(B^L)}{\tau_v(B^H)} = \frac{p}{1-p}\left[\frac{\alpha B^H - C}{C - \alpha B^L}\right]. \tag{46}$$

Similarly, the executive's expected welfare conditional on a proposal having been made with a BCA whose measured benefit is b^H and b^L is respectively

$$\alpha E\left[\widetilde{B}|\tau_v, b^H\right] - C = \frac{pq\tau_v(B^H)\left[\alpha B^H - C\right] - (1-p)(1-q)\tau_v(B^L)\left[C - \alpha B^L\right]}{pq\tau_v(B^H) + (1-p)(1-q)\tau_v(B^L)},$$
$$\alpha E\left[\widetilde{B}|\tau_v, b^L\right] - C = \frac{p(1-q)\tau_v(B^H)\left[\alpha B^H - C\right] - (1-p)q\tau_v(B^L)\left[C - \alpha B^L\right]}{pq\tau_v(B^H) + (1-p)(1-q)\tau_v(B^L)}.$$

We have established that either $\phi_v(b^H)$ or $\phi_v(b^L)$ or both must be positive. Suppose $\phi_v(b^H) > 0$ and $\phi_v(b^L) \geq 0$. Then $\alpha E\left[\widetilde{B}|\tau_v, b^H\right] - C \geq 0$, which implies

$$\frac{\tau_v(B^L)}{\tau_v(B^H)} \leq \frac{pq}{(1-p)(1-q)}\left[\frac{\alpha B^H - C}{C - \alpha B^L}\right].$$

However, since $\frac{q}{1-q} > 1$ (because $q > \frac{1}{2}$) this condition is inconsistent with (46). Suppose, instead, that $\phi_v(b^H) = 0$ and $\phi_v(b^L) > 0$. Then $\alpha E\left[\widetilde{B}|\tau_v, b^H\right] - C < 0$ and $\alpha E\left[\widetilde{B}|\tau_v, b^L\right] - C \geq 0$. This implies

$$\frac{p(1-q)}{(1-p)q}\left[\frac{\alpha B^H - C}{C - \alpha B^L}\right] \geq \frac{\tau_v(B^L)}{\tau_v(B^H)} > \frac{pq}{(1-p)(1-q)}\left[\frac{\alpha B^H - C}{C - \alpha B^L}\right],$$

which cannot hold since $\frac{1-q}{q} < \frac{q}{(1-q)}$. Thus, we cannot have a maximally separating equilibrium of form 2.

Consider a separating equilibrium of form 3. Necessarily,

$$E\left[\phi_v(\widetilde{b})|B^H\right]\left[\beta B^H - C\right] - k_r = \phi_v\left[\beta B^H - C\right] - k_r. \tag{47}$$
$$E\left[\phi_v(\widetilde{b})|B^L\right]\left[\beta B^L - C\right] - k_r = \phi_v\left[\beta B^L - C\right] - k_r = 0. \tag{48}$$

Thus $\phi_v = \frac{k_r}{\beta B^L - C} \in (0, 1)$. Moreover, from (48), $E\left[\phi_v(\widetilde{b})|B^L\right] = \frac{k_r}{\beta B^L - C} \in (0, 1)$ since $\beta \geq \frac{C + k_r}{B^L}$ from Assumption 2. From (47), $E\left[\phi_v(\widetilde{b})|B^H\right] = \frac{k_r}{\beta B^L - C} > 0$. This implies that we cannot have $\phi_v(b^H) = \phi_v(b^L) = 0$ (otherwise both $E\left[\phi_v(\widetilde{b})|B^L\right]$ and $E\left[\phi_v(\widetilde{b})|B^H\right]$ would equal zero). Nor can we have $\phi_v(b^H) = \phi_v(b^L) = 1$, for that would imply $E\left[\phi_v(\widetilde{b})|B^L\right] = 1$, contradicting that $E\left[\phi_v(\widetilde{b})|B^L\right] = \frac{k_r}{\beta B^L - C} \in (0, 1)$. Thus, we have the following possibilities: (a) $\phi_v(b^H) \in (0, 1), \phi_v(b^L) \in (0, 1)$; (b) $\phi_v(b^H) = 0, \phi_v(b^L) \in (0, 1)$; (c) $\phi_v(b^H) \in (0, 1), \phi_v(b^L) = 0$; (d) $\phi_v(b^H) = 1, \phi_v(b^L) \in (0, 1)$; (e) $\phi_v(b^H) \in (0, 1), \phi_v(b^L) = 1$; (f) $\phi_v(b^H) = 0, \phi_v(b^L) = 1$; (g) $\phi_v(b^H) = 1, \phi_v(b^L) = 0$. Let us further note that given the derived expressions for $E\left[\phi_v(\widetilde{b})|B^L\right]$ and $E\left[\phi_v(\widetilde{b})|B^H\right]$, $\phi_v(b^H)$ and $\phi_v(b^L)$ solve

$$q\phi_v(b^H) + (1-q)\phi_v(b^L) = \frac{k_r}{\beta B^L - C}. \tag{49}$$

$$(1-q)\phi_v(b^H) + q\phi_v(b^L) = \frac{k_r}{\beta B^L - C}. \tag{50}$$

However, if $\phi_v(b^H) = 0$, then (49) and (50) cannot hold simultaneously since $q > 1-q$. This rules out possibility (b). Analogous contradictions arise for possibilities (c)–(g). Hence, the only configuration consistent with a maximally separation equilibrium is $\phi_v(b^H) \in (0, 1)$, $\phi_v(b^L) \in (0, 1)$.
Let $\tau_v = \left(\tau_v(B^H), \tau_v(B^L)\right)$, be the probabilities with which the regulator proposes with a BCA. Given these strategies, we have

$$\alpha E\left[\widetilde{B}|\tau_v, b^H\right] - C = \frac{pq\tau_v(B^H)\left[\alpha B^H - C\right] - (1-p)(1-q)\tau_v(B^L)\left[C - \alpha B^L\right]}{pq\tau_v(B^H) + (1-p)(1-q)\tau_v(B^L)},$$
$$\alpha E\left[\widetilde{B}|\tau_v, b^L\right] - C = \frac{p(1-q)\tau_v(B^H)\left[\alpha B^H - C\right] - (1-p)q\tau_v(B^L)\left[C - \alpha B^L\right]}{pq\tau_v(B^H) + (1-p)(1-q)\tau_v(B^L)}.$$

Because $q > \frac{1}{2}$, for any $\tau_v(B^H), \tau_v(B^L)$, $\alpha E\left[\widetilde{B}|\tau_v, b^H\right] - C > \alpha E\left[\widetilde{B}|\tau_v, b^L\right] - C$. However, since a necessary condition for a maximally separating of form 3 is $\phi_v(b^H) \in (0, 1)$, $\phi_v(b^L) \in (0, 1)$, the executive must be indifferent between approval and rejection for each of the two possible measured benefit levels, i.e., $\alpha E\left[\widetilde{B}|\tau_v, b^H\right] - C = 0$ and $\alpha E\left[\widetilde{B}|\tau_v, b^L\right] - C = 0$, and as just seen, this is not possible for any strategy $\left(\tau_v(B^H), \tau_v(B^L)\right)$ followed by the regulator. Thus, we cannot have a maximally separating equilibrium of form 3. ■

Proof of Proposition 5 Let ϕ_v be the executive's approval probability for a proposed rule submitted without BCA and $E[\phi_v(b)|B]$ be the executive's expected approval probability for a proposed rule of type B submitted with BCA. A rule of type B is submitted without a BCA only if the following condition holds:

$$\phi_v(\beta B - C) \geq \max\{k_r, E[\phi_v(b)|B](\beta B - C)\}. \tag{51}$$

A rule of type B is submitted with a BCA only if the following condition holds:

$$E[\phi_v(b)|B](\beta B - C) \geq \max\{k_r, \phi_v(\beta B - C)\}. \tag{52}$$

Note that for a proposal to occur, it is necessary that $\beta B > C$ and the expected approval probability is positive; otherwise the expected payoff would be less than the proposal cost, k_r. Now, call the set of types over which the regulator proposes without a BCA $\mathbf{B}_n$ and the set of types over which the regulator proposes with a BCA $\mathbf{B}_m$. By assumption of a maximally separating equilibrium, both sets are nonempty. Upon seeing a proposal with a BCA, the executive's approval function is:

$$\phi_v(b) = \begin{cases} 0 & \text{if } \alpha E[\widetilde{B}|\widetilde{B} \in \mathbf{B}_m, \widetilde{b} = b] < C \\ \in [0, 1] & \text{if } \alpha E[\widetilde{B}|\widetilde{B} \in \mathbf{B}_m, \widetilde{b} = b] = C \\ 1 & \text{if } \alpha E[\widetilde{B}|\widetilde{B} \in \mathbf{B}_m, \widetilde{b} = b] > C. \end{cases}$$

By affiliation of $\widetilde{B}$ and $\widetilde{b}$, $E[\widetilde{B}|\widetilde{B} \in \mathbf{B}_m, \widetilde{b} = b]$ is an increasing function of b. Therefore, $\phi_v(b)$ is weakly increasing. By affiliation, $E[\phi_v(b)|B]$ must also be weakly increasing in B.

We now prove that $E[\phi_v(b)|B]$ must be constant in B over all $B \in \mathbf{B}_m$. Suppose otherwise: for some $B, B' \in \mathbf{B}_m$ where $B' > B$, we have $E[\phi_v(b)|B'] > E[\phi_v(b)|B]$. Since $E[\phi_v(b)|B]$ is weakly increasing in B, it is without loss of generality to let $B = \inf \mathbf{B}_m$. If $\phi_v > E[\phi_v(b)|B]$, then (52) cannot hold for B. Therefore, $\phi_v \leq E[\phi_v(b)|B]$ for all $B \in \mathbf{B}_m$. It therefore must be the case that if $B'' \in \mathbf{B}_n$, $B \geq B''$. For if that were not the case, then (51) would not hold for B'', as

$$\begin{aligned}\phi_v(\beta B'' - C) &\leq E[\phi_v(b)|B](\beta B'' - C)\\ &< E[\phi_v(b)|B''](\beta B'' - C),\end{aligned}$$

where the first inequality is because $\phi_v \leq E[\phi_v(b)|B] < E[\phi_v(b)|B']$ and the second is by affiliation. Therefore, $\mathbf{B}_n$ is entirely below B and $\mathbf{B}_m$ is entirely above B. This implies that $E[\widetilde{B}|\widetilde{B} \in \mathbf{B}_n] < E[\widetilde{B}|\widetilde{B} \in \mathbf{B}_m, \widetilde{b} = b]$ for any realization of b. Since $\phi_v > 0$, this means that $E[\widetilde{B}|\widetilde{B} \in \mathbf{B}_n] \geq \frac{C}{\alpha}$. As such, $\phi_v(b) = 1$ for all b. But this contradicts that $E[\phi_v(b)|B'] > E[\phi_v(b)|B]$. Therefore, $E[\phi_v(b)|B]$ is constant for all B. Based on this, (51) cannot hold for any $B \in \mathbf{B}_n$ unless $\phi_v = E[\phi_v(b)|B]$ for all B. But then all proposals are approved with a constant probability, which is outcome equivalent to a prohibited BCA equilibrium in which all proposals are approved with that probability. ■

Proof of Lemma 2 To establish the result, we must show that for any $\alpha' > \alpha$,

$$\begin{aligned}&EU_s^E(A^+, \alpha') - EU_s^E(0, \alpha') > EU_s^E(A^+, \alpha) - EU_s^E(0, \alpha) \text{ and}\\ &EU_s^E(0, \alpha') - EU_s^E(A^-, \alpha') > EU_s^E(0, \alpha) - EU_s^E(A^-, \alpha).\end{aligned}$$

To prove this, it suffices to show that $EU_s^E(A^+, \alpha) - EU_s^E(0, \alpha)$ and $EU_s^E(0, \alpha) - EU_s^E(A^-, \alpha)$ are increasing in α. From (27),

$$\begin{aligned}EU_s^E(A^+, \alpha) - EU_s^E(0, \alpha) &= p(1-q)\left[\alpha B^H - C\right] - (1-p)q[C - \alpha B^L] \text{ and}\\ EU_s^E(0, \alpha) - EU_s^E(A^-, \alpha) &= pq\left[\alpha B^H - C\right] - (1-p)(1-q)[C - \alpha B^L] - k_r,\end{aligned}$$

both of which are increasing in α. ■

Proof of Proposition 7 For $A^*(\alpha) = 0$, then from (27) the following inequalities must hold

$$\begin{aligned}&pq\left[\alpha B^H - C\right] - (1-p)(1-q)[C - \alpha B^L] - k_r \geq p\left[\alpha B^H - C\right] - (1-p)\left[C - \alpha B^L\right] - k_r.\\ &pq\left[\alpha B^H - C\right] - (1-p)(1-q)[C - \alpha B^L] - k_r \geq 0.\end{aligned}$$

The first inequality implies $\alpha \leq \overline{\alpha}_m(b^L)$. The second implies

$$\alpha \geq \widehat{\alpha}_s = \overline{\alpha}_m(b^H) + \frac{k_r}{pqB^H + (1-p)(1-q)B^L}.$$

Now, $\widehat{\alpha}_s < \overline{\alpha}_n$ if and only if $\overline{\alpha}_n - \overline{\alpha}_m(b^H) > \frac{k_r}{pqB^H+(1-p)(1-q)B^L}$. Using the expressions for $\overline{\alpha}_n$ and $\overline{\alpha}_m(b^H)$ this can be shown to be equivalent to the sufficient condition in the statement of the proposition. Because $\widehat{\alpha}_s < \overline{\alpha}_n < \overline{\alpha}_m(b^L)$, the set of α for which $A^*(\alpha) = 0$ is non-empty, and it includes regulation-averse, regulation-neutral, and regulation-sympathetic administrations. ∎

Acknowledgements We would like to thank Michael Livermore, Nicola Persico, and David Sappington for their helpful comments and suggestions.

Author Contributions CY developed the initial model and provided the first analysis of the problem we study in this paper. DB and AK built on this initial work to develop and analyze the model that appears in the submitted paper. CY wrote the initial drafts of the paper. DB took the lead in writing the current version of the paper (including preparing the two figures in the paper), with considerable help and significant input from AK. All authors reviewed the manuscript.

Data Availability No datasets were generated or analysed during the current study.

Declarations

Conflict of interest The authors declare no competing interests.

References

Adler, M., & Posner, E. (2006). *New foundations of cost-benefit analysis*. Harvard University Press.

Banks, J. S., & Sobel, J. (1987). Equilibrium Selection in Signaling Games. *Econometrica, 55*(3), 647–661.

Besanko, D., & Spulber, D. (1993). Contested mergers and equilibrium antitrust policy. *Journal of Law, Economics, & Organization, 9*(1), 1–29.

Bester, H., Lang, M., & Li, J. (2021). Signaling versus auditing. *RAND Journal of Economics, 52*(4), 859–883.

Bubb, R., & Warren, P. (2014). Optimal agency bias and regulatory review. *The Journal of Legal Studies, 43*(1), 95–135.

Center for Regulatory Effectiveness. (2019). The Evolution of Benefit-Cost Analysis in Federal Rulemaking (August 16). https://www.thecre.com/forum8/?p=724. Accessed April 3, 2023.

Cohen, M. (2004). George W. Bush and the environmental protection agency: A midterm appraisal. *Society and Natural Resources, 17*, 69–88.

Cole, D. (2012). Law, politics, and cost-benefit analysis. *Alabama Law Review*, 1, 55–89.

Congressional Research Service. (2011). Report RL 32397, Federal Rulemaking: The Role of the Office of Information and Regulatory Affairs. (March 21).

Congressional Research Service. (2017). Report R44840, Cost and Benefit Considerations in Clean Air Act Regulations (May 17).

Copeland, C. W. (2009). Federal rulemaking: The role of the Office of Information and Regulatory Affairs. Congressional Research Service. (June 9).

Crawford, V., & Sobel, J. (1982). Strategic information transmission. *Econometrica, 50*(6), 1431–1451.

Crémer, J. (1995). Arm's length relationships. *Quarterly Journal of Economics, 110*(2), 275–295.

Daley, B., & Green, B. (2014). Market signaling with grades. *Journal of Economic Theory, 151*, 114–145.

Decker, J. (2019). Deregulation, Regan-Style. *The Regulatory Review*. https://www.theregreview.org/2019/03/13/decker-deregulation-reagan-style/. Accessed November 8, 2021.

Dennis, B., & Mooney, C. (2017). Neil Gorsuch's Mother Once Ran the EPA. It Didn't Go Well. *Washington Post* (February 1). https://www.washingtonpost.com/news/energy-environment/wp/2017/02/01/neil-gorsuchs-mother-once-ran-the-epa-it-was-a-disaster/. Accessed August 31, 2022.
Dessein, W. (2002). Authority and communication in organizations. *Review of Economic Studies, 69*(4), 811–838.
Dewatripont, M., Jewitt, I., & Tirole, J. (1999). The economics of career concerns, Part I: comparing information structures. *Review of Economic Studies, 66*(1), 183–198.
Dudley, S. (2005). The Bush Administration's Regulatory Record. Available at SSRN https://ssrn.com/abstract=653963. Accessed August 31, 2022.
Dudley, S. (2021). Regulatory oversight and benefit-cost analysis: A historical perspective. *Journal of Benefit-Cost Analysis, 11*(1), 62–70.
Executive Order 13771. (2017). Reducing Regulation and Controlling Regulatory Costs. 82 FR 9339 (January 30) (pp. 9339–9341) https://www.federalregister.gov/documents/2017/02/03/2017-02451/reducing-regulation-and-controlling-regulatory-costs. Accessed July 8, 2022.
Fraas, A., Morgenstern, R. (2014). Changes in analytical perspectives across administrations. Resources for the Future Discussion Paper 14–35 (September). https://media.rff.org/documents/RFF-DP-14-35.pdf. Accessed August 11, 2020.
Friedman, L. (2020). G.A.O.: Trump Boosts Deregulation by Undervaluing Cost of Climate Change. *New York Times* (July 14). https://www.nytimes.com/2020/07/14/climate/trump-climate-change-carbon-cost.html. Accessed August 11, 2020.
Grossman, M., & Hopkins, D. (2015). Ideological Republicans and group interest Democrats: the asymmetry of American party politics. *Perspectives on Politics, 13*(1), 119–139.
Holmstrom, B. (1999). Managerial incentive problems: A dynamic perspective. *Review of Economic Studies, 66*(1), 169–182.
Jiang, W., & Margraff, R. (2021). The origin of cost-benefit analysis: A comparative view of France and the United States. *Cost Effectiveness and Resource Allocation, 19*(74), 2022. https://doi.org/10.1186/s12962-021-00330-3
Johnston, J. S. (2002). A game theoretic analysis of alternative institution for regulatory cost-benefit analysis. *University of Pennsylvania Law Review, 150*(5), 1343–1428.
Krishna, V., & Morgan, J. (2008). Contracting for information under imperfect commitment. *RAND Journal of Economics, 39*(4), 905–925.
Livermore, M., & Revesz, R. (2020). *Reviving rationality: Saving cost-benefit analysis for the sake of our environment and health*. New York: Oxford University Press.
Mannix, B. (2016). Benefit-cost analysis as a check on administrative discretion. *Supreme Court Economic Review, 24*, 155–168.
Moe, T., & Wilson, S. (1994). Presidents and the politics of structure. *Law and Contemporary Problems, 57*(2), 1–44.
Newell, R., Rogers, K. (2003). The U.S. Experience with the Phasedown of Lead in Gasoline. Resources for the Future Discussion Paper. https://web.mit.edu/ckolstad/www/Newell.pdf. Accessed November, 2022.
Nyborg, K., & Spangen, I. (2000). Cost-benefit analysis and the democratic ideal. *Nordic Journal of Political Economy, 26*, 83–93.
Office of Management and Budget. (1997). Report to Congress on the Costs and Benefits of Federal Regulations. Chapter 1: The Role of Economic Analysis in Regulatory Reform. https://obamawhitehouse.archives.gov/omb/inforeg_rcongress#toc. Accessed April 3, 2023.
Pavan, A., Tirole, J. (2022). Expectation conformity in strategic cognition. Working paper.
Pearce, D. W. (1983). *Cost-benefit analysis* (2nd ed.). New York: St. Martins Press.
Pearlstein, R. (2020). *Reaganland: America's right turn 1976–1980*. New York: Simon and Schuster.
Posner, E. (2001). Controlling agencies with cost-benefit analysis: A positive political theory perspective. *University of Chicago Law Review, 68*(4), 1137–1199.
Prat, A. (2005). The wrong kind of transparency. *American Economic Review, 95*(3), 862–877.
Prendergast, C. (2007). The motivation and bias of bureaucrats. *American Economic Review, 97*(1), 180–96.
Revesz, R., & Livermore, M. (2008). *Retaking rationality: How cost-benefit analysis can better protect the environment and our health*. New York: Oxford University Press.
Shapiro, S. (2020). OIRA's dual role and the future of cost-benefit analysis. *Environmental Law Reporter, 50*, 10385–10397.

Spenkuch, J., Teso, E., & Guo, X. (2023). Ideology and performance in public organizations. *Econometrica, 19*(4), 1171–1203.

Stahl, K., & Strauz, R. (2017). Certification and market transparency. *Review of Economic Studies, 84*, 1842–1868.

Sunstein, C. (2002). *The cost-benefit state: The future of regulatory protection*. Chicago: American Bar Association.

Sunstein, C. (2018). *The cost-benefit revolution*. MIT Press.

Tirole, J. (2016). Cognitive games and cognitive traps. Working paper.

Topkis, D. M. (1978). Minimizing a submodular function on a lattice. *Operations Research, 26*(2), 305–321.

Tozzi, J. (2011). OIRA's formative years: The historical record of centralized regulatory review preceding OIRA's founding. *Administrative Law Review, Special Edition: OIRA Thirtieth Anniversary Conference, 63*, 37–69.

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