

# *Left, Right, and Center: Strategic Information Acquisition and Diversity in Judicial Panels\**

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## Abstract

In the last fifteen years, numerous studies of multi-member courts have documented a phenomenon popularly known as “panel effects.” Two provocative findings from this literature are: (1) the inclusion of (non-pivotal) members from outside the dominant ideology on the panel predicts higher reversal rates of administrative agencies that are “like minded” with the panel’s median voter; and (2) when mixed panels do not reverse, they frequently issue unanimous decisions. The apparently moderating effects of mixed panels both pose a challenge to conventional median voter theories and call into question the predictability and legitimacy of judicial review. Accordingly, many scholars have offered their own explanation for panel effects (including collegiality, dissent aversion, deliberation effects, whistle-blowing, and others). In this paper, we propose a general model that (among other things) predicts panel effects as a byproduct of strategic information acquisition. The kernel of our argument is that ideologically extreme, non-pivotal members of deliberative panels have incentives to engage in costly information production in cases where pivotal members would rationally choose not to do so. As a result, diverse panel compositions can catalyze distinct forms of information production producing equilibrium panel effects. Our informational account – if correct – has normative implications for the composition of judicial panels in particular and for deliberative groups more generally.

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# 1 Introduction

Within the growing empirical literature on judicial review, three notable findings stand out. First, *politics matters*: Democrat appointed judges are more likely to uphold liberal Agency and/or trial court decisions and reverse conservative ones than are their Republican counterparts.<sup>1</sup> Second, *party matters*: while manifesting qualitatively similar behavior, Democrat and Republican do not mirror one another exactly (*e.g.*, Democrats appear to “cross the party line” more frequently than Republicans). And third, *diversity matters*: mixed three-judge panels (*i.e.*, two Democrats and one Republican or two Republicans and one Democrat) tend to make decisions that are more moderate than do homogenous panels dominated by a single party (Democrat or Republican).<sup>2</sup>

This paper focuses on the third feature – the evident moderating effects of panel diversity – and in the process says something about the other two. Our contribution is primarily theoretical: we develop and analyze a model connecting (a) hierarchical auditing of lower-tier actors (*e.g.*, administrative agencies or trial courts), (b) group deliberation within the auditing entity (*e.g.*, an appellate judicial panel); and (c) strategic decisions by group members to make costly investments in information acquisition relevant to deliberations (*e.g.*, about the case itself, underlying policy choices at play, doctrinal constraints, etc.). Our model predicts each of the empirical regularities noted above as an equilibrium phenomenon, and in particular the apparent moderation within politically diverse judicial panels. Specifically, we show that heterogeneous panel compositions are more likely to incentivize broad information production than are homogenous compositions. For example, a lone Republican (or Democrat) on a 3 judge panel may be willing to provide an informational public good to her counterparts even if they are not willing to provide it themselves. The endogenous pattern of information flow due to panel diversity, in turn, induces voting practices that manifest greater moderation than those of homogenous panels. To the extent that our hypothesis is correct, it holds implications as to whether mixed judge panels are desirable, or even should be required. (Miles & Sunstein 2008, Tiller & Cross 1999; cf. Schanzenbach & Tiller 2008, 2009).<sup>3</sup>

The framework we develop here builds on our prior work (Spitzer & Talley

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<sup>1</sup>See Revesz (1997), Cross and Tiller (1998), and Miles & Sunstein (2006, 2008), Sunstein, Schkade and Ellman (2004), as well as earlier work in political science, cited in note \_\_\_, for empirical confirmation. The explanation for this phenomenon is fairly widely accepted: ideological disposition. (Segal & Spaeth, 2002). See Stephenson 2009, at 46 (“Republican appointees are more likely, all else equal, to uphold conservative agency decisions and reject liberal agency decisions, while Democratic appointees are more likely to uphold liberal decisions and reject conservative decisions, and these effects are typically substantively as well as statistically significant.”). See generally Stephenson (2009).

<sup>2</sup>See also Peresie (2005), finding similar effects for male and female judges. For an excellent overview, Hettinger, Lindquist and Martinek 2007. For the history, Maveety (2005) and Kestellec (2008). Kestellec produces data suggesting that panel effects are a comparatively recent phenomenon, arising in the second half of the 20th Century. However, by 2011, there is no doubt that robust panel effects exist.

<sup>3</sup>As Stephenson (2009, pg. 47) points out, there are two effects from mixed judicial panels. One is the tendency of the minority judge to vote with the majority. The second, and in our opinion likely the more important effect, is the tendency of the majority judges to creep ever so

2000),<sup>4</sup> but departs from it in a few crucial ways. First, we generalize the model to yield a deeper understanding of appellate court dynamics (and hierarchical auditing more broadly). Rather than treating the appellate court as a unitary actor (as both we and Cameron, Segal & Songer 2000 did), we explicitly consider it as a multimember body. This generalization is critical, since strategic interaction among panelists is what generates the core intuitions we highlight here. Second, we tailor our framework to correspond roughly to some key institutional attributes in administrative law. When Agency decisions are appealed, the court must hear such appeals. Yet, for matters on appeal, judges have significant practical discretion over how much to scrutinize the Agency’s actions. Our model specifically captures this endogenous effort choice among individual judges sitting on a larger panel. Finally, our framework is amenable to calibration and testing with real-world data, and accordingly we demonstrate that a calibrated version of our model predicts patterns of panel effects that correspond well to those observed in the existing literature.

Political scientists have suggested a number of theories for explaining the moderating effect of including a minority judge on a three judge panel. A first set of explanations hinges on social *cohesion and collegiality* (e.g., Songer 1982, pg. 226), positing that social pressures may lead non-pivotal minority judges to go along with the majority, as a mechanism for enhancing (or preserving) inter-panelist harmony. Even if such tastes for collegiality are relatively weak, they may be enough to deter the minority panelist from taking the time and energy to author a dissent.<sup>5</sup> *Dissent aversion* – a set of predictions about when judges will allocate their time to writing dissents – partially relies on a theory of social cohesion and collegiality. Epstein, Landes and Posner (2011), for example, show that dissent incidence is negatively associated with caseload and

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subtly in the direction of the minority. This latter effect is more important because it changes the outcome of the case. In contrast, when the minority voter moderates his vote to join the majority, the outcome is likely left unchanged. As it happens, in our model, described below, both effects can occur simultaneously. In other words, and in certain circumstances, both Republican and Democratic judges are likely to vote a bit more like each other. Both effects stem from the increased willingness of minority judges to do costly research in situations where majority judges would not bother to do so.

<sup>4</sup>We are also implicitly building on Cameron, Segal, and Songer (2000), which was published contemporaneously with Spitzer & Talley (2000), and uses a model very similar in spirit. One of the few important differences is that in Cameron et al., the higher court can learn the state of the world with certainty once it pays the cost of an audit, whereas in Spitzer and Talley the Higher court has a better estimate of the true state of the world than does the Lower court, but is still somewhat uncertain.

<sup>5</sup>Within this literature, both social and workload-related costs/benefits can play a role. Atkins, (“social pressure”); Atkins & Green (empirical support for workload and dissents inversely related); Goldman (norm of consensus); Green (workload reduces dissents). See also Posner (2002, pg. 32) (“[m]ost judges do not like to dissent....Not only is it a bother and frays collegiality, and usually has no effect on the law, but it also tends to magnify the significance of the majority opinion.”); Landes & Posner (2009) (discussing “dissent aversion”).

Relatedly, in a contemporaneous piece to this one, Fischman (2009) studies an attitudinal model, augmented by a cost to writing a dissent. The higher the cost of the dissent, the more likely it is that a minority judge will choose to join the majority opinion. His model does not, however, predict that the majority judges will ever moderate their position and join the minority.

positively associated with both circuit size and intra-circuit ideological diversity, all of which may bear on the costs, benefits and sustainability of collegial norms among appellate court judges. In a related vein, some have posited that additional pressures from *group polarization* may play a more extreme role in homogenous panels, which can in turn lead to apparent moderation of mixed panels (*e.g.*, Sunstein, Schkade and Ellman, 2004, pg. 308). That is, individuals may become more extreme when interacting with like minded counterparts (Myers 1975; Asch 1951). Applied to judges, polarization effects predict that homogenous panels “reinforce” each other’s prior commitments, thereby leading to more ideologically extreme decision making (and apparently more moderation in mixed panels).

A second explanation, sometimes known as *whistleblowing*, is perhaps the leading explanation among positive political theory (“PPT”) scholars to explain panel effects. First developed by Cross and Tiller (1998), this account conjectures that a minority party panelist can effectively threaten to “tattle” on the majority (*e.g.*, through a dissent) if those majority actors ignore established precedent or doctrine. The minority member, they argue, can expose a majority’s manipulation or disregard of legal doctrine, and thus her credible threat to blow the whistle deters such manipulation in the first instance, producing more moderation. (Cross and Tiller 1998, p. 2156). The whistleblower account harbors a distinct role for formal legal doctrine as a constraint on judicial review. That is, the whistleblower account gets its traction from the existence of an independent, commonly subscribed legal canon, whose violation can be detected and communicated to an outside community. Our approach, in contrast, neither requires nor precludes the possibility that legal doctrine might also do some work and, in fact, allows for doctrine to be vague, contested, over- or under-determined, or simply unintelligible. In order to highlight the role of endogenous information production, we will focus only on ideology, information, choice and outcomes.<sup>6</sup>

A final explanation, perhaps the leading one among legal academics, was proposed by Revesz (1997, pg. 1732), and is sometimes identified as the *deliber-*

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<sup>6</sup>We hasten to add that the role of doctrine may certainly be important (and we have published on the role and characterization of doctrine before. (Spitzer & Tiller; Cohen & Spitzer (1994); Talley (1999)). The strategic formulation of doctrine by the Supreme Court, and its effects on lower courts, takes up a significant fraction of research in this field. See Cross & Tiller (2006), Jacobi (2009), Jacobi & Tiller (2007), Lax (2007, 2008), Lax & Landa (2009), McNollGast (1995), Strauss (1987), Tiller (1998), Shavell (2009), Stephenson (2006). Rodriguez and Weingast (2007) have extended this approach to the interaction between the courts and Congress. Kstellec (2007) extends Cross and Tiller’s whistleblower model into Kornhauser’s (1992a, b) “case space” and, by formalizing the model, explores the how three-judge panels (as opposed to individual judges), while not inducing perfect doctrinal control of lower courts by the Supreme Court, increase SCOTUS’s ability to see its preferred doctrine carried out. Kstellec (2010) extends the model again, to a two-level hierarchy (full circuit and SCOTUS) above three judge panels, and finds exactly the asymmetric form of control induced by whistleblowing that Cross and Tiller predicted.

It is important to note that the process of “information acquisition” we model here could, in principle, also pertain to conventional legal research on existing precedents, and as such whistleblowing would represent a special case of our framework. We take up this interpretation below.

ation hypothesis. In essence, by being empaneled with judges from the opposite political party and deliberating with them, one is naturally led to moderate her positions. The informational explanation that we propose here is perhaps closest in spirit to Revesz’ suggestion, but we develop it within a more formal theoretical framework, generating in turn more precise predictions about the mechanics of panel effects. Within our model, judges possessing ideologies distinct from the median judge have proportionally greater incentives to engage in costly research. Their efforts, communicated through a deliberative setting, produce effects akin to Revesz’ notion of deliberation. Consequently, the panel’s decisions not only reflect median voter’s preferences directly (the standard insight from PPT), but they also *indirectly* reflect preferences of panel members with preferences far from the median (and who have greater incentive to engage in search).

Before proceeding, one caveat deserves specific mention. Although our analysis aims to understand and explain judicial panel effects, it has obvious ties to other literatures in political science, psychology, economics and elsewhere on group effects within deliberative fora. These include papers on (so called) persuasion games,<sup>7</sup> inquisitorial versus advocacy systems,<sup>8</sup> political lobbying,<sup>9</sup> media reporting and bias,<sup>10</sup> and the value of ideological diversity more generally within deliberative fora.<sup>11</sup> We do not attempt to develop these links fully here, though our general approach may both inform such inquiries and is, in many respects, informed by them.

Our analysis proceeds as follows. Section 2 describes at greater length the literature relating to panel effects, along with the prevailing theories that have been posited to explain them. Section 3 presents our theoretical model and characterizes its equilibria. Section 4 uses simulation methods to calibrate our model to existing empirical data, and develops some preliminary thoughts about testing our model against alternatives. Section 5 discusses extensions of our model. Section 6 considers implications, and Section 7 concludes.<sup>12</sup>

## 2 Empirical Panel Effects

Before beginning with our analytic enterprise, it is perhaps useful to situate our claims within the empirical literature on panel effects. As noted in the introduction, during the last decade the empirical literature on judicial panel effects

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<sup>7</sup>Milgrom & Roberts (1986).

<sup>8</sup>Dewatripoint & Tirole (1999).

<sup>9</sup>De Figueiredo & Cameron (2008).

<sup>10</sup>Gentzkow and Shapiro (2006).

<sup>11</sup>For example, this paper ties into a substantial literature, reviewed in Farhang and Wawro (2004), on racial minority and female judges. Both Farhang and Wawro (2004), and Peresie (2005) emphasize the intersection between including minority judges on panels and deliberation. We believe that their initial steps are correct; to the extent that minority judges have preferences that are different from those of other judges, our information-based model should apply.

<sup>12</sup>A technical Appendix includes a number of technical derivations and proofs that are suppressed in the text.

has proliferated rapidly. Although we cannot canvass all of them here, a few of the central landmarks in this literature are worth recounting. Revesz (1997) is often credited with being the first legal academic to notice and document the phenomenon. He collected challenges to decisions of the Environmental Protection Agency that were brought in the DC Circuit between 1970 and 1994. Revesz divided the time into periods in which the membership of the DC Circuit was unchanged and utilized the random assignment of judges to test hypotheses about the effect of panel composition on votes and outcomes.<sup>13</sup> Employing a qualitative response analysis of industry challenges to EPA regulations, Revesz found that panel behavior differed by time period, and that Democrats and Republicans did not always act as the mirror images of one another. For the 1970s he found:

First, a Republican judge was significantly more likely to reverse when there was at least one other Republican on the panel. Second, for a Democratic judge, the probability of reversal was not significantly affected by the composition of the panel. Third, Democrats, but not Republicans, were significantly more likely to reverse in industry challenges raising a procedural claim than in industry challenges not raising such a claim.<sup>14</sup>

For the latter time periods of his study, Revesz reached a slightly different conclusion:

First, a Republican judge was significantly more likely to reverse when there was at least one other Republican on the panel. Second, a Democratic judge was significantly less likely to reverse when there was at least one other Democrat on the panel.<sup>15</sup>

We regard these results as empirical support for panel effects, though they are mixed as to which particular pattern of effects is supported by the data. In the 1970s the findings appear to be flat out asymmetric, but in the subsequent periods they appear more symmetrically distributed.

Shortly after Revesz's study, Cross and Tiller (1998) conducted an empirical test on 170 cases in which the DC Circuit reviewed Agency interpretations of regulatory statutes. They found that unified panels (RRR or DDD in our lexicon) were 17% less likely to defer to agencies than were split panels (RRD or DDR). It is difficult to interpret their findings in our framework; we are looking for moderation on a political dimension, not a tendency to defer. However, they produced one statistic that appears to support moderation by split panels. They calculated that unified panels deferred to Agencies only 33% of the time when the panel's politics were inconsistent with the Agency's position, but deferred to

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<sup>13</sup>Revesz also tested hypotheses unconnected to panel composition, and found voting patterns that are consistent with an ideological component to judicial voting.

<sup>14</sup>Revesz at 1759

<sup>15</sup>Revesz at 1760.

the Agency 62% of the time when the panel was split (significant at .05). (Cross and Tiller, 1998, pg. 2172). This is evidence for moderation, we believe.

Sunstein, Schkade and Ellman (2004) investigated the votes of federal appeals judges in thirteen categories. They found that the typical pattern of panel effects existed in most of the subject areas (e.g. campaign finance, affirmative action, EPA regulation); however, in at least one context (Title VII discrimination cases) it was muted, and in three areas (federalism, criminal law, takings clause) the pattern was missing entirely. In some of the areas the effects were symmetric, while in other areas not. In two areas (abortion and capital punishment) they found pure ideological voting, but no panel effects at all.

Miles and Sunstein (2006, 2008) also present evidence supporting panel effects<sup>16</sup> and exhibiting some asymmetries. They investigate all Circuit Court review of EPA and NLRB decisions between 1996 and 2006 for insufficient factual basis or for being arbitrary or capricious, which together they call “arbitrariness” review. Next, they compute “validation rate,” which is the rate at which the court upholds administrative action against challenge. Then they coded for the politics of the administrative action by considering who challenged Agency action; if industry challenged the Agency action then the Agency action was deemed liberal, whereas if a union or an environmental group challenged an Agency action, then the Agency action was deemed conservative. Last, Miles and Sunstein coded each judge’s political party as equal to the party of the appointing president for that judge.

Miles and Sunstein found the same basic ideological component of voting that others have found. Judges appointed by Democratic Presidents were more likely to vote to validate liberal administrative Agency actions than conservative actions. Judges appointed by Republican Presidents had the reverse tendency. But in addition, Republican appointees were more likely to validate conservative Administrative Agency actions when they were sitting with two other Republican Judges than when they were sitting with one or more Democrats. Democrat appointees appeared to behave in similar (but perhaps more complicated) ways.

Unfortunately, Miles and Sunstein constructed their measures by pooling all mixed panels, rather than separating, for example, DRR and DDR panels. So, we cannot observe the change in tendencies between a minority member of a panel and the same judge as part of a two-judge majority. Using their approach, Miles and Sunstein measure the empirical propensity of a Democratic judge to uphold Agency decisions when she is moved from a unified Democratic panel to a mixed panel. They find Democrat appointees are less likely to validate liberal agency decisions – and more likely to likely to uphold conservative decisions – when they are moved to mixed panels. Republican propensities move in the opposite qualitative direction (although Republican voting patterns were somewhat less sensitive to panel composition than were Democrats’). We regard these results as evidence in favor of panel effects; that is, inclusion on a mixed panel tends to moderate voting patterns. It is less clear whether the Miles & Sunstein results should be taken as evidence of symmetry or asymmetry between

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<sup>16</sup>In a similar vein, see Cox and Miles (2007).

Republicans and Democrats (and could be consistent with either<sup>17</sup>).

Landes and Posner (2008) “correct” and clean the most commonly used data bases, and then present a large number of empirical analyses on judicial review. They claim that they could not code lower Federal Court votes as majority or dissent, and hence they could not say much about panel effects *per se*. They did find, however, that judges appointed by Democratic Presidents were more likely to cast liberal votes than were judges appointed by Republican Presidents, and also that mixed panels appeared to create some "moderation" in views, at least among Federal Circuit panels (but not on the Supreme Court).

In an interesting recent paper that both reviews and contributes to the literature on gender effects in judging, Boyd et al. (2011) tested whether male and female judges vote differently in thirteen different doctrinal areas. They found significant panel effects in only one area: sex discrimination in employment, where males were far more likely to vote liberally when sitting with a female judge than when sitting with only other males. Boyd et al. interpret this result as reflecting an informational explanation of panel effects. Women have information about how employment discrimination works, which they can share with their panelists. Their interpretation meshes very nicely with the mechanism driving our model.<sup>18</sup>

Some recent pieces have injected some skepticism (or at least words of caution) into the enterprise of empirical estimation of judicial preferences.<sup>19</sup> Edwards and Livermore (2009, pg. 1916), for example, strongly criticize this literature, partly on the ground that it is based on an attitudinal model that does

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<sup>17</sup>Cf Schanzenbach and Tiller (2008), which reviewed the treatment of sentencing guidelines after the Supreme Court’s *Apprendi v. New Jersey* and *United States v. Booker* decisions. *Apprendi* and *Booker* rendered the guidelines “advisory.” Using an informal PPT model of strategic sentencing by District Court judges under the guidelines, they make empirical predictions:

The empirical implications, thus, are as follows: (1) policy preferences matter in sentencing—liberal (Democratic-appointed) judges give different (generally lower) sentences than conservative (Republican-appointed) judges for certain categories of crime; (2) the length of the sentence given by sentencing judges depends on the amount of political-ideological alignment between the sentencing judge and the circuit court; and (3) sentencing judges selectively use adjustments and departures to enhance or reduce sentences, and the use of departures is influenced by the degree of political alignment between the sentencing judge and the overseeing circuit court, while the use of adjustments is not so influenced.

Adjustments, which are very difficult to review by the appellate court, allow some (almost) unreviewable sentencing discretion to the sentencing judge, while departures, which are much more likely to be reviewed, give the sentencing judge much more discretion to adjust the sentence if (and only if) he is politically aligned with the Court of Appeal in his circuit.

Their data on effect of alignment are weakly supportive of their hypothesis. For Democratic judges who are sitting in a Democratic Circuit, the coefficients on length of sentence (shorter), probability of departing from the Guidelines (higher), and the size of downward departure from Guidelines (larger) are all consistent with their hypothesis, but only the coefficient on probability of departure is significant. We regard this as weak evidence in favor of the whistleblower theory, and weak evidence of some asymmetry in judicial review of lower courts.

<sup>18</sup>Kastellec (2011, working paper) finds similar results for African American Judges on the Courts of Appeal for affirmative action cases.

<sup>19</sup>Revesz 2002 defends the empirical study of courts against broadside attacks.



not take into account the dynamics of group deliberation. Our model is the first that we know of to attempt to characterize an important characteristic of deliberation – information exchange. For reasons that are not clear (at least to us), several commentators seem to regard collegial deliberation as inconsistent with ideological explanations. (Edwards and Livermore (2009, pg. 1917); Tacha (1995, pg. 586); Wald (1999, pg. 255)). As our model shows, however, the two concepts not only can coexist, but their interaction may be key to understanding panel effects.

In sum, the empirical literature provides overwhelming support for the proposition that ideological differences among judges “matter” for outcomes. It also provides significant evidence for a “moderation” effect in mixed panels, where minority and majority factions tend to move towards one another when voting relative to homogenous counterparts. Finally, there is some intermittent evidence that even as they exhibit qualitatively similar patterns, Republican and Democrat judges do not always behave as complete mirror images of each other. That said, the precise drivers of these phenomena are still not well understood. And accordingly, the next sections of this paper endeavor to offer a plausible predictive theory for them.

### 3 Model

In this section, we develop and analyze a formal model of strategic information acquisition among individual judges in multi-judge panels. Using this model, we show how ideological diversity, even if insufficient to change judicial preferences, can still generate voting patterns that manifest panel effects. The intuitive kernel of our argument lies in the endogenous nature with which judges produce information that is informative to all panel members in deliberation. Our model builds most directly on the basic framework set out in Spitzer & Talley (2000),<sup>20</sup> but it adds a few modifications and simplifications to focus on the effects of multi-member appellate courts. In order to expose our key intuitions, we will start with a simple information structure, addressing more complicated extensions in later sections.

#### 3.1 Framework

Consider a two-level hierarchy, consisting of a unitary initial actor,  $A$ , representing an administrative agency or a district court, and a reviewing/appellate panel,  $J$ , that may review the  $A$ 's decision. We assume that the decision at issue concerns a regulatory / policy outcome  $y$  from a policy space  $Y$ , normalized so that  $Y = \{-1, 1\}$ . Intuitively,  $Y$  could reflect a choice between a politically “Conservative” policy ( $y = 1$ ) and a “Liberal” one ( $y = -1$ ). For example, if the first-level actor is an administrative agency, it might be contemplating whether

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<sup>20</sup>See also Cameron et al. (2000), which employed a similar information structure to Spitzer & Talley (2000), and similarly assumed a unitary reviewing court.

to preserve a de-regulatory *status quo ante* (such as not requiring passive safety restraints) or to adopt a regulatory intervention (requiring them).<sup>21</sup>

Although we allow actors to be motivated by political commitments, we also suppose that they care about the *fit* between the ultimate policy choice and objective states of the world – what we will call “facts.” In the example above, these facts might embody information about how effective passive restraints are relative to their costs. We presume that some random variable  $X \in \mathbb{R}$  represents the “true” facts, and that  $X$  is commonly known *ex ante* to be normally distributed with mean  $\mu$  and precision  $\tau$ .<sup>22</sup> (Our framework also admits the limiting degenerate case when  $\tau \rightarrow 0$ , so that priors are essentially uninformative).

### 3.1.1 Judicial & Agency Actions and Preferences

Information about the true realization of facts,  $x$ , is important to all decision makers because it affects their assessment of which policy  $y$  is the best fit between the facts and policy commitments. In particular, we assume that each regulatory / judicial actor  $i$  realizes quadratic payoffs over policy outcomes of the form  $-(x + \theta_i - y)^2$ , where  $x$  and  $y$  are as described above, and  $\theta_i \in \mathbb{R}$  denotes the political leanings – or *ideology* – of the actor in question. Each actor’s ideology is drawn independently from distribution  $H(\theta)$ . We place little structure (at this stage) on the nature of this distribution across the population of actors (though a common assumption in the literature is that it consists of two mass points, corresponding to “Democrats” ( $\theta_i = \theta_D$ ), and “Republicans” ( $\theta_i = \theta_R > \theta_D$ )). Regardless, these preferences suggest that each actor possesses an ideal point in policy space,  $y_{\theta_i}^* = x + \theta_i$ , and utility falls in the squared distance from that point. Note that while actors’ preferences ( $\theta_i$ ) are presumed fixed, the location of their ideal points – which reflect their ideologies – also depend on facts ( $x$ ). This is deliberate, as our framework presumes actors who may lean left or right on *a priori* grounds, but who need not be committed “ideologues.” In principle, the underlying facts could be strong enough to overcome political predispositions, inducing a (say) liberal judge/agency to favor a conservative policy (or vice versa). Such “swayability” (at least for the median voter) lies at the core of the deliberative process.<sup>23</sup>

Figure 1 below illustrates the ideal point mapping, in the specific case where the  $x = \frac{1}{2}$ , comparing the ideal point of two decision makers: a “Democrat” (with  $\theta_i = \theta_D \equiv -1$ ); and a “Republican” (with  $\theta_i = \theta_R \equiv 1$ ). In the figure, the Republican judge leans toward conservative policies on a priori grounds;

<sup>21</sup>It would, in principle, be possible to allow for the policy space to involve more than two outcomes. We address this extension in Section 5.

<sup>22</sup>Because normal distributions make our analysis significantly more tractable, we will utilize them throughout the analysis below. As will become clear below, however, our general arguments do not turn crucially on this distributional form.

<sup>23</sup>For current purposes, we treat ideology as effectively an exogenous, “organic” element of judicial preferences; we therefore do not attempt to address what might cause different heterogeneous ideologies to begin with; nor do we consider whether information aggregation can cause ideologies to converge. See, e.g., Aumann (1976).

when she observes a relatively “conservative” set of facts ( $x = \frac{1}{2}$ ) her ideal point remains conservative, at  $y_R^* = 1.5$ . If constrained to choose policy  $y \in \{-1, 1\}$ , she will clearly prefer  $y = 1$ . The Democrat, in contrast, leans liberal; observing the same facts pushes her mildly right, but only enough to move her ideal point to  $y_D^* = -0.5$ . Thus, the Democrat judge would continue to favor  $y = -1$ , but with more ambivalence about her position than her Republican counterpart. Were  $x$  to take on a larger realization ( $x > 1$ ), it would be enough to sway the Democrat to support the conservative outcome. (And symmetrically with the Republican for  $x < -1$ ).

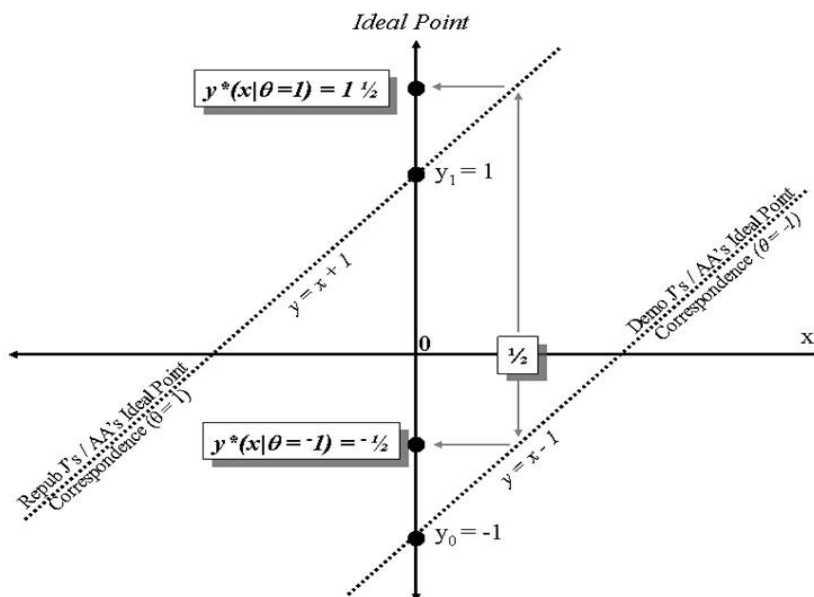


Figure 1: Ideal point as a function of facts ( $x$ ) & ideology ( $\theta$ )

Our model injects a significant complication into the story illustrated by Figure 1. Specifically, decision makers in this model never know with certainty what the “true” facts are. Rather, they endeavor to maximize  $-E_{x|\omega} \left\{ (x + \theta_i - y)^2 | \omega \right\}$ , where  $\omega$  denotes the decision maker’s available information (described in greater detail below).

The judicial review process in our posited game consists of two stages. In the first stage, the lower level actor (Player "A") possessing ideology  $\theta_A$  makes a decision about legal/regulatory policy. In reaching its decision, Player A is privy to a signal  $Z \in \mathbb{R}$ , which conveys noisy information about  $x$ . Specifically, we assume  $Z$  is normally distributed with mean  $x$  and precision  $\gamma$ . (We also assume that this signal is either collected at no incremental cost, or its collection is non-discretionary to Player A). After observing the signal, player A acts announces

a regulatory rule,  $y = -1$  or  $y = 1$ .

After player A makes a decision, the second stage begins. In this stage, an appeals court may hear player A's policy ruling with exogenous<sup>24</sup> probability  $\pi \in (0, 1)$ . The appellate court, denoted collectively by  $J$ , is in turn composed of an odd number of  $(2M - 1)$  judges, where  $M \in \{1, 2, 3, \dots\}$ , chosen at random – and only after  $A$  has acted – from the judiciary pool.<sup>25</sup> For a given panel, then, the set of judicial ideologies is given by  $\Theta \equiv \{\theta_1, \dots, \theta_{2M-1}\}$ . Without loss of generality, one can re-index the individual panelists in terms of ascending ideological “order statistics”,  $\{\theta_{(1)}, \dots, \theta_{(M)}, \dots, \theta_{(2M-1)}\}$ , so that  $\theta_{(1)}$  corresponds to the ideology of the *most liberal* judge on the panel,  $\theta_{(2M-1)}$  corresponds to the ideology of the *most conservative* judge, and  $\theta_{(M)}$  corresponds to the ideology of the *median* judge. In fact, we will be particularly interested in the 3-tuple  $\hat{\Theta} \equiv \{\theta_{(1)}, \theta_{(M)}, \theta_{(2M-1)}\}$ , which includes the most liberal, the most conservative, and median ideologies of the panel (the panel's “Left, Right, and Center” as it were).

Should the appellate panel hear the case, we assume it costlessly observes the realization of  $Z$  – that is, the factual signal / record upon which the agency relied.<sup>26</sup> In addition, however, any of the judges on the panel may, at a cost, invest in an “auditing” technology that reveals an additional signal – denoted  $V$  – where  $V \sim N(x, \frac{1}{\sigma})$ . Significantly, auditing is costly, imposing a fixed effort cost  $c > 0$  on the auditing judge, which enters additively into her payoff. The value of  $c$  reflects the opportunity cost of judicial time (which may be a function of resources, docket pressures, etc).<sup>27</sup> Nevertheless, each panelist acts independently in deciding whether to audit. We further assume that signal constitutes a common value across panelists: that is, if any of the judges purchase  $V$ , she can credibly share her observation with other members of the panel.<sup>28</sup> Moreover, if more than one judge purchases a signal, the second purchase provides no additional information. Once the judges (if any) have purchased and shared the signal, the panel makes a decision by majority vote.<sup>29</sup> Should the panel

<sup>24</sup>This can be endogenized in a more complex model. Cameron and Kornhauser 2006.

<sup>25</sup>A three-judge panel, therefore, would correspond to  $M = 2$ ; the U.S. Supreme court would correspond to  $M = 5$ . The assumption here is meant to track actual practice. Three-judge appeals panels are drawn randomly from the court of appeal judges in the circuit in which review takes place. Thus, the Agency can only form a probabilistic estimate of who might be on the panel. Further, if more than one suit is filed in timely fashion in different Circuits against the Agency action, a lottery determines which Circuit will hear the appeal (28 U.S.C. § 2112(a)). This vastly complicates the computational load on the Agency.

<sup>26</sup>Note that this assumption is different from Spitzer & Talley (2000), where the appellate judge was assumed only to observe the lower level actor's decision, and observed the lower court's signal only if investing in additional verification. In a later section we extend our analysis to the case where player A's signal is not observable without an additional investment.

<sup>27</sup>All our results carry over to the case where the realized value of  $c$  is stochastic, and drawn from a distribution function  $G(c)$  defined on  $c \in (0, \infty)$ .

<sup>28</sup>For now, we do not allow the auditing judge to hide or distort her monitoring activities on either the extensive or intensive margin. While such extensions are fairly straightforward (for the most part), they add distracting complications. In Section 5, we discuss how such alternative environments would operate within our framework.

<sup>29</sup>There is a parallel literature, originally due to Kornhauser (1992a, 1992b), which conceptualizes “law” (and which he calls an “extended rule”) as a mapping of all possible sets of

overturn A’s decision, we suppose that A suffers a reputational cost equal to  $\varepsilon \geq 0$ . To characterize a solution for this game, we require that all players’ policy votes and auditing decisions are consistent with Bayesian perfection.

### 3.1.2 Motivating J’s “Extra” Signal

Before proceeding, we pause briefly to motivate our assumption about an additional “signal” available to members of  $J$  through auditing. What would it mean, in institutional terms, for an appellate court panelist to spend significant resources to “take another draw” on the facts? One obvious meaning could simply be a closer examination of the materials in the docket. But since those materials are usually the same ones that the trial judge considered, the draw should have the same content. On the other hand, since appellate judges (and their clerks) have different backgrounds and abilities than the Agency administrator, and since they are acting at a different time, the nature of their inference may be substantially different. The Court of Appeals is supposed to review the entire record as part of its duty in an appeal. But a “review” can be done with more or less attention paid to the contents. Thus, a careful review of the docket plausibly fits with our characterization of taking “another draw.”

A second motivation centers on an alternative interpretation of “facts” in our model: legal materials and policy implications. A reviewing judge could spend resources finding precedents and doctrinal developments that the agency failed to consider, but which would bear on the ultimate outcome. Attentively, a reviewing judge could spend resources working out how the agency’s decision might yield counterintuitive policy effects, either on the issue directly in front of the Agency, or on issues that are connected to that issue. Under the right circumstances, this type of research might push other judges to change their votes.

Third, one could regard the docket materials that the Agency used as the “first” draw, with the appellate court’s subsequent draw coming from new materials about the same problem. Where would the new materials come from? A few possibilities suggest themselves. First, amicus briefs often contain or refer to studies that were not before the Agency. Second, Agencies often receive studies and written testimony after the closing date for the submission of evidence. Sometimes these studies were being created, but were not yet complete, at the time the Agency closed the docket. In other circumstances studies are done in response to the Agency’s “concise statement of basis and purpose” published in the Federal Register.<sup>30</sup> On appeal, the reviewing court must decide whether to consider the new materials, and how much attention to give to them.

As a fourth (and related) motivation, new information may be submitted by the parties themselves. Consider, for example, the famous case *Scenic*

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facts into outcomes. Our structure unpacks the way in which judges come to know the facts. However, in our structure, the translation into final outcomes is probabilistic for any true set of facts. This is because the judges cannot learn the facts with certainty.

<sup>30</sup> Administrative Procedure Act § 553.

*Hudson Preservation Conference v. Federal Power Commission*.<sup>31</sup> In *Scenic Hudson*, the court reviewed the FPC’s decision to grant permission to Consolidated Edison to build a pumped storage hydroelectric power plant on the Hudson River. The plaintiffs, who were residents and environmentalists, objected (perhaps strategically) that the plant would be very hard on fish, would look ugly, and would interfere with other uses of the Hudson River valley. After the closing of the docket, plaintiffs petitioned the FPC to allow additional evidence on the feasibility of gas turbines, rather than using hydroelectric power<sup>32</sup> and the relocation of the plant so as to avoid fish.<sup>33</sup> The court could have just dismissed these claims as untimely, and noted the wide discretion given to Agencies (sometimes) as to when to close their dockets. Instead, the court clearly took a serious (and, we might surmise, costly) look at the materials that parties had attempted to submit. According to the court’s opinion, it was the serious look at these materials that persuaded it to remand the proceeding to the FPC. Within our framework, a decision to “take another draw” may reflect a decision to consider materials submitted after the Agency’s docket closed.

## 3.2 Panelists’ Optimal Strategy

The first task for characterizing the equilibrium of this game is to analyze the incentives of the members of a representative judicial panel that is hearing an appeal, assuming that  $A$  has already rendered a decision. Ultimately, the members of that panel must decide both whether to collect additional information (become informed) and how to vote. To make predictions about their individual payoffs (and thus their behavior in a group), we need to compare the likely actions and expected payoffs of informed and uninformed judge, respectively. To do so, let us first consider the preferences of each panelist in isolation.

### 3.2.1 Uninformed Preferences and Decisions

Let us begin with a representative “uninformed” judge, who has ideology  $\theta_i$  and observes only the lower level actor’s signal,  $z$ . Define such an actor’s preferred outcome here to be  $y_i^U$ . Under the uninformed judge’s payoff function, it is easy to confirm that  $y_i^U = 1$  (i.e., panelist  $i$  favors the conservative outcome) if and only if<sup>34</sup>:

$$z \geq z_i^U \equiv -\frac{\theta_i(\tau + \gamma) + \tau\mu}{\gamma} \tag{1}$$

It clear by inspection that  $z_i^U$  is strictly decreasing in  $\theta_i$ , and thus for any two decision makers  $j$  and  $k$  with  $\theta_j < \theta_k$ ,  $z_j^U > z_k^U$ . Intuitively, this means

<sup>31</sup> 354 F.2d 608 (2<sup>nd</sup> Cir. 1965), cert. den. \_\_\_ U.S. \_\_\_ (196\_).

<sup>32</sup> *Id.* At 618.

<sup>33</sup> *Id.* at 624.

<sup>34</sup> The derivation emerges from Bayes’ theorem and the observation that  $(X|Z)$  is normally distributed with mean  $\frac{\tau\mu + \gamma z}{\tau + \gamma}$ , and variance  $\frac{1}{\tau + \gamma}$ . A number of the other derivations below also depend on manipulated distributional parameters of the normal distribution. See appendix for details.

that more liberal players are a “harder sell” on the conservative outcome: they require a higher public signal  $z$  than do relatively conservative players in order to support the conservative outcome. By the same reasoning, conservative actors are a harder sell on the liberal outcome. Should the judicial panel hear the case, of course, its collective decision will track the median voter’s preferences. Consequently, the uninformed panel’s decision will track the median voter’s preferred outcome,  $y_M^U$ , so that the majority votes for the conservative over the liberal outcome if and only if  $z \geq z_M^U \equiv -\frac{(\theta_{(M)} \cdot (\tau + \gamma) + \tau \mu)}{\gamma}$ .

Given this behavior, and after some algebraic manipulation, a panelist with ideology  $\theta_i$  sitting on a panel that has remained uninformed will realize an expected payoff of:

$$\begin{aligned} \pi_U(\theta_i | z, \theta_{(M)}) &= -E_{x|z} \left\{ ((x + \theta_i) - y_M^U)^2 | z \right\} & (2) \\ &= - \left( \frac{1}{\tau + \gamma} + \left( \frac{\tau \mu + \gamma z}{\tau + \gamma} + (\theta_i + 1) \right)^2 \right) + \begin{cases} 0 & \text{if } z \leq z_M^U \\ 4 \left( \theta_i + \frac{\tau \mu + \gamma z}{\tau + \gamma} \right) & \text{else} \end{cases} \end{aligned}$$

The intuition behind this payoff structure is perhaps best understood through a numerical example. Consider Figures 2A 2B and 2C below, for the parametric case where  $\mu = 0$ ,  $\tau = 0.5$ , and  $\gamma = 1$ . The figure envisions a 3-judge panel consisting of a “liberal” ( $\theta_{(1)} = -1$ ) a “centrist” ( $\theta_{(2)} = 0$ ) and a “conservative” ( $\theta_{(3)} = 1$ ), and depicts for each judge the expected payoffs associated with both the liberal policy choice (black curve) and the conservative one (gray curve). In addition, each curve distinguishes between equilibrium payoffs (solid lines) and out-of-equilibrium payoffs (dashed lines). In Figure 2B, depicting the centrist panelist, note that the judge’s equilibrium payoff tracks her maximal expected payoff, reflecting the power of the median voter to dictate outcomes. So long as the panel remains uninformed, its decision will track the median judge’s preferences as illustrated in Figure 2B. Note also that a local minimum of the median judge’s expected payoff occurs at  $z_M^U = 0$ , where she is indifferent (or perhaps more accurately, ambivalent) between the conservative and liberal policy. In Figure 2A, the liberal panelist is far more pre-disposed towards the liberal outcome than the conservative one. In fact, it takes a relatively strong factual case ( $z > 1.5$ ) to sway her to favor the conservative policy. Nevertheless, her equilibrium payoff experiences a downward discontinuity at  $z = 0$ , corresponding to the fact that at this point the median panelist would swing over to the the conservative policy outcome (prematurely, from the liberal judge’s perspective). Figure 2C illustrates the opposite case, for a judicial actor whose ideology is  $\theta_i = 1$ . For this judge, the indifference point between outcomes occurs at  $z_{-1}^U = -1.5$ , reflecting the fact that it takes an analogously strong case ( $z < -1.5$ ) to sway the conservative actor to the liberal policy. Similar to the liberal panelist, the conservative judge’s payoff also realizes a discontinuity (this one upward) at  $z = 0$ , reflecting the point where the median swings from

liberal to conservative.

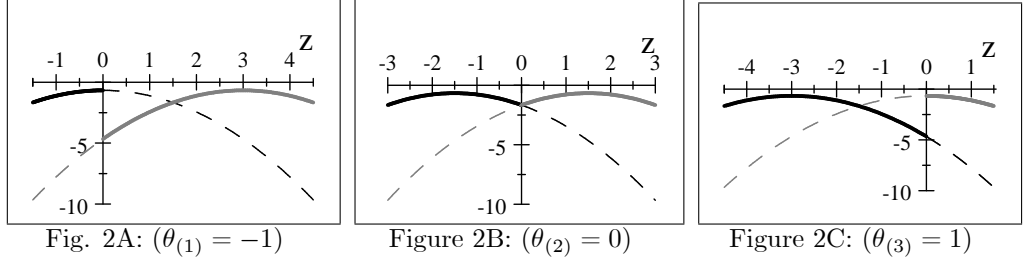


Figure 2. Uninformed Expected Payoffs of Mixed Judicial Panelists

As will become evident below, the location of the median judge’s indifference point – and any payoff discontinuities for the non-median judges at that point – relate directly to auditing incentives within the panel.

### 3.2.2 Informed Preferences and Decisions

Now consider strategies and payoffs assuming the panel becomes informed, so that the representative judge  $i$  with ideology  $\theta_i$  will develop an ideal point that depends on both  $z$  and  $v$ . As above, define an informed actor’s preferred choice to be  $y_i^I$ . It is once again easy to confirm that  $y_i^I = 1$  (i.e., panelist  $i$  favors the conservative outcome) if and only iff:

$$v \geq v_i^I \equiv - \left( \frac{\theta_i \cdot (\sigma + \tau + \gamma) + z\gamma + \tau\mu}{\sigma} \right)$$

In other words, an informed judge will favor the conservative outcome over the liberal one whenever the additional signal,  $v$ , is sufficiently strong relative to her ideology, her priors about  $x$ , and the content of the agency’s signal,  $z$ . As with the uninformed panel, an informed panel will issue a holding coinciding with the informed median judge’s preferred outcome, or  $y_M^I$ . Therefore, the informed panel will issue the conservative outcome if and only if  $v \geq v_M^I \equiv - \left( \frac{\theta_{(M)} \cdot (\sigma + \tau + \gamma) + z\gamma + \tau\mu}{\sigma} \right)$ .

For a judge with ideology  $\theta_i$  on an informed panel with ideological profile  $\Theta$ , her expected payoff conditional on being informed is given by<sup>35</sup>:

<sup>35</sup>See the Appendix for details of this derivation, and all other proofs.



$$\begin{aligned}
\pi_I(\theta_i|z, \theta_{(M)}) &= -E_{v|z} \left\{ E_{x|z,v} (x + \theta_i - y_M^I)^2 |z, v \right\} \\
&= - \left( \frac{1}{\tau + \gamma} + \left( \frac{z\gamma + \tau\mu}{\tau + \gamma} + (\theta_i + 1) \right)^2 \right) \\
&\quad + 4 \cdot \left( \theta_i + \left( \frac{\tau\mu + \gamma z}{\tau + \gamma} \right) \right) \left( 1 - \Phi \left( - \frac{\left( \theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma} \right)}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}} \right) \right) \\
&\quad + 4 \cdot \sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}} \cdot \phi \left( - \frac{\left( \theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma} \right)}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}} \right),
\end{aligned} \tag{3}$$

where  $\phi(\cdot)$  and  $\Phi(\cdot)$  represent the standard normal probability density and cumulative distribution functions, respectively.

### 3.2.3 The Value of Information

Having characterized the expected payoffs associated with both uninformed panels and informed panels, we are now in a position to consider the expected difference – denoted as  $\Delta(\theta_i|z, \theta_{(M)})$  – between the judge’s expected payoff in the informed state and its counterpart payoff in the uninformed state. Implicitly, then,  $\Delta(\theta_i|z, \theta_{(M)})$  corresponds to the expected value (in equilibrium) each judge places on additional information (in the form of signal  $v$ ). It is therefore a function of not only the judge’s own ideology, but also of the known facts in the uninformed state ( $z$ ) and the ideology of the median judge  $\theta_{(M)}$ , who provides the pivotal vote on the panel. Subtracting (2) from (3) yields the following:

$$\begin{aligned}
\Delta(\theta_i|z, \theta_{(M)}) &= \pi_I(\theta_i|z, \theta_{(M)}) - \pi_U(\theta_i|z, \theta_{(M)}) \\
&= 4 \cdot \sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}} \cdot \phi \left( - \frac{\left( \theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma} \right)}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}} \right) \\
&\quad + 4 \left( \theta_i + \frac{z\gamma + \tau\mu}{\tau + \gamma} \right) \cdot \begin{cases} \left( 1 - \Phi \left( - \frac{\left( \theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma} \right)}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}} \right) \right) & \text{if } z \leq z_M^U \\ -\Phi \left( - \frac{\left( \theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma} \right)}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}} \right) & \text{if } z > z_M^U \end{cases}
\end{aligned} \tag{4}$$

This expression embodies a core intuition from this paper. Note that for each judge  $i$ , the value of information hinges on both the judge’s own ideology ( $\theta_i$ ) and that of the median panelist ( $\theta_{(M)}$ ). This makes sense, since the judge’s own policy commitments should factor into whether she finds more information helpful, but so should the pragmatic assessment of whether additional information can affect the ultimate outcome – by swaying the median judge. An additional signal, therefore, not only helps to refine any judge’s assessment of the preferred policy, but it may also help win over a median judge who was leaning in the opposite direction. Alternatively, more information could cause

the judge to lose the support of the median judge who – absent more information – would have been allied with her. Consequently, the judge will tend to audit strategically and systematically only when more information is likely to help and not hurt. As a judge’s ideology grows further distant from that of the median judge, the magnitude of these latter effects (winning over or losing the support of a wavering median judge) grows, and eventually predominates.

We express these observations in a series of lemmas as follows:

**Lemma 1:** *For the median judge with ideology  $\theta_{(M)}$ , auditing is maximally valuable at her uninformed indifference point,  $z = z_M^U$ , and falls symmetrically in both directions as  $z$  diverges from  $z_M^U$ .*

**Lemma 2:** *If judge  $i$  is more conservative than the median judge ( $\theta_i > \theta_{(M)}$ ):*

- *Judge  $i$  values information more than the median judge when  $z \leq z_M^U$  and less than the median judge when  $z > z_M^U$ .*
- *The extent to which the more conservative judge’s valuation exceeds / falls short of the median judge’s increases strictly in  $\theta_i$ .*

*If judge  $i$  is more liberal than the median judge ( $\theta_i < \theta_{(M)}$ ):*

- *Judge  $i$  values information more than the median judge when  $z \geq z_M^U$  and less than the median judge when  $z < z_M^U$ .*
- *The extent to which the more liberal judge’s valuation exceeds / falls short of the median judge’s decreases strictly in  $\theta_i$ .*

The intuitions behind Lemmas 1 and 2 are perhaps best understood through an example. Figure 3, below, returns to the same calibration as in Figure 2, involving a 3-judge panel composed of a liberal judge, a centrist median judge, and a conservative judge, in which  $\hat{\Theta} = \{-1, 0, 1\}$ . The figure also continues to assume that  $\mu = 0$ ,  $\tau = 0.5$ , and  $\gamma = 1$ , and in addition that  $\sigma = 1$ . Each respective panel represents the value that the liberal, moderate and conservative judge attaches – in equilibrium – to the additional signal, as a function of the agency’s signal  $z$ . The median judge (Figure 2B) always places positive value on the extra signal, since she will dictate the final outcome, and such information can only help her with this choice. In fact, an additional signal is *most* valuable when  $z = 0$  – the point where median panelist is maximally ambivalent between the liberal and conservative policy options. As  $z$  moves away from this point of indifference, her preferred policy choice becomes more clear cut, and in turn the value she places on additional information falls off (symmetrically, as noted in Lemma 1).

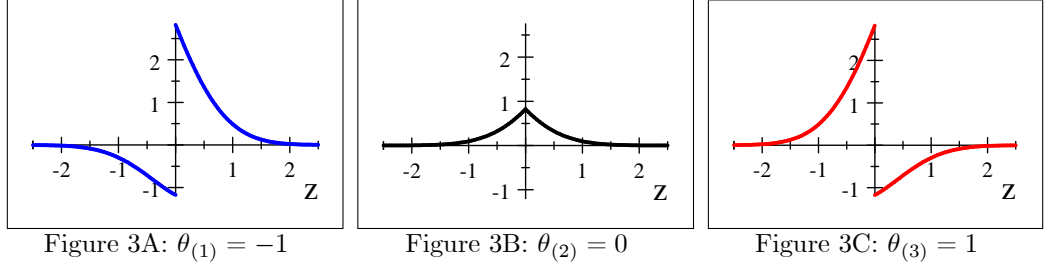


Figure 3. Expected Information Value of Auditing for Mixed Judicial Panelists

In contrast, the liberal and conservative judges (Figures 3A and 3C, respectively) attach more complicated equilibrium valuations to additional information (as described in Lemma 2). The liberal judge, for example, values additional information only when the agency's signal  $z \geq z_M^U = 0$ . Moreover, in this region, the liberal judge places a much higher value on learning the new signal than either of the other panelists. When  $z < 0$ , in contrast, the liberal judge may actually suffer *disutility* from additional information, and in any event places a much lower value information than the other panelists. The intuition for this result is as follows: when  $z \geq 0$ , the liberal judge knows that absent more information, the median panelist favors the conservative policy outcome. If she is able to convince the median judge to switch sides, the liberal judge can expect to receive a discontinuous upward shock to her payoff. But she cannot win over the median judge without some informational ammunition; by auditing, she may discover information that will bring the median voter on board, and in the process generate a significant welfare payoff. In contrast, when  $z < 0$ , the median panelist is already leaning her support towards the liberal policy; additional information, while nice in the abstract, runs an appreciable risk of pushing the median panelist to the other side of the political aisle. In the example pictured in Figure 3, this latter threat is so significant that it swamps other plausible values from auditing when  $z < 0$  for the liberal panelist. Exactly the opposite logic follows for the conservative judge: she places significant value on auditing when  $z \leq z_M^U = 0$ , so that the median judge is leaning towards the liberal outcome. In contrast, the conservative judge places no value (and even negative value) on more information when  $z > 0$ .

Put together, then, in this example *either* the liberal *or* the conservative judge (but generally not both) has a greatest incentive on the panel to collect additional information. As it turns out, this logic carries over more generally to panels of arbitrary size and ideology, an insight that we convey using Lemmas 3 and 4:

**Lemma 3:** *When  $z < z_M^U$  the most conservative judge (with ideology  $\theta_{(2M-1)}$ ) has the maximal incentive to audit. Similarly, when  $z > z_M^U$ , the most liberal judge (with ideology  $\theta_{(1)}$ ) has the maximal incentive to audit. If  $z =$*

$z_M^U$ , the most conservative (most liberal) panelist has the greatest incentive to audit when  $(\theta_{(2M-1)} - \theta_{(M)})$  is larger (smaller) than  $(\theta_{(M)} - \theta_{(1)})$ .

**Lemma 4:** If  $c \leq c(\hat{\Theta}, z)$ , at least one panelist has an incentive to audit (and thus learn  $v$ ), where

$$c(\hat{\Theta}, z) = 4\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}} \cdot \phi\left(-\frac{\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma}}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}}\right) \quad (5)$$

$$+ \begin{cases} 4\left(\theta_{(2M-1)} + \frac{\tau\mu + \gamma z}{\tau + \gamma}\right) \cdot \left(1 - \Phi\left(-\frac{\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma}}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}}\right)\right) & \text{if } z \leq z_M^U \\ -4\left(\theta_{(1)} + \frac{\tau\mu + \gamma z}{\tau + \gamma}\right) \cdot \Phi\left(-\frac{\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma}}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}}\right) & \text{if } z > z_M^U \end{cases}$$

This condition implicitly defines an “auditing range”  $[\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})]$  around  $z_M^U$ . When the panel audits, the additional signal is harvested by the most conservative (liberal) member whenever  $\underline{z}(\hat{\Theta}) \leq z < z_M^U$  (whenever  $z_M^U < z \leq \bar{z}(\hat{\Theta})$ ).

Note from Lemma 4 that the auditing interval is completely characterized by the ideologies of the median judge and the two ideologically extreme judges. No other judge’s ideology enters into the expression from Lemma 4 (at least with this characterization of the model<sup>36</sup>). In general, as the extreme members of the panel become increasingly extreme, the auditing range grows (and with it grows the prospect of agency reversal).

A number of corollaries immediately follow from inspection and/or differentiation of the expression in Lemma 4. They are as follows:

**Corollary 4.1:** The auditing range  $[\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})]$  is strictly increasing in the precision of the auditing technology ( $\sigma$ ), and strictly decreasing in the precision of  $A$ ’s signal ( $\gamma$ ) and in the realized cost of auditing ( $c$ ).

**Corollary 4.2:** The auditing range is strictly increasing in  $|\theta_{(2M-1)} - \theta_{(1)}|$ ;

**Corollary 4.3:** The auditing range is potentially asymmetric;

**Corollary 4.4:** The auditing range is invariant to all median- and extrema-preserving transformations of  $\Theta$ .

Corollary 4.1 is intuitive. Corollary 4.2 embodies the idea that all else constant, panel “diversity” (as measured by  $|\theta_{(2M-1)} - \theta_{(1)}|$ ) is more likely to

<sup>36</sup>Generalizations of the model might make other judges’ ideologies important in the analog of Lemma 4. For example, if the judges faced differential costs in auditing, a low-cost moderate judge may place a higher net benefit on auditing than an extreme judge who faces a high cost of auditing. Similarly, if a moderate judge can collect a more accurate signal than an extreme judge, that moderate judge may determine the extreme end of the interval. We discuss such generalizations below.

more informed scrutiny of the agency’s decision. This effect is directly due to the fact that preference differences between the median voter and the extreme wings of the panel are what drive the latter to audit when the median would not. Amplifying those ideological differences enhances this effect. Corollary 4.3, however, suggests that diversity need not inculcate symmetric scrutiny. In particular, as the conservative (liberal) wing of the party becomes more distinct from the median, the panel is increasingly likely to reject liberal (conservative) policies that the median voter would have favored if uninformed; but it is no more or less likely to reject conservative (liberal) policies that the uninformed median voter would have favored. Finally, Corollary 4.4 states the (perhaps surprising) result that the auditing range turns solely on ideologies of the Left, Right, and Center judges. Consequently, holding those ideologies constant, our model predicts identical auditing ranges (and reversal rates) for a 3-judge, 5-judge, 9-judge, or even a 99-judge panel.<sup>37</sup>

### 3.3 Agency’s Optimal Strategy

Having characterized the equilibrium strategy of the judicial panel  $J$  conditional on appeal, we now move backwards in sequence to analyze the strategy of Player A (the agency), which anticipates the equilibrium strategy described above. Recall that  $A$  is motivated both by a desire to implement her preferred outcome and to avoid being overturned by  $J$ . Moreover, recall that with probability  $(1 - \pi)$ , player  $A$ ’s decision will never be appealed, in which case the best she could do is to implement her sincere policy choice given  $z$ . On the other hand, if  $A$ ’s decision is appealed (with probability  $\pi$ ), her payoff becomes more complicated. On the one hand,  $A$  suffers a cost  $\varepsilon$  should her decision be overturned by  $J$ . But on the other hand, if the reviewing court also augments  $A$ ’s information through judicial review, they will issue a more informed policy choice, which will also affect – and possibly increase –  $A$ ’s welfare. Combining these factors,  $A$ ’s expected payoff given  $z$  is:

$$(1 - \pi) \cdot E_x \left( -(x + \theta_A - y_A)^2 | z \right) \tag{6}$$

$$+ \pi \cdot \left( E_{\hat{\Theta}, x} \left[ \left( 1 - q_{\hat{\Theta}, z} \right) \times \left( -(x + \theta_A - y_M^U)^2 - \begin{cases} 0 & \text{if } y_M^U = y_A \\ \varepsilon & \text{else} \end{cases} \middle| z; c > c(\Theta, z) \right) \right] \right. \\ \left. + E_{\hat{\Theta}, x, v} \left[ q_{\hat{\Theta}, z} \times \left( -(x + \theta_A - y_M^I)^2 - \begin{cases} 0 & \text{if } y_M^I = y_A \\ \varepsilon & \text{else} \end{cases} \middle| z, v, c \leq c(\Theta, z) \right) \right] \right)$$

where  $q_{\hat{\Theta}, z}$  is an indicator function taking on a value of 1 if, for an ideology configuration of  $\hat{\Theta}$ , the agency’s signal  $z$  lies within the panel’s auditing range.<sup>38</sup> Remember that because panelists are not selected until *after*

<sup>37</sup>We should note that extensions of our baseline model would likely weaken this invariance result. For example, if panelists faced differential costs in auditing, a low-cost moderate judge may place a higher net benefit on auditing than an extreme judge who faces a high cost of auditing. Similarly, if a moderate judge can collect a more accurate signal than an extreme judge, that moderate judge may determine the extreme end of the auditing range.

<sup>38</sup>In terms of Lemma 4, above,

player  $A$  has reached a decision, she may not know for sure whether the facts of the case before her will fall within  $J$ 's auditing interval, and she must therefore take expectations over the probability density of the ordered 3-tuple  $\hat{\Theta} = \{\theta_{(1)}, \theta_{(M)}, \theta_{(2M-1)}\}$ , which we denote as  $f(\hat{\Theta})$ .<sup>39</sup>

Inspection of  $A$ 's payoff allows some simplification of its analysis. First, note that  $A$ 's decision,  $y_A$  only enters into this expression in two ways: (1) It directly affects  $A$ 's payoff in the event that no appeal is heard, and (2) it affects the potential costs that  $A$  may suffer if she is overturned by  $J$ . Numerous other terms of this expression, including  $q_{\hat{\Theta}, z}$ ,  $(x + \theta_A - y_M^U)$  and  $(x + \theta_A - y_M^I)$ , are invariant to  $A$ 's ultimate choice, and can effectively be held constant. These observations, in turn, yield Lemma 5:

**Lemma 5:** *Given the equilibrium behavior of a panel with configuration  $\hat{\Theta}$ ,  $A$  will favor the conservative outcome if and only if:*

$$4(1 - \pi) \left( \frac{\tau\mu + \gamma z}{\tau + \gamma} + \theta_A \right) \geq \pi\varepsilon \cdot \left( \begin{array}{l} E(\Pr\{z < \underline{z}(\hat{\Theta})\}|z) - E(\Pr\{z \geq \bar{z}(\hat{\Theta})\}|z) \\ + E\Pr\{z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})] \cap v < v_M^I | z\} \\ - E\Pr\{z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})] \cap v \geq v_M^I | z\} \end{array} \right) \quad (7)$$

To best understand the expression in Lemma 5, it helps to think about the limiting cases for the probability of appeal ( $\pi$ ) and the cost to being reversed ( $\varepsilon$ ). Consider first how the agency would decide a case if its cost of being overturned were zero or negligible, so that  $\varepsilon \approx 0$ . This assumption may be plausible in many situations. One could imagine, for example, that agency appointees are not sufficiently long lived to worry much about a subsequent court's actions; or that public attention tends to wane over time so that even if the agency head remains, later reversals barely register on the political radar screen *de jure*; or that agencies derive considerable utility from expressing their policy stance (rather than from its actual implementation). In such environments, the right hand side of (7) effectively disappears, and  $A$ 's choice boils down to selecting the conservative outcome if and only if the left hand side of this expression is nonnegative, which occurs when  $z \geq z_A^U$ . Not surprisingly, this limiting case is identical to having the agency implement its sincere policy preference.

In a similar fashion, suppose cost of being overturned were non-trivial, but that the probability of appeal were negligible, so that  $\pi \approx 0$ . Here once again, the agency would focus on the left hand side of the expression above, and it would generate a sincere policy decision.

In contrast, suppose that both the costs of reversal were non-trivial and that the probability of appeal were close to unity. Here, the agency knows that its initial policy choice is almost certainly going to be revisited, and now it is the left hand side of the above expression that becomes close to zero. Now,  $A$  will

$$q_{\hat{\Theta}, z} = \begin{cases} 1 & \text{if } z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})] \\ 0 & \text{else} \end{cases} .$$

<sup>39</sup> The functional form of  $f(\hat{\Theta})$  is provided in the Appendix.

tend to focus solely on the right hand side of (7), and will issue a conservative opinion if:

$$\begin{aligned}
 & \underbrace{\Pr\{z < \underline{z}(\hat{\Theta})|z\} + E \Pr\{z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})] \cap v < v_M^I | z\}}_{E(\Pr\{J \text{ reverses a conservative decision } |z\})} \quad (8) \\
 \leq & \underbrace{\Pr\{z \geq \bar{z}(\hat{\Theta})|z\} + E \Pr\{z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})] \cap v \geq v_M^I | z\}}_{E(\Pr\{J \text{ reverses a liberal decision } |z\})}
 \end{aligned}$$

Although this expression looks complicated, its interpretation is simple – the agency’s strategy devolves into one of minimizing the expected probability of reversal. Effectively, the agency will endeavor to mimic the most likely decision of the future reviewing panel.

Finally, consider intermediate cases, where the combination of  $\varepsilon$  and  $\pi$  is sufficiently large to “matter” but not so large to dominate. Here, the agency will care both about its sincere policy commitments and its desire to avoid being overturned. Consequently, the agency’s behavior will turn on the relative stakes from each concern. For example, if the facts the agency observes in a case  $z$  are very close to A’s indifference point,  $z_A^U$ , then the agency will be ambivalent about which policy outcome it most desires. Here, its desire to avoid being overturned will tend to predominate. On the other hand, suppose the distribution of ideologies within the judiciary – and from which the panel is drawn – is highly dispersed, then it may be difficult for the agency to make strong predictions about whether the panel is ultimately more likely to overturn a liberal decision or a conservative one. Here, the agency may rationally throw up its hands at the prospect of gaming its decision against later reversals, and will instead concentrate on issuing a sincere policy decision.

### 3.4 Equilibrium

Having characterized the equilibrium payoffs of both A and all panelists in J, we can characterize an equilibrium for the game. Before doing so, however, it is necessary to dispose of a technical issue relating to equilibrium selection, particularly for the panelists on  $J$ . As should be clear from the above discussion, there can often be cases where more than one judge on a panel places positive value on auditing. Because auditing provides a public informational good to all, however, auditing by more than one panelist is not a pure strategy equilibrium, and any mixed strategy equilibria that support such outcomes are easily dominated by numerous coordinated pure strategy equilibria.<sup>40</sup> Thus, it is sensible to assume that the panelists will find some mechanism for coordinating their investments. One such mechanism, which we presume hereafter, is as follows:

<sup>40</sup>One potential variation of our framework would involve each judge having access to a separate signal that is not common to others. We discuss this more below.

**Assumption A:** (1) If multiple judges on the same panel value additional information enough to justify auditing, then the judge who places the greatest value on the additional signal is presumed to invest and provide information to the panel. (2) If two or more judges on the same panel share the same greatest value of an additional signal, they utilize a commonly-observable randomization device that selects one of them to audit.

Although Assumption A seems reasonable (at least to us), there are many alternatives that would generate outcome-equivalent equilibria.<sup>41</sup> Applying this selection assumption to the Lemmas above, the following result immediately emerges:

**Proposition 1:** *If Assumption A holds, the following is the unique equilibrium of the auditing game:*

- The agency issues a conservative opinion iff the condition in (7) is satisfied;
- If an appeal occurs, and if  $z \in [\underline{z}(\hat{\Theta}), z_M^U]$ , panelist  $\theta_{(2M-1)}$  audits (revealing  $v$ ), and the panel issues a conservative decision iff  $v \geq v_M^I$ ;
- If an appeal occurs, and if  $z \in (z_M^U, \bar{z}(\hat{\Theta})]$ , panelist  $\theta_{(1)}$  audits (revealing  $v$ ), and the panel issues a conservative decision iff  $v \geq v_M^I$ ;
- If an appeal occurs, and if  $z = z_M^U$ , the extreme panelist  $\theta_{(1)}$  or  $\theta_{(2M-1)}$  that is furthest from  $\theta_{(M)}$  audits (revealing  $v$ ). If both are equidistant from  $\theta_{(M)}$ , they randomize as to who audits. The panel issues a conservative decision iff  $v \geq v_M^I$ .
- If an appeal occurs, and if  $z \notin [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})]$ , the panel issues a conservative policy (overturning Player A if necessary) iff  $z \geq z_M^U$ .

Note that just as in Lemma 4, in Proposition 1 the auditing decisions and policy choice of the panel are fully characterized by the ideology of the Left, Right and Center panelists. No other judge's ideology enters into the expression from Proposition 1 (at least with this characterization of the model<sup>42</sup>). In general, as the extreme members of the panel become more and more extreme, the auditing range expands (as do the prospects for agency reversal). Notwithstanding the dominance of the median voter model in positive political theory,

<sup>41</sup>For example, an alternative assumption (that is outcome equivalent) posits that judge  $i$  audits a case with initial signal  $z$  if (1) she places a positive net value on auditing, and (2) the next judge closer to the median judge (if she exists) does not place a positive net value on auditing.

<sup>42</sup>Generalizations of the model might make other judges' ideologies important in the analog of Proposition 1. For example, if the judges faced differential costs in auditing, a low-cost moderate judge may place a higher net benefit on auditing than an extreme judge who faces a high cost of auditing. Similarly, if a moderate judge can collect a more accurate signal than an extreme judge, that moderate judge may determine the extreme end of the interval.



then, the results above suggest ways in which judicial panels (and other deliberative bodies) respond to their extreme wings rather than the middle. As such, it joins a growing literature in documenting how non-median members can affect outcomes, by lobbying, influencing, shaming, or (in our case) injecting different types of useful information. Given this effect, it is perhaps not surprising that there was so much concern about whether the moderately liberal Justice Souter’s replacement on the US Supreme Court – Sonya Sotomayor – was only mildly liberal or extremely liberal. Although her appointment did not have an effect on the median voter of the court, it might have changed the extreme in a way that could have influenced the median (and consternated the extreme right wing).

## 4 Examples, Simulations, and Empirical Implications

Although the framework developed above contains insights about how ideology, information, and deliberation interact within a somewhat general framework with differential ideologies, an immediate implication of the model pertains to panel effects along binary party lines. As noted in Section 2, the empirical literature provides significant support for the moderating effect of sitting on mixed panels instead of unified panels, documenting a tendency of minority and majority judges on mixed panels to move towards each other when voting. Below we demonstrate how this (and other) predictions can play out in our model, first in the form of a numerical example, and then in a simulation calibrated against real-world data. Finally, we develop some preliminary thoughts about how our model might be tested against alternatives in the literature.

### 4.1 Numerical Example

Consider a numerical example of our model involving a three judge panel. To fix ideas (and to concentrate on panel effects), suppose that the agency is a Democrat ( $\theta_A = -1$ ), that the cost of reversal ( $\varepsilon$ ) and/or probability of appeal ( $\pi$ ) is negligible, and that that – as in the calibration exercise above –  $\tau = 0.5$ ,  $\mu = 0$ , and  $\gamma = \sigma = 1$ . With these parameter values, it is easily confirmed that the ex ante chances of a liberal policy pronouncement by the agency are 80.649%, and the ex ante chances of a conservative pronouncement are 19.297%.

#### 4.1.1 Homogenous DDD Panel

Consider first a judicial panel composed entirely of share judges with left-of-center ideology identical to the agency, so that  $\theta_{(1)} = \theta_{(M)} = \theta_{(3)} = \theta_A = -1$ . We define this set of panelists as being a homogeneously democratic panel, or “DDD.” The solid line in Figure 4 below represents – for a given prior signal  $z$  – the expected value (to each panelist) of collecting an additional signal  $v$ . Notice that the value of information is symmetric around a maximum at  $z = 1.5$ ,

which is exactly the margin where the D-agency and D-judges are maximally ambivalent between the two policy outcomes. This makes great intuitive sense, as precisely at this margin of ambivalence where additional information is likely to be the most useful. In contrast, when  $z < -0.5$  or  $z > 3.5$ , the ex ante case provided by the first signal ( $z$ ) is so strong that an additional signal ( $v$ ) is effectively 0 for the  $D$ -panelists. That is, more information is overwhelmingly unlikely to change their decision, and thus the expected value of auditing is therefore quite modest.

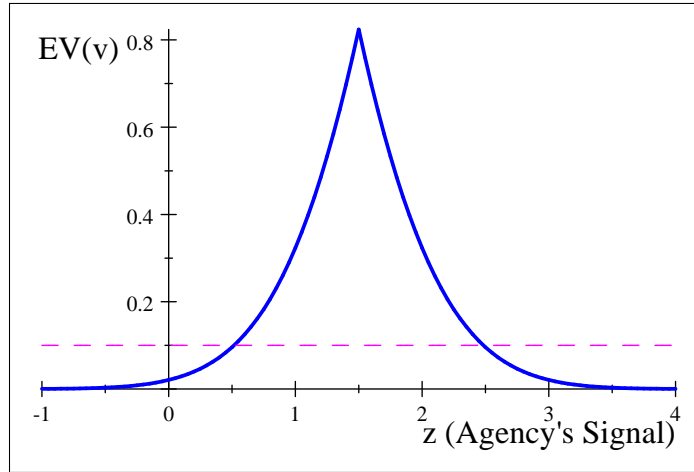


Figure 4: Auditing Range of DDD Panel

Continuing with the above diagram, suppose further that the distribution of costs of collecting the signal for a D-judge is given by a mass point  $c = \frac{1}{10}$  (represented by the dashed horizontal line). If the court consisted solely of a unitary D-judge, then she would audit any administrative opinion where the signal  $z \in [0.5155, 2.4845]$  (approximately). In the discussion that follows, we will refer to this interval as the "*majority auditing interval*". Inside it, they audit and base their decision on  $(z, v)$ . Outside it, they do not audit and base their decision solely on  $z$ . Note that this interval is symmetric around  $z = 1.5$  (the point of indifference for both the court and agency), and in this sense the D-court would engage in "two-sided" auditing of A. Thus, within this example, the equilibrium has the following characteristics:

- The D-aligned agency A issues the liberal (conservative) ruling whenever  $z < (\geq) 1.5$ .
- The DDD judiciary panel's approximate auditing interval is given by  $z \in [0.5155, 2.4845]$ , which is symmetric around  $z = 1.5$ .
- The DDD panel upholds the agency without an additional audit whenever  $z \notin [0.5155, 2.4845]$

- If the DDD panel audits, it will favor the conservative (overturning A if necessary) outcome whenever  $v + z > \frac{5}{2}$ . Otherwise it will favor the liberal outcome (overturning A if necessary).
- Viewed ex ante, the DDD court will (unanimously) overturn liberal policy positions by the D-agency at a rate of approximately<sup>43</sup> 6.227%. In addition, the DDD panel will (unanimously) overturn a conservative policy decision by the agency at a rate of 18.097%. The unconditional rate of reversal of the agency by the DDD panel in this case is 8.5142%.

#### 4.1.2 Heterogeneous DDR Panel

Now consider what happens if one replaces a Democrat panelist with a Republican — a “DDR” panel. According to conventional median voter logic, the injection of a single R panelist should not affect outcomes, since she is not a pivotal voter, and thus the panel’s decision rule (i.e., how they translate either  $z$  or  $(z, v)$  into policy space  $y$ ) cannot change from the DDD case, *so long as one holds available information constant*. However, available information may change with the addition of an R panelist, who faces different incentives to become informed of the additional signal ( $v$ ). In particular, the lone R may wish to audit cases that the majority would not – so long as his inquiry might plausibly sway their opinion. As predicted by Proposition 1, the R judge will tend to pick cases to audit which lie just to the “left” (in  $z$  space) of the D majority’s indifference points. These are the very issues about which the majority is potentially persuadable, but about which they are somewhat less actuated than is the R panelist.

The dark solid line in Figure 5 below depicts the maximal valuation that any of the panelists place on auditing (as a function of  $z$ ). Note that when  $z > 1.5$ , the diagram is identical to Figure 4. In this region, only the two Democrat judges place a positive value on auditing. The Republican panelist actively eschews auditing within this range, since the Democrat panelists are already leaning his way, and he fears that with more information he may lose them. In contrast, when  $z < 1.5$ , the diagram is identical to Figure 3c. Here, the Republican is strongly motivated to audit, as reflected by the upward shift of the valuation curve (relative to Figure 4) over that interval.

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<sup>43</sup>That is,

$$\int_{-\infty}^{\infty} \left( \int_{0.5155}^{1.5} \left( \int_{\frac{5}{2}-z}^{\infty} f(v|z, x) dv \right) f(z|x) dz + \int_{1.5}^{2.4845} \left( \int_{-\infty}^{\frac{5}{2}-z} f(v|z, x) dv \right) f(z|x) dz \right) f(x) dx$$

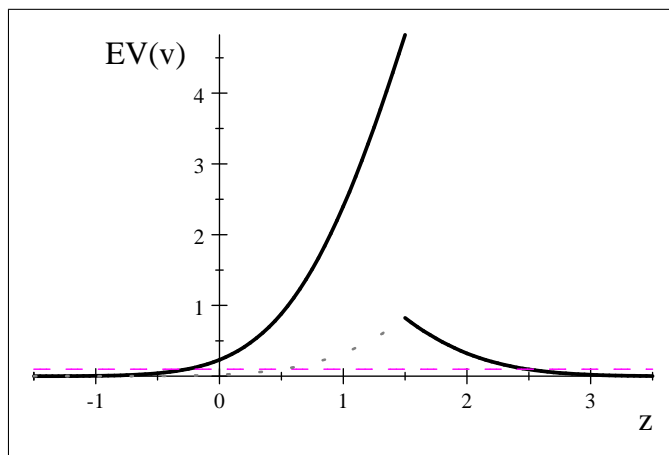


Figure 5: Auditing Interval of DDR Panel

Recall that in the DDD panel, if only the D judges could audit, they would choose to audit cases where  $z \in [0.5155, 2.4845]$  (approximately). Here, because of the added motivation of the R for  $z < 1.5$ , that interval increases to  $z \in [-0.2615, 2.4845]$  (approximately). Thus, within the DDR panel, the equilibrium is characterized as follows:

- D-Agency issues the liberal (conservative) ruling whenever  $z$  is less than (greater than) 1.5 .
- The DDR judiciary panel's approximate auditing interval is given by  $z \in [-0.2615, 2.4845]$ , which expands the DDD's auditing interval asymmetric to the left of  $z = 1.5$ .
- The DDR panel upholds the agency without an additional audit whenever  $z \notin [-0.2615, 2.4845]$
- If the DDR panel audits, it will favor the conservative (overturning A if necessary) outcome whenever  $v + z > \frac{5}{2}$ . Otherwise it will favor the liberal outcome (overturning A if necessary).
- Viewed ex ante, the DDR panel will (unanimously) overturn a liberal holding by the D-agency at a rate of approximately 7.194% (which exceeds the conditional reversal rate of the DDD panel (6.227%)). The DDR panel will overturn a conservative policy decision by the agency (sometimes unanimously and sometimes on a party line vote) at a rate of 18.097% (which is identical to the DDD panel<sup>44</sup>). Finally, the unconditional rate of reversal of the agency by the DDR panel in this case is 9.2941% (which is higher than the unconditional rate for the DDD panel of 8.5142%).

<sup>44</sup>To see why there is no change on this reversal rate, note that the upper bound of the auditing interval for the DDD and DDR panels is the same. This is because it is up to the most extreme *Democrat* to audit the agency's conservative policies. Republicans – quite happy with the conservative outcome – do not lift a finger to help, so the auditing and reversal probabilities are identical between the cases.

The key effect laid out above is an example of our core intuition regarding deliberative panel effects. In this example, expected reversal rates increase when one adds *even a single, non-pivotal minority member*, with the effect being driven solely by an enhanced expected frequency with which a *unanimous* panel reversals of liberal agency rules. To an outsider, this might look like the inclusion of the R on the panel has made the Ds more collegial, or the R has threatened to blow the whistle on the Ds. But the effect is distinct. Rather, simple self-interest in a noncooperative setting can drive an outcome where more information is being produced. In other words, the pivotal D voter isn't becoming "nicer"; she's just marshaling more information.

## 4.2 Calibrated Simulation

As another means for understanding our framework, we attempted to calibrate the parameters of our model to observed data, and in particular that of Miles and Sunstein (2008). Of particular interest is their Table 2 (Miles and Sunstein 2008, p. 786), which reports rates at which individual judges vote to validate an agency's decision, contingent on the other judges on the panel. The first column of the table below lists each possible panel composition; the second lists the type of judge within the panel; and the third lists Miles & Sunstein's (2008) reported empirical validation rate.<sup>45</sup> Note that the simulations below also estimate a single agency political ideology (which is slightly liberal), even though the actual data likely come from several different agency types (in terms of ideology).<sup>46</sup> The results, in our opinion, seem quite good. With a not unreasonable set of parameters we can come very close to the affirmance rates observed by Miles and Sunstein; the simulation averaged an error of 1.84% across all six conditions. The parameters used for this simulation reflect a "true" state of the world that is almost neutral ( $\mu = -.0227$ ) in expectation, but has low precision ( $\tau = .3677$ ). In addition, the agency's signal about the true state of the world appears noisy ( $\gamma = .0837$ ) when compared to the reviewing court's signal ( $\sigma = 1.3397$ ). We do not claim that our exercise proves that the parameter values represent the "true" characteristics of the courts and agencies. Rather, our exercise shows that *if* the characteristics embedded within the parameter values used in the simulation happened to be true, then we would observe affirmance rates very similar to those observed by Miles and Sunstein.

<sup>45</sup>The table reflects simulated affirmance rates using parametric values that best fit the actual outcomes under a least squares criterion. Other empirical fit criteria generate similar results.

<sup>46</sup>Specifically, we estimate a pooled agency ideology of  $\theta_A = -0.157$ , and an auditing cost of  $c = 0.7458$ . We also continue to assume in this simulation (as above) that the costs of reversal and/or the probability of appeal are modest, so that the agency issues sincere opinions the the distribution of panel types need not be factored into our analysis. This distributional information was not available in the Miles/Sunstein data. Including it would increase our degrees of freedom, so it would only cause our simulated results to improve.

Panel Composition	Panelist Type	Empirical Validation Rate (M&S 2008)	Simulated Val. Rate	Abs. Difference Sim. v. Empirical
$(D, D, D)$	$D$	0.746	0.7539	0.0079
$(D, D, R)$	$D$	0.697	0.6822	0.0148
$(D, D, R)$	$R$	0.667	0.6295	0.0375
$(D, R, R)$	$D$	0.678	0.6933	0.0153
$(D, R, R)$	$R$	0.604	0.6109	0.0069
$(R, R, R)$	$R$	0.551	0.5792	0.0282

Table 1: Simulated Affirmance Rates

Having satisfied ourselves that we could replicate their central summary results, we obtained the actual decision-level data from Miles and Sunstein (2008).<sup>47</sup> Again, the object was to see how well we could simulate their measured outcomes, but here we hoped to pull apart the Miles and Sunstein data into more granular categories, and then produce a simulation that came close. In particular, we went through the data and accounted for whether the *administrative agency* was under a Democrat or Republican administration, and then controlled for panel composition. In addition, for this exercise we simulated the probability of a panel (i.e. the median voter) voting to overturn the agency. This exercise produced following chart:<sup>48</sup>

Agency Type	Panel Composition	Empirical Reversal Rate	Simulated Reversal Rate	Absolute Difference
$D$	$(D, D, D)$	0	.1325	.1325
$D$	$(D, D, R)$	.4375	.2642	.1733
$D$	$(D, R, R)$	.3913	.4573	.0660
$D$	$(R, R, R)$	.5	.4969	.0031
$R$	$(D, D, D)$	.4	.4445	.0445
$R$	$(D, D, R)$	.3928	.3636	.0292
$R$	$(D, R, R)$	.4528	.3622	.0906
$R$	$(R, R, R)$	.25	.3121	.0621

Table 2. Simulations Using Agency Data

Note that this simulation – while still relatively solid – does not "fit" as well as the prior one. There are likely multiple reasons for this. First, there are two places where the data are non-monotonic. With a Democratic agency,

<sup>47</sup>We express sincere thanks to Tom Miles and Cass Sunstein for sharing their data with us.

<sup>48</sup>For this simulation we minimized the sum of the squares of the values in the last column, and the minimizing parameter values are  $\mu = -0.7841$ ,  $\tau = 0.05$ ,  $\gamma = 0.0029$ ,  $\sigma = 0.6395$ , and  $c = 4.786$ . We also fit the model using other maximands.

In addition we played around with different lag definitions of when an agency "becomes" associated with the president in charge, given that upon a change in administration, the incumbent agency may have to continue to defend its actions under the previous administration. As far as we could tell, such adjustments do not affect these results significantly (though we are still experimenting).

theory predicts that as we move from a DDR to a DRR judicial panel, the reversal rate should not fall. Yet, in the Miles / Sunstein data, the reversal rate from this change in judges falls from .4375 to .3913. Similarly, with a Republican agency, our theory predicts that when we move from a DDR to a DRR panel, the reversal rate should not rise. Again, the Miles/Sunstein granular data contradict this prediction. This effect could be mere chance; the number of cases in some of the cells is fairly small; or relatedly it might pertain to unobserved characteristics (issue level or judge level) that neither we nor Miles/Sunstein account for. In any event, when we fit the parameters in our simulation, our model does not allow the reversal rate to fall and rise in such non-monotonic ways in the way that it does in the data. Second, we are trying to fit the data on more dimensions in this simulation than in the prior one, which will tend to produce a looser fit. Third, in these simulations we assign ideology specific scores to the Democratic agency ( $\theta = -1$ ) and the Republican one ( $\theta = 1$ ). In Table 1, in contrast, we instead estimated an agency ideology that we applied across all cases (effectively giving us more degrees of freedom to calibrate). Nevertheless, even with these restrictions our model does reasonably well. The only large divergences take place in the first two rows of the chart, and perhaps in the R-DRR case. The other cases fit quite well.

At least as an initial matter, we find these simulations suggestive. They illustrate that there are parameter values for our model that make it perform, more or less, like empirical observations of judges. If our model had failed such a test – if we could not find parameters that made the model "look like" the data – then we would regard the model with some skepticism. However, since it passed this initial test at least from an eyeballing perspective, it will be a serious candidate for testing in future work. Although we do not concentrate on it here, another artifact of our model may be consistent with other empirical stylized facts in the panel effects literature. Although the sole R-panelist in the DDR panel is uncovering information instrumentally, for the purposes of swaying his D counterparts, it is possible that his additional digging will generate a signal that has the opposite effect: That is, it convinces the R-panelist that the liberal policy outcome is optimal even from his perspective. This effect is a small one, but under some circumstances the additional digging undertaken by the minority panel member can also cause him to switch allegiances.

### 4.3 Empirical Implications

Although the calibration exercise above illustrates the plausibility of our deliberative theory of panel effects, it is not a “test” of our theory *per se*. To test it, we would need to isolate situations where our information-based theory delivers different predictions other candidates (including certain versions of whistle-blowing, social collegiality, or attitudinal drift). Constructing such tests must be done with care (Epstein, et al, 2005; Sisk and Heise 2005; Fischman 2009). Although we leave for future work the task of designing a suitable set of cases for just such a comparison, we offer some possibilities below. Nevertheless, there is a sense in which our contribution already *is* empirically driven

– for our starting motivation (see Section 2) is to explain stylized empirical facts that a sizeable literature has already identified.

There are a number of potential approaches for testing of our model empirically. For example, Landes and Posner (2009) find strong evidence of mixed-ideology moderation on 3-judge panels, but fail to find it on the Supreme Court. Their failure to detect a moderation trend at the US Supreme Court level may be due to any number of factors. However, our model suggests one possibility – that they measured Court ideology through central-tendency measures (e.g., percent Republican-appointed) rather than variation at the extremes of the court’s ideological spectrum. Our analysis suggests that variation at the extremes (e.g., changes in the left-most or right-most wings of the court) are more likely to predict changes in auditing intensity and resulting panel effects.<sup>49</sup>

We may also gain empirical traction from the fact that our model produces panel effects in environments that are both *information poor* and *politically charged*. That is, limited information affords judges with the opportunity to investigate more, and political differences provide them (or at least some of them) with motivation to do so. Our framework therefore suggests that we are most likely to observe panel effects in domains where both characteristics are present (such as in environmental law, securities regulation or antitrust), and not in fields that are more purely political (such as abortion or gun control policy) or are largely technocratic (such as weights and measures policy).

Our account may also shed light on the role of “merit” in the Supreme Court confirmation process. Epstein and Segal (2005) measure merit by coding newspaper editorial evaluations of a nominee. They report that, other things being equal, merit is positively correlated with Senatorial votes for the candidate. Perhaps surprisingly, this effect is strong enough to overcome all or most political considerations. Thus, Scalia was confirmed unanimously, and Ginsburg was confirmed with only three dissenting votes. How can this be?<sup>50</sup> Our model provides at least a partial explanation if “merit” can be interpreted as a credible ability to enhance “accuracy.” In our model all judges have the same auditing precision; yet minority judges have an incentive to work hard (at least in some situations) to provide better information to the panel. To be sure, the minority judge’s efforts work to his favor; but perhaps less obvious is the fact that *majority judges may also be better off* by the inclusion of the minority judge, due to the public informational good he provides, which increases precision. The increased accuracy will allow better estimation of the state of the world, and better partitioning of the cases in which each judge wants to vote to uphold or reject the Agency. In this sense, ideological outliers can be good for everyone—a possibility that even a callous politician can love (or at least learn to live with).

Finally, our framework may provide an alternative approach for estimating

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<sup>49</sup> Appeals court panels, in contrast, consist of only three judges, and such aggregate measures do a better job of capturing ideological variation at *both* the median and the extremes.

<sup>50</sup> We exclude the obvious and extremely appealing hypothesis that former law professors are irresistible. Robert Bork, a former Yale Law Professor was rejected by the Senate.



ideological “scores” for judges and other legal actors (e.g., Martin & Quinn 2002; Epstein et al 2007b). In much of the existing ideological scoring literature, identification is achieved through an attitudinal model of voting that assumes complete information and excludes deliberation. One can estimate ideological scores under our framework too, but identification is based on a deliberative model of voting with incomplete information and endogenous search. Once estimated, the predictive power of these alternative scores could be compared to their attitudinal analogs (e.g., Martin-Quinn scores) as a means for testing the deliberative against the attitudinal model.<sup>51</sup>

## 5 Extensions

The analytical framework presented above also lends itself to a number of theoretical generalizations and extensions. Although we do not analyze all of them here, we briefly address some of the more promising ones, noting their likely effects on our model’s predictions.

An obvious extension of the model involves altering the informational environment at the *review* stage. For instance, one could imagine a structure (following on Spitzer & Talley (2000) and Cameron et al. (2000)), where the appellate panel cannot observe the factual input ( $z$ ) that undergirds A’s policy choice, but can instead only make equilibrium inferences from the agency’s ultimate decision ( $y_A$ ). The appropriateness of such an assumption would likely be context specific, and would require a close appraisal of the circumstances in administrative law and regulation where an agency’s information is reliably encapsulated in its record. Although we do not work through details of this extension here, our core arguments are likely carry over (with some caveats) to the case where A’s signal is unobservable. In fact, if the median panelist and the agency share similar ideologies, our results tend to become even *more* pronounced. For example, suppose a Democrat agency is reviewed by either a DDD or DDR panel. The agency’s decision signals to the majority panelists that a politically aligned actor observed a signal that they would likewise find persuasive, even if they cannot discern how strong that signal was. Unable to conduct a targeted audit of only those cases that are true “close calls,” the Democrats’ rational response might simply be to rubber stamp *all* of the agency’s decisions. A Republican minority panelist, in contrast, is more likely to retain an incentive to audit, but (just as above) she will do so only for A’s *liberal* pronouncements. Consequently, if A’s information were not observable, there can be equilibria where majority panelists never audit, and minority panelists (if any) engage strictly in one-sided auditing, reproducing (and even accentuating) the panel effects predicted in our baseline model.<sup>52</sup>

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<sup>51</sup>Such a comparison may also bear on the issue of whether judicial ideologies exhibit “drift” over time (say, on the Supreme Court). Our model suggests that episodes of apparent drift could actually be due to changing information production patterns that coincide with changing ideological compositions of the Court.

<sup>52</sup>Of course, the categorical nature of auditing in this case also implies that there can be

Alternatively, one could perturb the informational environment at the *deliberation* stage, permitting auditing panelists to misrepresent (or selectively disclose) information to their colleagues. A panelist might, for example, misrepresent the *extensive* margin of her auditing efforts, covering up (perhaps at a cost) whether she has taken a hard look. Alternatively, a panelist might misrepresent the *intensive* margin of her efforts, falsifying or distorting (again perhaps at some cost) the content the signal she observed. It is relatively simple to extend our model to allow for misrepresentation on the extensive margin. So long as a judge’s ideological leaning is known (or accurately conjectured) by other panelists, it will commonly knowledge whether she has an equilibrium incentive audit. The silence of a judge known to possess such an incentive creates an (accurate) inference by others that she discovered information inconsistent with her preferred position. In a manner akin to the “unraveling” phenomenon in information games (e.g., Milgrom & Roberts 1986), the equilibria identified above would substantially persist.

Misrepresentation on the intensive margin introduces a more complicated signaling game to our baseline model, and is therefore more involved. We conjecture, however, that such an extension could entail similar effects. Here, non-auditing panelists, wary of falsification, would rationally interpret the content of auditing judge’s signal in light of her ideology. When a complete separating equilibrium obtains, panelists can accurately “decode” the auditor’s signal, producing essentially the same equilibria described above (but introducing social costs from signaling). Under a complete pooling equilibrium, in contrast, the auditing judge sends uninformative signals, and other panelists simply ignore him. Anticipating this reaction, of course, the auditing judge would never harvest the signal to begin with. This outcome would be identical to the baseline model where the cost of auditing ( $c$ ) is prohibitive, and accordingly our model would not predict any panel effects. There may also be partially revealing equilibria, where some judges are willing to bear the cost of falsification, while others (those with less at stake) are not. In such equilibria, non-auditing panelists may selectively discount the resulting signal accordingly. We conjecture that in many such equilibria, the severity of the panel’s discount increases as the auditor’s ideology grows more “distant” from the median. Eventually, the marginal returns to diversity would eventually dissipate for “ideologue” judges, who are effectively non-credible. Nevertheless, our core results would likely persist for judges falling inside threshold.

Another extension of the model’s information structure might allow each panelist to draw a statistically independent auditing signal – either simultaneously with others or in sequence. Were this possible, *multiple judges* may choose to audit an agency decision, each in an effort to sway the median voter. We have explored with this extension in a sequential setting, and it tends to produce a nested version of our baseline model, where extreme panelists engage in a deliberative “tug-of-war” for the median voter’s favor. For example,

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cases when *both* Democrats and Republicans audit, or when *neither* do. Factoring these possibilities in, our panel effects result is likely to persist in the aggregate.

suppose the median panelist is leaning towards the liberal policy based on the agency’s developed facts. Under our baseline model, the most liberal panelist would never audit, but the most conservative panelist will – and the latter may produce information that wins over the median panelist for the conservative policy. Confronted with this new reality, the most liberal panelist may *herself* rationally choose to take another draw. Should she observe a signal that wins back the median panelist, then yet another conservative judge may audit, and so forth down the line until the costs of the next draw are prohibitive. Viewed in this light, independent draws on  $v$  would likely amplify the deliberative dynamics that our baseline model exposes.

We might also endeavor to expand the permissible policy space beyond two distinct policy outcomes. For example, one could introduce a “centrist” policy option ( $y = 0$ ) in addition to the liberal and conservative ones. This extension turns out to be a relatively straightforward within our model, and has the effect of dampening *all judges’* incentives to audit. For the median judge, a richer set of policy choices affords her the opportunity to fine tune the outcome to her ideal point to her *a priori* information, which reduces both the costs of error and the value of additional information. Consequently, with more policy options it can become more attractive simply to remain uninformed and adopt the centrist position than to invest in additional search. The more ideological judges will also value additional information less, but they will still have incentives that are qualitatively similar to the analysis above.<sup>53</sup>

Another obvious – but possibly difficult – extension is to endogenize the Agency’s decision to do research. In our baseline model, the Agency simply observes  $z$ ; there is no strategic choice involved. A literature going back at least to Gilligan and Krehbiel (1997),<sup>54</sup> however, investigates the incentives of an administrative agency (or legislative committee) to gather information and expertise as a consequence of delegated authority. This literature has been extended to consider judicial oversight (Stephenson, 2007, 2008) and its effects on an Agency’s decision to gather expertise. A sophisticated court will tend to consider the feedback effects of its decision rule on the Agency’s decision, and will incorporate these effects into its rule of review. We could follow this path with our model, by (say) permitting the agency to make a strategic investment in the precision of its initial signal, anticipating how judicial review subsequently plays out.

Finally, we might attempt to embed our model within a multiple level auditing game. (See generally George 1999; George & Solomine 2001). If we were to include the Full Circuit (for *en banc* review) and the Supreme Court, we would have four levels. Work is starting to be done with three levels, focusing on the

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<sup>53</sup>The principal difference is that with multiple policy choices, there may now be multiple auditing interval ranges “around” each of the median judge’s point of indifference between two outcomes.

Moving to a continuous policy spaces makes things harder. We conjecture, however, that doing so tends to dilute the additional incentives that extreme judges have over median judges to invest in more information.

<sup>54</sup>See also Bueno de Mesquita and Stephenson (2007)

Full Circuit’s decision to review.<sup>55</sup> Indeed, Clark (2009) provides an elaborate empirical test of granting en banc review within a three level principal agent framework, but does not provide a formal model. The equilibria of these models can be complex – a fact that may explain why some recent work (e.g., Landes & Posner 2009) fail to find panel effects at the Supreme Court level even though finding evidence at the Circuit Court level). Because our model provides a general framework for analyzing endogenous information production in arbitrarily sized panels, however, it may lend itself to such an extension.

## 6 Implications

In our framework, mixed panels produce more information, which – through deliberation – catalyzes more informed decisions. At the same time, of course, it need not follow that more informed decision making is always optimal, for at least two reasons: First, information in this model is purchased at a cost; even if majority panelists are eventually "brought around" with new information, it does not imply that uncovering the added information was cost justified *ex ante*. Second, the additional information is generated instrumentally, and is therefore likely skewed towards the interests of parties and political elites. If those interests do not plausibly coincide with the general interests of the citizenry, it is not obvious that more information is a real public good. These concerns aside, however, our analysis may lend at least *some* theoretical support to suggestions that we encourage (or even require) mixed panels within the federal judiciary (Schanzenbach and Tiller 2008).

Our framework does not directly allow us to make strong claims about legal doctrine, because doctrine is not a necessary ingredient of our model. However, it is a *possible* ingredient: as noted above, one plausible interpretation of our model is that the extra “signal” harvested by auditing panelists consists of undiscovered precedents, statutes, regulations or other persuasive authority over the issue. Under this interpretation, our model may suggest that mixed panels do a better job of uncovering and adhering to doctrine than do homogenous panels.<sup>56</sup>

Our model may also have implications for the burgeoning theoretical and empirical literature on Supreme Court appointments. In this literature, the Senate and President observe the departure of a member of the Supreme Court, and then they bargain in some structural setting over the new appointee (e.g., Krehbiel 2007). Both the Senate and the President evaluate new appointees by referring to their expected votes. In turn, these expectations are conventionally thought to be the function of each potential nominee’s individual characteristics. Our model (and the empirical literature that attracted us to it), however, suggests that the voting proclivities new appointees may be significantly more complex than this, and turn on who is empaneled with him/her. Moreover, the

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<sup>55</sup>Revesz (1997) at page 1747, investigates a “hierarchical constraint” hypothesis that stems from the possibility of Supreme Court review.

<sup>56</sup>On the other hand, our model can say little about writing opinions (majority or dissent).

new appointee may also perturb the voting proclivities of incumbent members of the Court. Embedding this feature into the appointment literature is an interesting (and in our mind worthwhile) challenge.

From a topical perspective, there may also be a number of applications of our approach. For example, many of the information production / deliberation arguments offered above could be applied to other multi-member political decision makers, such as administrative committees or agencies themselves.<sup>57</sup> Our approach may also dovetail with and contribute to the literature about the endogenous formation of peer groups through “homophily” (i.e., connection and information sharing among philosophically allied individuals<sup>58</sup>). Within organizational theory, our analysis may shed light on the extent to which heterogeneity of world views among block shareholders or corporate board members may better inform corporate decisions.<sup>59</sup> Similarly, our approach may shed light on the conditions under which having single versus numerous large block shareholders in the ownership structure of a company can facilitate efficient endogenous information production – a question that has been increasingly important recently.<sup>60</sup>

## 7 Conclusion

In this paper, we have presented a simple information-based model of panel deliberation at the circuit court level. Proposition 1 (and associated corollaries) captures central insights from the empirical literature. Most centrally, we have illustrated how mixed panels may induce equilibria manifesting the markers of “moderation” among majority (and even minority) panelists. The type of moderation we predict is not an artifact of endogenous preferences, collegiality, group cohesion or whistleblowing *per se*, but rather the product of endogenous patterns of information production, developed and provided by panelists who have diverse ideological commitments. In at least some respects, our argument is consistent with the claim that mixed panels produce not only different results, but also better results than their homogenous counterparts. At this point, our information-based theory joins a group of theories attempting to explain the phenomena of both majority and minority judges as a function of panel composition, and future empirical tests must sort out which theory has greatest explanatory power in practice. We have suggested a few promising routes for such tests, but we leave their execution for another day.

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<sup>57</sup>Cites.

<sup>58</sup>See, e.g., Currarini, Jackson & Pin (2008).

<sup>59</sup>For example, the now well-documented disagreements between Patricia Dunn (a “governance”-oriented director) and Tom Perkins and Jay Keyworth (two “strategy”-oriented directors) on the Hewlett Packard Board may have some benefits even while it potentially foments internal conflict. See, e.g., Wall St. Journal (10/9/06) “Boardroom Duel Behind H-P Chairman’s Fall, Clash With a Powerful Director; The Cautious Patricia Dunn And Flashy Tom Perkins Were a Combustible Pair” at A\_\_.

<sup>60</sup>See, e.g., Yucaipa American Alliance Fund LLC v. Reggio et al, C.A. No. 5465-VCS, (Del. Ch. 2010) (challenging a poison pill that “grandfathered” in a pre-existing 37-percent shareholder while being triggered by all others who surpassed 15 percent).

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## 9 Appendix

This appendix includes some basic identities and mathematical derivations that enter into the analysis, as well as proof of core propositions.

### 9.1 Distributional Identities

Analyzing the model in the text requires some manipulation of Gaussian distributions. For the reader's reference, some of the key identities are stated here. Recall from the model that the "true" state of the world,  $X$ , is distributed  $N(\mu, \frac{1}{\gamma})$ ; Player A's signal  $Z$  is distributed such that  $(Z|X) \sim N(x, \frac{1}{\gamma})$ ; and Player J's signal  $V$  about  $X$  is distributed such that  $(V|X) \sim N(x, \frac{1}{\sigma})$ . Because all primitives are distributed normally, each of the conditional random variables given in the Table below are also normal (see DeGroot 2004). Specifically,

Table A1 reports the mean and precision of five such conditionals:

Cond. RV	Mean	Precision
$X Z, V$	$\frac{\tau\mu+\gamma z+\sigma v}{\tau+\gamma+\sigma}$	$\frac{1}{\tau+\gamma+\sigma}$
$X Z$	$\frac{\tau\mu+\gamma z}{\tau+\gamma}$	$\frac{1}{\tau+\gamma}$
$X V$	$\frac{\tau\mu+\sigma v}{\tau+\sigma}$	$\frac{1}{\tau+\sigma}$
$V Z$	$\frac{\tau\mu+\gamma z}{\tau+\gamma}$	$\frac{\tau+\sigma}{(\tau+\gamma)\sigma}$
$Z V$	$\frac{\tau\mu+\sigma v}{\tau+\sigma}$	$\frac{\tau+\sigma+\gamma}{(\tau+\sigma)\gamma}$

Table A1. Conditional Distributions

In addition, we note that if  $X$  distributed  $N\left(\alpha, \frac{1}{\beta}\right)$ , the expectation of  $X$  conditional on  $x \geq \hat{x}$  (sometimes called the ‘‘Tail Conditional Expectation’’) is:

$$E(X|x \geq \hat{x}) = \alpha + \frac{1}{\sqrt{\beta}} \cdot \left( \frac{\phi((\hat{x} - \alpha)\sqrt{\beta})}{1 - \Phi((\hat{x} - \alpha)\sqrt{\beta})} \right) \quad (9)$$

where  $\phi(\cdot)$  and  $\Phi(\cdot)$  represent the standard normal probability density and cumulative distribution functions, respectively (Landsman & Valdez, 2005).

Finally, our model requires identifying various order statistics on the set of panelist ideologies,  $\Theta$ . Consider a vector of realizations  $\Theta \equiv \{\theta_1, \theta_2, \dots, \theta_{2M-1}\}$ , drawn independently from an identical distribution  $H(\theta)$  with associated density  $h(\theta)$ . Without loss of generality, we can reorder  $\Theta$  in terms of order statistics  $\{\theta_{(1)}, \dots, \theta_{(M)}, \dots, \theta_{(2M-1)}\}$ . Define  $\hat{\Theta} \subset \Theta$  as the 3-tuple  $\{\theta_{(1)}, \theta_{(M)}, \theta_{(2M-1)}\}$ , representing the minimal, median, and maximal elements of  $\Theta$ . The  $k$ -th order statistic, or  $\theta_{(k)}$ , has a probability density function given by:

$$h_{(k)}(\theta_{(k)}) = \frac{(2M-1)!}{(k-1)!(2M-1-k)!} (H(\theta_{(k)}))^{k-1} (1-H(\theta_{(k)}))^{(2M-1-k)} h(x) \quad (10)$$

Applying this expression iteratively, the joint pdf of  $\hat{\Theta}$ , in terms of  $H(\theta)$  and  $h(\theta)$ , is as follows:

$$\begin{aligned} f(\hat{\Theta}) &= \frac{(2M-1)!}{(M-2)!^2} \cdot h(\theta_{(1)}) \cdot h(\theta_{(M)}) \cdot h(\theta_{(2M-1)}) \\ &\quad \times (H(\theta_{(M)}) - H(\theta_{(1)}))^{(M-2)} (H(\theta_{(2M-1)}) - H(\theta_{(M)}))^{(M-2)} \end{aligned} \quad (11)$$

## 9.2 Derivation of Expected Payoff for Uninformed Judge

Consider a judge with ideology  $\theta_i$  sitting on an uninformed panel with ideological profile  $\Theta$ . Judge  $i$ 's expected payoff if informed (conditional on  $z$ ) is given by:

$$\begin{aligned}
\pi_U(\theta|z, \theta_{(M)}) &= -E_{x|z} \left\{ ((x + \theta_i) - y)^2 |z \right\} \\
&= \begin{cases} -E_{x|z} \left\{ (x + \theta_i + 1)^2 |z \right\} & \text{if } z \leq z_M^U \\ -E_{x|z} \left\{ (x + \theta_i - 1)^2 |z \right\} & \text{else} \end{cases} \\
&= -E_{x|z} \left( x^2 + 2x(\theta_i + 1) + (\theta_i + 1)^2 \right) + 4 \begin{cases} 0 & \text{if } z \leq z_M^U \\ E_{x|z} \left\{ (\theta_i + x) |z \right\} & \text{else} \end{cases} \\
&= \left( \frac{1}{\tau + \gamma} + \left( \frac{\tau\mu + \gamma z}{\tau + \gamma} + (\theta_i + 1) \right)^2 \right) + \begin{cases} 0 & \text{if } z \leq z_M^U \\ 4 \left( \theta_i + \frac{\tau\mu + \gamma z}{\tau + \gamma} \right) & \text{else} \end{cases},
\end{aligned}$$

which is the expression given in the text.

### 9.3 Derivation of Expected Payoff for Informed Judge

Assuming the panel becomes informed of  $v$ , it will issue a decision  $y_M^I$ , consistent with the median judge's ideology  $\theta_{(M)}$ . Expected payoff of any judge on the panel with ideology  $\theta_i$  is thus:

$$\begin{aligned}
\pi_I(\theta_i|z, \theta_{(M)}) &= -E_{v|z} \left\{ E_{x|z,v} (x + \theta_i - y_M^I)^2 |z, v \right\} \\
&= E_{v|z} \left[ \begin{array}{l} -E_{x|v,z} \left\{ (x + \theta_i + 1)^2 |z, v \right\} \quad \text{if } v \leq v_M^I \\ -E_{x|v,z} \left\{ (x + \theta_i - 1)^2 |z, v \right\} \quad \text{if } v > v_M^I \end{array} \middle| z, v \right] \\
&= - \left( \frac{1}{\tau + \gamma} + \left( \frac{z\gamma + \tau\mu}{\tau + \gamma} + (\theta_i + 1) \right)^2 \right) + E_{v|z} \begin{cases} 0 & \text{if } v \leq v_M^I \\ 4 \left( \frac{\tau\mu + \gamma z + \sigma v}{\tau + \gamma + \sigma} + \theta_i \right) & \text{if } v > v_M^I \end{cases} \\
&= - \left( \frac{1}{\tau + \gamma} + \left( \frac{z\gamma + \tau\mu}{\tau + \gamma} + (\theta_i + 1) \right)^2 \right) \\
&\quad + 4 \cdot \left( \theta_i + \left( \frac{\tau\mu + \gamma z}{\tau + \gamma} \right) \right) \left( 1 - \Phi \left( - \frac{\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma}}{\sqrt{\frac{\sigma}{(\sigma + \tau + \gamma)(\tau + \gamma)}}} \right) \right) \\
&\quad + 4 \cdot \sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}} \cdot \phi \left( - \frac{\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma}}{\sqrt{\frac{\sigma}{(\sigma + \tau + \gamma)(\tau + \gamma)}}} \right)
\end{aligned}$$

### 9.4 Proof of Lemmas 1-5

**Lemma 1:** For the median judge,  $\Delta(\theta_{(M)}|z, \theta_{(M)})$  is maximal at  $z = z_M^U$ , and falls symmetrically in both directions as  $z$  moves away from  $z_M^U$ . Consequently, when panel ideologies are homogenous, the auditing range also will constitute a symmetric interval around  $z_M^U$ .

**Proof:** First, note that  $\left(\theta_i + \frac{z\gamma + \tau\mu}{\tau + \gamma}\right)\Big|_{z=z_M^U} = 0$ . Therefore,  $\Delta(\theta_{(M)}|z, \theta_{(M)})$  simplifies to:

$$\begin{aligned}\Delta(\theta_{(M)}|z, \theta_{(M)}) &= 4 \cdot \sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}} \cdot \phi(0) & (12) \\ &= 4 \cdot \phi(0) \cdot \sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}} \\ &= \sqrt{\frac{8}{\pi}} \cdot \left(\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}\right)\end{aligned}$$

Note further that the standard normal density  $\phi(x)$  is maximized at  $x = 0$ , and thus term  $\alpha$  is maximized when  $z = z_M^U$ . As to term  $\beta$ , it is easily verified that term  $\beta$  is negative for all values of  $z \neq z_M^U$ . Thus, since both  $\alpha$  and  $\beta$  are individually maximized at  $z_M^U$ , so must their sum. Their symmetry of  $\Delta(\theta_{(M)}|z, \theta_{(M)})$  around  $z = z_M^U$  follows immediately from the symmetry of the standard normal distribution around 0. *QED*

**Lemma 2:** *If judge  $i$  more conservative than the median judge, so that  $\theta_i > \theta_{(M)}$ :*

- – *Judge  $i$  values information more than the median judge when  $z \leq z_M^U$  and less than the median judge when  $z > z_M^U$ .*
- *The extent to which the more conservative judge's valuation exceeds / falls short of the median judge's increases strictly in  $\theta_i$ .*

*If judge  $i$  more liberal than the median judge, so that  $\theta_i < \theta_{(M)}$ :*

- – *Judge  $i$  values information more than the median judge when  $z \geq z_M^U$  and less than the median judge when  $z < z_M^U$ .*
- *The extent to which the more liberal judge's valuation exceeds / falls short of the median judge's decreases strictly in  $\theta_i$ .*

**Proof:** An equivalent way to express the value of information for the non-median judge is to consider the degree to which judge  $i$ 's valuation of auditing exceeds that of the median judge. Denoting this valuation gap as  $\xi(\theta_i, \theta_{(M)}, z)$ , the following expression emerges:

$$\begin{aligned}\xi(\theta_i, \theta_{(M)}, z) &= \Delta(\theta_i|z, \theta_{(M)}) - \Delta(\theta_{(M)}|z, \theta_{(M)}) & (13) \\ &= 4 \cdot (\theta_i - \theta_{(M)}) \cdot \begin{cases} 1 - \Phi\left(-\frac{(\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma})}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}}\right) & \text{if } z \leq z_M^U \\ -\Phi\left(-\frac{(\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma})}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}}\right) & \text{if } z > z_M^U \end{cases}\end{aligned}$$

The statements in the Lemma come directly from inspection and/or differentiation of  $\xi(\theta_i, \theta_{(M)}, z)$ . *QED*

**Lemma 3:** When  $z < z_M^U$  the most conservative judge (with ideology  $\theta_{(2M-1)}$ ) has the maximal incentive of all panelist to audit. Similarly, when  $z > z_M^U$ , the most liberal judge (with ideology  $\theta_{(1)}$ ) has the maximal incentive to audit. If  $z = z_M^U$ , the most conservative (most liberal) panelist has the greatest incentive to audit when  $(\theta_{(2M-1)} - \theta_{(M)})$  is larger (smaller) than  $(\theta_{(M)} - \theta_{(1)})$ .

**Proof:** Direct implication of Lemma 2.

**Lemma 4:** If  $c \leq c(\hat{\Theta}, z)$ , the panel will audit (and thus learn  $v$ ) where

$$c(\hat{\Theta}, z) = 4\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}} \cdot \phi\left(-\frac{\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma}}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}}\right) \quad (14)$$

$$+ \begin{cases} 4\left(\theta_{(2M-1)} + \frac{\tau\mu + \gamma z}{\tau + \gamma}\right) \cdot \left(1 - \Phi\left(-\frac{\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma}}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}}\right)\right) & \text{if } z \leq z_M^U \\ -4\left(\theta_{(1)} + \frac{\tau\mu + \gamma z}{\tau + \gamma}\right) \cdot \Phi\left(-\frac{\theta_{(M)} + \frac{z\gamma + \tau\mu}{\tau + \gamma}}{\sqrt{\frac{\sigma}{(\tau + \gamma + \sigma)(\tau + \gamma)}}}\right) & \text{if } z > z_M^U \end{cases}$$

This criterion implicitly defines strictly positive (but possibly asymmetric) auditing interval  $[\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})]$  around  $z_M^U$ . When the panel audits, the additional signal is collected by the most conservative (liberal) member whenever  $z \in [\underline{z}(\hat{\Theta}), z_M^U]$  (whenever  $z \in (z_M^U, \bar{z}(\hat{\Theta})]$ ).

**Proof:** Direct implication of Lemmas 2-3.

**Lemma 5:** Given the equilibrium behavior of a panel with configuration  $\hat{\Theta}$ ,  $A$  will make the conservative decision if and only if:

$$4(1 - \pi) \left( \frac{\tau\mu + \gamma z}{\tau + \gamma} + \theta_A \right) \geq \pi \varepsilon \cdot \left( \begin{array}{l} E\left(\Pr\{z < \underline{z}(\hat{\Theta})\} | z\right) - E\left(\Pr\{z \geq \bar{z}(\hat{\Theta})\} | z\right) \\ + E\Pr\left\{z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})] \cap v < v_M^I | z\right\} \\ - E\Pr\left\{z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})] \cap v \geq v_M^I | z\right\} \end{array} \right)$$

**Proof:** Conditional on knowing  $z$ , if  $A$  issues the conservative decision ( $y_A = 1$ ), her expected payoff will be:

$$-(1 - \pi) \cdot E\left((x + \theta_A - 1)^2 | z\right) \quad (15)$$

$$- \pi \varepsilon \cdot \left( \iiint_{\hat{\Theta} | z < \underline{z}(\hat{\Theta})} f(\hat{\Theta}) d\hat{\Theta} + \iiint_{\hat{\Theta} | z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})]} \Phi(-(\theta(\tau + \gamma) + z\gamma + \tau\mu)) f(\hat{\Theta}) d\hat{\Theta} \right)$$

where  $f(\hat{\Theta})$  is as derived above. If  $A$  issues the liberal decision ( $y_A = -1$ ), in contrast, her expected payoff will be:

$$\begin{aligned}
& -(1 - \pi) \cdot E \left( (x + \theta_A + 1)^2 \mid z \right) \\
& - \pi \varepsilon \cdot \left( \iiint_{\hat{\Theta} \mid z > \bar{z}(\hat{\Theta})} f(\hat{\Theta}) d\hat{\Theta} + \iiint_{\hat{\Theta} \mid z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})]} (1 - \Phi(-(\theta(\tau + \gamma) + z\gamma + \tau\mu))) f(\hat{\Theta}) d\hat{\Theta} \right)
\end{aligned} \tag{16}$$

Consequently,  $A$  will make the conservative decision if and only if the difference between these two expressions is positive, or:

$$4(1 - \pi) \left( \frac{\tau\mu + \gamma z}{\tau + \gamma} + \theta_A \right) + \pi \varepsilon \cdot \left( \begin{aligned} & \iiint_{\hat{\Theta} \mid z > \bar{z}(\hat{\Theta})} f(\hat{\Theta}) d\hat{\Theta} - \iiint_{\hat{\Theta} \mid z < \underline{z}(\hat{\Theta})} f(\hat{\Theta}) d\hat{\Theta} \\ & + \iiint_{\hat{\Theta} \mid z \in [\underline{z}(\hat{\Theta}), \bar{z}(\hat{\Theta})]} (1 - 2\Phi(-(\theta(\tau + \gamma) + z\gamma + \tau\mu))) f(\hat{\Theta}) d\hat{\Theta} \end{aligned} \right) \geq 0 \tag{17}$$

Rearranging and substituting appropriate expectation operators yields the expression in the text.