Abstract

I argue the Supreme Court learns to craft legal rules by relying on the Courts of Appeals as laboratories of law, observing their decisions and reviewing those that best inform legal development. I develop a model that shows how the Supreme Court leverages multiple Courts of Appeals decisions to identify which will be most informative to review, and what decision to make upon review. Because an unbiased judge only makes an extreme decision when there is an imbalance in the parties’ evidence, the Supreme Court is able to draw inferences from cases it chooses not to review. The results shed light on how hierarchy eases the inherent difficulty and uncertainty of crafting law and on how the Supreme Court learns to create doctrine.
1 Introduction

The opportunity to learn from subordinates’ successes and failures is one of the fundamental strengths of hierarchical organizations. American states are referred to as laboratories of democracy for just this reason: “It is one of the happy incidents of the federal system that a single courageous State may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country” (New State Ice Co. v. Liebmann, 285 U.S. 262 (1932), Justice Brandeis, dissenting). The federal government can observe states’ social and economic experiments and adopt the best practices. The same is true in the federal courts, where new law is developed in the lower courts as the Supreme Court watches. Inferior courts filter arguments for the Supreme Court, identifying doctrines that are best for particular areas of law. This hierarchy of experimentation can help the judges at the top develop informed opinions and make good decisions. In short, hierarchy can help superiors learn. But that learning is not always straightforward. Aggregating the results of many agents’ experiments, and understanding the causes of their successes and failures, requires careful supervision and strategic review. In this paper, I explore how a supervisor can best learn from a group of agents in the context of the federal judicial hierarchy. I show how the Supreme Court uses the Courts of Appeals as laboratories of law, observing their decisions and reviewing cases to learn about doctrine.

I present a formal model in which a high court learns about doctrine by aggregating the decisions of multiple lower courts. Although the high court can review only one case, it can observe the outcome of many cases. Allowing the high court to learn from a group of lower courts leads directly to the conclusion that the high court’s review decisions hinge on estimates of which cases will be most informative to review.

The model simultaneously helps to explain stylized facts about review and to illuminate
new areas for empirical study. For example, it has long been known that the Supreme Court
reviews in order to resolve conflicts in the lower courts, which is true in the model presented
here. But the model here shows how not all cases are equally good vehicles for resolving
lower court conflict. Instead, the Supreme Court will be more likely to review cases from
the side of the conflict it ultimately disagrees with—a result that is consistent with the
patterns presented in Wasby (2005) and Summers and Newman (2011). Similarly, it has
long been known that although the Supreme Court is more likely to review the decisions
of judges who are ideologically distant, it also frequently reviews and reverses the decisions
of its ideological allies (Walson 2011). The model presented here offers a rationalization for
these phenomena. It also makes a series of novel empirical predictions, including which case
will be most informative and what the probability of reversal will be conditional on review.

2 Learning, supervision, and decision making

While the Supreme Court decides under 100 cases per year, the subordinate Courts of Ap-
peals decide tens of thousands of cases each year (United States Courts 2007). The Supreme
Court reviews so few cases because it “casts itself in an Olympian role” (Shapiro 2006):
while lower courts focus on dispute resolution, the Supreme Court focuses on articulating
doctrine—that is, on structuring dispute resolution by crafting rules that apply to sets of
cases.

Articulating doctrine involves inherent uncertainty (Black and Owens 2012) and diffi-
culty. Therefore, understanding the creation of doctrine requires an understanding of how
the Supreme Court learns. The Court might learn by hearing multiple cases on related
questions over time (Cooter, Kornhauser and Lanc 1979, Niblett 2013, Baker and Mezzetti
2012), or by relying on information received in briefs and during oral argument (Johnson,
Wahlbeck and Spriggs 2006), or by relying on lower courts’ prior decisions. This last pos-
sibility has received ample recent scholarly attention, because the Supreme Court’s role is not only to articulate doctrine, but to do so from atop a hierarchy. In a hierarchy where multiple agents communicate to principals, agents’ messages can interact with—and sometimes counteract—one another, thereby providing more information than the sum of their messages (Epstein 1998, Dewatripont and Tirole 1999, Battaglini 2002, Minozzi 2011). The judicial hierarchy thus affords the Supreme Court two benefits: it can aggregate the decisions of lower courts and, if it wishes, it may review some of their decisions to better understand them. Which cases deserve further review? Calvert (1985) considers a principal who has two potential sources of advice and can choose to learn from only one; however, the principal does not observe anything before choosing which advisor to consult. In the judiciary, the Supreme Court sees certain salient facts—like who made the decision, and what decision was reached—before deciding whether to review a case. The model presented here includes such considerations.

Because the Supreme Court takes so few cases, understanding which Courts of Appeals decisions deserve Supreme Court review, and how to reconcile the inevitable differences that arise between them, is an important question that has received considerable attention (e.g. Perry 1991, Cameron, Segal and Songer 2000, Lax 2003, Kastellec 2007, Clark 2009, Beim, Hirsch and Kastellec 2012). Most of this research has understood the hierarchy as a disciplinary organization; thus, the advantage of learning from subordinates is generally ignored to focus on the difficulty of auditing them. This research argues that the Supreme Court should prefer to review decisions of which it is suspicious, such as decisions made by courts it sees as biased and decisions with which it believes it is likely to disagree.

A small set of models conceptualizes the judicial hierarchy as a team (Cameron and Kornhauser 2005) trying to resolve cases correctly, but these focus on learning about individual cases, rather than the doctrines that are the primary object of Supreme Court work.
With few exceptions (e.g. Cameron 1993, McNollgast 1995, Lax 2003), models of the judicial hierarchy are dyadic—the Supreme Court supervises only one lower court.

But as an empirical matter, the Supreme Court is rarely if ever engaged in a dyadic interaction with one lower court about one case. It is exceedingly rare that the Supreme Court will grant certiorari unless the case is of broader import. A growing body of literature acknowledges that, in reality, the Supreme Court supervises multiple lower courts simultaneously (Lindquist, Haire and Songer 2007) and learns from them. Most Supreme Court opinions cite at least one Courts of Appeals opinion other than the case being reviewed (George and Berger 2005). Repeated experimentation in lower courts is known to aid law creation (Clark and Kastellec 2013), and the Supreme Court allows new legal questions to percolate in the lower courts before resolving them (Klein 2002). Importantly, decisions informing the Supreme Court are often in conflict with one another, which the Supreme Court uses to its advantage. The Rules of the Supreme Court of the United States mention conflict in the lower courts as a reason to consider granting certiorari, and indeed, conflict is an excellent predictor of review (Estreicher and Sexton 1984, Caldeira and Wright 1988).

The Supreme Court also seems to adopt doctrine developed in the lower courts. When lower courts are in disagreement, the Supreme Court generally decides in favor of the side that more circuits agree with (Klein and Hume 2003, Lindquist and Klein 2006). Lower courts’ citation practices inform the Supreme Court about how doctrines have been interpreted (?) and language from lower courts’ opinions often finds its way into the opinions of the Supreme Court (Corley, Collins and Calvin 2011). Clark and Carrubba (2012) and Carrubba and Clark (2012) argue that because doctrine is costly to produce, the Supreme Court adopts and disseminates rules developed in lower courts. But this scholarship focuses exclusively

\[ \text{Gewirtzman (2012) provides an exceptionally comprehensive review of the literature on the hierarchy as a learning institution.} \]
on the relationship between the Supreme Court and lower courts, whereas this relationship is in fact mediated through litigants. An important feature of American jurisprudence is that a lower court judge, however he may want to defend his decision, does not have a voice upon review. Instead, the Supreme Court’s information is provided primarily by litigants. During oral argument, for example, lawyers’ arguments may influence the justices’ decisions (Johnson, Wahlbeck and Spriggs 2006).

Therefore, a number of questions remain about how the Supreme Court can use the lower courts to its advantage in doctrinal development. For example, it is clear the Supreme Court uses lower court conflict as a cue to review a legal question. For almost every year since 1987, the reason given most often for granting certiorari has been to resolve federal court conflict. The Court allows conflicts to percolate before stepping in to resolve them. Is it sufficient to review a case from one side of the conflict, or is it more beneficial to review both? That is, when should the Court consolidate cases for review? If the Court does review just one case, is one more informative than another? Are there characteristics of “good vehicles” for developing doctrine? When, if ever, should the Court hold petitions for certiorari, to allow itself the opportunity to review earlier lower court cases, that might already have influenced future decisions? Answering these questions requires a theory that acknowledges the Supreme Court supervises many lower courts simultaneously—an acknowledgment that is rare in both theoretical and empirical literature on the judicial hierarchy (though see, for example, Lindquist and Klein 2006).

This paper builds on these findings to understand how they interact and to answer some of these remaining questions. In the model, the Supreme Court aggregates lower court decisions to learn which case to review, then what decision to make upon review. The Court learns both directly from lower courts’ decisions and from lawyers’ arguments and evidence. In so doing, the paper speaks to scholarship on strategic communication in hierarchical organizations in
general, and to long-standing literatures on the judicial hierarchy in specific. I explore the effects on the informational environment of allowing lower courts to learn from one another’s decisions and allowing the Supreme Court to consolidate cases for review.

3 The model

The model (based on the architecture of that in Dewatripont and Tirole (1999)) consists of a unitary Supreme Court that supervises two unitary lower courts, \( LC_I \) and \( LC_{II} \). I refer to the lower courts as “judges” and occasionally refer to a lower court judge as “he.” I refer to the Supreme Court as “it.”

The goal is to choose one of three doctrines—\( A \), \( M \), or \( B \)—to apply. Each of the three courts wishes to choose the best doctrine to fit a new legal question. For example, when police conduct warrantless searches in motorhomes, the courts must decide whether the appropriate doctrine comes from searches of houses or searches of cars (see California v. Carney and Friedman (2006)). In such cases, the justices seek to learn facts about the world that make one doctrine or another more applicable. Often, these are best understood as social-scientific facts. For example, in the case of the motorhome search, the justices sought to understand how owners relate to their motorhomes, referencing Motor Home and RV Lifestyle magazines and studying the motorhome’s interior for signs that it functioned as a living space (California v. Carney, Justice Stevens, dissenting.) These represent existing doctrines or approaches, which might be thought of as liberal, moderate, and conservative policies, respectively. The Court is extending these by deciding which is most applicable for a new fact pattern. An example of this is sex discrimination law, in which judges struggled with the choice between rational basis review and strict scrutiny and ultimately created the doctrine of intermediate scrutiny.\(^3\)

\(^2\)Of course, most cases at the Courts of Appeals are simple applications of existing law; this model focuses on the subset of difficult, law-creating cases, either “gap filling” or cases of first impression in which multiple
Judges prefer the doctrine that best suits the state of the world, but because the area of law is relatively new, they do not know which one that is. I assume that there are two unknown state variables, \( \theta_A \) and \( \theta_B \), that together determine the state of the world. Payoffs to the courts depend on the conjunction of both variables and the choice of doctrine. A sufficient summary of the state is \( \theta = \theta_A + \theta_B \). It is common knowledge that:

\[
\begin{align*}
\theta_A &= \begin{cases} 
0 & \text{with prob. } 1 - \alpha \\
-1 & \text{with prob. } \alpha 
\end{cases} \\
\theta_B &= \begin{cases} 
0 & \text{with prob. } 1 - \alpha \\
1 & \text{with prob. } \alpha 
\end{cases}
\]

Thus

\[
\theta = \begin{cases} 
-1 & \text{with prob. } \alpha(1 - \alpha) \\
0 & \text{with prob. } 1 - 2\alpha + 2\alpha^2 \\
1 & \text{with prob. } \alpha(1 - \alpha) 
\end{cases}
\]

For every state of the world there is an associated doctrine: \( A \) if \( \theta = -1 \), \( M \) if \( \theta = 0 \), and \( B \) if \( \theta = 1 \).

In the model, the two lower courts hear lawyers’ arguments for both sides of the dispute, then decide their cases. The Supreme Court observes the decisions the lower courts make, but not the arguments that led to those decisions. Even so, it can draw simple inferences about those arguments from the judges’ choices.

In particular, the justices can distinguish when a lower court judge has made a moderate decision and when his decision is immoderate. The justices can also make reasonably strong deductions about the arguments that led to each. In some instances, it is obvious what arguments must have been presented—an unbiased judge only makes an extreme decision if one party’s evidence was much stronger than the other’s. Other decisions are ambiguous—moderate decisions can arise either because strong arguments were presented for both liberal and conservative positions or because both sides’ arguments were weak. This allows the doctrines could plausibly be applied.
Supreme Court to make an informed choice about which case to review, whereupon the Supreme Court will learn what arguments were presented in that case. The Supreme Court can let the lower courts’ decisions stand, or it can choose to review one of the lower courts’ decisions, at some cost, before announcing the final doctrine. Reviewing the ambiguous case will always be more informative; therefore, the ambiguous decision is more likely to be reviewed. After review, some information allows the Supreme Court to make dispositive rulings while other information is only suggestive. As a result, the Supreme Court may either reverse or affirm after review. The sections that follow present equilibria describing what choices lower court judges make, which cases the Supreme Court reviews, and what the Supreme Court does upon review.

The game proceeds as follows. First, lawyers present evidence to the lower courts about the value of $\theta$. Each lower court then makes a decision based on the evidence he sees. The Supreme Court sees the lower court judges’ decisions, but does not see the evidence that led to those decisions. It uses this information to update its beliefs about $\theta$ and decide whether, and which, case to review. (The Supreme Court can review at most one case.) If the Supreme Court reviews, it learns the arguments that lower court heard, then makes its decision—whether to affirm or reverse the decision it reviewed and which doctrine to choose. I discuss each of these steps in detail below; the game is summarized in Figure 1.

### 3.1 Decision making in the lower courts

Simultaneously, the lower courts each hear a case. Both cases depend on the value of $\theta$, which is common across both courts. The judges wish to learn about $\theta$, which in turns means they wish to learn about $\theta_A$ and $\theta_B$. Two lawyers—one in each lower court—search for evidence about $\theta_A$.³ Their searches are independent. The same is true for $\theta_B$: two lawyers,

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³I discuss the game as if lawyers are presenting evidence to the lower court, but abstract away from strategic advocacy by the lawyers—I assume that incentives are such that a lawyer presents any evidence he finds and assume lawyers cannot fabricate evidence, so lawyers’ messages are always truthful. The incentives
one in each lower court, independently search for evidence. Each lawyer then privately presents the results of his search to his judge. \( m_A \) denotes the messages of the lawyers for \( \theta_A \); \( m_B \) denotes the messages of the lawyers for \( \theta_B \). Each message takes on one of two values: for \( i \in \{A, B\} \) a lawyer either finds and presents hard evidence \( |m_i| = 1 \) to the judge, or does not find any conclusive evidence and so presents \( m_i = 0 \). As in Che and Kartik (2009), evidence “could take the form of scientific evidence obtainable by conducting an experiment, witnesses or documents locatable by investigation, a mathematical proof, or a convincing insight that can reveal something about the state.” Legally, they are legislative facts (which are often solved by expertise and may pertain to many cases), as opposed to adjudicative facts (which pertain to a particular party) (Davis 1942).

that maintain this condition are the focus of Dewatripont and Tirole (1999). From their results it is possible to deduce that promising the lawyers sufficiently high wages can always satisfy this condition, so long as the lawyers care only about winning their own case.

Figure 1: Play of game
If $\theta_i = 0$, both lawyers are unable to find any hard evidence and send messages $m_i = 0$. If $|\theta_i| = 1$, each lawyer finds hard evidence of this with probability $q$. When he finds evidence that $|\theta_i| = 1$, a lawyer sends message $|m_i| = 1$. Even if $|\theta_i| = 1$, however, a lawyer may fail to find evidence of this fact. This happens with probability $1 - q$. In this instance, the lawyer sends message $m_i = 0$ even though $|\theta_i| = 1$. Therefore, when a lawyer for $\theta_A$ presents no hard evidence, this merely suggests $\theta_A = 0$, as it is also possible that $\theta_A = -1$ but the lawyer did not find the evidence. In contrast, a message of $m_A = -1$ proves $\theta_A = -1$. Thus, presenting evidence perfectly reveals the state of the world, but failing to present evidence is merely suggestive. Notice also that if $\theta_i = 0$ both lawyers will send $m_i = 0$, but if $|\theta_i| = 1$ the lawyers may send different messages if one’s search is successful and the other’s is not.

However, each lower court judge observes only his own lawyers’ messages—he cannot learn what the other lower court did or what messages the other lower court received.

Thus, a lower court judge observes one of four possible message pairs—$(0,0)$, $(0,1)$, $(-1,0)$, or $(-1,1)$. After observing one of these pairs, each judge makes an inference about the value of $\theta$, which incorporates the primitive probability that $|\theta_i| = 1$, $\alpha$; and the conditional probability that a lawyer’s search is successful, $q$. After establishing a posterior belief about the value of $\theta$, each lower court judge makes a decision, $A$, $M$, or $B$, to correspond to his belief.

### 3.2 Learning and decision making at the Supreme Court

Both cases are then automatically appealed to the Supreme Court. The Supreme Court can review either one of the lower courts’ decisions, or neither, but not both.\footnote{In practice, the Supreme Court may consolidate cases and hear them together. I ignore this option to maintain a focus on the Supreme Court’s choices when it does not have the resources to read every lower court’s opinion on a particular question. Proposition 3 relaxes this assumption and considers the conditions under which the Supreme Court will choose to consolidate cases for review.} The Supreme Court sees both lower courts’ rulings but does not directly observe the evidence the judges
saw. In terms of verisimilitude, this is a reasonable stylization of the appeals process: lower courts’ rulings are presented in the briefs petitioning for review, while lawyers’ arguments are only submitted if the Supreme Court chooses to review the case. Cert petitions occasionally contain previews of the lawyers’ arguments on the merits, but are generally not sufficiently fleshed out for the Supreme Court to determine whether they are valid—this investigation occurs upon review, in reading briefs, hearing oral argument, and deliberating.

After seeing the lower courts’ rulings, the Supreme Court updates its beliefs about $\theta$ and decides whether to review either of the lower courts’ decisions. If the Supreme Court chooses not to review a case, the lower courts’ decisions stand and the game ends. If the Supreme Court does choose to review a case it learns the messages that judge saw, but it must also pay a cost of review $c$. This parameter encompasses the opportunity cost of reviewing said case (instead of a case on a different matter) and the time and resources expended reading briefs and hearing arguments. Once the Supreme Court has heard the arguments presented in that case, it uses this information to further update its beliefs about $\theta$. (Note that the messages are preserved perfectly between the Courts of Appeals stage and the Supreme Court stage; there is no additional information collection between the stages.) Based on its estimates of $\theta$, the Supreme Court then chooses a disposition and a doctrine. The disposition, to reverse or affirm, pertains only to the case it is reviewing. The doctrine, $A$, $M$, or $B$, is a universally binding precedent that can effectively reverse or affirm the decision not reviewed. Like the lower court judges, the Supreme Court chooses the doctrine that matches its beliefs about $\theta$. Its decision to reverse or affirm the lower court’s ruling follows immediately from this doctrinal choice—it affirms their decision if it agrees based on its own estimate of $\theta$. Of course, the Supreme Court’s estimate of $\theta$ may be different from the lower court’s estimate, for although neither can see the arguments presented in the unreviewed lower court, the Supreme Court’s beliefs are also based on the additional
information provided by the unreviewed lower court’s decision, which the reviewed lower court cannot see.

### 3.3 Preferences and beliefs

Before the game begins, each judge believes $p r(\theta_A = -1) = p r(\theta_B = 1) = \alpha$, and believes that if $|\theta_i| = 1$ a search is successful with probability $q$, that is,

$$p r(m_A = -1|\theta_A = -1) = p r(m_B = 1|\theta_B = 1) = q.$$  

After seeing messages from the lawyers, a lower court judge is able to update his beliefs about $\theta$. Lower court judges update their beliefs based only on their own advocates’ messages. Thus, after hearing arguments, $LC_I$’s beliefs about $\theta$ are a function of $(\alpha, q, m_{AI}, m_{BI})$ and $LC_{II}$’s beliefs about $\theta$ are a function of $(\alpha, q, m_{AII}, m_{BII})$. The Supreme Court is able to update its beliefs about $\theta$ based on both lower courts’ decisions. After seeing the lower courts’ decisions, the Supreme Court’s beliefs about $\theta$ are a function of $\alpha$, $q$, and the lower courts’ decisions. If the Supreme Court chooses to review one of the lower courts’ decisions, it learns the evidence that lower court received. This allows it to update its beliefs again. If it reviews $LC_I$, the Supreme Court’s beliefs are a function of $(\alpha, q, m_{AI}, m_{BI})$ and $LC_{II}$’s decision; if it reviews $LC_{II}$, its beliefs are a function of $(\alpha, q, m_{AII}, m_{BII})$ and $LC_I$’s decision.

<table>
<thead>
<tr>
<th>$\theta$</th>
<th>Unbiased</th>
<th>Biased</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-1   0   1</td>
<td>-1 0 1</td>
</tr>
<tr>
<td>B</td>
<td>-1   -L  0</td>
<td>-1 -L</td>
</tr>
<tr>
<td>M</td>
<td>-L -L 0</td>
<td>-L 0</td>
</tr>
</tbody>
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Table 1: Judges’ preferences over doctrine, conditional on the state of the world $\theta$. All judges get 0 from choosing the right doctrine. Mistakes cost $-1$ or $-L$, where $0 < L < 1$. **Left panel:** Unbiased judges lose more utility from large mistakes than small ones, but have symmetric preferences otherwise. **Right:** For judges biased against $B$, wrongly choosing $B$ is more costly than wrongly choosing $A$.  

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All judges agree on the best doctrine when they know the value of \( \theta \) with certainty—\( A \) when \( \theta = -1 \), \( M \) when \( \theta = 0 \), and \( B \) when \( \theta = 1 \). But judges may differ in their views of the costs for certain types of mistakes, so when there is uncertainty about the value of \( \theta \) they may disagree about which doctrine to choose. Consider a suit brought by an injured car owner against the manufacturer, where the judge must decide if the manufacturer’s safety efforts met a standard of care. If the manufacturer is indeed liable for an injury that he should have prevented, all judges agree he should be penalized. But the judges might disagree as to the best outcome if there is uncertainty about whether he is liable: some may believe the manufacturer should not be overburdened with requirements based on inconclusive claims of liability, while others might believe that protecting consumers should take precedence. This is formalized by letting some judges suffer more from choosing \( A \) than \( B \) when the correct decision is \( M \). Furthermore, under certain conditions, a judge’s fear under uncertainty can be so extreme that one lawyer could never provide enough evidence to convince him to choose a particular result. For example, a judge biased in favor of consumers might only be willing to choose a low standard of care if all evidence suggests manufacturers are never liable, so that one lawyer could never present enough evidence in one case to convince him of such.

Because all judges agree what they should do if the facts are clear, a judge who chooses the doctrine that corresponds to the state of the world always gets utility 0. If the doctrine he chooses is wrong, he incurs some cost; these costs vary across judges and doctrines. The panels of Table 1 show different arrangements of these costs. Consider the lefthand panel. In that panel, a judge loses 1 if he chooses \( A \) when \( \theta = 1 \) or \( B \) when \( \theta = -1 \). This is a bad mistake, where there is a large mismatch between doctrine and the state of the world. If he makes a smaller mistake—choosing \( A \) or \( B \) when \( \theta = 0 \), or \( M \) when \( \theta = -1 \) or 1—the judge loses \( L \), where \( 0 < L < 1 \). Thus, if a judge chooses doctrine \( M \), for example, his expected utility is \(-L \cdot pr(\theta = -1) - L \cdot pr(\theta = 1)\). In the righthand panel, the judge is wary of
choosing doctrine $B$. This is formalized by making a small mistake as costly as a large one, so that choosing $B$ when $\theta = 0$ costs 1. But choosing $A$ when $\theta = 0$ still costs this judge only $L$. This imbalance captures judicial bias—the judge is willing to choose doctrine $A$, even if it might be the wrong doctrine, but he is less willing to choose doctrine $B$, even if it might be the right doctrine. Notice this bias pushes a judge toward moderation—rather than leading lower court judges to choose $B$ when evidence suggests they choose $M$, this operationalization makes biased judges unwilling to risk movements away from moderate doctrine. Such a conception might mean that a biased judge fears a slippery slope, or that a liberal judge is unwilling to extend conservative doctrine in a case that is plausibly distinguished from conservative precedent.

Finally, note that each judge’s utility is affected only by his ruling and the true state of the world, not the rulings of others. Lower court judges care only about resolving the dispute correctly based on the evidence they see, without concern for future doctrine or response from the Supreme Court.\footnote{I choose to assume lower court judges do not fear reversal for two reasons. First, even if Courts of Appeals judges fear reversal, this is not likely to come into play in cases of first impression. Second, the assumption highlights the challenge of learning from agents who are purely self-interested. See \textit{Klein and Hume} (2003).}

\section{Optimally learning from agents’ decisions}

As a baseline, I begin by considering lower courts whose preferences are identical to one another and to the Supreme Court. Presented with the same information, every judge in this version of the game would make the same decision. The equilibrium from this game is presented in Section 4.1. I then consider a scenario where the Supreme Court supervises one ideological ally and one judge who is biased. Section 4.2 presents the equilibrium under these conditions. Section 4.3 then considers how the informational environment changes when lower courts can learn from one another’s decisions. All proofs appear in the appendix.
4.1 Supervising two unbiased judges

Lower court judges attempt to resolve cases based on the evidence lawyers present. A lower court judge learns the probability of each state, \( \theta \in \{-1, 0, 1\} \), from the lawyers’ arguments. Recall that before he sees the results of the lawyers’ searches for evidence, the judge’s prior beliefs are \( Pr(\theta_A = -1) = Pr(\theta_B = 1) = \alpha \). Suppose a lawyer’s search is unsuccessful, so the judge receives a message \( m_i = 0 \). Define the judge’s posterior belief \( pr(\theta_A = -1|m_A = 0) \equiv \hat{\alpha} = \frac{\alpha - \alpha q}{1 - \alpha q} \) (and likewise \( pr(\theta_B = 1|m_B = 0) \equiv \hat{\alpha} \). This posterior belief encapsulates the chances that \( |\theta_i| = 1 \) and the lawyer was simply unsuccessful in proving this.

I restrict \( \hat{\alpha} < 1/2 \), which ensures that after observing \( m_i = 0 \), the lower court judge is more inclined to believe that \( \theta_i = 0 \) than \( |\theta_i| = 1 \). Then, if a lower court judge receives a message pair of \((-1, 0)\), he believes it is more likely that \( \theta = -1 \) than that \( \theta = 0 \). (Since he knows \( \theta = \theta_A + \theta_B \), \( \theta_A = -1 \), and \( \theta_B \in \{0, 1\} \), he knows \( \theta \neq 1 \).) In other words, after seeing \((-1, 0)\) he believes it is more likely that \( A \) is the best doctrine than that \( M \) is. But he is not sure—it is possible that \( \theta_B = 1 \) and the lawyer failed to find evidence of this, in which case \( \theta = 0 \) and \( M \) is the best doctrine.

A lower court judge suffers equal utility loss if he chooses \( A \) when he should have chosen \( M \) or if he chooses \( M \) when he should have chosen \( A \) (and likewise for \( B \)). As a result, after hearing arguments, the lower court judge decides which state is most likely given the probabilities described above, and chooses the associated doctrine. Messages \((-1, 0)\) and \( \hat{\alpha} < 1/2 \) imply \( \theta = -1 \) is most likely; therefore a judge who sees \((-1, 0)\) will choose \( A \). The same is true for \((0, 1)\)—this will lead the lower court judge to choose \( B \). If he receives a message pair of \((-1, 1)\), a lower court judge will choose doctrine \( M \), for he knows \( \theta = 0 \) with certainty. If the lower court judge receives a message pair of \((0, 0)\), there is still a
strictly positive probability on all values of $\theta$. If the lower court judge chooses $A$ and $\theta = 1$, he will experience a large loss in utility. Likewise, it will be very costly to choose $B$ if it happens that $\theta = -1$. Choosing $M$ guarantees the lower court will not incur too large a loss, no matter what the value of $\theta$ is. After $(0, 0)$, therefore, the lower court judge will choose doctrine $M$. To summarize, the lower court judge will choose $A$ if and only if he receives messages $(-1, 0)$. Likewise, he will choose $B$ if and only if he receives messages $(0, 1)$. But he will choose $M$ after either $(0, 0)$ or $(-1, 1)$.

This leads to the first stage of Supreme Court inference. If lower courts are behaving optimally, then sometimes the Supreme Court can perfectly infer what messages a judge must have received without reviewing the case. This occurs after a lower court reaches a decision of $A$, in which case the Supreme Court can be sure that lower court must have received messages $(-1, 0)$, or after a lower court makes a decision of $B$, in which case the Supreme Court can be sure that judge received messages $(0, 1)$. On the other hand, when the Supreme Court observes a decision of $M$, it does not know if it was reached because of messages $(0, 0)$ or $(-1, 1)$. This uncertainty is the primary driving force behind the results that follow: the Supreme Court can only learn the messages prompting a ruling of $M$ by paying a cost, $c$, to review the case. Although the Supreme Court does not directly observe the lawyers’ messages, it has an advantage that the lower courts do not: it sees the results of two cases, and can make an informed decision about whether it is worthwhile to review a case, and if so, which one.

When both lower courts issue the same ruling, $A$, $B$, or $M$, there is nothing to gain from review. Any of these decisions could be wrong, but upon review the Supreme Court cannot learn enough to want to change the lower courts’ decisions. If the courts both decide $A$ or $B$, the Supreme Court can perfectly infer the messages they received, and because it shares the same beliefs and preferences as the lower courts, it would rule the same way. If both lower
courts decide $M$, review will be informative—it will change the Supreme Court’s beliefs about $\theta$—but it will never be outcome-consequential, as the Supreme Court will always choose $M$. If the Supreme Court observes one lower court choose $A$ and the other choose $B$, the Supreme Court concludes with certainty that $\theta = 0$ without reviewing either case—but it still must pay $c$ in order to communicate this to the lower courts. Since either case is an equally good vehicle, it randomly chooses one to review. It reverses the decision and announces a doctrine of $M$. If one court rules either $A$ or $B$ while the other court rules $M$, the Supreme Court could learn valuable information by reviewing the case that generated the ruling of $M$. Suppose $LC_I$ has made a decision of $A$ and $LC_{II}$ has made a decision of $M$. Under these conditions, the Supreme Court can perfectly infer the messages that $LC_I$ saw—they must have been $(-1,0)$. Based only on the fact that $LC_I$ chose $A$, the Supreme Court knows for sure that $\theta_A = -1$ and is slightly more confident that $\theta_B = 0$ than before. It uses this information to make an inference about the messages $LC_{II}$ saw, knowing it is more likely that $LC_{II}$ received evidence that $\theta_A = -1$ and less likely that $LC_{II}$ received evidence that $\theta_B = 1$. Then the Supreme Court decides whether to pay $c$ to review $LC_{II}$’s decision. If it discovers $LC_{II}$’s decision was generated by messages of $(-1,1)$, the Supreme Court learns with certainty that a decision of $M$ is correct. If $LC_{II}$’s decision was generated by messages of $(0,0)$ the Supreme Court is much more inclined to believe the appropriate doctrine is $A$ than $M$, but it still does not know this with certainty and so finds it less beneficial to reverse the decision than otherwise. It will review $LC_{II}$’s decision if either the probability of learning $(-1,1)$, or the costs from an incorrect decision, are sufficiently high. These beliefs and actions describe the equilibrium in the game with homogeneous agents.

**Proposition 1 (Equilibrium with homogeneous agents)** In the game with homogeneous agents, the following occurs in the unique equilibrium. Each lower court chooses:
A iff he receives messages \((-1, 0)\)

B iff he receives messages \((0, 1)\)

\(\begin{array}{l}
M \text{ if he receives messages } (0, 0) \text{ or } (-1, 1) \\
\end{array}\)

After seeing the lower courts’ decisions, the Supreme Court does the following.

- **If the lower courts chose** \((A, A)\), \((B, B)\), or \((M, M)\), the Supreme Court does not review a case.

- **If the lower courts chose** \((A, M)\), the Supreme Court reviews LC\(_{11}\) if

\[ c < L \left[ 1 - 2 \frac{\alpha(1 - q)^2}{1 - 2q\alpha + 2q^2\alpha} \right] \]

otherwise it does not review either case.

  - If it discovers \(M\) was generated by messages \((-1, 1)\), it determines \(\theta = 0\), affirms the decision of \(M\), and issues universal precedent \(M\).
  
  - If it discovers \(M\) was generated by \((0, 0)\), it believes \(\theta = -1\) with \(p > 1/2\), reverses the decision of \(M\), and issues universal precedent \(A\).
  
  - Parallel equilibrium strategies hold for \((M, A)\) \((B, M)\), and \((M, B)\).

- **If the lower courts chose** \((A, B)\) or \((B, A)\), the Supreme Court determines \(\theta = 0\). If \(c < 2L\), it reviews a case (either case), reverses the decision, and issues universal precedent \(M\).

The most notable result in this equilibrium is the tendency to review ambiguous decisions. Given that the Supreme Court can afford to review only one case, it is most likely to review decisions of \(M\). When costs are low and one lower court has made a decision of \(M\) while the other has not, the Supreme Court is more likely to review the \(M\) decision than the other. When costs are low, a decision of \(M\) is always reviewed unless both lower courts reach a decision of \(M\). This is because reviewing a decision of \(M\) is always informative, and outcome-consequential unless both lower courts make that decision. (Recall that reviewing after both lower courts choose \(M\) may improve the Supreme Court’s certainty in its decision, but will still always lead it to choose doctrine \(M\).) In contrast, a decision of \(A\) is never informative.
to review. Thus, decisions of A are only reviewed if the other lower court makes a decision of B; even then, the Supreme Court may choose to review the other case.

As the cost of review rises, though, decisions of M become less likely to be reviewed. This is because observing simultaneous decisions of A and B guarantees maximum utility upon review, while reviewing a decision of M is less beneficial in expectation. Thus, when costs are moderately high, the Supreme Court is more likely to review extreme conflict (where one lower court chooses A and the other chooses B) than moderate conflict (where one lower court chooses M and the other does not). This is consistent with Black and Owens (2009), who find that the Supreme Court is particularly likely to review extreme conflicts. Furthermore, here the Supreme Court never reviews unless there is conflict.

Finally, even though all judges are identical, the Supreme Court reviews and reverses lower courts’ decisions. In fact, if costs are moderate, so that the Supreme Court is willing to review decisions of (A, B) but not when one lower court has decided M, all of the Supreme Court’s decisions will be reversals, even though the lower courts are perfectly faithful agents.

4.2 Bias in the lower courts

To understand how ideological bias affects learning, consider a scenario in which the Supreme Court is supervising one lower court who shares its unbiased ideological preferences (LC1) and one lower court who is biased against outcome B (LCII). LCII prefers to choose B if θ = 1, but if θ = 0 he incurs a large loss from choosing B. LCII will therefore only choose B if he is very sure θ = 1. To consider the full effects of this bias, I put an additional condition on $\hat{\alpha}$ so that after seeing (0, 1) LCII is not sure enough that θ = 1 to be willing to choose B. This condition is $L < \frac{\hat{\alpha}}{1-\hat{\alpha}}$. Because of this assumption, LCII’s loss from a ruling of B when θ = 0 is larger than that from a ruling of M when θ = 1. Thus, LCII chooses M

\[\text{It would also be sufficient to increase the loss from choosing B when } \theta = 0 \text{ to an amount greater than 1. I choose to manipulate } \hat{\alpha} \text{ instead for algebraic simplicity.}\]
after seeing \((0, 1)\).

\(LC_{II}\)'s bias means the Supreme Court cannot learn as much about \(\theta\) before deciding whether to review. Now, the only time the Supreme Court chooses not to intervene is when both lower courts decide \(A\). In every other situation, the Supreme Court will review one of the lower courts’ decisions, as long as its cost of review is sufficiently low.

**Proposition 2 (Equilibrium with Heterogeneous Agents)** In the game with heterogeneous agents and a biased lower court, the following occurs in the unique equilibrium.

**Lower Court I chooses:**
\[
\begin{align*}
A & \text{ iff he receives messages } (-1, 0) \\
B & \text{ iff he receives messages } (0, 1) \\
M & \text{ iff he receives messages } (0, 0) \text{ or } (-1, 1)
\end{align*}
\]

**Lower Court II chooses:**
\[
\begin{align*}
A & \text{ iff he receives messages } (-1, 0) \\
M & \text{ iff he receives messages } (0, 1), (0, 0) \text{ or } (-1, 1)
\end{align*}
\]

After seeing the lower courts’ decisions, the Supreme Court does the following.

- **If the lower courts chose \((A, A)\), the Supreme Court does not review a case.**

- **If the lower courts chose \((A, M)\), then the Supreme Court reviews \(LC_{II}\) if**
\[
c < L[1 - 2 \frac{\alpha(1-q)^2}{(1-\alpha)(1-q)^2 + \alpha(1-q)^2 + \alpha q(1-q) + \alpha q^2}],
\]
otherwise it does not review a case. If it reviews and discovers \(M\) was generated by messages
  - \((0, 0)\), then the Supreme Court reverses \(LC_{II}\)'s decision and issues doctrine \(A\).
  - \((-1, 1)\), then the Supreme Court affirms \(LC_{II}\)'s decision and issues doctrine \(M\).
  - \((0, 1)\), then the Supreme Court affirms \(LC_{II}\)'s decision and issues doctrine \(M\).

- **If the lower courts chose \((M, A)\), then the Supreme Court reviews \(LC_I\) if**
\[
c < L \left[1 - 2 \frac{\alpha(1-q)^2}{1 - 2q\alpha + 2q^2\alpha}\right],
\]
otherwise it does not review a case. If it reviews and discovers \(M\) was generated by messages
  - \((-1, 1)\), then the Supreme Court affirms \(LC_I\)'s decision and issues doctrine \(M\).
  - \((0, 0)\), then the Supreme Court reverses \(LC_I\)'s decision and issues doctrine \(A\).
• If the lower courts chose \((M, M)\), then the Supreme Court reviews \(LC_{II}\) if \(\alpha < 2q(1-q)\) and \(c < c^*(L, \alpha, q)\), otherwise it does not review a case. If it reviews and discovers \(M\) was generated by messages

- \((0, 0)\) or \((-1, 1)\), then it affirms the decision and issues doctrine \(M\).
- \((0, 1)\), then it reverses \(LC_{II}'s\) decision and issues doctrine \(B\).

• If the lower courts chose \((B, A)\) then the Supreme Court takes either case if \(c < 2L\), reverses the decision, and issues doctrine \(M\). If \(c \geq 2L\), it does not review.

• If the lower courts chose \((B, M)\) then the Supreme Court reviews \(LC_{II}\) if

\[
c < L - 2L \frac{\alpha(1-q)^2}{1 - \alpha + \alpha(1-q)(1-q + q^2)},
\]

otherwise it does not review a case. If it reviews and discovers \(M\) was generated by messages

- \((0, 0)\), then the Supreme Court reverses \(LC_{II}\) and issues doctrine \(B\).
- \((-1, 1)\), then the Supreme Court affirms \(LC_{II}\) and issues doctrine \(M\).
- \((0, 1)\), then the Supreme Court reverses \(LC_{II}\) and issues doctrine \(B\).

This equilibrium differs from the equilibrium with two homogeneous, unbiased courts in two important ways. First, the probability of review is higher with a biased lower court than without. When one court is biased, the Supreme Court grants \textit{certiorari} in all cases it would review under homogeneity as well as in additional cases. Under ideological homogeneity, the Supreme Court grants \textit{certiorari} only if there is conflict in the lower courts. Even though the Supreme Court would learn the fact pattern that led to one of the courts’ choices, review without conflict would never be outcome-consequential. With a biased lower court, however, the Supreme Court \textit{does} review after the courts reach the same conclusion. This is because the lower courts might reach the same conclusion for different reasons, and that possibility merits the Supreme Court’s attention.

Most of this additional review falls on the biased agent, who now chooses \(M\) and earns review when his messages are \((0, 1)\). As a result, the Supreme Court is more likely to review

\footnote{See proofs for formula for \(c^*\).}
the biased lower court than its ideological ally. This result is similar to previous models of the judicial hierarchy, but the result is more subtle: occasionally the Supreme Court will prefer reviewing its ideological ally to reviewing the biased lower court (such as when the lower courts make decisions \((M, A)\)). This is consistent with recent empirical findings on lower court ideology and Supreme Court review: \cite{LindquistHaireSonger2007} and \cite{Walson2011} show that while the Supreme Court reviews decisions from ideologically opposed lower courts more often than allied lower courts, it still reviews its allies at a significant rate, and \cite{ClarkCarrubba2012} show that the Supreme Court prefers to review lower courts that are moderately distant (as opposed to most distant).

Second, the probability of an affirmance is higher when one lower court is biased. Whenever the Supreme Court affirms with two unbiased lower courts, it also affirms when one lower court is biased. It affirms under additional situations because biased decisions are sometimes affirmed in equilibrium. This occurs when the unbiased lower court chooses \(A\), and the biased judge chooses \(M\) despite receiving messages which would lead an unbiased judge to choose \(B\). Together, these messages guarantee that the appropriate doctrine is \(M\). \(LC_I\)'s decision of \(A\) implies \(\theta_A = -1\), and the messages from \(LC_{II}\)'s lawyers—\((0, 1)\)—imply \(\theta_B = 1\). Thus, after seeing \((A, M)\) and reviewing \(LC_{II}\)'s decision, the Supreme Court knows \(\theta = -1 + 1 = 0\). Therefore, even though \(LC_{II}\) behaved contrary to how the Supreme Court would have wanted, the Supreme Court upholds his decision.

This ability to leverage information contained in a decision that is never reviewed has important implications for how many cases the Supreme Court has to hear. When the Supreme Court is confronted with multiple petitions for \textit{certiorari} that are closely related, it has the option of consolidating the appeals and hearing them as one case. Although this occurs frequently,\footnote{According to the Supreme Court Database, in the 2010 term, the Supreme Court issued 85 written} scant empirical and theoretical attention has been paid to when, why,
and how the decision to consolidate is made. This model provides a potential avenue for early exploration of such a question. Consider, for example, a Supreme Court that can pay $2c$ to review both decisions, or $c$ to review either one. The Supreme Court will almost never choose to review both cases. (Even if the second case cost only some small quantity $\epsilon$ to review, the Supreme Court would still not review both.)

**Proposition 3 (Case Consolidation)** *With homogeneous lower courts, the Supreme Court will never choose to consolidate cases. With heterogeneous lower courts, the Supreme Court only chooses to consolidate cases if both have made a decision of $M$.*

Recall that whenever a lower court makes a decision of $A$ or $B$, the Supreme Court cannot learn anything by reviewing the decision. Recall also that after the lower courts have made decisions ($A,B$), the Supreme Court is able to reverse and issue a doctrine of $M$ by reviewing only one lower court. Therefore, the Supreme Court has no incentive to review both cases unless both lower courts have made a decision of $M$. Notice then that when both homogeneous lower courts have made a decision of $M$, review is not outcome-consequential—the Court will continue to choose $M$ no matter what it learns. Therefore, it has no incentive to review both cases. Only when heterogeneous lower courts both make decisions of $M$ might the Supreme Court choose to review both cases. In other words, there is rarely a need for the Supreme Court to look at the arguments and evidence from all cases, even if lower courts are assumed to learn nothing from one another.

### 4.3 Learning within lower courts

While the previous results assume lower courts cannot observe one another’s decisions, in practice the Courts of Appeals may learn from each other. Under what conditions does a
peer circuit’s decision affect a lower court judge’s choice? How does this affect the Supreme Court’s informational environment?

When lower courts learn from one another, the probability of review falls considerably. The need for learning-based review falls even further. The reason is the following: the bulk of the Supreme Court’s work is supervisory. When lower courts can learn from one another, a large swath of the Supreme Court’s workload is taken over by appellate court judges. Consider, for example, a lower court who observes messages \((0,1)\) and knows a previous lower court has made a decision of \(A\). If lower courts were judging in isolation, it would fall to the Supreme Court to review one case and set a universal doctrine of \(M\). If lower courts are able to observe each other’s decisions, though, they are able to take the workload off the Supreme Court by making the decision of \(M\) themselves.

**Proposition 4** When homogeneous, unbiased lower courts can observe one another’s decisions, the following is true in the unique equilibrium:

- \(LC_1\) makes choices as he would before.

- \(LC_{11}\) makes the following decisions.

  - He decides \(A\) if \(LC_1\) has decided \(A\) and he sees evidence \(0,0\) or \(-1,0\), or if \(LC_1\) has decided \(M\) and he sees evidence \(-1,0\) and \((q^2 + 1 - q)\alpha < 1/2\).

  - He decides \(B\) if \(LC_1\) has decided \(B\) and he sees evidence \(0,0\) or \(0,1\) or if \(LC_1\) has decided \(M\) and he sees evidence \(0,1\) and \((q^2 + 1 - q)\alpha < 1/2\).

---

9For this proposition, the assumption that the Supreme Court’s loss from incorrect decisions is equal in magnitude (not only in balance) to lower courts’ loss from incorrect decisions becomes critical. This is because a lower court now has an opportunity to change its decision on the basis of a prior lower court’s ruling, so that differences in risk aversion between the Supreme Court and the Courts of Appeals can have important implications.
He decides $M$ if he receives evidence $-1,1$; if $LC_I$ has decided $A$ and he sees evidence $0,1$ or if $LC_I$ has decided $B$ and he sees evidence $-1,0$; or if $LC_I$ has decided $M$ and he sees evidence $0,0$ or $(q^2 + 1 - q)\alpha > 1/2) -1,0$ or $0,1$.

- The Supreme Court’s behavior is as follows.

- If both lower courts have decided $A$, or if both lower courts have decided $B$, or if both lower courts have decided $M$, the Supreme Court does not review.

- If the sequence of decisions was $M, A$ or $M, B$, the Supreme Court reviews the decision of $M$ if $c < L \star \left[ -2 \frac{\alpha \star (1-q)^2}{\alpha \star (1-q)^2 + \alpha \star q^2 + (1-\alpha)} + 1 \right]$.

- If the sequence of decisions was $A, M$ or $B, M$, the Supreme Court reviews either if $c < L$ and issues a binding doctrine of $M$.

Therefore, the Supreme Court reviews much less often. It reviews only decisions of $M$ in equilibrium, which are now much less ambiguous. When the decision of $M$ is preceded by a decision of $A$ or $B$, review is intended to increase uniformity (there is nothing to learn). When a decision of $M$ is succeeded by a decision of $A$ or $B$, the Supreme Court would only find it useful to review the decision of $M$.

5 Discussion and Conclusion

Law is not static. As society changes, new problems emerge, new classes of disputes arise, and doctrine must adapt to govern their resolution. This paper aims to understand the process by which the Court extends doctrine to adjudicate these new cases. In so doing, it joins the literature advancing a perspective on the judicial hierarchy as a learning organization (Kornhauser1989, Cooter, Kornhauser and Lane1979, Klein and Hume2003, Baker and Mezzetti2012, Corley, Collins and Calvin2011, Niblett2013, Carrubba et al.2012, Clark and Kastellec2013). This approach contrasts with the dominant mode of understanding the
hierarchy over the last decade—the disciplinary or hierarchical control perspective. Instead of focusing on how the Supreme Court monitors the resolution of existing disputes, this new literature focuses on understanding the process by which the Supreme Court learns how to extend, develop, and adapt existing doctrine to fit new questions. Outside of the judicial literature, hierarchy is known to encourage division of labor: the Supreme Court may specialize in answering difficult questions while relying on agents to answer easier ones (Garicano and Zandt 2013). This model, however, conceives of the Supreme Court as specializing in supervision rather than in the resolution of similar, but more difficult, questions.

The paper demonstrates that the Courts of Appeals serve as laboratories of law: the Supreme Court watches their decisions to learn how best to extend doctrine. Before establishing a rule to govern future lower courts’ decisions, the Supreme Court learns which rule will be best by considering lower courts’ decisions in previous cases. This requires analyzing multiple lower courts’ decisions in concert, using one to gain leverage on the implications of another. The Supreme Court is then able to make informed decisions about which cases to review, and upon review is able to make informed doctrinal extrapolations from the case at hand. Based on this theory, the model identifies which cases the Supreme Court will choose to review and what doctrine it will support.

The theory’s underlying premise—that lower courts’ decisions are useful for doctrinal development, but only in concert—is consistent with the U.S. Supreme Court’s own conception of its role. In the mid-1980s, justices and policymakers became concerned about the Supreme Court’s workload. The number of filings had ballooned while the number of signed opinions had remained relatively constant, resulting in an increasingly small percentage of cases being decided on the merits. In the ensuing discussions about the proper role for the Supreme Court, there grew a discussion of whether the Supreme Court should be in the business of articulating doctrine that should be self-evident to anyone who reads the balance of
evidence in the lower courts. A number of parties—including Chief Justice Warren Burger, the Hruska commission, and the Freund committee—called for the creation of various forms of an intercircuit panel that would resolve such straightforward questions. In the terms of this model, an intercircuit panel would be tasked with certifying a doctrine of $M$ after the lower courts had ruled $(A, B)$. This would leave the Supreme Court free to spend its time on the more difficult issues—deciding whether a set of decisions $(A, M)$ should imply a doctrine of $M$ or one of $A$. In other words, the notion of the Supreme Court being, by definition, an institution that learns about difficult issues, is pervasive among institutional designers and justices.

In *U.S. v. Mendoza* (464 U.S. 154), the Supreme Court unanimously held that the federal government cannot be stopped from relitigating a question of law, even if it has lost on that same issue in a previous lawsuit against a different party. Explaining the decision, Chief Justice Rehnquist wrote that “A rule allowing nonmutual collateral estoppel against the Government ... would substantially thwart the development of important questions of law by freezing the first final decision rendered on a particular legal issue. Allowing only one final adjudication would deprive this Court of the benefit it receives from permitting several courts of appeals to explore a difficult question before this Court grants certiorari.” If it were possible to collaterally estop the federal government, then failing to find evidence in favor of the government’s position in the first case would prevent any future attempts to find this information—which would severely hamper the Supreme Court’s opportunities to learn.

In its exploration of hierarchical learning, the model offers theoretical explanations for a number of stylized facts, including why the Supreme Court focuses on resolving conflicts between lower courts, why the Supreme Court is more likely to review ideologically distant lower courts, and why, despite this propensity, the Supreme Court often reviews and reverses
the decisions of its allies. Concurrently, however, the model challenges existing explanations for other empirical patterns. For example, because prior literature has focused on discipline in the hierarchy, many have understood Courts of Appeals judges’ dissenting opinions to be signals of non-compliance (Epstein, Landes and Posner (2011); Kastellec (2007); Beim, Hirsch and Kastellec (2012); though see Hettinger, Lindquist and Martinek (2004)). The learning perspective suggests dissents may also be pieces of evidence—perhaps a judge can choose to search for information and write a dissenting opinion that presents the evidence he finds.\footnote{This possibility—where ideological extremism motivates judges to search for information when their colleagues do not—is considered in Spitzer and Talley (2012). Such a model might also bear some resemblance to Gailmard and Patty (2013), in which an agent has observed the results of one search and may choose whether to investigate again.} Similarly, in the model presented here an affirmance is doctrinally useful, whereas in disciplinary models, they occur only as an accident of incomplete information. This alternative intuition might better explain the Supreme Court’s opinions affirming decisions of lower courts. Affirmances are mistakes in disciplinary models, so they can be assumed to yield short opinions without much argumentation; here they are equally effective vehicles for communicating doctrine.

Beyond the judicial application, the addition of a second lower court adds the conceptual concerns of consistency and choice of review to the learning dynamics considered in Dewatripont and Tirole (1999). By studying iterative hierarchical learning—how lower court judges learn from lawyers and how higher courts learn from lower courts’ decisions—the paper contributes to a broader literature on information-gathering and optimal experimentation in hierarchical organizations. Two extensions to the theoretical model stand out as particularly relevant for further exploration of these questions. First, what would change if the lower courts cared about the final doctrine articulated by the Supreme Court, in addition to caring about the dispositions of their own cases? Here, lower court judges’ preferences
are myopic; therefore, lower court judges resolve cases based only on the evidence they see, with no eye toward policy-making. It is interesting to consider how the model would change if lower court judges feared reversal or wished to aid the Supreme Court in its law-creation pursuits. Second, this model ends once the Supreme Court chooses a doctrine. In practice, the Supreme Court monitors the application of its chosen doctrine. Such an extension would re-introduce the disciplinary dynamics that have characterized previous work on the judicial hierarchy; as such, it could integrate established results on optimal monitoring with new results on law creation through experimentation.

References


Appendix I: Proofs

Lemma 5 Review is never advantageous after $M, M$ with homogenous lower courts.

Proof.  

After $M, M$ there are three possibilities for what evidence may have been presented: 

\[((0, 0); (0, 0)), ([0, 0); (-1, 1)], \text{ or } [(-1, 1); (-1, 1)]\). No matter which the Supreme Court ultimately reviews it will affirm.
The expected utility without review is:

\[
EU_H[\text{no review}] = -2L \cdot pr(\theta_A = -1, \theta_B = 0| M, M) - 2L \cdot pr(\theta_A = 0, \theta_B = 1| M, M) - 0 \cdot pr(\theta_A = -1, \theta_B = 1| M, M)
\]

\[
EU_H[\text{no review}] = -4L \cdot pr(\theta_A = -1, \theta_B = 0| M, M)
\]

Since lawyers never find evidence when none exists, this equals = \(-4L \cdot pr(\theta_A = -1, \theta_B = 0| 0, 0; 0) \cdot Pr(0, 0; 0|M, M) - 8L \cdot pr(\theta_A = -1, \theta_B = 0|0, 0; -1) \cdot Pr(0, 0; 0|M, M)\).

The expected utility from review is:

\[
EU_H[\text{review}] = -c + 0 \cdot pr(-1, 1|M, M) - 4L \cdot pr(0, 0; \theta_A = -1, \theta_B = 0|M, M)
\]

And these are equal.

\[\blacksquare\]

**Proof.** Ideological Homogeneity.

1. **The Lower Courts** When a lower court judge observes \((-1, 1)\) he believes \(pr(\theta = 0) = 1\). Since \(M\) maximizes utility when \(\theta = 0\), the lower court chooses it.

   When a lower court judge observes \((0, 0)\) he believes \(pr(\theta = -1) = pr(\theta = 1) = \frac{(1-q)\alpha}{1+\alpha-2q\alpha}\). He believes \(pr(\theta = 0) = \frac{1-\alpha}{1+\alpha-2q\alpha}\). Therefore, his expected utility from choosing \(A\) or \(B\) is

   \[-L \cdot \frac{\alpha(1-q)}{1+\alpha-2q\alpha} - L \cdot \frac{\alpha(1-q)}{1+\alpha-2q\alpha} - \left[-\frac{(1-q)\alpha}{1+\alpha-2q\alpha} - L \cdot \frac{1-\alpha}{1+\alpha-2q\alpha}\right]\]

   \[= -L\alpha(1-q) + \alpha(1-q) - L\alpha(1-q) + L(1-\alpha)\]

   \[= L(1-\alpha) + (1-q)(\alpha - 2L\alpha) > 0.\]

   He chooses \(M\).

   I place restrictions on \(\hat{\alpha}\) so that after observing \((-1, 0)\) the lower court judge is more inclined to believe \(\theta = -1\) than \(\theta = 0\) and after observing \((0, 1)\) the lower court judge is more inclined to believe \(\theta = 1\) than \(\theta = 0\). These conditions are \(\hat{\alpha} < 1/2\). Thus, lower courts
choose $M$ after $(0, 0)$ and $(-1, 1)$; $A$ after $(-1, 0)$, and $B$ after $(0, 1)$.

2. The Supreme Court  Given lower court judges’ strategies, the Supreme Court makes the following inferences after each observed history:

After $(A, A)$ the Supreme Court knows messages must have been $(-1, 0; -1, 0)$. It can gain no information from taking a case and so does not. The same holds for $(B, B)$.

After $(M, M)$ the Supreme Court knows messages must have been either $(0, 0; 0, 0)$ or $(-1, 1; 0, 0)$ or $(0, 0; -1, 1)$ or $(-1, 1; -1, 1)$. By taking a case it can gain utility from certainty but it will never reverse. Therefore, it will never review after seeing $(M, M)$. Table 2 shows all possible histories and the utility change from review.

<table>
<thead>
<tr>
<th>State of the world</th>
<th>Messages</th>
<th>Utility change</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta = -1$</td>
<td>$(0,0;0,0)$</td>
<td>-2L without review, -2L with review</td>
</tr>
<tr>
<td>$\theta = -1$</td>
<td>$(-1,1;0,0)$</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = -1$</td>
<td>$(-1,1;-1,1)$</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = 1$</td>
<td>$(0,0;0,0)$</td>
<td>-2L without review, -2L with review</td>
</tr>
<tr>
<td>$\theta = 1$</td>
<td>$(-1,1;0,0)$</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = 1$</td>
<td>$(-1,1;-1,1)$</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = 0 + 0$</td>
<td>$(0,0;0,0)$</td>
<td>0 without review, 0 with review</td>
</tr>
<tr>
<td>$\theta = 0 + 0$</td>
<td>$(-1,1;0,0)$</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = 0 + 0$</td>
<td>$(-1,1;-1,1)$</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>$(0,0;0,0)$</td>
<td>0 without review, 0 with review</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>$(-1,1;0,0)$</td>
<td>0 without review, 0 with review</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>$(-1,1;-1,1)$</td>
<td>0 without review, 0 with review</td>
</tr>
</tbody>
</table>

Table 2: All possible states of the world that could generate decisions $(M, M)$. The Supreme Court never gains from review.

After $(A, M)$ or $(M, A)$ or $(B, M)$ or $(M, B)$ the Supreme Court wishes to learn whether $\theta = 0$ and the message simply failed to reveal this or whether evidence suggests $|\theta| = 1$. Without review, the Supreme Court knows that one lower court’s decision is right and the other is wrong. By assumption, being wrong by choosing $M$ or by not choosing $M$ are equally costly, therefore without review the Supreme Court’s utility is $-L$. By reviewing
the decision of $M$ the Supreme Court may learn which occurred. Therefore the Supreme Court will review the decision of $M$ whenever the expected potential benefit of additional information outweighs the cost $c$ of taking the case. The Supreme Court’s expected utility change after review is as follows:

<table>
<thead>
<tr>
<th>State of the world</th>
<th>Messages</th>
<th>Utility change</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta = -1$</td>
<td>(-1,0,0,0)</td>
<td>-L without review, 0 with review</td>
</tr>
<tr>
<td>$\theta = -1$</td>
<td>(-1,0,-1,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>(-1,0,0,0)</td>
<td>-L without review, -2L with review</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>(-1,0,-1,1)</td>
<td>-L without review, 0 with review</td>
</tr>
</tbody>
</table>

Thus the Supreme Court’s utility without review is $-L$. The Supreme Court’s utility if it reviews is $-c - 2L \times Pr(\theta = -1 + 1; -1, 0; 0, 0|A, M)$. Therefore the Supreme Court will review if

$$-c - 2L \frac{\alpha^2(1-q)^3 q}{Pr(A,M)} > -L$$

$$L - 2L \frac{\alpha^2(1-q)^3 q}{Pr(A,M)} > c$$

$$c < L \left[ 1 - 2 \frac{\alpha^2(1-q)^3 q}{Pr(A,M)} \right]$$

$$c < L \left[ 1 - 2 \frac{\alpha^2(1-q)^3 q}{\alpha(1-\alpha)q(1-q) + \alpha^2 q(1-q)^3 + \alpha^2 q^2(1-q)} \right]$$

$$c < L \left[ 1 - 2 \frac{\alpha(1-q)^2}{1 - 2\alpha q + 2q^2 \alpha} \right]$$

After (A, B) the Supreme Court’s beliefs are $Pr(\theta = 0) = 1$. Its utility without review is $-2L$. Its utility upon review is $-c$. The Supreme Court reviews whenever $c < 2L$. ■

Proof. Ideological Heterogeneity.

1. The Lower Courts  

$LC_I$ behaves as the lower courts did in Ideological Homogeneity. After $LC_{II}$ sees (0,1) his expected utility from each possible decision is:

$$EU_{LC_{II}}[B] = -1 \times Pr(\theta = 0|0,1) = -\hat{\alpha}$$

$$EU_{LC_{II}}[M] = -L \times Pr(\theta = 1|0,1) = -L(1 - \hat{\alpha})$$

$$EU_{LC_{II}}[A] = -1$$
So $LC_{II}$ chooses $M$ so long as $L < \frac{\alpha}{1-\alpha}$, which I assume henceforth.$^{12}$ Thus after seeing $(0, 1)$, $LC_{II}$ chooses $M$ instead of $B$. After seeing $(-1, 0)$, he chooses $A$.

2. The Supreme Court  After observing $(A, A)$; $(B, A)$; or $(M, A)$ the Supreme Court’s beliefs and strategies are as in Ideological Homogeneity. After observing $(A, M)$; $(M, M)$; or $(B, M)$ the Supreme Court’s beliefs are different.$^{13}$

After $(A, M)$: The Supreme Court knows $\theta_A = -1$ but does not know if $\theta_B = 0$ or $= 1$. It can review $LC_{II}$ to learn this: if it observes $(0, 0)$ it updates the probability that $\theta_B = 0$; if it observes either $(-1, 1)$ or $(0, 1)$ it concludes with certainty that $\theta_B = 1$. The Supreme Court loses $L$ from each decision of $M$ with $|\theta| = 1$ and $L$ from each decision of $A$ or $B$ with $\theta = 0$. Without reviewing either case, the Supreme Court’s expected utility is:

$$-L * Pr(\theta = 0) - L * Pr(\theta = -1) - 2L * Pr(\theta = 1)$$

. Since $pr(\theta = 1|A, M) = 0$, this is equal to $-L$.

$LC_{II}$ observed either $(0, 0)$, $(-1, 1)$, or $(0, 1)$. Upon reviewing and discovering either $(-1, 1)$ or $(0, 1)$ the Supreme Court will know $\theta = 0$ with certainty and will be able to achieve utility 0 by setting doctrine $M$. If it learns $(0, 0)$, it will know $\theta_A = -1$ and will believe more strongly that $\theta_B = 0$, but will still not know this with certainty and will incur some loss from choosing $A$ despite the possibility that $\theta = 0$.

$^{12}$It would also be acceptable to increase the loss from $B$ to a loss still greater than 1. I choose to manipulate $L$ instead for algebraic simplicity.

$^{13}$After observing $(A, B)$; $(M, B)$; or $(B, B)$ beliefs are off-path; I assume that the Supreme Court believes $LC_{II}$ received messages $(0, 1)$. 

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Therefore its utility from review is 

\[-c - 2L \Pr(\theta = -1 + 1; -1, 0; 0|B, M)\].

It will review so long as

\[-c - 2L \Pr(\theta = -1 + 1; -1, 0; 0|B, M) > -L\]

\[L - 2L \Pr(\theta = -1 + 1; -1, 0; 0|B, M) > c\]

\[c < L - 2L \Pr(\theta = -1 + 1; -1, 0; 0|B, M)\]

\[c < L[1 - 2\frac{\Pr(\theta = -1 + 1; -1, 0, 0)}{\Pr(B, M)}]\]

\[c < L[1 - 2\frac{\alpha(1-q)^2}{(1-\alpha)(1-q)^2 + \alpha(1-q)^2 + \alpha q(1-q) + \alpha q^2}]\]

**After (B, M):** The Supreme Court knows \(\theta_B = 1\) but does not know whether \(\theta_A = 0\) or \(\theta_A = -1\). It can review \(LC_{II}\) to learn this: if it observes either (0, 0) or (0, 1) its posterior belief that \(\theta_A = 0\) grows stronger; if it observes (-1, 1) it concludes with certainty that \(\theta_A = -1\).

Its utility gain from reviewing is as follows:

\[
\begin{array}{|c|c|c|}
\hline
\text{State of the world} & \text{Messages} & \text{Utility change} \\
\hline
\theta = 1 & (0,1;0,0) & -L \text{ without review, 0 with review} \\
\theta = 1 & (0,1;0,1) & -L \text{ without review, 0 with review} \\
\theta = 1 & (0,1;-1,1) & \text{Cannot happen} \\
\theta = -1 + 1 & (0,1;0,0) & -L \text{ without review, -2L with review} \\
\theta = -1 + 1 & (0,1;0,1) & -L \text{ without review, -2L with review} \\
\theta = -1 + 1 & (0,1;-1,1) & -L \text{ without review, 0 with review} \\
\end{array}
\]
Therefore it will review if:

\[-L < -c - 2L \star P_r(\theta = -1 + 1; 0, 1; 0, \bar{B}, M)\]

\[-L < -c - 2L \alpha^2 (1-q)^2 q \frac{\alpha^2 (1-q)^2 q}{P_r(B, M)}\]

\[c < L - 2L \alpha (1-\alpha)(1-q)^2 q + \alpha^2 [q(1-q) + q^2 (1-q)^2] q^3(1-q)^3 + q^4 (1-q)^4\]

\[c < L - 2L \alpha (1-\alpha)(1-q)^2 q + \alpha^2 [q(1-q) + q^2 (1-q)^2] q^3(1-q)^3 + q^4 (1-q)^4\]

After (M, M): The Supreme Court puts positive probability on all values of \(\theta\). The utility change from reviewing is as follows:

<table>
<thead>
<tr>
<th>State of the world</th>
<th>Messages</th>
<th>Utility change</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\theta = -1)</td>
<td>(0,0;0,0)</td>
<td>-2L without review, -2L with review</td>
</tr>
<tr>
<td>(\theta = -1)</td>
<td>(0,0;0,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = -1)</td>
<td>(0,0;-1,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = -1)</td>
<td>(-1,1;0,0)</td>
<td>Cannot happen</td>
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<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = -1)</td>
<td>(-1,1;-1,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = 1)</td>
<td>(0,0;0,0)</td>
<td>-2L without review, -2L with review</td>
</tr>
<tr>
<td>(\theta = 1)</td>
<td>(0,0;0,1)</td>
<td>-2L without review, 0 with review</td>
</tr>
<tr>
<td>(\theta = 1)</td>
<td>(0,0;-1,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = 1)</td>
<td>(-1,1;0,0)</td>
<td>Cannot happen</td>
</tr>
<tr>
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<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = 1)</td>
<td>(-1,1;-1,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = -1 + 1)</td>
<td>(0,0;0,0)</td>
<td>0 without review, 0 with review</td>
</tr>
<tr>
<td>(\theta = -1 + 1)</td>
<td>(0,0;0,1)</td>
<td>0 without review, -2L with review</td>
</tr>
<tr>
<td>(\theta = -1 + 1)</td>
<td>(0,0;-1,1)</td>
<td>0 without review, 0 with review</td>
</tr>
<tr>
<td>(\theta = -1 + 1)</td>
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</tr>
<tr>
<td>(\theta = -1 + 1)</td>
<td>(-1,1;0,1)</td>
<td>0 without review, -2L with review</td>
</tr>
<tr>
<td>(\theta = -1 + 1)</td>
<td>(-1,1;-1,1)</td>
<td>0 without review, 0 with review</td>
</tr>
<tr>
<td>(\theta = 0 + 0)</td>
<td>(0,0;0,0)</td>
<td>0 without review, 0 with review</td>
</tr>
<tr>
<td>(\theta = 0 + 0)</td>
<td>(0,0;0,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = 0 + 0)</td>
<td>(0,0;-1,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = 0 + 0)</td>
<td>(-1,1;0,0)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = 0 + 0)</td>
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<td>Cannot happen</td>
</tr>
<tr>
<td>(\theta = 0 + 0)</td>
<td>(-1,1;-1,1)</td>
<td>Cannot happen</td>
</tr>
</tbody>
</table>

Therefore, the Supreme Court’s expected utility without review is

\[-2L \star P_r(\theta = 1; 0, 0; 0, 1|M, M) = -2L \frac{\alpha(1-\alpha)q(1-q)}{P_r(M,M)}\]

\[= -2L \frac{\alpha(1-\alpha)q(1-q)}{(1-\alpha)^2 + \alpha(1-\alpha)(1-q)^2 + \alpha^2 (1-q)^4 + q^2 (1-q)^4 + q^3 (1-q)^4 + q^4 (1-q)^4}\]
The Supreme Court’s expected utility with review is

\[ -c - 2L \frac{\alpha^2 q(1-q)^3 - \alpha^2 q^3 (1-q)}{(1-\alpha)^2 + \alpha(1-\alpha)(1-q)^2 + \alpha(1-\alpha)(1-q) + \alpha^2 [(1-q)^4 + (1-q)^3 q + 2(1-q)^2 q^2 + q^4 (1-q) + q^3]} \]

The Supreme Court will review if:

\[ -c - 2L \frac{\alpha^2 q(1-q)^3 - \alpha^2 q^3 (1-q)}{(1-\alpha)^2 + \alpha(1-\alpha)(1-q)^2 + \alpha(1-\alpha)(1-q) + \alpha^2 [(1-q)^4 + (1-q)^3 q + 2(1-q)^2 q^2 + q^4 (1-q) + q^3]} > 0 \]

\[ c < 2L \frac{\alpha q(1-q)(1-q)}{(1-\alpha)^2 + \alpha(1-\alpha)(1-q)^2 + \alpha(1-\alpha)(1-q) + \alpha^2 [(1-q)^4 + (1-q)^3 q + 2(1-q)^2 q^2 + q^4 (1-q) + q^3]} \]

Otherwise it will not review. □

**Proposition 6 (Case Consolidation)** With homogeneous lower courts, the Supreme Court will never choose to consolidate cases. With heterogeneous lower courts, the Supreme Court only chooses to consolidate cases if both have made a decision of $M$. 

**Proof.**

- With either homogeneous or heterogeneous lower courts, the following is true.

\[ Pr(-1, 0 | A) = 1. \text{ Therefore, reviewing a decision of A is never informative.} \]

\[ Pr(0, 1 | B) = 1. \text{ Therefore, reviewing a decision of B is never informative.} \]

Therefore, consolidation is never advantageous if the lower courts decide $(A, A)$; $(A, B)$, $(A, M)$, or $(B, M)$. Consolidation may only be advantageous if the lower courts both decide $M$.

- With homogeneous lower courts, there is no incentive to review after $(M, M)$ by Lemma 1.

- With heterogeneous lower courts, the following are the expected gains and losses from review after $(M, M)$:
<table>
<thead>
<tr>
<th>State of the world</th>
<th>Messages</th>
<th>Utility change</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta = -1$</td>
<td>(0,0;0,0)</td>
<td>-2L without review, -2L with review, -2L if review both</td>
</tr>
<tr>
<td>$\theta = -1$</td>
<td>(0,0;0,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = -1$</td>
<td>(0,0;-1,1)</td>
<td>Cannot happen</td>
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<td>$\theta = -1$</td>
<td>(-1,1;0,0)</td>
<td>Cannot happen</td>
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<td>$\theta = -1$</td>
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<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = -1$</td>
<td>(-1,1;-1,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = 1$</td>
<td>(0,0;0,0)</td>
<td>-2L without review, -2L with review, -2L if review both</td>
</tr>
<tr>
<td>$\theta = 1$</td>
<td>(0,0;0,1)</td>
<td>0 without review, 0 with review, 0 if review both</td>
</tr>
<tr>
<td>$\theta = 1$</td>
<td>(0,0;-1,1)</td>
<td>Cannot happen</td>
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<tr>
<td>$\theta = 1$</td>
<td>(-1,1;0,0)</td>
<td>Cannot happen</td>
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<tr>
<td>$\theta = 1$</td>
<td>(-1,1;-1,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>(0,0;0,0)</td>
<td>0 without review, 0 with review, 0 if review both</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>(0,0;0,1)</td>
<td>0 without review, -2L with review, -2L if review both</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>(0,0;-1,1)</td>
<td>0 without review, 0 with review, 0 if review both</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>(-1,1;0,0)</td>
<td>0 without review, 0 with review, 0 if review both</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>(-1,1;0,1)</td>
<td>0 without review, -2L with review, 0 if review both</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>(-1,1;-1,1)</td>
<td>0 without review, 0 with review, 0 if review both</td>
</tr>
<tr>
<td>$\theta = 0 + 0$</td>
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</tr>
<tr>
<td>$\theta = 0 + 0$</td>
<td>(0,0;0,1)</td>
<td>Cannot happen</td>
</tr>
<tr>
<td>$\theta = 0 + 0$</td>
<td>(0,0;-1,1)</td>
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<tr>
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</tr>
<tr>
<td>$\theta = 0 + 0$</td>
<td>(-1,1;-1,1)</td>
<td>Cannot happen</td>
</tr>
</tbody>
</table>

Therefore the Supreme Court will review both if

$$0 < -c_{both} + 2L \cdot pr(\theta = 1; 0, 0; 0, 1) - 2L \cdot pr(\theta = -1 + 1; 0, 0; 0, 1)$$

$$0 < -c_{both} + 2L \cdot \alpha(1 - \alpha)q(1 - q) - 2L \cdot \alpha^2q(1 - q)^3$$

$$0 < -c_{both} + 2L \cdot (\alpha(1 - \alpha)q(1 - q) - \alpha^2q(1 - q)^3)$$

$$0 < -c_{both} + 2L \cdot \alpha q(1 - q)(1 - \alpha - \alpha(1 - q)^2)$$

Learning within lower courts.

1. Lower Courts
• Since LC1’s informational environment is unchanged, its decisions are unchanged.

• If LC11 sees messages (−1, 1), it knows θ = 0 with certainty and so decides M.

If LC11 sees messages (0, 0), it follows the decision of LC1, for in expectation, LC1’s decision is the best indication of the true value of θ.

If LC11 sees messages consistent with LC1’s decision (such as (−1, 0) after a decision of A) it again follows the decision of LC1.

If LC11 sees messages directly inconsistent with LC1’s decision (such as (−1, 0) after a decision of B), it is able to conclude with certainty that θ = 0 and decides M.

If LC11 sees messages (−1, 0) and knows LC1 decided M, its expected utilities are as follows:

<table>
<thead>
<tr>
<th>State of the world</th>
<th>Messages</th>
<th>Choose A</th>
<th>Choose M</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ = −1 + 1</td>
<td>0,0;−1,0</td>
<td>-L</td>
<td>0</td>
</tr>
<tr>
<td>θ = −1 + 1</td>
<td>-1,1;−1,0</td>
<td>-L</td>
<td>0</td>
</tr>
<tr>
<td>θ = −1 + 0</td>
<td>0,0;−1,0</td>
<td>0</td>
<td>-L</td>
</tr>
<tr>
<td>θ = −1 + 0</td>
<td>-1,1;−1,0</td>
<td>Cannot happen</td>
<td>Cannot happen</td>
</tr>
</tbody>
</table>

Therefore, LC11 will choose M iff:

\[ \alpha^2 q(1 - q)[q^2 + (1 - q)^2] > \alpha(1 - \alpha)q(1 - q) \]

\[ \alpha[q^2 + (1 - q)^2] > (1 - \alpha) \]

2. Therefore, in order for a set of decisions (M, A) to have been made, it must be the case that \( \alpha[q^2 + (1 - q)^2] > (1 - \alpha) \).

3. **The Supreme Court** The following are the universe of possible sets of decisions made
by the lower courts and the Supreme Court’s responses in equilibrium.

- $(A, A)$ The Supreme Court chooses not to review either case by Lemma 1.
- $(A, M)$ The Supreme Court knows with certainty that $LC_{II}$ received messages $(-1, 1)$ and therefore knows with certainty that $\theta = 0$. The Supreme Court’s expected utility without review is $-L$. The Supreme Court’s expected utility after review is $-c$. It reviews (either case) if $c < L$.
- $(A, B)$ In equilibrium this stream of decisions is never made.
- $(M, M)$ The Supreme Court chooses not to review either case by Lemma 1.
- $(B, A)$ In equilibrium this stream of decision is never made.
- $(B, M)$ The Supreme Court knows with certainty that $LC_{II}$ received messages $(-1, 1)$ and therefore knows with certainty that $\theta = 0$. The Supreme Court’s expected utility without review is $-L$. The Supreme Court’s expected utility after review is $-c$. It reviews (either case) if $c < L$.
- $(B, B)$ The Supreme Court chooses not to review either case by Lemma 1.
- $(M, B)$ The Supreme Court’s expected utility is as follows.

<table>
<thead>
<tr>
<th>State of the world</th>
<th>Messages</th>
<th>With Review</th>
<th>Without Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta = -1 + 1$</td>
<td>0,0;-1,0</td>
<td>-L</td>
<td>-2L</td>
</tr>
<tr>
<td>$\theta = -1 + 1$</td>
<td>-1,1;-1,0</td>
<td>-L</td>
<td>0</td>
</tr>
<tr>
<td>$\theta = -1 + 0$</td>
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<tr>
<td>$\theta = -1 + 0$</td>
<td>-1,1;-1,0</td>
<td>Cannot happen</td>
<td>Cannot happen</td>
</tr>
</tbody>
</table>

Therefore,

$$EU_H[\text{No review}] = -L$$

$$EU_H[\text{Review}|M, A] = -2L * pr(\theta = -1 + 1| M, A) = -2L * pr(0, 0; -1, 0| A, M)$$

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\[
\begin{align*}
&= -2L \frac{\alpha^2 q(1-q)^3}{\alpha^2 q(1-q)^3 + \alpha^2 q^3(1-q) + \alpha(1-\alpha)q(1-q)} \\
&= -2L \frac{\alpha^2 q(1-q)^2}{\alpha^2 q(1-q)^2 + \alpha q^2 + (1-\alpha)} \\
&= -2L \frac{\alpha^2 q(1-q)^2}{\alpha^2 q(1-q)^2 + \alpha q^2 + (1-\alpha)}
\end{align*}
\]

Therefore H will review iff:

\[
-2L \frac{\alpha^2 q(1-q)^2}{\alpha^2 q(1-q)^2 + \alpha q^2 + (1-\alpha)} - c > -L
\]

\[
-2L \frac{\alpha^2 q(1-q)^2}{\alpha^2 q(1-q)^2 + \alpha q^2 + (1-\alpha)} + L - c > 0
\]

\[
-2L \frac{\alpha^2 q(1-q)^2}{\alpha^2 q(1-q)^2 + \alpha q^2 + (1-\alpha)} + L > c
\]

\[
L \left[ -2 \frac{\alpha^2 q(1-q)^2}{\alpha^2 q(1-q)^2 + \alpha q^2 + (1-\alpha)} + 1 \right] > c
\]

Therefore in order for H to review it must be the case that \(\alpha[q^2+(1-q)^2] > (1-\alpha)\) and

\[
L \left[ -2 \frac{\alpha^2 q(1-q)^2}{\alpha^2 q(1-q)^2 + \alpha q^2 + (1-\alpha)} + 1 \right] > c
\]