# COMMON LAW EVOLUTION AND JUDICIAL IMPACT IN THE AGE OF INFORMATION

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**Abstract**—All common law systems draw from the past. As judges draft opinions, they cite to relevant case law to guide their decision-making. These citations provide a record of how new legal developments draw on previous holdings. This Article presents the first thorough data-driven analysis of how different patterns of drawing from precedent are related to the influence a judicial opinion has on the evolution of the law.

We show that there are previously undiscovered patterns in the way that common law systems evolve. By focusing on two measures of the age of the references cited in a judicial opinion—*reach* (average age of cited works) and *range* (variance of ages cited)—we find that there is one type of citation behavior that is strikingly more likely to be used in highly influential opinions. Cases featuring low reach and high range are more than twice as likely as other types of cases to go on to be highly influential opinions. Evidence for these conclusions is based on three sets of judicial opinions that span a century of time and diverse jurisdictions—the U.S. Supreme Court, the Supreme Court of Canada, and the Supreme Court of India. While these three jurisdictions vary in the way they cite to precedent, the single referencing pattern found to exist behind especially influential cases suggests there is a nearly universal commonality in the evolution of the law.

Our findings help us better understand how common law high courts draw from the past to support important legal holdings. In addition to our substantive findings, this article demonstrates the power of computational legal studies of large datasets to generate novel analyses and findings of previously undiscovered empirical legal patterns.

INTRODUCTION

Common law reasoning depends, fundamentally, on interpreting the past in light of the present. As judges attempt to resolve present disputes, they apply the precedent of the past to guide, explain, and justify the outcomes that they reach.[1] Subsequently, the decisions that judges write go on to become precedent for future judges to refer to and cite.

Despite its centrality to the common law process, we know very little about precedent citation practices and how they relate to the development of the common law.[2] At one point in time, the choice of which precedent to cite was simple: judges cited to analogous cases that they themselves had ruled on or were immediately familiar with.[3] This changed as it became more common for court reporters to publish opinions and the body of citable case law grew. With more published case law, appealing to the relatively small set of precedent one was immediately familiar with became outmoded, and citations to opinions written by others and recorded in reporters became the norm.[4] Today, judges and lawyers have access to more precedent than ever before via specialized databases that offer them the text of millions of cases and untold amounts of secondary legal information.[5] As this body of information has grown, our capacity to master information has remained approximately fixed. This has led to a situation where, as time has progressed,

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[1] *See* ROSCOE POUND, THE SPIRIT OF THE COMMON LAW 65 (Marshall Jones Co. Publishers 1921) (describing the doctrine of precedent as "one of the three distinctively characteristic institutions of the Anglo-American legal system").

[2] *See* Stefanie A. Lindquist & Frank B. Cross, *Empirically Testing Dworkin's Chain Novel Theory: Studying the Path of Precedent*, 80 N.Y.U. L. REV. 1156, 1156 (2005) ("Precedent is one of the most important areas of legal research, but currently there is no dominant working theory, and only limited empirical evidence, about its role in judicial decision-making.").

[3] *See* T. Ellis Lewis, *The History of Judicial Precedent: II*, 46 L. Q. REV. 341, 341 (1930) (showing that when laws were often assembled in Year Books from approximately 1535–1765 [t]he citation of cases usually took the form of an appeal to memory. Judges and counsel gave their recollections of what had happened in cases in which they themselves had taken part, or which they had heard, when such cases resembled the ones before the Court, and it was presumed that all present would remember them. The personal element was predominant, as opposed to the reference by time and place. *Id.*).

[4] *See* T. Ellis Lewis, *The History of Judicial Precedent: IV*, 48 L. Q. REV. 230, 238–39 (1932) (noting that after regular court reporter publication began, "[j]udicial decisions were cited as much as they are to-day; they were treated as authorities, but there was no strict hierarchy.").

[5] *See infra* Part I.A.

legal practitioners can master only a smaller and smaller fraction of the body of legal knowledge. This "burden of knowledge"[6] is common across research fields, but has yet to be studied in law.

We also know little about the relationship between how an opinion draws on the past and the impact it goes on to have on the legal system. There is a long tradition and large body of literature discussing legal change.[7] From Holmes' *The Common Law*,[8] discussing differences between ancient and contemporary law, to more recent works discussing changes in specific doctrinal areas,[9] legal scholars have long been interested in studying how the law changes. However, prior to this Article, there have been few, if any, attempts to analyze empirically large bodies of common law in an attempt to detect *patterns* common to change within legal systems. By analyzing how tens of thousands of opinions in multiple Supreme Courts draw on the past, we help further our understanding of how courts draw on the past to make the law of the present. The extent to which an opinion reaches back in time to support its holdings will influence a legal system's rate of change. Similarly, the extent to which opinion drafters integrate precedent from a wide variety of time periods will affect how stable a legal system is over time. This temporal aspect of precedent evolution has been virtually unstudied, but is important for understanding how past law support present day decisions.

This Article applies a new method of precedent citation analysis to help improve our understanding of how practitioners draw from the past and how the law evolves. By looking to the citation practices of the United States, Canadian, and Indian Supreme Courts, we show for the first time that there are fundamental/nearly universal cross-jurisdictional commonalities in the way the law evolves.[10] While these three jurisdic-

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[6] Benjamin F. Jones, *The Burden of Knowledge and the "Death of the Renaissance Man": Is Innovation Getting Harder?*, 76 THE REV. ECON. STUD. 283, 283 (2009).

[7] *See, e.g.*, Louis Kaplow, *An Economic Analysis of Legal Transitions*, 99 HARV. L. REV. 509 (1986); George L. Priest, *Measuring Legal Change*, 3 J. L. ECON. & ORG. 193 (1987); Oona A. Hathaway, *Path Dependence in the Law: The Course and Pattern of Legal Change in a Common Law System*, 86 IOWA L. REV. 601 (2001); Roscoe Pound, *What of Stare Decisis*, 10 FORDHAM L. REV. 1 (1941); Neal Katyal, *Sunsetting Judicial Opinions*, 79 NOTRE DAME L. REV. 1237 (2003–2004).

[8] O.W. HOLMES, THE COMMON LAW (Belknap Press of Harv. U. Press 1963).

[9] *See, e.g.*, LEE EPSTEIN, THE SUPREME COURT AND LEGAL CHANGE: ABORTION AND THE DEATH PENALTY (1992); James A. Henderson Jr & Theodore Eisenberg, *The Quiet Revolution in Products Liability: An Empirical Study of Legal Change,* 37 UCLA L. REV. 479 (1989).

[10] *See infra* Part IV.

tions vary in the way they cite to precedent, there is a single referencing pattern that is universally more likely to appear in important legal decisions.

Citing precedent grounds an opinion in the past.[11]  By doing so, citations leave a record of how the law evolves as it draws from the past to create law for the present.  Because of this unique record that references leave, scholars have long understood that studying citation patterns can provide distinctive insight into the legal system.[12]  As Professors Landes and Posner wrote in 1976, "to the extent that judicial citation practices exhibit regularities explicable within a systematic analytical framework, a statistical analysis of precedent should reveal them."[13]  However, until recently, large-scale analyses of citation practices were impractical; data was difficult to acquire, analysis methods were rudimentary, and computational power was insufficient.  In the last decade, all three of these barriers to large-scale empirical citation analysis have been greatly reduced.  Citation data is now available in machine-readable form,[14] citation analysis methods have become much more sophisticated,[15] and powerful computers have become widely available.[16]

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[11] *See* Green v. United States, 355 U.S. 184, 215 (1957) (noting that respect for precedent helps courts to remember their institutional role, "transcending the moment."); *see also* Stephen Markman, *Precedent: Tension between Continuity in the Law and the Perpetuation of Wrong Decisions*, 8 TEX. REV. L. & POL. 283, 283 (2003) (arguing that citations to precedent promote "the stability, the predictability, and the efficiency of the legal system").

[12] *See generally* W.M. Landes & R.A. Posner, *Legal Precedent: A Theoretical and Empirical Analysis*, 19 J. L. & ECON. 249 (1976); John Henry Merryman, *The Authority of Authority: What the California Supreme Court Cited in 1950*, 6 STAN. L. REV. 613 (1954) [hereinafter Merryman, *The Authority of Authority*]; John Henry Merryman, *Toward a Theory of Citations: An Empirical Study of the Citation Practice of the California Supreme Court in 1950, 1960, and 1970*, 50 S. CAL. L. REV. 381 (1977) [hereinafter Merryman, *Toward a Theory of Citations*].

[13] Landes & Posner, *supra* note 12, at 252.

[14] *See, e.g.*, *About*, COURTLISTENER, https://www.courtlistener.com/about/; WORLD LEGAL INFO. INST. (WORLDLII), http://www.worldlii.org/ (providing machine readable text of judicial opinions for a variety of jurisdictions).

[15] *See, e.g.*, James H. Fowler et al., *Network Analysis and the Law: Measuring the Legal Importance of Precedents at the U.S. Supreme Court*, 15 POL. ANALYSIS 324 (2007); James H. Fowler & Sangick Jeon, *The Authority of Supreme Court Precedent*, 30 SOC. NETWORKS 16 (2008); Loet Leydesdorff, *How Are New Citation-Based Journal Indicators Adding to the Bibliometric Toolbox?*, 60 J. AM. SOC'Y FOR INFO. SCI. & TECH. 1327 (2009).

[16] *See* Robert J. Samuelson, *The Power of Moore's Law*, WASH. POST, (Apr. 19, 2015), http://www.washingtonpost.com/opinions/the-power-of-moores-law/2015/04/19/f1806c98-

This Article capitalizes on these developments by applying new methods of analyzing legal precedent citations. Doing so illustrates the promise of computational legal studies as we discover general patterns in the ways that common law systems evolve that would otherwise have remained undiscovered. We proceed in five parts.

In Part I, we discuss the evolution of the legal information system and the recent explosion in the availability of citable precedent. The amount of information that is readily accessible has dramatically increased in recent years. This is as true for legal information as it is in other fields. The legal system has evolved from oral tradition, to inscriptions on stone tablets, to informal notes taken down during rulings, to formal court reporters, to the present electronic system that makes vast quantities of legal information immediately available. At each stage of evolution, the amount of precedent available to practitioners has increased.

The amount of citable precedent available to practitioners again expanded when the Federal Rules of Appellate Procedure were altered to allow citation to unpublished judicial opinions.[17] Previously, many federal courts limited the amount of precedent they produced by making distinctions between "published" and "unpublished" precedent. When electronic access made the distinction between published and unpublished decisions anachronistic, the Federal Rules of Appellate Procedure Advisory Committee suggested that all federal judicial opinions be treated equally regardless of their publication status.[18] This greatly expanded the world of citable precedent leaving legal practitioners with a greatly expanded universe of citable precedent.

In Part II we discuss the implications of an increasingly large universe of legal information. Increasing stocks of precedent create challenges for lawyers and judges. It is no longer possible to read and be fa-

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e6b6-11e4-9a6a-c1ab95a0600b_story.html (describing the "almost unfathomable" explosion in computing power).

   [17] FED. R. APP. P. 32.1 advisory committee's note to 2006 amendment, subdiv. (a); *see infra* Part 0. *See also* William L. Reynolds & William M. Richman, *The Non-Precedential Precedent—Limited Publication and No-Citation Rules in the United States Courts of Appeals*, 78 COLUM. L. REV. 1167 (1978) (charting the history of rules limiting citation to non-published opinions).

   [18] *See* FED. R. APP. P. 32.1 advisory committee's note to 2006 amendment, subdiv. (a) ("Under Rule 32.1(a), a court of appeals may not prohibit a party from citing an unpublished opinion of a federal court for its persuasive value or for any other reason.").

miliar with the entirety of the law.  As the amount of information available increases, our ability to master information remains approximately fixed.[19]  This creates a situation where, as time progresses, legal practitioners are aware of a smaller and smaller proportion of the entire body of legal knowledge.  This "burden of knowledge"[20] is common across research fields, but has yet to be studied in law.

By their nature, common law systems draw from the past when adjudicating disputes in the present.  We focus on this aspect of legal practice by examining how judges incorporate precedent in their opinions and how their citation patterns influence future legal developments.  As they draft opinions, judges must select from an increasingly large body of precedent that can be used to support their decisions.  The degree to which they reach back in time to draw on distant precedents will influence a legal system's rate of change. Similarly, the degree to which judges are able to integrate precedent from a wide variety of time periods will influence how stable a legal system is over time.  This temporal aspect of precedent evolution has been understudied, leaving us with little knowledge of how judges draw from the past to support their present day decisions.

In Part III we review the literature on precedent citation studies. Empirically analyzing how judges cite to precedent has long shown promise in helping us understand how legal systems function.[21] Citations can be conceptualized in at least two ways: (1) as the outgoing references from an opinion showing how it draws on the past; and (2) as the incoming references from later opinions that show how the opinion influences

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[19] ALBERT EINSTEIN, IDEAS AND OPINIONS 69 (Carl Seelig et al. eds., Sonja Bargmann trans., Crown Publisher, Inc.) (7th prtg. 1963) ("[K]nowledge has become vastly more profound in every department of science. But the assimilative power of the human intellect is and remains strictly limited. Hence it was inevitable that the activity of the individual investigator should be confined to a smaller and smaller section of human knowledge.").

[20] Jones, *supra* note 6, at 283.

[21] *See, e.g.*, Landes & Posner, *supra* note 12, at 250 (analyzing "empirically an economic approach to legal precedent that is derived mainly from the analysis of capital formation and investment"); Merryman, *The Authority of Authority*, *supra* note 12, at 620-21 (comparing the persuasive power of statutes and case law with authoritative power of secondary sources that have been cited by higher courts); Merryman, *Toward a Theory of Citations*, *supra* note 12, at 381-82 (discussing "data on citations by justices of the California Supreme Court in cases that it decided in 1950, 1960, and 1970" to assess citation patterns between justices and time periods).

future legal developments.[22]  Most previous studies of precedent citations focus on citations from a single perspective, analyzing either how an opinion is grounded in existing law or how it goes on to influence future decisions.

We present a new and more holistic approach towards precedent citation analysis by accounting simultaneously for both citation perspectives.  We analyze how the citations judicial opinions make influence the probability that those opinions will themselves go on to be highly cited in the future.  This allows us to uncover universal trends in how highly influential judicial opinions from common law high courts ground themselves in the past.

Part IV presents our data and findings.  We draw on data from the Supreme Courts of the United States, Canada, and India.  Using this data, we examine how decisions in each court support their findings by citing precedent.  Measuring both how far back in time the decisions reach to find relevant precedent and the range of precedent ages they cite to, we observe how courts draw on the past to support their opinions.  Along with our focus on how opinions are grounded in the past, we also observe how many citations each opinion goes on to receive in the future.  This provides insight into the relationship between the influence of each case and its referencing behavior.

We show that amid the various ways to draw from the past—ways that include citing older work, citing very recent work, citing across time evenly, and citing on the heels of recent precedent while also interspersing references to further in the past—there is one pattern of referencing behavior, appearing in approximately one fifth of all decisions, that is much more likely to go on to influence future legal developments.  These opinions draw primarily on recent precedent, while also interspersing citations to older rulings.  This finding that there is a single citation style that judges are more likely to use in highly influential cases, is consistent across the courts we examine. Our consistent results across multiple jurisdictions suggest that there is some universality to the way that the common law develops and the way it draws upon the past to support im-

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[22] In economics and other social sciences that analyze citations, these two perspectives on citations are referred to as "forward" and "backward" citations.  Forward citations are incoming references from subsequent creations, while backward citations are those references that the object of study makes.  *See* Xiaojun Hu et al., *On the Definition of Forward and Backward Citation Generations*, 5 J. INFORMETRICS 27, 27 (2011).

portant legal developments. This is a new observation that our novel method of precedent citation analysis allows. It has implications both for the way we understand legal system evolution, and in showing the promise of new data-driven methods of legal analysis.

In Part V we explore potential explanations for why one citation style accounts for a disproportionate number of highly influential Supreme Court opinions. We examine the possibility that our results are driven by opinions that overrule precedent, the legal issues in question, or judicial ideology. Our analyses show that there is no obvious single explanation for why one citation pattern is so much more likely to be associated with high impact cases. Our results do not appear to be driven by cases that overrule existing precedent or by the types of legal issues discussed in the cases. Nor can the relationship be explained by judicial ideology. Looking to the degree of controversy that underlies the dispute in question does shed some light on why we observe the one uniquely influential citation pattern that we do. Cases where the justices are not in unanimous agreement are both more likely to go on to be high impact and to demonstrate the influential citation pattern that we identify.

Our finding that there is one type of citation pattern that is highly overrepresented among influential opinions might be related to the appeal process. Each of the courts we study is a court of discretionary appeal, and it may be the case that they choose to grant appeals in cases where the majority of relevant precedent fits with our observed patterns. This would suggest some generality in the way that legal issues arise in common law jurisdictions.

Finally, we provide a brief conclusion that discusses the implications of our findings and suggests areas for future research. In the present study we have uncovered a degree of universality in the manner in which common law systems evolve. We need more research to demonstrate other commonalities between and distinctions amongst legal systems, and work that helps interpret these findings to further our understanding of how legal systems function and evolve.

## I. THE INFORMATION EXPLOSION

Modern society is defined by near universal access to vast stores of information. Researchers estimate that by 2013 the world contained 4

zettabytes of data.[23]  This vast stock of information simultaneously cre-ates opportunities while imposing costs.  For instance, having a diverse set of information to draw upon during the creative process can lead to better artwork[24] and more successful scientific and technological devel-opments.[25]  However, individuals can only dedicate up to about 2000 hours per year acquiring expertise in any given area.[26]  Given limitations on our ability to process information and the ever-increasing size of our global store of knowledge, it is inevitable that individuals will perceive a smaller-and-smaller proportion of the knowledge stock as time goes by.[27]

This "burden of knowledge"[28] is one of the most influential modern realities shaping business, education and culture.  Our demand for new and better ways to search through and access information has led to the rise of some of the world's most influential firms such as Google and Microsoft.[29]  Meanwhile, demand for experts able to help firms deal with

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[23] DJ Patil, *A Memo to the American People from U.S. Chief Data Scientist Dr. DJ Patil: What is Data Science, and Why Does it Matter?*, WHITEHOUSE.GOV (Feb. 20, 2015, 12:01 PM), https://www.whitehouse.gov/blog/2015/02/19/memo-us-chief-data-scientist-dr-dj-patil-unleashing-power-data-serve-american-people.  A zettabyte is equivalent to one trillion giga-bytes.  *Zettabyte,* WIKIPEDIA (last modified July 20, 2016, 11:55 PM), https://en.wikipedia.org/wiki/Zettabyte.

[24] *See, e.g.*, Brian Uzzi & Jarrett Spiro, *Collaboration and Creativity: The Small World Problem*, 111 AM. J. SOC. 447, 492-93 (2005) (showing that optimal team structure for creators of Broadway plays encourages exposure to diverse information).

[25] *See, e.g.*, Brian Uzzi et al., *Atypical Combinations and Scientific Impact*, 342 SCI. 468, 468 (2013) (explaining that "research within narrow boundaries is unlikely to be the source of the most fruitful ideas . . . [or] scientific breakthroughs"); Xiaolin Shi et al., *The Impact of Boundary Spanning Scholarly Publications and Patents*, 4 PLOS ONE 1, 1 (2009) (recognizing that knowledge that is shared between "disciplinary initiatives" is "more likely to lead to inno-vative and groundbreaking research . . . [and] higher impact work").

[26] *See* K. Anders Ericsson et al., *The Making of an Expert*, HARV. BUS. REV., July-Aug. 2007, at 119, https://hbr.org/2007/07/the-making-of-an-expert ("[A]cross a wide range of ex-perts, . . . very few appear to be able to engage in more than four or five hours of high concen-tration and deliberate practice at a time. In fact, most expert teachers and scientists set aside only a couple of hours a day. . . .").  *But see* David Z. Hambrick et al., *Deliberate Practice: Is That All It Takes to Become an Expert?*, 45 INTELLIGENCE 34, 43 (2014) (emphasizing that the amount of practice time required to develop expertise can dramatically vary between individu-als).

[27] *See* Jones, *supra* note 6, at 283.

[28] *Id.*

[29] Competition over the search market has been an important influence in the high tech firm space.  *See, e.g.*, Dan Kedmey, *Microsoft's Clever Plan to Get You to Love Bing*, TIME, Apr. 6,

the information explosion has led to the rise of new careers in data science[30] and transformations in educational offerings.[31]

The law has not been isolated from these trends. Lawyers, judges, lawmakers, and students are all challenged by the burden of knowledge as the amount of available primary and secondary legal information steadily increases while our cognitive capacity remains the same. Below, in Part IV, we explore how the law copes with the burden of knowledge, by asking how judges navigate the vast stores of precedent available to them and draw from the past to support the decisions they render in the present. Before moving on to our empirical analysis however, we will first chart the transformative changes that the legal information system has undergone.

## A.  Legal Information

*1. Technological Changes*—Like information more generally, the stock of legal information has monotonically increased for thousands of years. The development of writing is perhaps the most influential of the technological developments that have contributed to this trend.[32] Prior to the development of writing, laws—in as much as we consider rules and procedures transferred via oral tradition laws—were transmitted via reli-

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2015 (exemplifying the endless competition between major search engine companies like Google and Bing).

[30] *See, e.g.*, Monya Baker, *Industry Allure: PhD Holders with Quantitative Skills Are Landing Posts at Technology Companies*, 520 NATURE 253, 254 (2015) (describing wave of PhD holders' move from academic settings to become industry data scientists).

[31] *See, e.g.*, Jen Todd, *TSU to Bring Data Science Experts from Harvard, China*, THE TENNESSEAN (Mar. 16, 2015), http://www.tennessean.com/story/news/education/2015/03/16/tsu-bring-data-science-experts-harvard-china/24860627/ (describing the growth of Tennessee State University's data science program); OBJ Staff, *Carleton Launches Institute for Data Science*, OTTAWA BUS. J. (Apr. 2, 2015), http://www.obj.ca/Technology/2015-04-02/article-4099211/Carleton-Launches-Institute-for-Data-Science/1 (announcing a new data science center at Carleton University); Sara Miller, *Robert and Pamela Goergen Commit $11 Million to Institute for Data Science*, UNIVERSITY OF ROCHESTER: NEWSCENTER (Mar. 25, 2015), http://www.rochester.edu/newscenter/robert-and-pamela-goergen-commit-11-million-to-institute-for-data-science-95122/ (announcing funding for a data science center at the University of Rochester); Janelle Nanos, *UMass Amherst Launches New Center for Data Science*, BOSTON GLOBE: BETABOSTON (Apr. 9, 2015), http://www.betaboston.com/news/2015/04/09/umass-amherst-launches-new-center-for-data-science/ (announcing a data science center at the University of Massachusetts).

[32] *See generally* WALTER J. ONG, ORALITY AND LITERACY: THE TECHNOLOGIZING OF THE WORD 156-179 (1982) (summarizing the importance of oral traditions to early legal systems).

gious tradition, legends, stories and epic poems.[33]  Appeals to these laws required inquiring into a society's oral tradition and dispute resolution procedures to determine the preferred outcome in a dispute.[34]

As humans learned how to record language and meaning, they became able to write down their laws and rules.  This led to the creation of the written legal codes that we find amongst the earliest script artifacts.[35] Written legal codes represent a paradigmatic shift from oral-based legal information systems, as writing legal rules down caused them to become more stable and definite.

Although written legal codes were transformative, rules chiseled into pillars were still very different from our modern legal information system.  Early legal publishing in England marks the beginning of a legal information era that would be recognizable to a modern lawyer. From the 13th to the 16th Centuries, "Year Books" compiled notes on what occurred in courts of law, serving a function similar to modern court reporters.[36]  Later came the "nominative court reports" so called because they carried the name of the reporter, an individual who would compile or record notes on court decisions.[37]  These reports demonstrate one of the early problems arising from the growth in legal information: questionable accuracy. With no canonical reports, lawyers and judges depended on the court reporters to record the law accurately.  Unfortunate-

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[33] *See, e.g.*, MICHAEL GAGARIN, *Early Greek Law, in* THE CAMBRIDGE COMPANION TO ANCIENT GREEK LAW 82-94 (Michael Gagarin & David Cohen eds., Cambridge University Press 2005) (discussing the importance of oral traditions to the formation of ancient Greek law).

[34] *See id.* at 86-90.

[35] *See* D. Oswald Dykes, *Code of Hammurabi*, 16 JURID. REV. 72, 72-74 (1904) (discussing the importance of the Hammurabi Code and its contributions to early written legal development); *see also* O.B. Jenkins, *The Code of Hammurabi, Compared with American Law*, 39 AM. L. REV. 330, 331 (1905) (explaining and describing the purpose, components, and focus of the Hammurabi Code).

[36] *See* Robert C. Berring, *Legal Research and Legal Concepts: Where Form Molds Substance*, 75 CALIF. L. REV. 15, 17 (1987) (defining Year Books as "collections of notes taken down concerning actions at court," which today, are commonly referred to as "court reporters").

[37] *Id.* at 17–18.  The court reporter system in the United States became truly prolific in the mid-19th century after the Supreme Court ruled that reporters held no copyright in the laws they reported, enabling many reporters to re-publish the text of opinions reported elsewhere. *See generally* Wheaton v. Peters, 37 U.S. 591 (1834).

ly, these reports often contained inaccuracies and contradictions, compli-
cating the practitioner's job.[38]

The quantity and type of legal information available again expand-
ed dramatically with the establishment of the major legal publishing
houses like West,[39] and the creation of legal citators like *Shepard's Cita-
tions* to track the treatment of precedent in subsequent decisions.[40]  The
growth of legal publishing houses led to an increase in the number of
cases being published, making it more difficult for lawyers and judges to
stay abreast of the law and more difficult for them to decide which cases
to cite in their briefs and opinions.  Some estimate that by 1895, so much
new legal information was being created that a lawyer hoping to keep
abreast of the reported cases would have needed to read 200 pages per
day, 300 days per year, in order to do so.[41]

At the same time as the legal publishing houses were increasing the
number of cases published across the country, citators began systemati-
cally tracking the citations between cases.[42]  These citators were in part
an attempt to reduce the search costs that legal practitioners incurred
when trying to navigate the increasingly complex legal information envi-
ronment.  By providing a centralized source tracking how precedent is
treated, citators like Shepard's allowed practitioners some peace of mind
in a world where they could not possibly read all of the cases that might
cite a precedent they wished to rely upon.[43]  While they almost certainly
helped many practitioners save time, citators also increased the complex-

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[38] *See* Berring, *supra* note 36, at 18; *see also Law Reporting*, N.Y. TIMES (May 19, 1873),
http://query.nytimes.com/gst/abstract.html?res=9506E3D7173AE63BBC4152DFB366838866
9FDE&legacy=true.

[39] John West founded his first legal publishing business in 1872, his company went on to
dominate the local court reporting market.  *See* Thomas A. Woxland, *Forever Associated with
the Practice of Law: The Early Years of the West Publishing Company*, 5 LEGAL REF. SERV.
Q. 115, 115–16 (Spring 1985).

[40] *See* Patti Ogden, *Mastering the Lawless Science of Our Law: A Story of Legal Citation
Indexes*, 85 L. LIBR. J. 1, 2, 27-29 (1993) (introducing Frank Shepard's creation of Shepard's
Citation in 1875, which tracked judicial citations in its books).

[41] *Id.* at 18.

[42] *See id.* at 18-27.

[43] *See Frank Shepard is Dead*, CHI. DAILY TRIB., (Sept. 29, 1900), https://www.newspapers
.com/image/28526151 (quoting Frank Shepard describing his publications as "a great time-
saving scheme for lawyers in referring to various laws while looking over records.").

ity of the legal system by introducing and formalizing a new element into brief and opinion writing: Shepardizing.[44]

Following the rise of legal publishers and citators, the development of new electronic information and communication technologies further transformed the universe of legal information.  By the 1960s, practitioners had begun using computers for legal information retrieval.[45]  Computer research systems soon evolved into systems similar to those available to lawyers and judges today, with remote access to large legal databases.[46]  The remote databases available in the 1970s eventually became HTTP compliant, allowing practitioners to access them from any personal computer with Internet access, and eventually from smartphones and tablets.[47]  This technologically enabled transformation in the way law is accessed has fundamentally altered the way practitioners engage with precedent. Whereas they once had to pour over books, seeking out relevant precedent piece by piece, they can now simultaneously search across virtually all of the legal information that might possibly be relevant. This change will have important implications for how the law evolves,[48] but because we lack a detailed understanding of how legal practitioners choose to make the citations they do and how those

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[44] *See* Gosnell v. Rentokil, Inc., 175 F.R.D. 508, 510 n.1 (N.D. Ill. 1997) ("It is really inexcusable for any lawyer to fail, as a matter of routine, to Shepardize all cited cases . . . .").

[45] Peter Nycum, *Law and Computers: Overview Update 1975*, 68 L. LIBR. J. 234, 237 (1975).

[46] By the mid 1970s, practitioners could rent a Lexis terminal for $3000 per month that allowed access to statutes, federal & state court decisions, legislative history, and federal regulations. *Id.* at 247–48.

[47] By the mid-1990s there was a variety of legal information available online. *See generally* Don MacLeod, *The Internet, LEXIS and WESTLAW: A Comparison of Resources*, 19 DATABASE 50 (1996). By the late 1990s, both Lexis and Westlaw allowed practitioners to search their increasingly vast databases from any Internet-connected computer. *See* Peter B. Maggs, *The Impact of the Internet on Legal Bibliography*, 46 AM. J. OF COMP. L. SUPPLEMENT 665, 670–71 (1998).  Mobile legal information search has been available for a number of years now.  *See* Ruth S. Stevens, *Legal Research: Is There an App for That?*, MICH. B. J., June 2012, at 54-55 (2012).

[48] *See* Robert Berring, *Chaos, Cyberspace and Tradition: Legal Information Transmogrified*, 12 BERKELEY TECH. L.J. 189, 1675 (1997) [hereinafter *Chaos, Cyberspace, and Tradition*] (arguing that legal information is transforming from a stable universe of settled sources into a free-for-all of competing authority); Berring, *supra* note 36, at 26–27 (stating that "the ability to search without an imposed structure will nakedly expose the myth of the common law and the beauty of the seamless web to the general legal world" and that the "law is likely to atomize and specialize even further").

choices affect future legal developments, the details of those implications remain unclear.

*2. Rule Changes*—In addition to the technological developments transforming the legal information system, recent changes to the rules governing precedent have vastly expanded the number of citable opinions created every year. When case law was principally available in published reporter form, there was a meaningful distinction between published and unpublished decisions. The non-publication of decisions was popular in many jurisdictions. By the late 20th century, about 75% of all circuit court opinions went nominally unpublished.[49] However, changes in legal information technology made the distinction between published and unpublished cases less meaningful. Once practitioners began to shift from seeking case law in hardcopy published volumes to seeking it online—where many "unpublished" cases are available—the amount of available case law increased dramatically.[50]

Prior to formal changes in the Federal Rules of Appellate Procedure (FRAP), circuits treated these unpublished decisions differently. For instance, the 9th Circuit held that its rule prohibiting citation to unpublished cases was constitutional.[51] While the 8th circuit originally held that unpublished decisions had precedential effect and could be cited, that ruling was vacated on rehearing *en banc* and the issue was never resolved in that circuit.[52] Much of the distinction between circuits was removed in 2006 following the adoption of Federal Rule of Appellate Procedure 32.1. Under Rule 32.1:

> [A] court of appeals may not prohibit a party from citing an unpublished opinion of a federal court for its persuasive value or for any other reason. In addition, under Rule 32.1(a), a court may not place any restriction on the citation of such opinions. For example, a court may not instruct parties that the citation of unpublished opinions is discouraged, nor may a court forbid parties to cite unpublished opinions when a published opinion addresses the same issue.[53]

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[49] Stephen L. Wasby, *Unpublished Decisions in the Federal Courts of Appeals: Making the Decision to Publish*, 3 J. APP. PRAC. & PROCESS 325, 325 (2001).

[50] *See id.* at 326.

[51] Hart v. Massanari, 266 F.3d 1155, 1180 (9th Cir. 2001).

[52] Anastasoff v. U.S., 223 F.3d 898, 905, *vacated*, 235 F.3d 1054, 1056 (8th Cir. 2000).

[53] Fed. R. App. P. 32.1 advisory committee's note to 2006 amendment.

This rule came into effect in 2007,[54] greatly expanding the universe of citable precedent available since then and further complicating the task of legal information seeking.

<center>*          *          *</center>

Most of the developments discussed above were intended to make legal information seeking easier.  The various technological and publishing developments all sought to help practitioners sort through an increasingly large universe of legal information.  Similarly, changes to the treatment of unpublished decisions sought to make the rules of legal research comport more fully with the realities of contemporary legal publishing.  However, because of the nature of the legal services market, and the role of the adversarial process in legal disputes, these developments have created new challenges for practitioners.  The explosion of new sources, both primary and secondary, forces lawyers to navigate a "dizzying array" of information.[55]  At the same time, access to more legal information has led to an information arms race where practitioners have incentive to perform more-and-more research, citing to more-and-more precedent as it becomes possible to do so.[56]  The alternative is to be out-researched by the opposing side, or perhaps to be in breach of professional duties.[57]  Quite simply put, the amount of information now available to legal practitioners is well in excess of what any human could possibly hope to read and understand.[58]  This has made the task of legal information seeking fundamentally important to the modern practice of law.  Surprisingly, this is an area we know relatively little about.

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[54] *Id.*

[55] *Chaos, Cyberspace, and Tradition*, *supra* note 48, at 200 ("As more and more publishers enter the fray, producing a dizzying array of electronic products, things will grow more confusing. Where once a lawyer did not have to think about the information that she was going to use, now choices will be popping up like zits on a teenaged face.").

[56] *See* Casey R. Fronk, *The Cost of Judicial Citation: An Empirical Investigation of Citation Practices in the Federal Appellate Courts,* 2010 U. ILL. J. L., TECH. & POL'Y 51, 51 (2010) (showing that the number of citations in Federal appellate court opinions has increased by approximately 50% between 1957 and 2007).

[57] *See* Rule 1.1 Competence, Ann. Mod. Rules Prof. Cond. § 1.1 (2015) ("The interrelated obligations of thoroughness and preparation require a lawyer to investigate all relevant facts and research applicable law.").

[58] Robert C. Berring, *Legal Research and the World of Thinkable Thoughts*, 2 J. APP. PRAC. & PROCESS 305, 314 (2000) ("There is simply too much stuff to sort through. No one can write a comprehensive treatise any more, and no one can read all of the new cases.").

## II. Information Seeking

The amount of legal information that practitioners must deal with has dramatically increased in recent decades. This information explosion shows no sign of abating, and indeed seems likely to accelerate as information technology continues to transform legal practice. Ninety percent of the data in the world was created in the last two years.[59] This constant creation of new information confronts practitioners with an ever-changing barrage of legal information that they must cope with in their legal practice. We know very little about how practitioners deal with this challenge. Our work *infra* in Part IV begins to shed light on the implications of this phenomenon by empirically analyzing the information that judges rely upon in their decisions and the impact that those decisions go on to have. First, before moving on to our empirical analyses, we will briefly explore the tensions implicit in a system of increasing information.

### A. The Tension Between Diverse Inputs and Search Costs

Information is a public good. As a non-excludable product, my use of information does not preclude your use of it. This is what Thomas Jefferson referred to when he wrote that "He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me."[60] The public good nature of information has generated great wealth as the information revolution has transformed society, creating new industries and improving quality of life. However, more information is not an unmitigated good. With more information comes increased complexity and search costs.

Because new knowledge is produced by recombining prior knowledge,[61] rising search costs do not simply slow research; they raise

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[59] *What is Big Data?*, IBM (last visited Sept. 10, 2016), http://www-01.ibm.com/software /data/bigdata/what-is-big-data.html.

[60] Letter from Thomas Jefferson to Isaac McPherson (Aug. 13, 1813).

[61] *See generally* Richard R. Nelson & Sidney G. Winter, An Evolutionary Theory of Economic Change 130 (1982) (arguing that innovation "consists to a substantial extent of a recombination of conceptual and physical materials that were previously in existence."); Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. Econ. Persp. 29 (1991) (arguing that inventions are generally produced by building upon prior work).

the risk that discoveries and developments will go unmade. When finding the appropriate knowledge to recombine becomes difficult, innovation moves more slowly and society risks missing out on combinations that would have been made if search functioned ideally. This point has been made repeatedly when discussing technical or business innovations.[62] However, it may not be as clear how the knowledge recombination paradigm applies to the law.

Although the common law is a conservative institution, it does change as it adapts to the constantly evolving society that it regulates. Much of this change occurs as a result of judicial creativity.[63] As judges combine legal ideas with one another or with non-legal ideas in new ways, they adapt the law and create new legal ideas and doctrines. As a general example, consider the law of intellectual property. It does not regulate anything that would have traditionally been considered "property." However, in order to establish stronger innovation incentives, legislators, judges, and scholars have drawn liberally on property law as an analogy, combining the principles of property law with the realities of the intellectual products that patent, copyright and trademark regulate.[64] For a more specific example, consider how the Supreme Court treated the Affordable Care Act (ACA) penalties for Americans who do not purchase adequate health insurance.[65] While under a straightforward interpretation these penalties were perilously close to an unconstitutional aggrandizement of federal powers, Justice Roberts saved the constitutionality of the Act by considering its regulatory scheme in combination

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[62] *See, e.g.*, NELSON & WINTER, *supra* note 61, at 130; JOSEPH SCHUMPETER, THE THEORY OF ECONOMIC DEVELOPMENT: AN INQUIRY INTO PROFITS, CAPITAL, CREDIT, INTEREST, AND THE BUSINESS CYCLE 65 (Redvers Opie trans. 1951); Lee Fleming & Olav Sorenson, *Technology as a Complex Adaptive System: Evidence from Patent Data*, 30 RES. POL'Y 1019 (2001); D. Charles Galunic & Simon Rodan Insead, *Resource Recombinations in the Firm: Knowledge Structures and the Potential for Schumpeterian Innovation*, 19 STRATEGIC MGMT. J. 1193 (1998).

[63] *See* Pound, *supra* note 7, at 11 (discussing examples of judicial creativity); Edward Rubin & Malcolm Feeley, *Creating Legal Doctrine*, 69 S. CAL. L. REV. 1989, 1991 (1995) ("Even the common law that we inherited from England, despite its apparently ancient lineage, can often be traced to specific acts of judicial creativity.").

[64] Pittman v. Chi. Bd. of Educ., 64 F.3d 1098, 1104 (7th Cir. 1995) (analogizing real property to intellectual property for the purpose of takings clause analysis); Henry E. Smith, *Intellectual Property as Property: Delineating Entitlements in Information*, 116 YALE L.J. 1742 (2007) (generally discussing the analogies between real and intellectual property).

[65] Nat'l Fed'n of Indep. Bus. v. Sebelius, 567 U.S. 1 (2012).

with the Federal Government's power to levy taxes.[66]  So considered, the ACA became a constitutional exercise of federal power and created a new way to appreciate federal taxation powers.  This demonstrates how making new law often arises when Justices draw on seemingly disparate precedent, combining and recombining the law in novel ways.

When we consider the importance of idea recombination to the development and application of the law, it becomes obvious how an information explosion might raise challenges.  Growth in the amount of legal information increases the search space that practitioners must navigate in order to find appropriate precedent to rely upon and potentially recombine into new legal arguments or ideas.  When the quantity of law becomes so great that no practitioner can hope to master it all, the techniques that they use to search and select which precedents they will rely upon become centrally important to how the law evolves.

We know almost nothing about how different search strategies might lead to different outcomes for the legal system.  Below, in Part 0 we show that there are patterns in common amongst common law jurisdictions and similarities in the ways that precedent citation strategies relate to future legal developments.  However, before we move to our empirical analysis, let us first consider the day-to-day realities of legal information seeking in a little more detail.

## B. Law & Information Seeking

Legal research is essential to legal practice.  Although there are many aspects to legal research, the search for relevant precedent is the most fundamental form of legal information seeking.  Both lawyers and judges are required to seek out and cite past precedent to inform their analyses of current legal disputes.[67]  As the scale of the legal information universe expands, practitioners are forced to search through more-and-more law and make more-and-more decisions as to what to rely upon and what not to rely upon.[68]  This makes legal information seeking more

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[66] *See id.* at 32.

[67] *See, e.g.*, MODEL RULES OF PROF'L CONDUCT 3.3(a)(2) (AM. BAR ASS'N 2016) (obliging lawyers to cite adverse precedent).

[68] Alvin M. Podboy, *The Shifting Sands of Legal Research: Power to the People*, 31 TEX. TECH L. REV. 1167, 1192–93 (2000) (quoting Steven Keeva, *The Joy of Not Knowing,* 26 L. PRAC. MGMT. 46, 46 (2000)) ("The amount of law the average lawyer is required to know these days seems to proliferate like some mutant culture spilling from legislative and judicial petri

complex and leads to behavioral variety that can demonstrate underlying tendencies within the law that would previously have remained undetected. Despite the changes in the way legal information is ordered and accessed, we know surprisingly little about how legal practitioners cite precedent and how those choices might influence the development of the law.

The practice of citing relevant law is one of the longest-standing legal traditions.[69] It can be traced at least as far back as the Roman Empire, when citations included pointers to specific civil code sections.[70] American citation norms were originally adopted from English standards and then subsequently evolved in conjunction with changes in the way legal information was published.[71] Today, the art of seeking out relevant precedent and citing it appropriately is one of the first legal skills that all American law students are taught.[72]

When seeking out legal information relevant to an issue, lawyers and judges must take a variety of considerations into account. Relevance is obviously one of the prime concerns, but is not necessarily an objective function of a case's details. Reasonable legal minds can disagree about whether a precedent applies or whether it is distinguishable.[73] In addition to relevance, practitioners must consider a precedent's authoritativeness and persuasiveness.[74] The passage of time plays into practition-

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dishes. And keeping up with clients' businesses in today's nanosecond environment demands constant vigilance."); *see also* Lawrence Duncan MacLachlan, *Gandy Dancers on the Web: How the Internet Has Raised the Bar on Lawyers' Professional Responsibility to Research and Know the Law*, 13 GEO. J. LEGAL ETHICS 607 (1999–2000).

[69] *See generally* Byron D. Cooper, *Anglo-American Legal Citation: Historical Development and Library Implications*, 75 L. LIBR. J. 3 (1982).

[70] *Id.* at 4.

[71] *Id.* at 17–20.

[72] *See* 2014–2015 STANDARDS & RULES OF PROCEDURE FOR APPROVAL OF LAW SCHOOLS Standard 302(b) (AM. BAR ASS'N 2014) [hereinafter AMERICAN BAR ASSOCIATION] (requiring ABA approved law schools to instruct students in legal research and writing).

[73] *See generally* Richard M. Re, *Narrowing Precedent in the Supreme Court*, 114 COLUM. L. REV. 1861 (2014).

[74] *See* Pound, *supra* note 7, at 5–6 (describing the common law norm of stare decisis, which is central to precedent citation choices, as

a technique of finding the grounds of decision in recorded judicial experience, making for stability by requiring adherence to decisions of the same question in the past, allowing growth and change by the freedom of choice from among competing analogies of equal authority when new questions arise or old ones take on

er's legal information searching as they attempt to find the most persuasive relevant precedent. As precedent becomes more distant, the analogies between cases grow weaker.[75] On the other hand, as precedent grows older it also becomes more well-established, and perhaps therefore more persuasive.[76] These factors all come into play when practitioners engage in legal information seeking.

Legal information seeking leaves a record. As lawyers, judges and clerks sort through the mass of legal information available to them, they leave traces of their search in their briefs and opinions by citing to the case law they rely upon. In common law systems cases are most commonly cited to invoke their authority.[77] We can therefore draw upon this record to help us understand not only how practitioners deal with the overwhelming amount of legal information available to them, but also to shed light on the practices and strategies that are related to particularly influential legal work. By empirically examining citation patterns and legal development, we can shed light on how the common law draws from the past to reinvent itself continuously. Our analysis will rely on studying the citations between cases and how citation patterns relate to a case's ultimate impact on the legal system. Before we proceed to describe our methods and results, we will briefly review the literature on legal citation analysis.

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new forms. In that technique, there is a distinction between binding authority and persuasive authority. The decision of the ultimate court of review in a common-law jurisdiction is held to bind all inferior courts of that jurisdiction and also the court itself in future cases involving the question of law decided or at least necessary to the decision rendered. Beyond that it may furnish an analogy and be the basis of legal reasoning upon new and different questions raised by different states of fact.

*Id.*).

[75] Some have even advocated for the "sunsetting" of precedent in some areas of law. *See, e.g.*, Katyal, *supra* note 7, at 1237.

[76] *See* Snyder v. Harris, 394 U.S. 332, 338 (1969) (arguing that there is a high bar to meet if the Court is to consider altering the interpretation of a statute if precedent shows it has been interpreted in a given for "more than a century and a half").

[77] Richard A. Posner, *An Economic Analysis of the Use of Citations in the Law*, 2 AM. L. & ECON. REV. 381, 385 (2000) ("In a system of case law, previously decided cases provide a reason independent of analytical power for reaching a particular outcome in the current case, and the citation of such a case is an invocation of that authority.").

### III. PRECEDENT, CITATIONS AND THE EVOLUTION OF THE LAW

The citation network created by judicial opinions as they cite one another can provide unique insight into the law.[78] Citations demonstrate the influence of prior opinions as they show how previous applications of the law are related to its future development.[79] While legal scholars have begun to explore ways to use citation analysis, previous work has done little to integrate our understanding of the relationship between the citations that opinions *make* and those they *receive*. In Part IV *infra* we will address this by not only proposing, but also applying, novel measures that provide powerful insight into the relationship between judicial opinion citations and case law importance.

The law is privileged with a uniquely rich citation tradition. In common law jurisdictions like the United States, there is an ethical obligation to cite relevant case law when drafting a brief.[80] Judges similarly ground their opinions in the law by citing to relevant precedent as they write their opinions.[81] These citations leave a rich record of relationships between cases as opinions cite precedent and the law evolves.

Scholars have drawn upon the law's rich citation data to analyze legal impact, judicial behavior, and legal evolution and change.[82] Each of these three types of legal citation analyses has contributed in its own way to our understanding of the law. However, much of the promise of legal citation analysis remains unrealized because scholars have yet to adequately integrate these various perspectives on citations. Although pre-

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[78] *See* Thomas A. Smith, *The Web of Law*, 44 SAN DIEGO L. REV. 309, 311 (2007) ("Applying network analysis to the Web of Law yields insights into the overall structure of law that are of significant jurisprudential interest.").

[79] *See* Charles A. Johnson, *Citations to Authority in Supreme Court Opinions*, 7 L. & POL'Y 509, 509 (1985) (arguing that "systematic analysis of citations hold potential for contributing to our understanding of the judicial process").

[80] Federal Rule of Civil Procedure 11 requires that a brief's legal arguments be "warranted by the existing law." Failure to cite a relevant precedent can expose lawyers to Rule 11 sanctions. Fed. R. Civ. P. 11(b)–(c).

[81] *See* Posner, *supra* note 77, at 382 ("Judges, lawyers who brief and argue cases, and law professors and students engaged in traditional legal-doctrinal research could all be thought . . . to make their living in part by careful citation both of judicial decisions and of law-review articles and other secondary materials.").

[82] *Id.* ("The seriousness with which the legal profession takes citations suggests that the analysis of citations in law is likely to uncover more systematic features, a more consistent practice, of citing than would a similar analysis in fields for which citing is of less consequence.").

vious research into legal citations has shown us which opinions are the most influential, how judges choose which citations to include, and how precedent depreciates as it ages, we have little understanding of how these three factors interact with one another. In Part IV we empirically analyze the relationship between the citations an opinion makes, the age of the precedent it cites and the citations it then ultimately goes on to receive, but first the following sections will briefly review prior research into legal citations.

### A. Incoming Citations: Measuring Impact

Judge Posner and Professor Landes provided one of the earliest calls for increased research into judicial citations.[83] In an early paper on the topic they empirically studied the citation practices of the federal judiciary.[84] Their analysis provides a description of how much precedent opinions cite, the age of that precedent, and the rate at which precedent depreciates.[85]

Subsequent work has followed from Posner and Landes's early analysis, carving out a small body of legal citation research. Much of this work uses citations as a proxy measure of an opinion's influence or importance.[86] Other work uses citations as a measure of a judge or circuit's influence on the law.[87] We can consider this the *citation impact* school of legal citation analysis. It largely parallels the sorts of analyses

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[83] Landes & Posner, *supra* note 12, at 252 ("[T]o the extent that judicial citation practices exhibit regularities explicable within a systematic analytical framework, a statistical analysis of precedent should reveal them.").

[84] *Id.*

[85] *Id.* at 252–84.

[86] Ryan C. Black & James F. II Spriggs, *An Empirical Analysis of the Length of U.S. Supreme Court Opinions*, 45 HOUS. L. REV. 621, 678 (2008) (showing that the length of Supreme Court opinions is a positive predictor of its incoming citations); Posner, *supra* note 77; Fowler & Jeon, *supra* note 15; Fowler et al., *supra* note 15; Smith, *supra* note 78; Ryan Whalen, *Bad Law Before It Goes Bad: Citation Networks and the Life Cycle of Overruled Precedent*, *in* NETWORK ANALYSIS IN L. (Radboud Winkels et al. eds., Law, Science & Technology, ESI 2013).

[87] *See, e.g.*, William M. Landes et al., *Judicial Influence: A Citation Analysis of Federal Courts of Appeals Judges*, 27 J. LEGAL STUD. 271, 271 (1998) ("This article uses citations to the published opinions of judges . . . to measure the influence of individual judges."); Stephen Choi & Mitu Gulati, *A Tournament of Judges?*, 92 CALIF. L. REV. 299 (2004) (proposing the use of citation impact as an objective criteria to help guide judicial promotions).

used to assess impact in many areas of scientific research.[88]  This body of work is characterized by its focus on incoming citations, those citations that an opinion receives from future opinions.[89]  Measuring these citations provides insight into how much influence a given opinion has on the future application and development of the law.  However, this focus on incoming citations is not the only way that legal citations can be used in empirical research.

## B.  Outgoing Citations: Understanding Judges

Outgoing citation research focuses not on the citations that cases receive from later opinions, but on the citations that opinions *make.* Rather than trying to measure a case's importance, this body of work attempts to better understand how and why judges make the citations that they do.  Professor Merryman undertook one of the earliest empirical projects in this area, analyzing the citations in opinions written by the California Supreme Court.[90]  This and other work demonstrates the importance of both traditional legal concerns (*e.g.* stability and authority) and more commonplace decision-making processes (*e.g.* habit and prestige) to judicial citation decisions.[91]

More recent work focusing on the citations that judges make has approached the issue as a case study in judicial behavior.  This work often seeks evidence of bias in judicial decision-making by tracking the relationship between judicial citation behavior and ideology.[92]  Choi and Gulati use citation analysis to show that judges cite opinions written by judges of the opposite political party less frequently than we would ex-

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[88] *See, e.g.*, EUGENE GARFIELD & ROBERT KING MERTON, CITATION INDEXING: ITS THEORY AND APPLICATION IN SCIENCE, TECHNOLOGY, AND HUMANITIES (Wiley N.Y. 1979); Eugene Garfield, *Citation Analysis as a Tool in Journal Evaluation*, 178 SCI. 471 (New Series, 1972); Leydesdorff, *supra* note 15; Michael J. Moravcsik & Poovanalingam Murugesan, *Some Results on the Function and Quality of Citations*, 5 SOC. STUD. OF SCI. 86 (1975).

[89] In some areas of research, notably in patent citation analyses, incoming citations are referred to as *forward* citations because they can be traced forward in time through the citation network.

[90] Merryman, *The Authority of Authority*, *supra* note 12, at 650-72.

[91] *Id.* at 654; *See also* Merryman, *Toward a Theory of Citations*, *supra* note 12 (providing a broader examination of citation practice).

[92] For an overview of research into judicial behavior, see Jeffrey A. Segal & Albert D. Cover, *Ideological Values and the Votes of US Supreme Court Justices*, 83 AM. POL. SCI. REV. 557, 557–59 (1989).

pect by chance.[93]  Similarly, they show that there appears to be citation cliques amongst judges with many judges preferring to cite opinions written by judges who have previously cited them.[94]

Research focusing on outgoing citations provides insight into choices that judges make, showing us how they choose to support their decisions.  However, by only focusing on the outgoing citations, we lose the ability to measure how citation decisions might affect an opinion's future impact or influence future legal evolution.

### C.  Using Citations to Measure Legal Evolution and Change

In addition to the insight they provide into judicial behavior and the impact that cases have on the legal system, we can use citation patterns to measure legal change and evolution.  By tracking citations over time, we can see how quickly decisions go on to have an impact on the legal system and how long their influence lasts.

Much of this work focuses on "precedent depreciation" as it measures the rate at which cases are cited after their publication.[95] Scholars have long noted that the passage of time has ambivalent effects on legal precedent.[96]  On the one hand, the passage of time lends opinions authority, as they remain on the books the norm of *stare decisis* bestows a sense of permanence upon judicial opinions.[97]  On the other hand, as time goes by, society and the law that regulates it changes. The social and legal transformations that accompany the passage of time make the factual (and perhaps the ideological) analogies between current

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[93] Stephen J. Choi & G. Mitu Gulati, *Bias in Judicial Citations: A Window into the Behavior of Judges?*, J. LEGAL STUD. 87, 87 (2008).

[94] *Id.*

[95] *See, e.g.*, Ryan C. Black & James F. Spriggs II, *The Citation and Depreciation of U.S. Supreme Court Precedent*, 10 J. EMPIRICAL LEGAL STUD. 325, 325 (2013) ("An enduring piece of legal wisdom contends that the value of court opinions depreciates as they age . . . ."); Landes & Posner, *supra* note 12, at 255 (showing that Supreme Court decisions depreciate more slowly than their lower court counterparts).

[96] Case law also treats precedent age ambivalently. *Compare* Runyon v. McCrary, 427 U.S. 160, 186 (1976) (Powell, J., concurring) (arguing that precedent is more relevant when the case was "recently" decided) *with* Washington v. W.C. Dawson & Co., 264 U.S. 219, 238 (1924) (Brandeis, J., dissenting) (arguing that stare decisis has less sway when "[t]he decisions are recent ones").

[97] John W. Salmond, *The Theory of Judicial Precedents*, 16 L. Q. REV. 376, 382 (1900) ("[A] precedent acquires added authority from the lapse of time.").

legal disputes and aging precedent less fitting. As a result, while we might believe that older and more venerable precedent has more authority, evidence shows that precedent depreciates quite quickly, and generally becomes all but dormant within thirty years of publication.[98]

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These three types of legal citation analyses—focusing on impact, judicial behavior, and precedent depreciation—have each contributed to our understanding of the law. However, we know little about how they work in conjunction with one another. How does the judicial behavior that determines which citations are included in an opinion interact with the cited precedent's age and the ultimate impact that the decision will have?

We propose a novel method of legal citation analysis that accounts for not only the incoming or outgoing citations, but also measures how the cases that a judge cites in her opinion relate to that opinion's ultimate probability of having impact on future legal developments. This new method unites the three types of citation analysis above by looking to judicial behavior, precedent age, and legal impact. Doing so allows us to better understand how judges deal with the explosion of legal information available and ground their opinions in the past. We show that there are four distinct citation patterns, and that these patterns hold across common law jurisdictions. One pattern is particularly strongly associated with judicial opinions that go on to have a significant impact on the legal system. But, before we move on to discuss our results, let us first describe our methods.

## IV.  METHOD & RESULTS

Simultaneously tracking both the citations that judicial opinions make and those they receive allows us to empirically examine how practitioners navigate the legal knowledge landscape. As judges draft opinions, they and their clerks search back in time for precedent relevant to their holdings. The citations to these precedents demonstrate how judges

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[98] Black & Spriggs, *supra* note 95, at 343 fig. 1 (showing the steep depreciation curve for Supreme Court precedent); *see also* Salmond, *supra* note 97, at 383 ("A moderate lapse of time will give added vigour to a precedent, but after a still longer time the opposite effect may be produced, not indeed directly, but indirectly through the accidental conflict of the ancient and perhaps partially forgotten principle with later decisions.").

rely on the past in order to justify the legal decisions of the present. We measure these citations both in terms of their age and the variance of their ages and subsequently demonstrate that there is a universal type of judicial citation behavior that dominates all others in predicting high-impact cases.

This sort of "chronometric" analysis demonstrates the role that time plays in the development of the common law. Measuring the age and age-variance of cited precedents reveals how far back in time opinion drafters reach to find relevant precedent, and the degree to which they draw on precedent from a wide range of times. This Article represents the first time this has been done in the context of legal decisions, in doing so we reveal fascinating universality in the way the common law evolves.

## A.  The Measures

1. *Chronometric Reach*—Chronometric reach—defined as the average age of precedent that an opinion cites—provides a key insight into how the opinion integrates prior legal knowledge. This variable measures the average number of years an opinion "reaches" back in time for relevant precedent measured over all the prior cases it references. Cases with a high average citation age rely on older, likely well-settled, law to support their conclusions while those with a low mean citation age rely on opinions decided more recently. Chronometric reach speaks to how dynamic a legal system is. A hypothetical legal system with predominantly high mean citation ages would tend to be more conservative (i.e., new cases reference relatively older work) than one with a low mean citation age (i.e., new cases reference relatively recent work). By consistently relying on older case law, legal change would tend to occur more slowly in a high mean citation age system.

On the other hand, a legal system where new cases are predominantly cited allows for more rapid doctrinal evolution. If we accept that the norm of stare decisis generally discourages abrupt legal change, then we can see that a tendency to cite to newer cases allows judges to engage in incremental legal change more quickly.[99] Citing to consistently newer

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[99] Jill E. Fisch, *The Implications of Transition Theory for Stare Decisis*, 13 J. CONTEMP. LEGAL ISSUES 93, 96 (2003) ("A court that is precluded from ignoring or overruling a precedent is limited to more evolutionary forms of lawmaking. Over a series of decisions, a prece-

cases allows judges to compound the minor changes made by previous judges.[100]  Over time this results in doctrine that transforms more quickly than it would have in a legal system more inclined to rely on older cases.

In the analysis that follows, we measure citation age as the mean age of all precedent cited by cases in our dataset.  As a simplified example, consider an opinion issued in 1995 that cites four precedents, one issued in 1990, one in 1980, one in 1987, and one in 1985.  This opinion's chronometric reach would be 7.5.[101]  For more specific examples of how this measure is calculated, consider two recent Supreme Court decisions: *Texas Department of Housing and Community Affairs v. The Inclusive Communities Project, Inc.*[102] and *Horne v. Department of Agriculture*.[103] If we look to the references made in the court's *Inclusive Communities* opinion, the average age of precedent cited is 33.9 years.[104]  On the other hand, the *Horne* opinion references significantly older precedents with an average age of 50.1 years.[105]  Measuring chronometric reach in this manner provides insight into the degree to which an opinion primarily relies on new or old law. However, it does not account for how mixed the opinion is in the ages of cases it relies upon.  For that, we need to measure chronometric range.

2. *Chronometric Range*—The variance in ages of the precedent cited by an opinion provides further insight into how it is grounded in existing law.  This variable measures how wide-ranging an opinion is in choosing relevant precedent from which to cite.  To detect the age variance element of an opinion's citations we measure the chronometric range by taking the coefficient of variation of the ages of cited precedent. Using the same simple four citation example as above, an opinion written

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dent that is never formally overruled may lose much of its force through incremental judicial decision making.").

[100] *Id.*

[101] First, we calculate the age of each cited case (5, 7, 8, and 10 years in this case).  Then, take the mean of those ages.

[102] Texas Dep't of Hous. & Cmty. Affairs v. Inclusive Cmtys. Project, Inc., 576 U.S. __, 135 S. Ct. 2507 (2015).

[103] Horne v. Dep't of Agric., 576 U.S. __, 135 S. Ct. 2419 (2015).  *Horne* and *Inclusive Communities* were decided within days of one another, and as of this writing it is not clear which will go on to be the more influential case.  As we will show below, our method of chronometric citation analysis provides insight into the likelihood that each of these cases will go on to be a frequently-cited high impact case of the future.

[104] *Inclusive Cmtys. Project, Inc.*, 576 U.S. __, 135 S. Ct. 2507.

[105] *Horne*, 576 U.S. __, 135 S. Ct. 2419.

in 1995 citing precedent from 1990, 1988, 1987, and 1985 would have a chronometric reach of 0.240.[106]  For more specific examples, consider the *Horne*[107] and *Inclusive Communities*[108] opinions referred to above. We saw above that the Inclusive Communities opinion has a chronometric reach of 33.9.  The standard deviation of ages cited in this opinion is 30 giving us a coefficient of variation, or chronometric range, of 0.89. The *Horne* opinion has a chronometric reach of 50.1, and a standard deviation of 36.74, giving us a chronometric range score of 0.73.  So, we see that although *Inclusive Communities* has a lower chronometric reach than *Horne*—meaning it cites to comparatively recent precedent—it has a higher chronometric range score—showing that it cites to precedent from across a wider, more dispersed temporal range.

Opinions with high chronometric range scores cite precedent from across a wide range of ages that are centered around the mean age.  Thus, range reveals how widely or narrowly around the mean reference age are the references in the ruling.  If two rulings have similar variance but different means, they will reference different sets of precedent.  The coefficient of variation reveals how widely or narrowly around the mean age are the ages of the references works controlling for differences in the size of the mean age.  By referring to both newer and older cases, these opinions with high range integrate case law across the decades grounding themselves in both well-established and newer judicial opinions.  On the other hand, opinions with low range cite cases from a single period in time, whether that period is recent or distant.  These low range cases integrate only a small temporal segment of the law.  Figure 1 shows a graphical representation of how both of our measures are calculated.

We currently know very little about the chronometric reach or range of judicial citations.[109]  In addition to our lack of knowledge about how judges integrate precedent from different time periods, we know even less about how these choices relate to an opinion's ultimate impact.

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[106] The coefficient of variation is defined as the ratio of the standard deviation to the mean. In our example opinion's case the standard deviation is 1.803 normalizing by the mean of 7.5 results in 0.240.

[107] *Horne*, 576 U.S. __, 135 S. Ct. 2419.

[108] *Inclusive Cmtys. Project, Inc.*, 576 U.S. __, 135 S. Ct. 2507.

[109] For instance, in their relatively small sample, Landes and Posner show that the half-life of Supreme Court citations to Supreme Court precedent was 13 years, that the age distribution is skewed, and that the skewness arises partially because of the growing production of precedent. Landes & Posner, *supra* note 12, at 255.

In the following, we will explore how judicial opinions cite to precedent from preceding years and decades, and subsequently analyze how those citation tendencies relate to impact. In doing so, we show that high impact cases are much more likely to demonstrate particular chronometric reach and range patterns. This is true not only for opinions of the United States Supreme Court but also for cases from a variety of common law high courts.

**Figure 1**
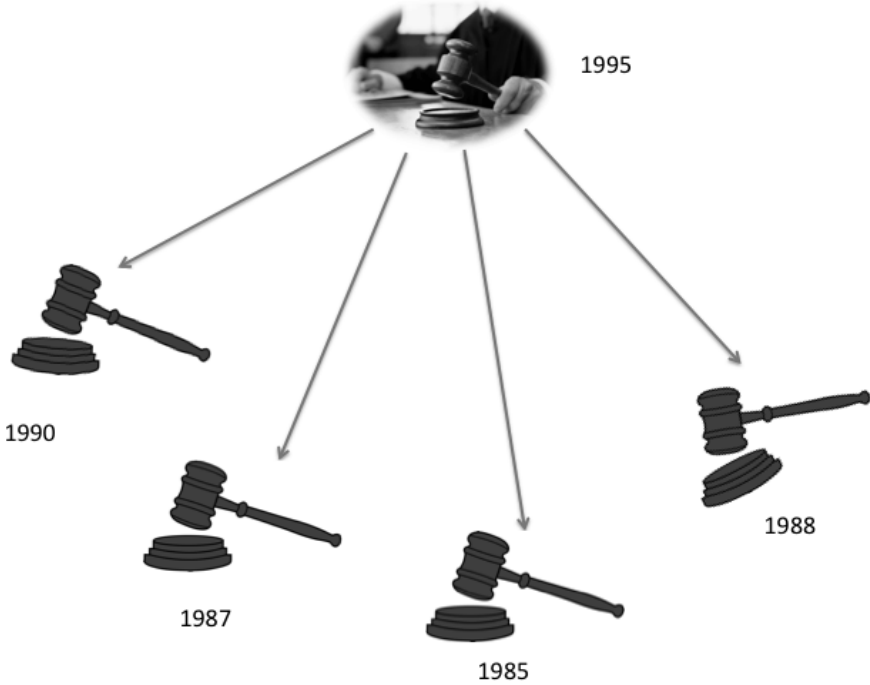


**Demonstration of citation of Supreme Court judgments**. A judgment in 1995 cites four precedents delivered in 1990, 1988, 1987 and 1985. We measure the observed chronometric reach and chronometric range of the decision in 1995. In this example the chronometric reach is 7.5 and the coefficient of variation (chronometric range) is 0.240.

## B.  The Data

We apply our chronometric reach and range analysis on decisions written by high courts in three common law countries.  Our data for the United States Supreme Court includes all decisions issued from 1895 to

1994.[110]  These 19,234 decisions contain 216,754 of citations to Supreme Court precedent.  We also analyze the highest courts in both India[111] and Canada.[112]  Our Canadian Supreme Court data includes all decisions from 1950 to 2006.  These 3416 of opinions contain 22,762 citations. The Indian Supreme Court data we analyze extends from India's independence in 1947 to 2006 and includes 275,251 citations.

We measure both the chronometric reach and chronometric range of each case in our dataset.  Our measurement proceeds in three steps:

Compute the difference between the publication year of the focal judgment and the publication years of its referenced precedents.

Compute the mean of the values in (1) to assign a *chronometric reach* to a judgment.

Compute the coefficient of variation for the values in (1) to assign a *chronometric range* to a judgment.

In addition to the chronometric reach and range measures, we note how many times each case is cited by future cases.  This forward citation measure provides insight into which cases are particularly influential.[113]

## C.  Results

There is substantial variation in the way in which judicial opinions ground themselves in existing law.  The below will first briefly describe our chronometric reach and range findings before looking at the two in tandem, and subsequently demonstrating how a single pattern tends to crop up repeatedly in high impact opinions.

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[110] Our data extends to 2002, but in order to study impact, we need to allow time for opinions to receive citations.  Our impact analysis looks to the number of citations that an opinion receives in the first eight years after it is decided.

[111] We gathered Indian Supreme Court data from the Legal Information Institute of India. *See* LEGAL INFORMATION INSTITUTE OF INDIA, http://liiofindia.org/ (last updated Aug. 26, 2016).

[112] Our Canadian Supreme Court Data comes from the Canadian Legal Information Institute. *See* CANADIAN LEGAL INFORMATION INSTITUTE, https://www.canlii.org/en/ (last visited Aug. 26, 2016).

[113] Fowler et al., *supra* note 15, at 336–43.  The authors' findings suggest that the number of citations a case receives is a useful measure of how important that case is. This measure is positively correlated with both the number of amici briefs filed in relation to the case, and the likelihood that the *New York Times* will cover a case's outcome.  *Id.*

*Reach & Range Individually*—The United States Supreme Court's citation history demonstrates a clear preference for citing recent precedent. We can see this by comparing the chronometric reach of observed citations with the reach we would expect to see if citations were made at random across time (i.e., if referencing behavior showed no biases related to time). By comparing our real observations with simulated observations that we design to show no biases in time (see Figure 2), we see a clear and growing divergence between the observed chronometric reach and the reach we would expect to see if there were no underlying preference for recent precedent. The mean chronometric reach across years varies somewhat, but stays generally within the 10-30 years range. The reach we expect to see increases almost linearly as each issued opinion contributes to a stock of precedent that ages consistently with each passing year.[114] This bias towards citing recent precedents shows general agreement with the literature on precedent depreciation. There, scholars have shown that precedent is most likely to attract citations in the first few years after it is published.[115]

The range values are relatively stable over time, with a mean of 0.8025. This shows that the standard deviation of the age of precedent cited in U.S. Supreme Court opinions is about 80% as large as the mean age cited. So, on average we would expect a case with a chronometric range of 20 years, to have a chronometric reach of about 16 years.

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[114] This tendency to cite recent precedent is also present in the Canadian Supreme Court data. *See* CANADIAN LEGAL INFORMATION INSTITUTE, https://www.canlii.org/en/ (last visited Aug. 26, 2016). There, the mean reach range also varies between around 10-30 years, and demonstrates a clear and growing divergence from the reach we would expect if citations were made at random. *Id.* Interestingly, the Indian Supreme Court citation data shows a different pattern. *See* LEGAL INFORMATION INSTITUTE OF INDIA, http://liiofindia.org/ (last updated Aug. 26, 2016). Indian Supreme Court decisions are less likely to cite to previous Indian Supreme Court precedent—preferring statutory citations—this difference in citation norms provides useful variation in the data we analyze. *Id.* We show below that, even though the Indian Supreme Court has substantially different citation norms, the universal pattern associated with high impact cases remains true for the Indian Supreme Court as it does for other common law high courts.

[115] *See* Black & Spriggs, *supra* note 95, at 342 (demonstrating that for most cases the probability of being cited is highest only a few years after issuance. By year 20, the probability of being cited has largely dissipated).

**Figure 2**
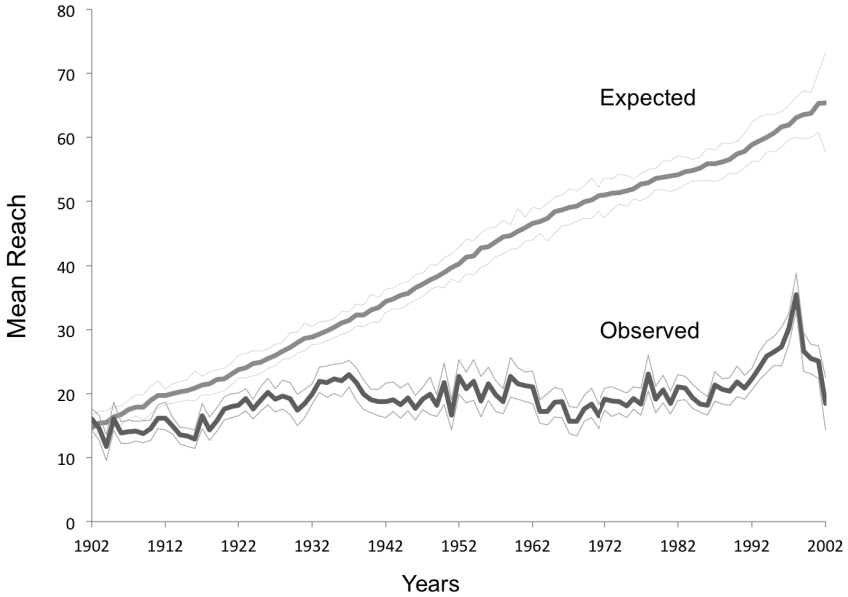


*Reach & Range Together*—When we simultaneously take into account both chronometric reach and range, we find commonalities amongst all of the jurisdictions we study. Accounting for both measures simultaneously allows us to classify the citation patterns in opinions into four distinct types:

*Low Reach / Low Range*: These opinions cite primarily to recent precedent. They feature both low chronometric reach and low chronometric range.

*Low Reach / High Range*: These opinions cite primarily to recent precedent, but also feature more citations to older precedent than their *low reach/low range* counterparts. This results in low chronometric reach—although not as low as that seen in the *Low/Low* category—but high chronometric range.

*High Reach / Low Range*: Opinions demonstrating the *high reach/low range* citation pattern ground themselves in primarily older precedent. Citing to older case law leaves them with high chronometric

reach scores, while the exclusion of more recent citations results in a low chronometric range score.

*High Reach / High Range*: These opinions cite to precedent across a wide variety of ages. This results in both high chronometric reach and chronometric range scores.

We define these types by plotting chronometric reach and range along two axes and subsequently looking to the four quadrants of the plot. In our analysis below we report results from dividing the distribution based on the mean of both the range and reach measure.[116] This separates opinions into one of the four types described above.

Table 1

|            | Low Range | High Range |
|------------|-----------|------------|
| Low Reach  | 20.2 %    | 20.2%      |
| High Reach | 39.4%     | 19.9%      |

Table 1. Showing the distribution of the four types of citation patterns in United States Supreme Court opinions.

The low reach/low range, low reach/high range, and high reach/high range patterns each makes up makes up about 20% of all opinions while the high reach/high range pattern accounts for almost 40% of all cases. However, one type of citation pattern is much more likely to appear in particularly influential opinions.

*Chronometric Patterns and Case Impact*—We have shown above that there is wide variation in the way judges ground their opinions in precedent. Some focus on newer precedent, some on older. Some cite to precedent spanning many decades, while others limit their citations to opinions issued within a short window of time. These observations help us better understand how the law is applied, but do little to help us understand how the law evolves. To understand how time factors into legal evolution we need to look both backward, at the citations that opinions make, and forward to the citations they receive. Doing so shows us that, although there is substantial variation in how judges draw on the past, opinions that use the low reach/high range citation pattern are much more likely to be the high impact cases that go on to receive many cita-

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[116] To test the robustness of our results we also replicated our analysis after dividing into quadrants based on the median rather than the mean. This leads to no substantial differences in outcome.

tions.  These opinions with their low chronometric reach and high chronometric range draw primarily on relatively recent precedent, but also cite to more distant opinions.  Our analyses below show that this type of citation pattern is much more likely to be associated with particularly important Supreme Court precedent, and that this association holds across common law jurisdictions.

In order to measure how citation practices relate to an opinion's ultimate impact, we define "highly influential" cases and measure how citation patterns affect the probability that an opinion will become highly influential in future years.  A highly influential case is any opinion that later goes on to be in the top 5 percent of cited cases in the eight years after it is decided.  This measure identifies those cases that go on to have a particularly out-sized effect on the legal system.[117]  Figure 3 below shows the probability that cases will go on to become highly influential based on the type of citation pattern they exhibit.  In these graphs, the dotted "no difference" line represents the baseline probability that any opinion will be a "highly influential" one.  The y-axis shows multiples of how much more or less likely it is that a case in any of the four categories will go on to become highly influential. So, a value of 2X demonstrates that a case is twice as likely as the background rate to go on to become highly influential.

It is immediately obvious that the low reach/high range cases are uniquely likely to become highly influential cases.  The 95% confidence intervals plotted here show the margin of error in our estimates of the mean[118] and show that the difference we observe is both statistically and substantively significant.  On the other hand, we see that the other three types of citation patterns have similarly low, and barely distinct, proba-

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[117] To be certain that our particular definition of "highly influential" cases was not driving the results, we varied the definition to include cases that go on to be in the top 1 and top 10 percentile and observed no substantial change to our results.  We feel that using a binary highly influential or not-highly influential definition as opposed to a continuous measure of impact (e.g. number of citations received) is preferable given the highly skewed nature of the citation data in question. Most cases have minimal impact on future legal evolution, while there are a relatively small number of stand out cases that go on to have very high impact.  *See* Fowler & Jeon, *supra* note 15, at 19, fig. 2.  Our binary "highly influential" definition helps us measure the relationship between citation practices and these uncommon-but-important cases.

[118] The 95% confidence interval is standard in statistical studies, it is akin to a margin of error value in polling, and says that average behavior falls within this interval nineteen times out of twenty.  *See generally* Robert J. Thornton & Jennifer A. Thornton, *Erring on the Margin of Error*, 71 S. ECON. J. 130 (2004) (explaining use of confidence interval and margin of error).

bilities of going on to become highly influential. In fact, in all three of the jurisdictions we examine, both the high reach/low range and low reach/low range types of opinions are significantly *less* likely to go on to be highly influential, while the high reach/high range opinions have essentially the same probability as the background rate. Only the low reach/high range opinions are significantly *more* likely to be highly influential and the difference is substantial.

The uniqueness of the low chronometric reach and high chronometric range cases remains significant when we subject our data to statistical analysis. Using a multivariate model that allows us to control for a variety of factors that we would expect to be related to how likely an opinion is to be highly influential,[119] we find that chronometric reach remains negatively associated while chronometric range is positively associated with the probability that an opinion will go on to become highly influential.[120] These findings suggest the outsized influence that these low reach / high range cases have is truly related to these chronometric patterns rather than some other element. of the opinion.

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[119] We control for a variety of factors that one would expect might be associated with how many citations an opinion receives. These include the year of publication, the number of references the opinion makes, and the importance of the cases it cites. Below we explore additional explanations such as the legal issues covered in the cases, whether they overrule existing precedent and the ideology of the drafting judge. *See infra* Part V.

[120] Refer to Appendix A for a further discussion of these results and their implications.

**Figure 3**
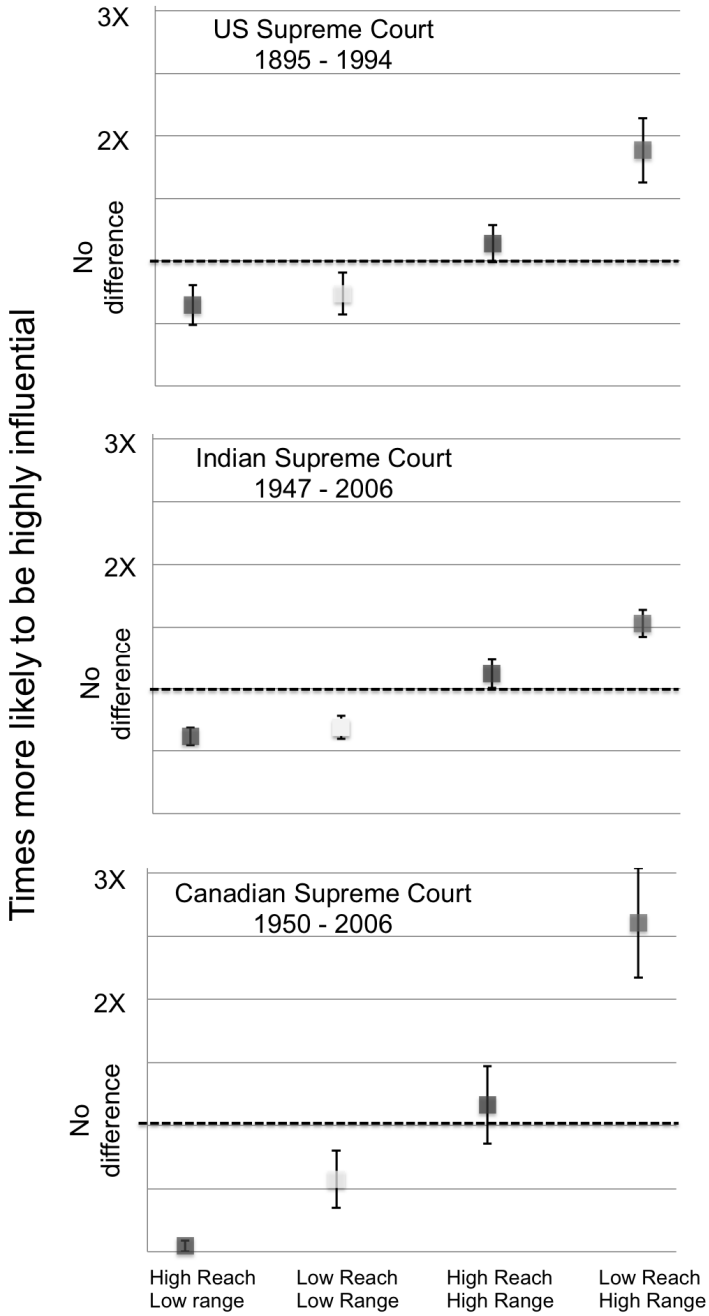
Our findings help provide insight into which cases will go on to become particularly influential in the future. Consider *Horne*[121] and *Inclusive Communities*,[122] the sample cases we previously examined.[123] Recall that *Horne* had a chronometric reach of 50.1 years and a range of 0.73, while *Inclusive Communities* had a chronometric reach of 33.9 years and a chronometric range of 0.89. Both of these cases were decided very recently, and as of yet we have little insight into which will be more influential in the future. However, our results suggest that if we had to choose which of them would be more influential, knowing nothing about the substance of the cases or potential future related legal developments, we would confidently select *Inclusive Communities* as the more likely stand out case. It relies on a more recent body of precedent, as reflected in its relatively low chronometric reach. Meanwhile, it also draws on precedent from a wider range of ages, as reflected in its range score of 0.89. Our analysis shows that this lower chronometric reach and higher range are both related to case impact.

This sort of phenomenon appearing in one court might be dismissed as an idiosyncratic outcome of that court's citation norms. However, to observe almost identical results across jurisdictions suggests some universal process underlying the evolution of the common law. For some reason, or perhaps a collection of reasons, important cases are much more likely to cite primarily to recent law while also reaching back to more distant precedent. Although it is beyond the scope of one paper to both uncover and fully-explain this phenomenon, we offer some potential interpretations of these findings below.

## V.  Interpreting our Results

As shown above, there is a pattern of citation behavior that appears to be universal across common law high courts. Opinions that cite predominantly recent precedent, while also reaching back further into the past to draw upon older precedent, are significantly more likely to be high impact decisions.[124] In this Part we discuss some potential explanations for why this is the case. There is a variety of plausible explanations

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[121] Horne v. Dep't of Agric., 576 U.S. __, 135 S. Ct. 2419 (2015).

[122] Texas Dep't of Hous. & Cmty. Affairs v. Inclusive Cmtys. Project, Inc., 576 U.S. __, 135 S. Ct. 2507 (2015).

[123] *See supra* Part IV.A.

[124] *See supra* Part IV.C.

for why high impact cases are more likely to use the low reach/high range citation pattern. One might suspect that these cases are those that go on to alter precedent and thus garner more citations. Alternately, there could be some systematic differences in the way the legal issue a case deals with influences both its citation pattern and the likelihood that it will go on to be cited. Judicial ideology presents another possible explanation for citation tendencies.[125]

In exploring these possible explanations for our observations, we show that none of them adequately explains our results. There is no apparent relationship between the low reach/high range pattern and opinions that alter precedent. Similarly, our results hold even when we control for the legal issue cases deal with, suggesting that the issues in question are not driving our results. We do find some relationship between our results and the degree of controversy surrounding a case. When Supreme Court justices are in disagreement about the outcome of a case, they are more likely to draft a low reach/high range opinion, and those opinions are more likely to go on to become highly influential. However, this relationship is relatively weak and can only partially explain our findings. Similarly, it does not appear to be the case that judicial ideology drives our results. When we test for judicial ideology effects we see little relationship between ideology and citation styles.

## A. Overruling Cases

As we attempt to understand why opinions with citations that have low reach but high range might go on to be cited more, one might wonder whether this phenomenon is related to alterations in precedent. After all, an opinion that overrules or strongly alters established precedent would seem to fit the low reach/high range pattern. It would perhaps cite to recent precedent discussing the latest treatment of the legal issue in question, while also citing to the more distant precedent that it overrules. If this is the case, and opinions that alter precedent themselves go on to be cited more than usual, it could partially explain why low reach/high range cases are more influential.

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[125] In addition to the potential explanations for the findings examined in this Part, a consideration has been made as to whether the observations made were reflective of some universal tendencies in legal writing.

However, when we examine the probability of each type of citation pattern resulting in altered precedent, we see that both the low reach/high range pattern and the low reach/low range pattern are equally *unlikely* to be used in opinions that alter precedent.[126]  On the other hand, the high reach/high range and high reach/low range patterns are about two-and-a-half times more likely to be used in precedent altering opinions.[127]

**Figure 4**
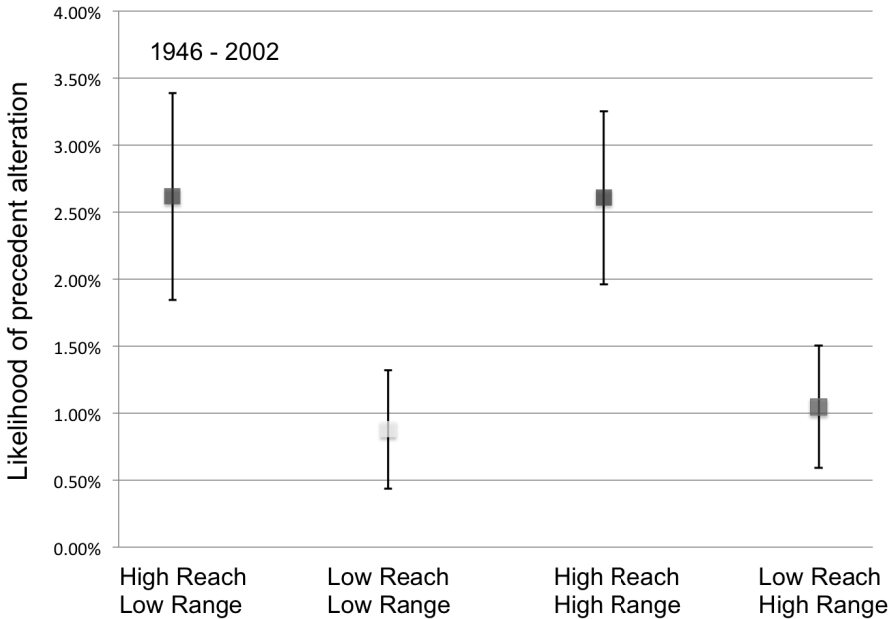


This demonstrates that the relationship between the low reach/high range pattern and impact does not arise due to a relationship between using the low reach/high range pattern in opinions that overrule precedent. Rather, opinions that overrule precedent are more likely to use the high reach/high range or high reach/low range patterns.  This makes intuitive sense as both of these patterns feature high chronometric reach and these

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[126] We rely on the Supreme Court Database's "Formal Alteration of Precedent" variable for this analysis.  *See* Harold J. Spaeth et al., 2014 Supreme Court Database, Version 2014 Release 01, http:///scdb.wustl.edu/_brickFiles/2014_01/SCDB_2014_01_codebook.pdf.

[127] Note that no opinion is *likely* to alter precedent because opinions that explicitly alter precedent are rare occurrences.

sorts of cases must almost by definition deal with older cases and discuss the evolution of a particular doctrinal area.

### B.  *Legal Issues & Controversy*

Another way to consider our results is to think about the observed citation patterns as an outcome of the legal issue in question.  It could be that some legal issues lend themselves to judicial opinions that cite relatively recent precedent while also interspersing citations to older precedents.  If these types of legal issues were also in areas that are frequently litigated or otherwise likely to be highly cited at the Supreme Court, it could in part explain why low reach/high range cases are more likely to be highly influential.

Our results[128] show that even when we control for the legal issue area of the cases, low chronometric reach and high range remain significantly related to the probability that a case will go on to become highly influential.[129]  This suggests that our findings about the association between the low reach/high range citation pattern and high influence cases is not limited to cases that deal with a subset of legal issues.  Rather, in addition to being general across common law jurisdictions, the association appears to be general across legal issue areas.

Although the general legal issue area does not appear to be driving our results, one might suspect that the *specific* issues that cases deal with affect both the way judges draw on precedent and the impact that cases go on to have.  While we cannot statistically control for the specific legal issue covered in each case, we can consider whether or not the underlying issues affect citation behavior by looking at the degree of controversy and disagreement surrounding the litigated issues.  When there is substantial disagreement on the Court as to the correct outcome of a case,

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[128] The results discussed here, where legal issue areas were controlled, are substantially unchanged from those reported in Appendix A, Table 2.

[129] The chronometric distance variable loses significance in the model, including all of the control variables.  This is likely due to a reduction in statistical power.  As this study only used issue area data for years 1946 and on, this study dealt with a substantially smaller dataset than that used for the models reported in Table 2 in Appendix A.  Along with the smaller dataset, the addition of the legal issue area fixed effects adds fourteen dummy variables to the model, decreasing this study's statistical power.

the Justices leave a record of their disagreement in the vote count. Cases with unanimous vote outcomes suggest that the underlying legal issue is not as controversial as a decision resulting in a split vote.[130]

If we examine the various types of citation patterns and how they relate to non-unanimous votes, we again see that the low reach/high range pattern is unique amongst its peers (see Figure 2).[131] Opinions that cite to relatively recent, but also temporally dispersed, precedent are significantly more likely to arise from cases where the Justices disagree. The other three citation patterns are statistically equivalent to one another in the degree to which they are associated with split votes. However, low reach/high range opinions are about 10% more likely to arise when the Justices do not agree.

**Figure 5**
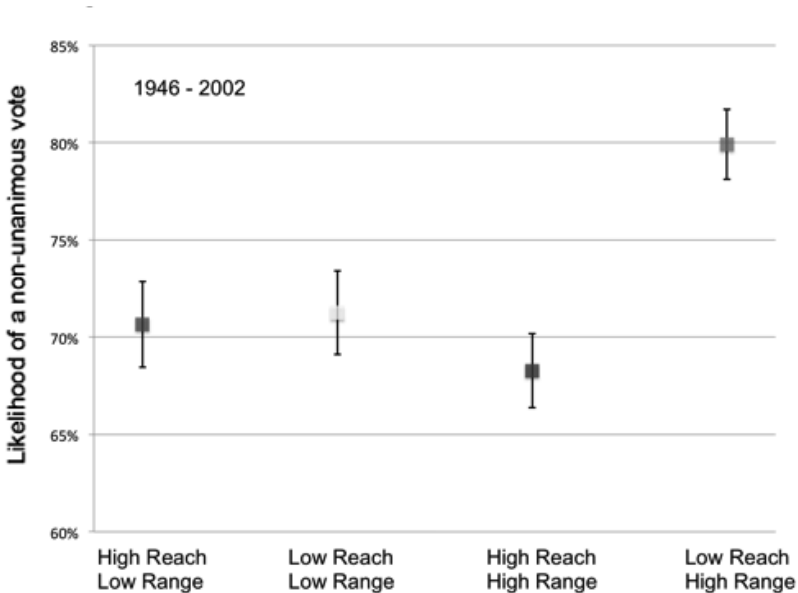


It is clear that, in addition to their relationship with highly influential cases, opinions using the low reach/high range citation pattern are al-

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[130] For a general discussion on unanimity on the Supreme Court, see Harold J. Spaeth, *Consensus in the Unanimous Decisions of the U.S. Supreme Court*, 72 JUDICATURE 274 (1989).

[131] We use the Supreme Court Database's voting data for this analysis. *The Supreme Court Database*, WASH. U. L., http://supremecourtdatabase.org/data.php?s=2 (last visited May 5, 2017).

so related to controversial legal issues. These two relationships may themselves be related to one another. When we examine whether cases featuring controversial issues are more likely to go on to be highly influential, we do see a moderate correlation.[132] These moderate correlations suggest that cases with split votes do indeed go on to receive slightly more citations than unanimous cases and are somewhat more likely to become highly influential cases. However, despite their significance the magnitude of the relationship between split votes and case impact is relatively low suggesting that case controversy does not fully explain why low reach/high range opinions are much more likely to go on to be influential than their peers.

It makes sense for the Justices to treat controversial cases with split votes differently than those they unanimously agree upon, because the issues these cases involve have different potential to reoccur in future cases. At the outset, controversial issues are more likely to reach the court.[133] A unanimous decision provides a strong signal to lower courts about what outcomes should be, and to potential litigators about the outcome to expect should they petition the Court on a similar issue. On the other hand, the split votes that controversial issues lead to provide mixed signals and some encouragement to litigants by demonstrating the disagreement that exists on the Court. Furthermore, the Court may be more likely to grant writs of certiorari when disagreement on the Court exists, so that they have the opportunity to provide clarity about the state of the law.[134] The divergent futures that controversial and non-controversial legal issues have present the Justices with different scenarios as they consider the implications of unanimous and split decisions. As they draft their opinions, these implications may affect how an opinion draws from the past and cites precedent.

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[132] The correlation between having a split vote and being a highly influential case is 0.0533, while the correlation between having a split vote and the number of citations a case receives is 0.0956. Both correlations are significant at the $p < 0.001$ level.

[133] Spaeth, *supra* note 130, at 274 (stating that "one should not expect the Court to decide cases about which consensus exists").

[134] Certiorari is often granted with just a plurality of votes. Those in the minority might vote to hear cases on similar issues with the hope that the development of the law will favor their position. *See* Margaret Meriwether Cordray & Richard Cordray, *The Philosophy of Certiorari: Jurisprudential Considerations in Supreme Court Case Selection,* 82 WASH. U. L. Q. 389, 405, 407, 410–12 (2004).

If we assume that Supreme Court justices engage in somewhat different writing and citation styles when drafting a unanimous as opposed to a split-vote decision, we can see a potential explanation for why the low reach/high range pattern is more common in split vote opinions. Split vote opinions must be drafted with the knowledge that at least some members of the Court disagree.  This raises the specter of future disagreements involving the same issue, and increases the likelihood that the case in question will be subject to repeated analysis and perhaps even pressure to overrule or limit it as time goes by.  This could motivate justices to support their decisions in ways that differ from how they would do so when drafting a unanimous opinion.  Drawing from precedent that demonstrates how the issue has been treated recently (low chronometric reach) and also integrating the analysis with how the legal issue has progressed and advanced over time (high chronometric range) presents strong support for an opinion and help buttresses it against future argument.

## C.  Judicial Ideology

In recent decades, the dominant paradigm in studies of judicial behavior has tended to view judicial activity through the lens of ideology.[135]   There are intuitive reasons to believe that ideology may explain some of the chronometric patterns we observed above.  For instance, the popular understanding of "conservative" may lead one to believe that conservative judges will be more likely to refer to older precedent, while "liberal" judges will be more likely to cite to recent opinions.[136]   If this were true it would lead opinions written by more conservative judges to have higher chronometric reach scores, and perhaps higher chronometric range as well.

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[135] *See, e.g.*, Jilda M. Aliotta, *Combining Judges' Attributes and Case Characteristics: An Alternative Approach to Explaining Supreme Court Decisionmaking*, 71 JUDICATURE 277, 280 (1987) (showing that "being a Democrat is associated with casting votes in favor of equal protection claims"); Segal & Cover, *supra* note 92, at 557–59 (reviewing the literature on judicial behavior and ideology); Rorie Spill Solberg & Stefanie A. Lindquist, *Activism, Ideology, and Federalism: Judicial Behavior in Constitutional Challenges before the Rehnquist Court, 1986–2000*, 3 J. EMPIRICAL LEGAL STUD. 237, 248 fig.2 (2006) (showing a relationship between ideology and judicial activism).

[136] *See* MERRIAM-WEBSTER'S COLLEGIATE DICTIONARY 265 (11th ed. 2006) (defining conservatism as "the tendency to prefer an existing or traditional situation to change").

In order to explore the relationship between ideology and chronometric citation patterns, we draw upon Martin–Quinn scores and associate them with opinions in our dataset.[137]   Martin–Quinn scores estimate the location of Supreme Court Justices along an ideological continuum.[138]   Negative scores are associated with liberalness, while positive scores are associated with conservativeness.[139]   When we separate all opinions in our dataset for which we have available Martin–Quinn scores (those from 1946–2002) into our four types of citation style, we find no significant difference in the ideology scores of the justices authoring the opinions.  This suggests that ideology is not associated with a particular type of citation pattern.

However, to understand further any relationship that ideology may have with citation behavior, we also separate our chronometric types into its constituent parts and independently measure the relationship between ideology and chronometric reach and range.  When we correlate Martin–Quinn scores with both reach and range measures we find that, while there is no relationship between judicial ideology and chronometric reach, there is a small relationship between ideology and range.[140]   This relationship however does not persist in a multivariate model.  When we model ideology as a function of both reach and range and the other control variables we included in our above models, we see no significant relationship between ideology and the way judges draw from the past.[141]  This suggests that judicial ideology is not driving the results we observe.

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[137] Andrew D. Martin & Kevin M. Quinn, *Dynamic Ideal Point Estimation via Markov Chain Monte Carlo for the US Supreme Court, 1953–1999*, 10 POL. ANALYSIS 134, 134–35 (2002); *See also* Martin-Quinn Scores, http://mqscores.berkeley.edu/index.php (last visited May 5, 2017).

[138] *See* Andrew D. Martin et al., *The Median Justice on the United States Supreme Court*, 83 N.C. L. REV. 1275, 1281 (2004).

[139] *Id.* at 1300.

[140] Reach / Martin–Quinn: $r = -0.057$ ($p = 0.067$); Range / Martin–Quinn: $r = 0.075$ ($p < 0.0001$).

[141] For the sake of readability, we have opted not to include the full results tables for these models. Any relationship between ideology and reach/range washes out quite quickly when we begin adding control variables to the model. This is true both when we model the raw Martin–Quinn scores, and when we treat them as a binary conservative/liberal variable.

## D. Legal Evolution

Our findings suggest some universality in the manner in which legal systems change. That legal systems change over time is empirically demonstrable. That those changes happen in an evolutionary manner, as the law and society adapt to one another's changes has long been an attractive analogy.[142] Our findings show that common law high courts engage in similar citation styles when drafting opinions that go on to be particularly influential in future legal developments. There are two potential explanations for why this might be the case.

It could be the case that the low reach/high range pattern is particularly good at providing support for legal conclusions. Citing predominantly to recent precedent while also integrating some references to more distant judicial opinions may provide the most convincing support for legal conclusions. If this is true, then the Justices might opt to support contentious decisions by engaging in this particularly convincing type of precedent seeking and citation.[143]

Alternately, it could be the case that important legal issues tend to arise at the Supreme Court at times when the low reach/high range citation pattern is naturally the most apt. In this instance, the cases that go on to be cited more than their peers speak to legal issues where the precedent that is most on point is predominantly recent, while also implicating some older rulings. This explanation would suggest that our observations above about the peculiarly important role that the low reach/high range pattern plays are not due to choices made by opinion drafters, but rather are the outcome of the legal evolution process.

The sort of evolutionary patterns that we observe could arise if high courts deal with important legal issues in a cyclical manner, with cases about related issues clustered together in time. If this cluster of related

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[142] *See* John A. Harrington, *'Red in Tooth and Claw': The Idea of Progress in Medicine and the Common Law*, 11 Soc. & Legal Stud. 211, 223 (2002) ("To lawyers in particular, the evolutionary perspective revealed that the law was able to adapt itself gradually, that is without convulsion or revolution, to new social and economic circumstances.").

[143] This explanation is less satisfying at the Supreme Court level. In lower courts, there is more binding precedent for judges to sort through and select from when choosing which citations to make. The Supreme Court has fewer decisions to make. Furthermore, there is evidence to suggest that—at least when compared on ideological terms—judges do not engage in significant precedent cherry-picking. Anthony Niblett, *Do Judges Cherry Pick Precedents to Justify Extra-Legal Decisions? A Statistical Examination*, 70 Md. L. Rev. 234, 234-35 (2010).

opinions is followed by a period during which the Court does not address the issue, we can see how the low reach/high range citation pattern might arise.  As the court deals with the cluster of related cases, these cases are likely to reference one another, leading those cases dealt with later in the cluster to have a lower chronometric reach.  The relatively high range would arise as cases also cite back to opinions from previous cycles.

Evidence shows that, at least for some issues, the Court does indeed follow this sort of clustered-cyclical pattern.  Professor Baird argues that legal issues often arise at the Supreme Court "with a small number of cases and then, after a period of time, balloon[]."[144]  In this model of Court agenda-setting, early cases "provide the Court with an opportunity to make a significant decision.  This politically important decision then signals the appropriate interest groups to mobilize litigation."[145]  After the Court has litigated a series of related cases, it will have settled the law in that area and, for a period of time, turn its attention elsewhere.[146]

Discretionary appeal is key to this model.  All of the courts we examine are the highest courts in their respective jurisdictions, and each hears most of its cases after a discretionary appeal process.[147]  As such, these courts are free to grant appeals to cases implicating issues that they feel are most legally or socially pressing.[148]  These issues are often the most contentious, leading to repeated litigation of similar legal issues as parties on either side push for the Supreme Court to side with them.

Clustered repeated litigation separated by periods of comparative inactivity can contribute to the low reach/high range citation pattern.  When related legal issues are repeatedly litigated, the Justices have a stock of recent precedent treating the issues in question that they are like-

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[144] VANESSA A. BAIRD, ANSWERING THE CALL OF THE COURT: HOW JUSTICES AND LITIGANTS SET THE SUPREME COURT AGENDA 39 (Univ. of Va. Press 2007).

[145] *Id.*; *See also* H.W. PERRY, DECIDING TO DECIDE: AGENDA SETTING IN THE UNITED STATES SUPREME COURT 221 (Harvard Univ. Press 2009) (arguing that "it is the issue, not the case that is primary" and demonstrating how legal issues can dominate judicial agenda-setting decisions).

[146] BAIRD, *supra* note 144, at 39 (arguing that there is a fad-like trend for issues at the Supreme Court).

[147] PETER MCCORMICK, SUPREME AT LAST: THE EVOLUTION OF THE SUPREME COURT OF CANADA 86–87 (2000); KERMIT L. HALL ET AL., THE OXFORD COMPANION TO THE SUPREME COURT OF THE UNITED STATES 47 (2d ed. 2005); Abhisek Dash Choudhury, *Review Jurisdiction of Supreme Court of India: Article 137*, SOC. SCI. RES. NETWORK, Apr. 4, 2012, at 1.

[148] *See* MCCORMICK, *supra* note 147, at 86–87; HALL ET AL., *supra* note 147, at 47–48.

ly to cite to.  This would lead to a relatively low chronometric reach. Meanwhile, if the legal issue is truly important there is likely to be older precedent on the books from previous cycles.  Citing this precedent would lead to high chronometric range.

That these low reach/high range cases are so much more likely to be each studied jurisdiction's highly influential cases suggests a degree of uniformity in the way these legal systems evolve.  In each of these jurisdictions, the most influential cases are likely to be predominantly related to other recent cases, while also implicating a few older precedents. This suggests legal systems that are responsive to recent jurisprudence while also being aware of how a legal issue has historically been treated.

To better understand what it means that the low reach/high range pattern is so important in our legal system, imagine the implications if one of the other three citation styles were strongly related with high impact cases.  If we had seen that opinions using the high reach/high range citation style were the most likely to go to be high impact, it would suggest a legal system where issues arise intermittently and where there is no clear preference for recency in citation to the cases treating those issues.

Alternately, if low reach/low range opinions were those most likely to go on to become highly influential, it would suggest a legal system that underwent relatively frequent major changes with influential cases building principally on recent law and not drawing on more distant precedent.  If the high reach/low range citation pattern was most associated with highly influential opinions, it would suggest a legal system with strongly entrenched rules and a tendency for Justices to root important cases in well-established precedent.

### E.  Practical Implications

Our results reveal a fascinating universality in the way common law systems evolve.  We've seen that highly influential cases are much more likely to draw on precedent from predominantly recent opinions, while also citing to selected older case law.  This discovery helps improve our understanding of how legal systems develop, while also opening avenues for future research.  In addition to these academic implications, our analysis also has practical implications.  Our findings that the age distribution of references cited is an important aspect of opinion drafting has implica-

tions for the way legal search results are presented, the way legal research is taught, and the way teams of lawyers are assembled.

*Legal Information Search*—Our finding that there is an optimal distribution of ages in precedent referencing behavior suggests some takeaways for the legal information search industry. Current search technologies tend to order results chronologically or by relevance.[149] This seems intuitive, as recency and relevance are important factors to take into account when searching case law. However, our results suggest that instead of rank-ordering results in this fashion, legal search could benefit from focusing on the distribution of cases presented to users. Few search providers attempt to provide an appropriate mix of references when presenting results. Internet search engines such as Google or the online legal search providers like Westlaw order results primarily based on the number of citations each result has received.[150] Because citations take time to accrue, any such ordering method will by its nature privilege older information. Many search engines also have an option to sort by date,[151] but this either presents results in chronological or reverse chronological format.

We saw above that the amount of legal information that practitioners need to search through is at an all-time high and is continually increasing.[152] Given this, legal search providers are an integral component of modern legal practice and an essential aide to lawyers, clerks and judges. Our findings suggest that, in order to best assist information seekers, search providers should experiment with new ways to present search results, with increased focus on presenting an optimal mix of references rather than a rank-ordered list. By focusing on the element of

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[149] In their default case law search results, the two leading legal information search providers, Lexis-Nexis and Westlaw, both order results by "relevance." *See* LEXIS ADVANCE® HOME, https://advance.lexis.com/ (last visited May 5, 2017); WESTLAWNEXT, https://a.next.westlaw. com/ (last visited May 5, 2017). The way relevancy is measured will vary by provider, but typically is a product of search term similarity and document importance. Each provider also allows for date-based filtering, court-based filtering, and jurisdiction-based filtering. *Id*.

[150] *See* Lawrence Page et al., *The PageRank Citation Ranking: Bringing Order to the Web*, TECHREPORT (Jan. 29, 1998), http://ilpubs.stanford.edu:8090/422/. The Page Rank algorithm patented by Google founders Larry Page and Sergey Brin has long featured prominently in how Google orders its search results. This algorithm relies on hyperlinks (the online equivalent of citations) to determine how a webpage ranks.

[151] *See* WestlawNext, *supra* note 149 (allowing users to sort results by date).

[152] *See supra* Part I.

time, we show that a mix of predominantly recent—but not necessarily the *most* recent—and some older precedent may be the most important set of precedent to focus on. Along with these chronometric factors, there may be other case aspects suitable for similar treatment. For instance, there may be optimal distributions of reference similarity or reference importance that legal information search could leverage in order to present users with more effective results lists. This Article's findings present an initial step in understanding the importance of reference combinations, but there are many areas for potential future research.

*Training*—In addition to teaching substantive law, legal training focuses extensively on educating students about how best to search for legal information.[153] Our findings provide insight into new ways to conceive of legal information search and train students, clerks and judges to find cases. Traditional training focuses on finding relevant analogous cases. Our findings suggest that, in addition to finding cases based on relevance, training should encourage practitioners to focus on the variety of cases they examine for support.

This would entail training practitioners to assess the case law they rely on not solely on its individual relevance to the issue in question, but also how it fits into the set of precedent they rely upon. In terms of chronometric issues, our results suggest that, when forced to make decisions about which content to cite, it is advisable to focus on predominantly new precedent combined with a few older seminal references. Training could thus focus more on educating students to search for an appropriate distribution of related precedent.

*Collaboration*—Team work is increasingly important to the practice of law.[154] Our results suggest that when assembling teams, law firms would be well advised to consider the distribution of experience on the team. Mixing individuals highly familiar with recent developments along with those more familiar with seminal cases may lead to more successful legal collaborations. Granted, expert lawyers will strive to become as familiar as possible with all relevant precedent. However, as

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[153] *See* AMERICAN BAR ASSOCIATION, *supra* note 72.

[154] *See generally* Shawn W. Cutler & David A. Daigle, *Using Business Methods in the Law: The Value of Teamwork among Lawyers*, 25 T. JEFFERSON L. REV. 195 (2002); *See also* John Szmer et al., *Does the Lawyer Matter? Influencing Outcomes on the Supreme Court of Canada*, 41 L. & SOC'Y REV. 279, 292–93 (2007) (showing that the number of lawyers on a team improves chances of litigation success).

discussed above, doing so is becoming increasingly difficult as the amount of legal information continues to increase.[155]  In order to ensure an appropriate mix of experience across legal eras, firms should strive to combine lawyers highly familiar with a legal issues background with those most familiar with recent developments.  Assembling teams by combining individuals with expertise across a wide range of times will set them up to successfully incorporate precedent from multiple eras.

CONCLUSION

The above has shown that there is a single type of citation pattern that is highly likely to appear in particularly influential court cases, and that this trend is consistent across multiple common law jurisdictions. Those cases that draw predominantly on recent precedent, while also interspersing citations to older rulings are significantly more likely to go on to be highly cited in the future than their peers.  These findings help us understand how practitioners draw on precedent in a legal information system that has changed drastically in recent decades, leaving us with vast and ever-expanding bodies of precedent.

All law draws on the past, but all methods of drawing on the past are not interchangeable.  When particularly important cases are decided, Justices are more likely to rely on the low reach/high range citation pattern.  Future research should build upon this finding to attempt to more fully understand why this relationship exists. Although we control for the legal issues that cases cover and show that the relationship between low reach/high range citation patterns and impact remains, it is possible that there are unquantified and uncategorized aspects of the high impact cases in question that drive this finding.  We remain uncertain about the extent to which the relationship between the low reach/high range citation pattern drives impact by grounding decisions optimally in the law and the extent to which it is driven by the nature of the legal issues treated in cases.

As the quantity of precedent continues to grow, practitioners will be forced to sort through even more law, making more and more decisions about what to include and what to exclude in their memos, briefs, and opinions.  By examining both out-going and in-coming citations, this Article is the first to explore how these decisions relate to legal develop-

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[155] *Supra* Part I.

ment.  While there remains much that we do not know about how prece-
dent citations relate to legal evolution, they are clearly important and
their study can reveal elusive truths.

## Appendix A

Table 2 below shows the results of logistic regression models that measure the effects of reach and range on the odds that a case will become highly influential.[156]  This analysis extends the analysis shown in Figure 3 by testing whether the results in Figure 3 are robust to alternative explanations.  For example, suppose the influence of a ruling is related to how many references a ruling cites under the thesis that the more references a ruling incorporates, the more general is the ruling, and if a ruling is more general it may garner more citations from other rulings.  If this is the case, we would like to know that the effects of chronometric mean and variance on a rulings influence hold after controlling for the number of references cited in a ruling.  The logistic regression makes these computations for us.  In the logistic regression below, we control for the "Number of References," "Mean Citations in bibliography," and "Year Effect" as explained in the footnotes.  Controlling for alternative explanations for our effects, we find that the results hold for Canadian, Indian, and U.S. courts.  The results show that chronometric reach is negatively related with the odds that an opinion will go on to become highly influential.[157]  On the other hand, chronometric range is positively correlated with highly influential outcomes.[158]  For the most part, this remains the case even when we control for the number of citations a case makes,[159] the year a case is decided in, and the importance of the precedents that the case cites to.[160]

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[156] Logistic regression models the effect that a variable has on the odds of a binary outcome occurring.  Here, the coefficients presented can be interpreted as the amount of change in the long odds of a case becoming highly influential given a one-unit increase in the relevant variable.  *See generally* DAVID W. HOSMER JR & STANLEY LEMESHOW, APPLIED LOGISTIC REGRESSION (2nd ed. 2004).

[157] This can be seen from the negative coefficients in the chronometric reach row, showing that as the reach of a case's citations increases, the odds that the case will become highly influential decrease.

[158] We see this in the chronometric range row showing uniformly positive and generally statistically significant coefficients.  This shows that, holding other model variables constant, as range increases the odds that a case will become highly influential increase.

[159] The *Mean Citations in bibliography* term controls for the number of citations that each case makes.  To control for outliers, we separate cases into ten equal sized bins based on the number of references they cite and treat this as a categorical variable.

[160] The *Reference Fixed Effects* term controls for the importance of the cases that each opinion cites.  We do this by calculating the mean number of citations to the cases that the opinion cites.  Doing so ensures that the effects we observe are not being driven by a two-step process wherein cases citing influential precedent go on to be influential.

Table 2

| | Indian Supreme Court | | Canadian Supreme Court | | United States Supreme Court | |
|---|---|---|---|---|---|---|
| **Chronometric reach** | -0.001* | -0.005*** | -0.078** | -0.024 | -0.011*** | -0.017*** |
| **Chronometric range** | 0.806*** | 0.286*** | 2.195*** | 0.303 | 2.019*** | 0.891*** |
| **Mean Citations in bibliography** | | 0.0006*** | | 0.074*** | | 0.067*** |
| **Year fixed effects** | | Y | | Y | | Y |
| **Reference fixed effects** | | Y | | Y | | Y |
| **Psuedo R²** | 0.022*** | 0.10*** | 0.156*** | 0.36*** | 0.059*** | 0.327*** |

\* $p < 0.05$; \*\* $p < 0.01$; \*\*\* $p < 0.0001$

In all of the models presented, the only two non-statistically-significant coefficients are in the full Canadian Supreme Court model. This is caused by the relatively smaller dataset of Canadian opinions we have to work with. We lose much of our statistical power when controlling for year with our limited set 3416 of Canadian precedent. That said, the signs remain consistent with the rest of our findings. Furthermore, when we drop the year fixed effects (but retain the other control variables) the results are consistent with our other findings.