Politics and Administration: Evidence from the U.S. Patent Office, 1837-2015*

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Abstract

The expansion of the administrative state is among the most important institutional changes in American political history. In this paper, we study the political responsiveness of bureaucratic outputs across the last 180 years. Using panel data based on more than seven million patents issued by the United States Patent Office between 1837 and 2015 and presidential election voting patterns, we find that a state's political alignment with the presidential administration increased patent rates by 7 to 10 percent. These patterns are driven nearly entirely by the period prior to personnel examination requirements instituted in 1869; we find no evidence of an association between political alignment and patenting in any of the eras commonly used to periodize the administrative state after this date. Our results demonstrate the importance of bureaucratic expertise for the role of politics in administrative decision making and shed new light on the political economy of American innovation.

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The contemporary administrative state would be utterly unrecognizable to the authors of the U.S. Constitution. Beginning with only three departments and a few dozen federal employees in 1789, American central government in the nation's early years was regarded as a "midget institution in a giant land" (Murrin 1980, 425) that had "little effect on the social, economic, religious, and intellectual developments that were shaping American civilization" (Pessen 1978, 2). More than a half-century after the nation's founding, Tocqueville (1969 [1835], 72) was struck by "the absence of ... government or administration." From such humble beginnings, the "wrenching and controversial changes" (Carpenter 2001, 5) that resulted in the expansion and transformation of the federal bureaucracy between the Civil War and World War II are "indisputably [among] the most important developments in American government" (Gailmard and Patty 2013, 1). This transformation not only increased the size of the federal workforce but also dramatically expanded the authority and reach of the federal government. Today, the "administrative state is the nexus of policy making" (Lewis 2004, 1) and "[b]ureaucratic policymaking is the hallmark of modern American government" (Carpenter 2001, 5).

In this paper, we study bureaucratic outputs from the era of Tocqueville to today. Though existing scholarship documents the nature of the administrative state and its accomplishments in earlier periods of American history (e.g., John 1995; Skocpol 1992), characterizes the emergence and development of the modern bureaucratic apparatus (e.g., Bensel 1990; Skowronek 1982), and identifies the mechanisms through which it gained political autonomy and developed expertise (e.g., Carpenter 2001; Gailmard and Patty 2013), we know considerably less about the consequences of these developments for the administrative outputs produced by the federal government. On this score, scholarship on the consequences of institutional development within the bureaucracy is somewhat more limited than research that studies how institutional change affected the behavior of Congress (e.g., Binder 1997; Schickler 2001; Wawro and Schickler 2006), the judiciary (e.g., Francis 2014; Gillman 1993; Whittington 2007), and the presidency (e.g., Milkis

1999; Moe and Howell 1999; Tulis 1988).[1]

We test the hypothesis that bureaucratic outputs are responsive to control by political principals and examine how this relationship varies across periods of institutional change. An important theoretical scholarship argues that bureaucratic behavior is responsive to institutional arrangements that structure the identity and sanctioning power of relevant principals, including Congress, key legislators, the president, and interest groups (Banks and Weingast 1992; Calvert, McCubbins, and Weingast 1989; McCubbins, Noll, and Weingast 1987; Moe 2006; Turner Forthcoming). Recent empirical scholarship documents the responsiveness of administrative processes and outcomes, including the allocation of federal program spending (e.g., Berry, Burden, and Howell 2010; Kriner and Reeves 2015) and emergency relief funds (Reeves 2011), provision of information to congressional requestors (Lowande 2019), rulemaking (Haeder and Yackee 2018; Potter 2017, 2019) and regulatory enforcement (e.g., Wood and Waterman 1991), and siting of federal outposts (Gordon and Simpson 2018; Rogowski 2016), to political principals. The strategic lobbying of regulators following a bill's passage (You 2017) further suggests a role for politics in administrative behavior. Despite good theoretical reason to suspect that intra-institutional changes in political arrangements would moderate the nature of these relationships (see, e.g., Selin 2015), however, this scholarship generally does not examine how bureaucratic responsiveness to political principals varies over time.

We examine the responsiveness of administrative outputs to political factors using data on more than seven million patents issued by the United States Patent Office between 1837 and 2015. Using panel data on presidential election voting patterns and the annual allocation of patents across states, we find that a state's political alignment with the presidential administration increased patent rates by 7 to 10 percent. These results are robust across model specifications,

[1]Nearly four decades ago, Cooper and Brady (1981) made a similar point when arguing that research on Congress was insufficiently "diachronic." Our research responds to more recent calls for better integrating the executive branch in research on American political development (Whittington and Carpenter 2003) and using quantitative methods to test theories of institutional change (Wawro and Katznelson 2014).

subsets of observations, and characterizations of key variables. We also, find, however, that these patterns are driven nearly entirely by the period prior to personnel reforms within the Patent Office. Prior to 1869, the year in which the Patent Office began requiring written merit examinations, electing its preferred presidential candidate was worth an increase in patenting rates of more than 30 percent. We find no evidence of an association between political alignment and patenting in any of the eras commonly used to periodize the history of the administrative state after this date. Consistent with our proposed mechanism, original data on employment patterns among patent examiners from 1837 to 1937 show that personnel reforms were associated with significantly reduced turnover, suggesting that greater stability and expertise helps to insulate an organization's decisions from political influences. Our results demonstrate the importance of bureaucratic expertise for the role of politics in administrative decision making and shed new light on the political economy of American innovation.

The Politics of Administration

Though Article II of the U.S. Constitution vested "the executive Power" in the presidency, it made no specific provisions for the structure and form of the executive branch. Instead, the Constitutional Convention left the design of bureaucracy to Congress. That convention delegates did not themselves develop an administrative structure, however, did not reflect a view that bureaucracy would play only a limited role in the new national government. Instead, as Hamilton argued in *Federalist 72*:

> The administration of government, in its largest sense, comprehends all the operations of the body politic, whether legislative, executive, or judiciary; but in its most usual, and perhaps its most precise signification. it is limited to executive details, and falls peculiarly within the province of the executive department. The actual conduct of foreign negotiations, the preparatory plans of finance, the application and dis-

> bursement of the public moneys in conformity to the general appropriations of the legislature, the arrangement of the army and navy, the directions of the operations of war, these, and other matters of a like nature, constitute what seems to be most properly understood by the administration of government.

Largely adopting the English model of administration (Carpenter 2005), the First Congress created three Cabinet-level departments (War, State, and Treasury) in addition to the Post Office Department and the Office of the Attorney General. The size and scope of the administrative state has evolved and expanded in the more than two centuries since, today comprising nearly three million civilian employees.

The design of bureaucratic institutions naturally raises questions of political control (Moe 1989). Because the executive branch is responsible for implementing laws passed by the legislative branch, Congress and the president have frequently clashed over their shared authority to control the bureaucracy. The president's authority to appoint and remove executive branch officials, for instance, has animated debates between presidents and Congress throughout American history, while presidents have often rejected Congress's attempts to wield greater oversight powers with respect to the executive branch. This struggle has contributed to a range of important institutional developments across American history including civil service reform and the creation of independent agencies.

The core question concerns the responsiveness of administrative decision making—and, by extension, the administrative state—to control by political principals. While Congress possesses oversight capabilities, appropriations power, and statutory authority to reorganize bureaucratic institutions, the president holds appointment and removal powers and can use Article II powers to create new entities. Using a separation of powers framework, an important literature studies the mechanisms through which Congress and the president can induce greater responsiveness to their preferences (Epstein and O'Halloran 1999; McCubbins and Schwartz 1984; Moe 1987, 1989; Weingast and Moran 1983).

In this paper, we study the role of politics in shaping bureaucratic outputs. A quarter-century before becoming President, Woodrow Wilson (1887, 210) articulated a view that distinguished public bureaucrats from elected politicians: "Politics is thus the special province of the statesman, administration of the technical official. Policy does nothing without the aid of administration; but administration is not therefore politics." This perspective suggests that a bureaucracy composed of expert professionals insulated from political pressures is the most efficient and effective means for serving the public will and responding to the challenges of industrialization. We evaluate the extent to which this normative perspective explains patterns of administrative behavior.

Patronage, Political Control, and Institutional Development

Institutional arrangements, including those related to political control, have varied tremendously over American history, and thus the relationship between politics and administrative outcomes is likely to have varied along with them. A rich literature in political science, public administration, and history identifies a number of institutional changes, both within and outside of the federal bureaucracy, that have potential implications for administrative decision making. First, at the level of governing regimes, the incentives for bureaucrats, presidents, and members of Congress were likely quite different during the patronage era than in later periods of party politics (James 2006). These incentives shaped the ways political actors conceived of and interacted with the federal bureaucracy. For instance, as Carpenter (2001, 47) describes, "[t]hrough most of the 1800s, administrative capacity in the United States—the collective talent of bureaucracies to perform with competence and without corruption—was the minimally sufficient ability to distribute federal largesse to electorally favored constituencies." James (2006) further periodizes the nineteenth century based on parties' motivations to extract the greatest possible rents as a labor recruitment device (prior to Civil War) and to best serve the party's electoral interests (post-Reconstruction). The nature of party goals thus could have had implications for the goals that political principals hoped to achieve and the motivation of federal bureaucrats to act upon them.

Second, legislators and the presidents have had varying incentives and capacities to exert political control over bureaucracies. With respect to Congress, developments in the party system and variation in its internal capacities may be associated with varying degrees of political control. For instance, Kernell and McDonald (1999) suggest that the emergence of candidate-centered elections produced greater incentives for legislators to prioritize how the provision of service by bureaucracies affected their constituencies. Likewise, increasing trends in congressional careerism (Polsby 1968) and capacity via the provision of staff and other resources (Bolton and Thrower 2016) likely enabled legislators to better accumulate expertise and information about bureaucratic performance, thereby strengthening their capacity to exercise political control. Presidential influence over administration may also have varied in important ways. In the late nineteenth century, for instance, White (1958, 175-180) noted that bureaus often eluded control by their department, to say nothing of the prospects for presidential control. But Moe (1989) highlights the mechanisms by which presidents have exerted control over bureaucracy in the modern era, and Kagan (2001, 2246) observes the "dramatic transformation in the relationship between the President (and his staff) and the administrative state" since around 1980. These developments could shape the degree to which bureaucratic outcomes are responsive to political from the executive and legislative branches.

Finally, the nature of the bureaucracy itself also transformed during this period. The adoption of civil service reforms beginning with the Pendleton Act contributed to a dramatic increase in administrative capacity between the 1880s and roughly 1920 (Skowronek 1982). For positions subject to its provisions, the Pendleton Act required competitive exams and provided for some measure of job security. Over the course of the next 30 years, presidents subjected an increasing share of civil service positions to these reforms. Alongside these developments, bureaucrats were increasingly technically proficient and crafted reputations among coalitions of interest groups that helped insulate them from political control (Carpenter 2001). As the bureaucracy professionalized, civil servants may have been able to secure greater distance from political principals

in ways more consistent with the Progressive vision outlined by Wilson (1887).[2]

As we describe below, we conduct our study in the context of a single bureaucratic entity, the Patent Office, across a wide swath of American history. We do so by investigating the extent to which its administration decisions—those which concern the issuance of patents—are responsive to presidential politics. That bureaucratic officials may make decisions on the basis of political factors is relatively uncontroversial, as existing scholarship describes a number of ways in which regulatory decisions (Wood and Waterman 1991), the distribution of goods and resources (Gordon 2011; Rogowski 2016), and rulemaking procedures (Potter 2017, 2019) reflect political calculations. Yet at least three key aspects of our study are unique. First, relative to most other instances of bureaucratic policymaking, evaluating patent applicants is an explicitly scientific endeavor. Evaluating the merits of claims to innovation requires extensive expertise. Second, patents bear only limited resemblance to public goods distributed by bureaucracies, such as national defense and infrastructure projects. Third, we examine variation in political responsiveness across periods of institutional change. As Carpenter (2001, 11) argues, "the neglect of bureaucratic organizations in studies of administrative development is unfortunate" because "it leaves the most important political outcomes—the impact of policies on citizens—unstudied. Only by focusing on administrative outcomes can transformations in the relationship between state and society be properly analyzed." Our inquiry therefore contributes to scholarship that more explicitly incorporates bureaucracies and the executive branch into accounts of American political development (Carpenter 2001; Gailmard and Patty 2013; Skowronek 1982; Whittington and Carpenter 2003).

[2]We do not assume these developments were exogeneous to the bureaucracy's relationship with adjoining institutions; consistent with Gailmard and Patty (2013), it is likely that many of these institutional changes reflected the goals of presidents and Congress.

Institutional Context of the Patent Office

Across American history, patenting has been among the most economically significant decisions issued by federal bureaucrats. Patents provide inventors with sole property rights over inventions for a set period of time. Historians, economists, political scientists, and legal scholars have all recognized the economic and political importance of the decisions handed down by the patent office. The U.S. patent system was "revolutionary," according to Khan and Sokoloff (2004, 400), and Thomas Jefferson wrote that it had "given a spring to invention beyond my comprehension" (quoted in Boyd 1961, 578-580). For Abraham Lincoln, the patent system "added the fuel of interest to the fire of genius" (quoted in Basler 1953, 363). Summarizing the views of economists, Gordon (2016, 312) concludes that patenting was "[p]erhaps the most important government activity to stimulate growth," and Patent Office Commissioner Charles Duell (1901, ix) attributed "the patent system more than any other cause . . . for the industrial revolution of the [nineteenth] century." Reflecting on the stimulative impact of the patent system, Commissioner William E. Simmonds (1893, v) characterized the country's inventors as "the true nation builders, the true promoters of civilization. They take nothing from the public; they ask nothing from the public; they simply add to the sum of human knowledge, to the sum of human possessions, and to the sum of human happiness."

Beyond its economic significance, the patent office is well-positioned for studying bureaucratic responsiveness to politics. Its reach, for example, extends across a wider swath of the economy than most other entities of the federal government. According to Beresford (1886),

> "The United States Patent office possesses a significance which does not attach to any other Bureau of the Government. There is no branch of industry, trade, or manufacture over which it does not extend its encouraging and protecting arm. The farmer and the mechanic, the dealer in every useful implement, the miller, the miner, the weaver and the iron worker, all realize the value and importance of this Bureau."

In addition, the patent office's political importance in earlier periods may even exceed its importance today. As Usselman and John (2006, 98) write, patent regulation in the nineteenth century "raised some of the most fundamental questions of the age . . . [confronting] every branch of nineteenth-century American government as well as every jurisdiction: federal, state, and local." Moreover, nineteenth-century conflicts involving the patent office presaged the rise of interest group politics in the twentieth century.

Political History of Patenting

The patent office is implicitly referenced in Article I, Section 8 of the U.S. Constitution, which provides Congress with the power "[t]o promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." The authors of the Constitution appeared to consider this a self-evident power, with Madison arguing in *Federalist 43* that "the utility of this power will scarcely be questioned." Accordingly, the Patent Act of 1790 created the Patent Board, housed within the Department of State. The Board consisted of three members, the Secretary of State, Secretary of War, and the Attorney General, and had the authority to grant or deny applications for patents. This authority allowed the Board to grant patents "for any such useful art, manufacture, engine, machine or device as they should deem sufficiently useful and important." Applications required support for two of the three members for a patent to be granted. The application process was time-consuming for both applicants and the Board members, and initially required that the applicant complete an examination. Moreover, the Board appeared frequently unimpressed with the originality and usefulness of the inventions proposed through patent applications, as only three patents were granted in the first year. According to Beresford (1886), however, "the severity of [the Board's] scrutiny and the strictness with which it exercised its power caused great dissatisfaction" and led to the passage of the 1793 Patent Act. This Act provided sole authority to the Secretary of State and eliminated the examination requirement, as virtually every inventor seeking a patent was

granted it upon application.

The number of patents soared through the early nineteenth century, which taxed the courts by leaving them to adjudicate claims of infringement. The Patent Act of 1836 established a formal Patent Office in the Department of State, which was headed by a Commissioner appointed by the Secretary, and freed the Secretary of State from being personally involved in reviewing patent applications. The Act also resurrected provisions from the 1790 Act that required an examination of each patent application and established a standard for novelty and usefulness. Perhaps most importantly, the 1836 Act provided for the hiring of paid examiners, perhaps the first system in the world to do so. As a result of this legislation, "a reorganized federal Patent Office carefully vetted every application before granting a patent" (Howe 2007, 534). Moreover, according to Weber (1924, 24), the 1836 Patent Act "provided, for the first time in any country, the means of protecting the rights of inventors in an intelligent, scientific, and adequate way … [t]he effective protection given by this act to the rights of property in ideas soon became a powerful agent in stimulating inventive genius in the United States." The Patent Office was transferred to the Department of Interior in 1849, where it remained until being transferred to the Department of Commerce in 1925.

Political Control of the Patent Office

Secondary accounts present somewhat conflicting accounts of political responsiveness within the patent office. On the one hand, the patent office appeared to be quite autonomous, in part because of the technical nature of its work. As the Commissioner of Patents (1893, iv) described, "A competent Examiner must possess a wide range of scientific and technical knowledge, a trained capacity for analysis and comparison of mechanism, a fair knowledge of law in general, and a thorough knowledge of … patent law … The code of procedure and practice in the Patent Office is more complicated than that of any court of law, and necessarily so … there is no similar number of men in the world, gathered into one body, performing duties as delicate and difficult as

those performed by the examining corps of the Patent Office." The technical complexity required in patent examiners helped bolster the office's reputation. As Gordon (2016, 313) writes, "The patent office was fair, respected, impartial, and not subject to bribes and corruption." Perhaps as a result, Congress "consistently deferred to the commissioner of patents due at least in part of the technical complexity of patent law" (Gailmard and Patty 2013, 61). These patterns of deference led Usselman and John (2006, 98) to conclude that the office "wielded an impressive degree of bureaucratic autonomy."

Some accounts, on the other hand, characterize the patent office and its appointees as subject to political pressure and political processes. These accounts emphasize the political nature of appointments within the office and the opportunities for discretion by its officials. White (1958, 223) points out, for instance, that "[d]espite the technical nature of the Patent Office operations, its overhead was politically appointed and politically responsible." Frequent changes in Patent Office Commissioners in the mid-to-late nineteenth century may have underscored its political nature. "The record of the tenure of the office proves that political preference was the usual basis of choice. From 1869 to 1901 there were fourteen commissioners," White (1958, 223) writes. With this frequent turnover, "it must appear inevitable that there could not have been uniformity or the constant exercise of the wisest discretion in the granting of patents" (*Annual Report of the Commissioner of Patents for the Year 1877* 1878). Consistent with this impression, Post (1976, 28) argues that "it eventually began to appear that an examiner's assessments were highly subjective. One might differ a great deal from another in how assiduously he searched for precedents, and, especially, in his propensity to take into account parallel physical principles between one sort of device and another." As Reingold (1960, 156-157) wrote, "the issuance of a patent simply means that the language of the patent specifications met whatever standards of patentability were in effect at a given time." The discretion provided to patent examiners and frequent turnover in patent office leadership led several observers to conclude that the early patent office was more political than commonly believed (Hoogenboom 1959; Post 1976; White 1954).

While research in economics has studied the economic factors that shape patenting activity (Schmookler 1962, 1966), scholars have paid considerably less attention to the political correlates of patenting activity. Consequently, we know relatively little about the political character of a major class of economically consequential activities undertaken by the federal government since 1790. Moreover, we know even less about how the nature of this political character has changed across the course of American history. Before processing, one final theoretical point about the patent office merits discussion. We adopt a distributive politics framework for characterizing patenting activity. Unlike divide-the-dollar scenarios, such as the allocation of scarce federal program dollars, patenting decisions are generally not zero-sum. That is, the approval of one patent application does not reduce opportunities for approving other patent applications.[3] In these scenarios, therefore, the incentives for responsiveness to political principals may be somewhat more limited than in cases where higher-stakes administrative decisions attract greater interest (and, potentially, political pressure) from those principals (see, e.g., Ritchie and You 2019).

Aggregate Patterns in Patenting Activity

Figure 1 displays the annual number of patents granted across the history of the United States.[4] In the nation's early years, relatively few patents were granted. Three patents were issued in 1790, and 1808 was the first year in which more than 100 patents were issued. This figure gradually yet steadily increased through the mid-twentieth century, dipping just slightly during World War II before experiencing dramatic surges between roughly 1950 and 1970, 1980 to 2000, and 2005 through 2015.

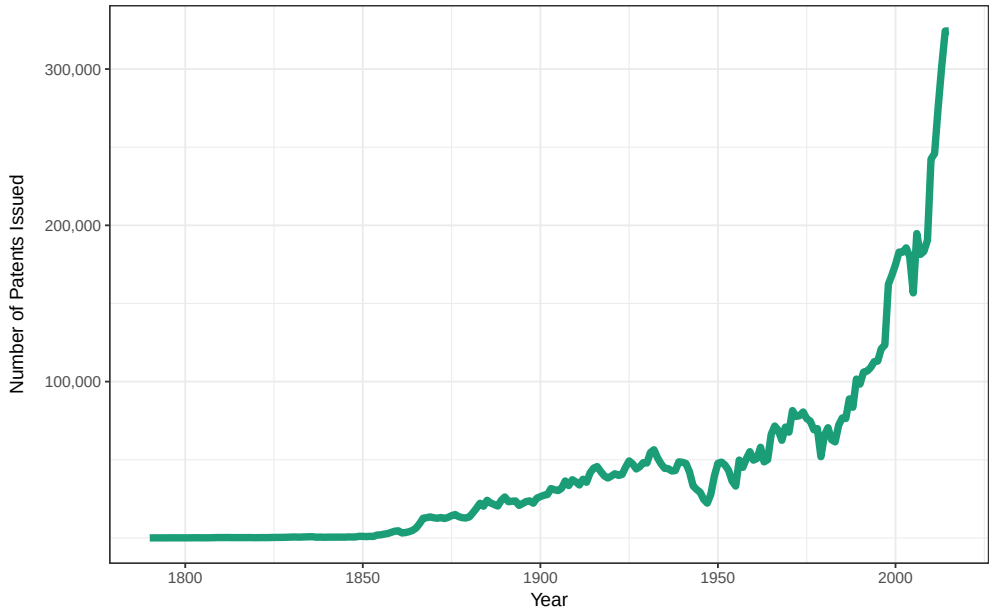
Figure 2 shows how the number of patents issued in a given year corresponds to the number of applications received in that year.[5] The figure shows substantial variation in patenting relative to

[3] An important exception is when multiple application concern the same invention.

[4] These data represent both *utility* and *design* patents. Though former term generally reflects *inventions* in the colloquial use of the term, these statistics are not disaggregated for the entire time period.

[5] Unfortunately, to our knowledge, aggregate data on patent applications are not available prior to 1840. Note that these data do not necessarily reflect the percentage of applications that were granted; the length of the patent

Figure 1: Annual patents issued, 1790–2015



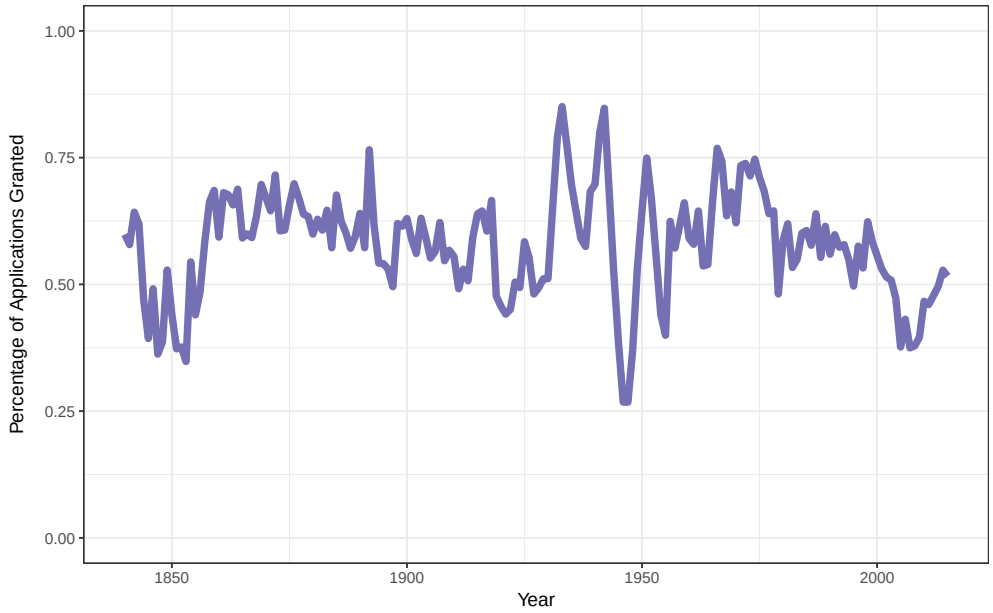
Data for 1790 to 1970 are from Series W 96-106, *Historical Statistics of the United States: Colonial Times to 1890*, Part II. Data for 1971 to 2015 are from "U.S. Patent Statistics Chart," *U.S. Patent and Trademark Office, Patent Technology Monitoring Team* (available at https://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm).

application rates. Overall, the rate of patenting relative to applications was about 0.57; however, this figure ranges from a low of 0.27 (in both 1946 and 1947) to a high of 0.85 (in 1933). In addition to these rather large differences separated by a relatively short period of time, the data show some other temporal trends in patenting rates. Patenting rates declined fairly dramatically from around 1841 through the early 1850s before increasing again and remaining relatively stable at about 0.65 for several decades. More recently, patenting rates have declined from around 0.75 in the mid-1970s to 0.50 (and sometimes lower) in recent years. One possible interpretation of the data in this figure is that the decision criteria used to judge patenting applications varied across time, perhaps reflecting the leadership of the Patent Office, the composition of the examiners, and other political and/or institutional factors.[6]

review process varied across time and the nature of the proposed invention. It is not possible to construct such a measure without application-level data, which does not appear to be available prior to the last several decades.

[6]It is also possible, we note, that changes in the nature of patent applications could also explain these patterns. Unfortunately, we are unable to evaluate this possibility because we lack an objective measure of patent 'quality' at the application level.

Figure 2: Ratio of Patents to Applications, 1840–2015



Data for 1840 to 1970 are from Series W 96-106, *Historical Statistics of the United States: Colonial Times to 1890*, Part II. Data for 1971 to 2015 are from "U.S. Patent Statistics Chart," *U.S. Patent and Trademark Office, Patent Technology Monitoring Team* (available at https://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm).

Overall, the data establish two key descriptive facts. First, the volume of patenting activity has increased dramatically across American history. The increased volume of patenting activity has been especially dramatic in recent decades.[7] Second, the volume of patenting activity is not a simple reflection of the volume of applications received by the Patent Office. Instead, Figure 2 suggests that the criteria for reviewing applications and granting patents have changed meaningfully across time. We use these stylized facts as starting points for our empirical analysis.

Data and Measures

We investigate administrative responsiveness to political factors using data on patenting activity from 1837 to 2015. We rely on two primary data sources to characterize patenting activity. First, we use newly available historical data on patenting activity from Petralia, Balland, and

[7]For instance, the Patent Office issued five million patents between 1836 and 1991. Five million more patents have been issued in the last 28 years alone.

Rigby (2016) to measure patenting volume from 1836 to 1975. These data use digitized patent documents to identify the inventor, location, and year of each issued patent. Second, we use data from the United States Patent and Trademark Office (2015), which covers the period from 1963 to 1975. With these data, we calculate the annual volume of patenting activity for each state between 1837 and 2015. For states admitted after 1836, we include them beginning with the year following the first presidential election after they were admitted.[8] While a few studies outside political science have studied geographic variation in patenting rates (e.g., Feldman and Florida 1994; Malecki 1981), none has evaluated the political or electoral bases for these patterns.

We note two key limitations of the data and the resulting time series. First, the Petralia, Balland, and Rigby (2016) data are not comprehensive but rather are estimates generated from machine learning algorithms applied to the text of patent documents. However, the authors report that the database covers approximately 99.3% of all patents issued to U.S. residents during this time period. While we may be somewhat more skeptical of using the county-level designations reported in these data—for instance, upon inspecting the data we noticed that some patents were assigned to inventors in counties that had not yet been formally organized—we are considerably more comfortable using the state-level designations. Second, the Petralia, Balland, and Rigby (2016) data include all patents (i.e., both utility and design patents), while the United States Patent and Trademark Office (2015) data include only utility patents.

Despite both of these limitations, however, several supplementary analyses help justify our use of these data. First, as Figure A.1 in the Supplementary Appendix shows, we find an extremely high correlation between the patent measures for the thirteen-year period (1963 to 1975) they overlap. The correlation between the measures in level form is $r = 0.94$, and the correlation between the logged values of these measures (the form used in our empirical specification below) is $r = 0.99$. The Petralia, Balland, and Rigby (2016) data appear to understate levels of patenting

[8]For instance, South Dakota was admitted to the union in 1889; it first appears in our data in 1893, following the presidential election of 1892. We do not include states prior to these dates because no election returns are available for them.

activity (relative to United States Patent and Trademark Office 2015) most frequently for West Virginia and New Mexico, and overstate them for California, New York, Illinois, and Pennsylvania. Second, therefore, to ensure these measurement issues do not systematically affect our results, we have re-estimated our models while (1) using only the Petralia, Balland, and Rigby (2016) data (thus ending our analysis in 1975), (2) substituting United States Patent and Trademark Office (2015) data for 1963 through 1975, and (3) omitting the states noted above where the discrepancies between the measures are the largest. All of these supplementary analyses produce results consistent with those reported in the main text (see Tables A.1, A.2, and A.3.)

Figure 3 below shows the annual per-capita number of patents issued to residents of each state between 1837 and 2015. For the purposes of comparison, the y-axes reflect the logged number of patents issued per 10,000 residents. The data reveal considerable variation in patenting rates both between states and across time. Patenting rates were highest in Delaware during the mid-twentieth century, but have been consistently low in states such as Arkansas and Mississippi. In recent decades, patenting rates have increased substantially in states such as Idaho, Minnesota, North Carolina, Vermont, and Washington, but have declined somewhat in states including Nevada and Rhode Island. We use this state-level variation in patenting to examine how administrative behavior responds to a state's political characteristics.

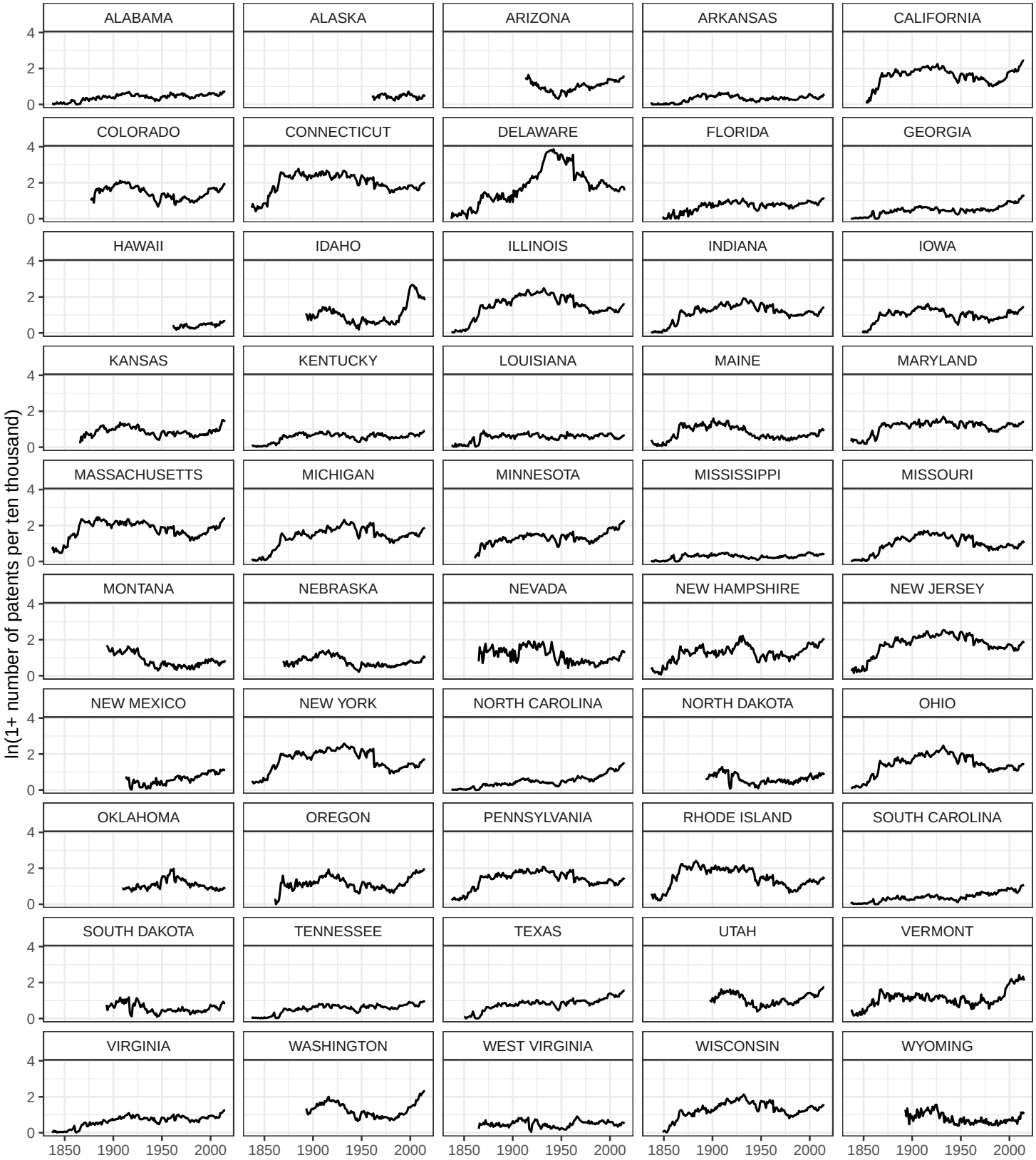
Empirical Strategy

We leverage the panel nature of the data described in Figure 3 and use a differences-in-differences design to estimate the degree to which administrative behavior is responsive to political congruence.[9] Specifically, we estimate the following model:

$$\ln(\text{patents} + 1)_{it} = \beta_0 + \alpha_i + \delta_t + \beta_1 \text{President won state}_{it} + \epsilon_{it}, \tag{1}$$

[9]We note that we do not interpret our results as the effects of political congruence on *innovation*. Instead, we regard patents as a form of government-backed property rights that result from administrative action. This latter phenomenon is our object of study.

Figure 3: Patenting Activity across States, 1837–2015



Figures show the annual number of patents in each state. Data from 1837 to 1975 are from Petralia, Balland, and Rigby (2016). Data from 1976 to 2015 are from the United States Patent and Trademark Office (2015).

where the dependent variable is the number of patents granted to residents of state i in year t. Because the distribution of this variable is right-skewed, we use the natural log of the number of patents (plus one). The main independent variable is an indicator, *President won state*, that characterizes whether (a majority of) the state's electoral votes in the most recent presidential election were cast for the sitting president.[10] In additional analyses, we distinguish the effects of competitive states, where the margin of victory was smaller than 10 percentage points, from "solid" states, where the margin of victory was more than 10 percentage points. We obtain positive estimates for both states, though the latter is more precisely estimated.[11] The coefficient for β_1 thus is the key parameter of interest. If patenting activity is responsive to the political characteristics of the states in which inventors live, we expect to observe a positive coefficient estimate for β_1. We include state fixed effects (α_i) to control for observed and unobserved time-invariant attributes that may affect patenting activity across states. We also include time fixed effects (δ_t) to account for secular trends in innovation, patenting activity, and patent applications. As we describe below, we also estimate additional models that control for state population and include state-specific linear time trends. Finally, β_0 is a constant term and ϵ_{it} is a random error term, which we cluster on state.

Using equation (1), the coefficient for *President won state* is identified by comparing patenting

[10]This measure offers two clear advantages over other related measures, such as the percentage of a state's popular votes cast for the winning presidential candidate. First, it is available for all states and years in the time frame under study. Some of the states during this time frame did not report popular vote totals, and using a popular vote-based measure would thus exclude these states from our study. Second, we avoid imposing assumptions about the functional form of the relationship between presidential vote share and patenting activity. For instance, it is unlikely than a ten percentage point increase in support for the sitting president would have the same effect in states who otherwise would cast 25 and 45 percent of its popular votes, respectively. In addition, presidential candidates compete over winning states rather than popular votes in those states; therefore, a binary measure of whether a state supported the winning presidential candidate is arguably a better measure on theoretical grounds. Finally, this measure offers the benefits of being straightforward to interpret in our regression models. However, Appendix A.3 shows that the results are substantively similar when using state presidential vote share rather than its vote in the Electoral College, although the coefficients are less precisely estimated. Consistent with the concern about linearity in the relationship between vote share and patenting, Table A.5 shows that the relationship between vote shares and patenting declines as states voted for president candidates at increasingly high rates. Moreover, Table A.6 shows that the results using our binary indicator are robust when excluding states for which popular vote totals were unavailable.

[11]See Table A.7.

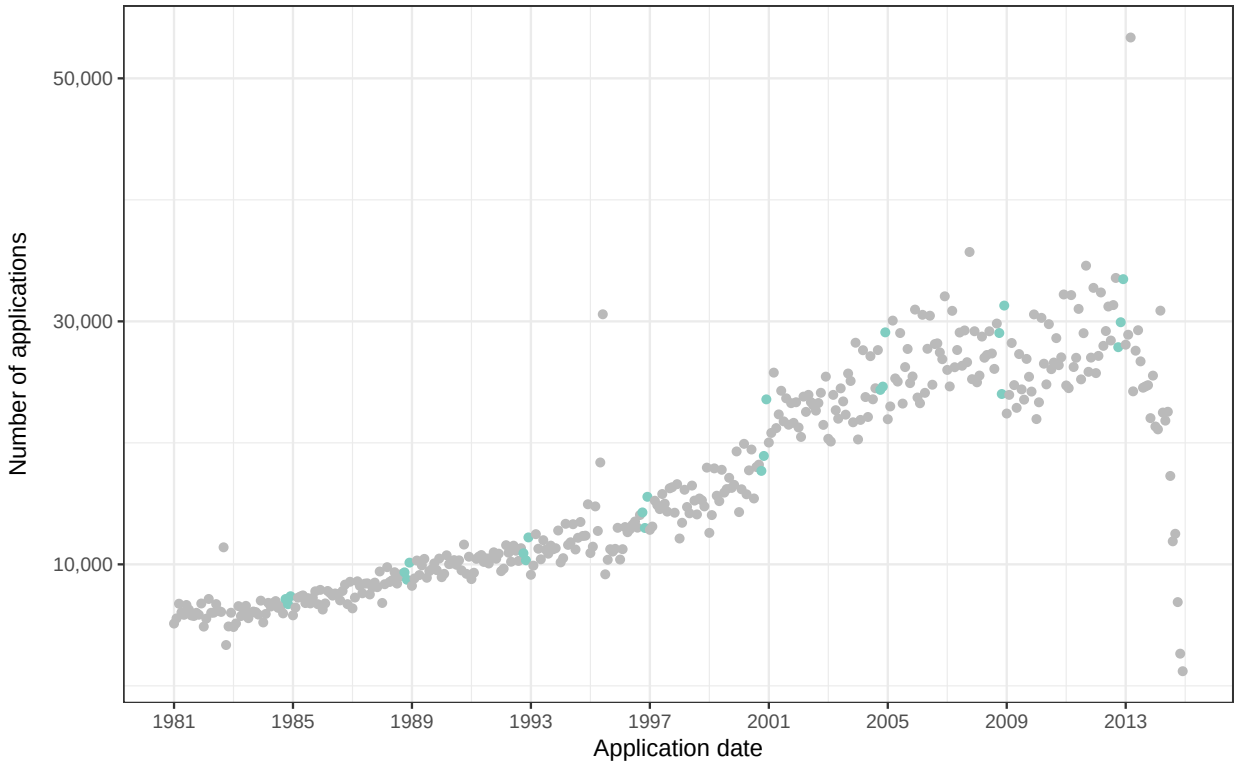
outcomes within states that correspond to changes in a state's political alignment with the current presidential administration. Within-state changes in the values of this variable are driven by two sources of variation. In the first, state preferences change, in which a state that did not formerly vote for a particular presidential candidate then do so when the current president seeks re-election. Analogous logic applies to a state's changing partisanship, such that the state begins supporting Republican or Democratic candidates when it used to support candidates from the other party. In the second, the partisan identity of the presidential administration changes, inducing changes in a state's alignment with the party of the presidential administration currently in office.

The key identifying assumption (i.e., parallel trends) on our analysis is that absent changes in support for the current president, patenting outcomes in states that did not cast its electoral votes for the current presidential administration would have followed the same trends as those in states that did not support the current presidential administration. This assumption is somewhat difficult to evaluate in this setting particularly because patents require patent applications; in a more ideal setting, we would observe identical patent applications from applicants in different states and document the Patent Office's response.

We might worry about our identifying assumption if applicants strategically adjust their behavior in response to their alignment with the administration currently in office. A preliminary inspection of application rates suggests this is not the case. Unfortunately, systematic data on patent applications over a long period of time—particularly for applications that were *not* granted—do not appear to exist in machine-readable format. Instead, using data from Marco et al. (2015) on the timing of 6.8 million patent applicants submitted between 1981 and 2014, we examined application rates by month. These data are shown in Figure 4. We are particularly interested in whether application rates appear to spike or decline in the final months of a presidential administration, perhaps reflecting applicants' views that the current or next administration might supply a more favorable reading. As the figure shows, however, patenting patterns appear to

move smoothly across time, with few if any discontinuous spikes and none that correspond to election timing. Of course, these data are only from a relatively limited period of time and cannot address the possibility that some potential applicants may be more likely to submit applications at the end of a term while others would prefer to wait for the next administration. However, they do provide some evidence to suggest that aggregate patterns of patent applications do not reflect cyclic activity.

Figure 4: Investigating political cycles in patent applications, 1981–2014



Points indicate the number of monthly patent applications received, January 1981 to December 2014. Points in green indicate months corresponding to the sixteenth quarter of a presidential administration.

Results

We begin our analysis by studying the relationship between a state's support for the current presidential administration and the number of patents granted to its inventors. Table 1 reports the

results. Column (1) displays the results of a bivariate regression of patents on *President won state*, along with state and year fixed effects. The coefficient estimate for β_1 is positive and statistically significant, indicating that states that supported the current presidential administration received significantly greater numbers of patents relative to states that did not support the winning presidential candidate. Moreover, the magnitude of the estimate is rather substantial, indicating that states who supported the president received ten percent more patents relative to states that did not. Column (2) reports results when adding a control for a state's population (logged). Again, we find a positive and statistically significant coefficient estimate for *President won state*. Finally, in column (3) we add state-specific linear trends. This specification reduces our reliance on the parallel trends assumption and helps address the possibility that changes in a state's political alignment with the president is correlated with other trends in the state-level innovation and patenting activity. Here, we continue to find strong evidence that a state's alignment with the current presidential administration is associated with substantially higher rates of patenting activity.

Table 1: Patenting Activity and State Presidential Election Results, 1837-2015

	(1)	(2)	(3)
President won state	0.100*	0.078*	0.063*
	(0.036)	(0.020)	(0.016)
Population (logged)		1.189*	1.321*
		(0.094)	(0.168)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	7,769	7,769	7,769

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

The magnitudes of the estimated effects for *President won state* compare favorably with other analyses that study the association between political factors and administrative decision mak-

ing. For instance, studying the allocation of federal grants in recent decades, Kriner and Reeves (2015) show that counties in states that supported the president received 4 to 6 percent more federal grant dollars and Berry, Burden, and Howell (2010) show that geographic constituencies represented by a member of the president's party received about 4 percent more spending than other constituencies. Similarly, studying the distribution of federal post offices in the late nineteenth century, Rogowski (2016) finds that counties represented in the House by a member of the president's party received a 6 percent larger increase in post offices relative to other counties. Finocchiaro (2015) finds considerably larger effects when studying the allocation of federal buildings around the turn of the twentieth century, finding that majority party status conferred a 40 percent increase in appropriations for federal projects. Focusing on an earlier period of American history, however, Gordon and Simpson (2018) find no relationship between majority party status and the provision of federal buildings, and only limited evidence that moderate members of Congress received larger shares of federal resources. On the whole, therefore, our estimated effects of a state's support for the incumbent presidential administration on patenting activity fits comfortably within the range of effects for politically related factors on administrative outputs in other domains.

Moreover, the results shown in Table 1 are robust to a variety of additional specifications and subsets of observations. First, we find substantively similar results when studying a balanced panel of states. While the coefficient estimates occasionally fall short of statistical significance at conventional levels, likely from dramatically reduced power due to the inclusion of only 17 states, the estimates are consistently positive and similar in magnitude to those in Table 1.[12] Second, we do not find any compelling evidence that our results are driven disproportionately by states inside or outside of the South.[13] Though the coefficients are estimated with varying degrees of precision and sometimes fall short of statistical significance, again likely due to decreased statistical power

[12]Using a balanced panel results in the elimination of all states that were admitted after 1836 in addition to states that seceded and joined the Confederacy. See Table A.8.

[13]For the purposes of this analysis we define the South as the eleven states of the Confederacy.

when limiting our analyses to subsets of states, they are consistently positive and of reasonably similar magnitudes.[14]

Third, the results are robust to an alternative identification strategy using lagged values of the dependent variable. We estimated versions of the models in Table 1 but replaced state fixed effects with *n*-period lags of each state's patenting rates, where we varied *n* from one to five.[15] In each model, the coefficient for *President won state* continues to be positive and statistically significant, providing support for our main results. We note that the coefficients are consistently smaller in magnitude than those in Table 1; consistent with Angrist and Pischke (2008, 246-247), these results could indicate a potential lower bound on our main estimates.

Fourth, we investigated the possibility of omitted variable bias due to the exclusion of state economic conditions from our models. These factors may be correlated with the demand for patenting and/or opportunities for innovation at the state level. Unfortunately, to our knowledge, government-published statistics on state economic factors are not available prior to the mid-twentieth century. While a variety of sector-specific outcomes are available from the Census for states in the nineteenth century, these measures are not consistently available across decades. Instead, we use estimates of state output per worker (in real 2000 dollars) and average years of schooling from Turner et al. (2007). The schooling measure is available annually from 1840 to 2000, while the output per worker measure is available for each Census decade from 1840 to 1920 and annually from 1929 to 2000. We linearly interpolate values for the intervening years. Our main results are robust to the inclusion of each of these measures.[16] Consistent with what one might expect, patenting activity is significantly higher in states with higher levels of economic performance, measured using both economic outputs and human capital. Interestingly, we also find that patenting rates are more responsive to state political factors in states with lower levels of economic performance. Put differently, our models provide evidence that political alignment

[14] See Table A.9.

[15] Because we omit state fixed effects, we also omit state-specific linear trends. See Table A.10.

[16] See Table A.11.

with the current presidential administration is associated with significantly greater increases in patenting rates among states at lower levels of economic development, but that the benefits of political alignment on patenting activity attenuate as economic performance improves. We do not wish to overinterpret this finding given limitations of measurement and potential endogeneity, but it does suggest the possibility that political alignment with the administration in power may help substitute for lower levels of economic capacity.

Fifth, the results are robust to accounting for congressional factors that may also advantage some states over others in securing patents. Oversight powers, along with the Senate's role in confirming nominations to the executive branch, provide Congress with potential influence over executive branch decision making. These influences were likely to be most acute for legislators who served on their respective chamber's Committee on Patents.[17] We used data from Canon, Nelson, and Stewart (1998) to identify which states' legislators served on these committees.[18] We created two indicators, *House committee* and *Senate committee*, which distinguished whether a given state had at least one legislator on the Patent Committee in each chamber. Overall, 21 percent of state-year observations had at least one member on the House Committee on Patents and 15 percent had at least one member on the Senate Committee on Patents. We also created an indicator, *Either chamber*, which distinguished whether a state had at least one member on the Patent Committees across both chambers. We then estimated models similar to those in Table 1.[19] While most of the coefficients for committee representation are positive, indicating that states with representation on the relevant committees experienced greater patenting activity, only one of the six coefficients is statistically significant. Moreover, the inclusion of these variables does not meaningfully change the coefficient estimates for *President won state*. While Congress may indeed have had its own source of institutional power for influencing administrative outputs, this

[17]Both the House and Senate committees were in existence from 1837 to 1946, after which jurisdiction over the Patent Office was transferred to the Judiciary committees.

[18]These data were obtained from http://web.mit.edu/17.251/www/data_page.html (accessed November 4, 2019).

[19]See Table A.12.

potential power does not appear to have confounded our estimates of the other political factors affecting the distribution of patents.

Sixth, we also considered whether the findings above are driven primarily by the political composition of a state's congressional delegation rather than its alignment with the presidential administration. To do so, we calculated the share of each state's House delegation that was from the same party as the president and included this variable in the models estimated in Table 1. For the sake of comparison with our indicator for *President won state*, we also created an indicator for states where the president's party held the majority of the state's House seats.[20] The coefficient for the composition of the state's House delegation is not statistically significant in any of the six models; instead, it is small in magnitude, indistinguishable from zero, and negatively signed in several of them.[21] Moreover, the inclusion of this variable does not substantially change the coefficient estimates for *President won state*. Though not dispositive, we regard these results as evidence that patenting activity was responsive to a state's political relationship with the executive branch rather than being mediated through Congress.

Finally, our theoretical discussion posited that administrative outputs were responsive to political control. We therefore considered whether the patterns shown in Table 1 were moderated by partisan context. In particular, we studied whether the relationship between presidential voting patterns and patenting activity varied with the incidence of divided and unified government, which characterizes the degree of institutional conflict between the president and Congress. If, on the one hand, administrative decisions are more distributive in character during periods of divided government (in the context of other distributive policies, see, e.g., Lohmann and O'Halloran 1994; McCarty 2000; McCubbins 1991), then states that supported the president should experience exceptionally high patenting rates in periods of divided government. On the other hand,

[20]The correlations between these indicators and state-level voting patterns in presidential elections are relatively modest. The correlation between *President won state* and the percentage of seats held by the president's party is 0.45; the correlation *President won state* and whether the president's party held a majority of seats is 0.36.

[21]See Tables A.13 and A.14.

however, if Congress is more likely to conduct oversight of administrative agencies during divided government, then patenting rates might be more responsive to presidential election results during unified government. Our results provide support for the latter argument.[22] We estimated the same model specifications in Table 1 and distinguished a state's electoral support for the president during divided and unified government. While the coefficients are consistently positive in both conditions, the coefficient for *President won state* during unified government is significantly larger in magnitude than during divided government, and the latter is not statistically distinguishable from zero. While not dispositive, these results suggest that interbranch conflict may largely mitigate the tendency for administrative outputs to respond to political factors.

Politics, Administration, and Institutional Development

We now examine how administrative responsiveness to political factors changed over the 180 year period represented in our data. Our primary interest is in identifying the degree of continuity—or lack thereof—from the findings shown in Table 1 across various eras of institutional development and political arrangements. Specifically, we study the association between patenting activity and a state's support for the presidential administration across four eras. While the choice of any dates to characterize the relevant eras is somewhat arbitrary, we draw heavily from existing accounts and our knowledge of developments within the Patent Office that would be theoretically expected to have some relationship with its administrative procedures and decisions.

Therefore, we estimate versions of the models shown above for the following set of dates: 1837–1868; 1869–1932; 1933–1980; 1981–2015. The first period pre-dates the civil service reform movement in the United States during which time spoils and partisan patronage dominated personnel politics within the executive branch. The Patent Office adopted some of the reforms that ultimately were contained in the Pendleton Act earlier than most other agencies; for instance, the

[22] See Table A.15.

Patent Office initiated competitive examinations beginning in 1869. According to the Commissioner of the Patent Office (1878, ix), "Men better fitted for the special work have been selected for appointment; the ablest, most diligent, and faithful men have been promoted; and ...the effect, generally, upon the Office has been to stimulate industry, attention to business, and studious habits." Therefore, we mark this year as the beginning of the second era of our study. Skowronek (1982) and others note that the transformation of the bureaucracy through the political insulation of its personnel and the professionalization of its procedures was not complete until the dawn of the New Deal era. Moreover, as Gailmard and Patty (2013, 115) argue, "Franklin Roosevelt's administration represents a clear turning point in the practical understanding of the relationship between politics and administration." Therefoe, we mark the end of the second era with 1932. Finally, to study the recent transformation of the administrative state characterized by Moe (1985) and Kagan (2001), we extend the third period through 1980 and distinguish the final period from 1981 to 2015.

Table 2 reports results when estimating separate models for each of the four periods described above. Our primary finding is that the relationship between a state's support for the president and patenting activity, as documented in Table 1, is concentrated in the first time period of our study. The coefficient for *President won state* is large in magnitude and statistically significant for the years between 1837 and 1868 (inclusive) and indicates that states experienced increases in patenting rates of approximately a third when they were aligned with the presidential administration currently in office. During the era of patronage, our results suggest, states won by the president experienced substantial increases in patenting activity.

The results in Table 2 also reveal, however, that patenting activity appeared to be insulated from electoral support for the remaining time period of our analysis. The coefficients in each subsequent time period are all small in magnitude, inconsistently signed, and none of them approach conventional levels of statistical significance. Moreover, these three coefficients are statistically indistinguishable from each other. In the middle third of the nineteenth century, administrative

outputs from the Patent Office may have reflected the nature of the patronage state, resulting in the disproportionate provision of administrative outputs to jurisdictions who provided political support for the president. But since the latter third of the nineteenth century, patenting activity appears to have had no association with a jurisdiction's political support for the president.

Table 2: Patenting Activity and State Presidential Election Results, 1837-2015

	1837-1868	1869-1932	1933-1980	1981-2015
President won state	0.321*	-0.004	-0.024	0.020
	(0.072)	(0.021)	(0.030)	(0.019)
Population (logged)	1.446*	1.213*	0.817*	1.774*
	(0.452)	(0.096)	(0.238)	(0.335)
State Fixed Effects	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓
Observations	919	2,756	2,344	1,750

Robust standard errors clustered on state are in parentheses. * $p < 0.05$.
Dependent variable is the logged number of patents in each state by year.

While we suggest it is no accident that the patterns documented above happen to coincide with the professionalization of the personnel process within the Patent Office, we also find that our results are robust to the years we use to define each of the four eras. We estimate additional models where we vary the beginning and end years of each of the time periods by plus and minus five years. For instance, we estimate models in which we vary the start date for period 2 between 1864 and 1874 and the end date between 1927 and 1937. The results from these additional analyses are strongly consistent with those reported in Table 2.[23] For example, the coefficients for the first period vary between 0.258 and 0.330, similar to the coefficient (0.321) reported in Table 2. Additional analyses for the other time periods also provide results substantively identical to those in Table 2 when perturbing the start and end dates of each era. Finally, we also find nearly identical results to Table 2 when including measures of schooling and worker output as described above.[24]

[23] See Table A.16.
[24] See Table A.17.

Potential Mechanisms: Personnel, Expertise, and Political Insulation

In a final set of analyses, we consider more closely our supposition that internal personnel changes at the Patent Office help explain the patterns shown in Table 2. These changes, implemented in 1869, institutionalized examination requirements for patent examiners. These exams served as a potential barrier to entry and helped ensure the expertise of officials responsible for evaluating applications. Moreover, this expertise likely served as a source of autonomy and deference from other political officials and institutions.

We study this potential explanation and evaluate changes in the composition of the patent office during the nineteenth and early twentieth centuries. To do so, we collected new data on rates of turnover among the individuals who served in 1,426 Patent Office examiner positions over the course of a century. Examiners are principally responsible for evaluating the merits of applications submitted to the Patent Office. We used data from biennial editions of the *Official Register of the United States* to study how the composition of the examiners changed between 1837 and 1937. During this period, it is worth noting, the number of examiners in the Patent Office expanded dramatically, from two in 1837 to 65 in 1937. We study turnover in each biennium by evaluating the percentage of examiners in year t that were also examiners in year $t + 2$.

Figure 5 shows the values of this measure for each biennium between 1837 and 1937.[25] The figure shows considerable variation in turnover and stability. In several years—for instance, 1851 and 1859—two-thirds of the examiners were no longer in service two years later. Both of these years, we point out, correspond with partisan transitions in presidential administrations, including Whig Millard Fillmore to Democrat Franklin Pierce in the former instance and Democrat James Buchanan to Republican Abraham Lincoln in the latter instance.[26] During the similar time period, turnover rates were quite low, and frequently zero, when there was no change in the president's party. For instance, Franklin Pierce's Patent Office had the same examiners in 1855 as

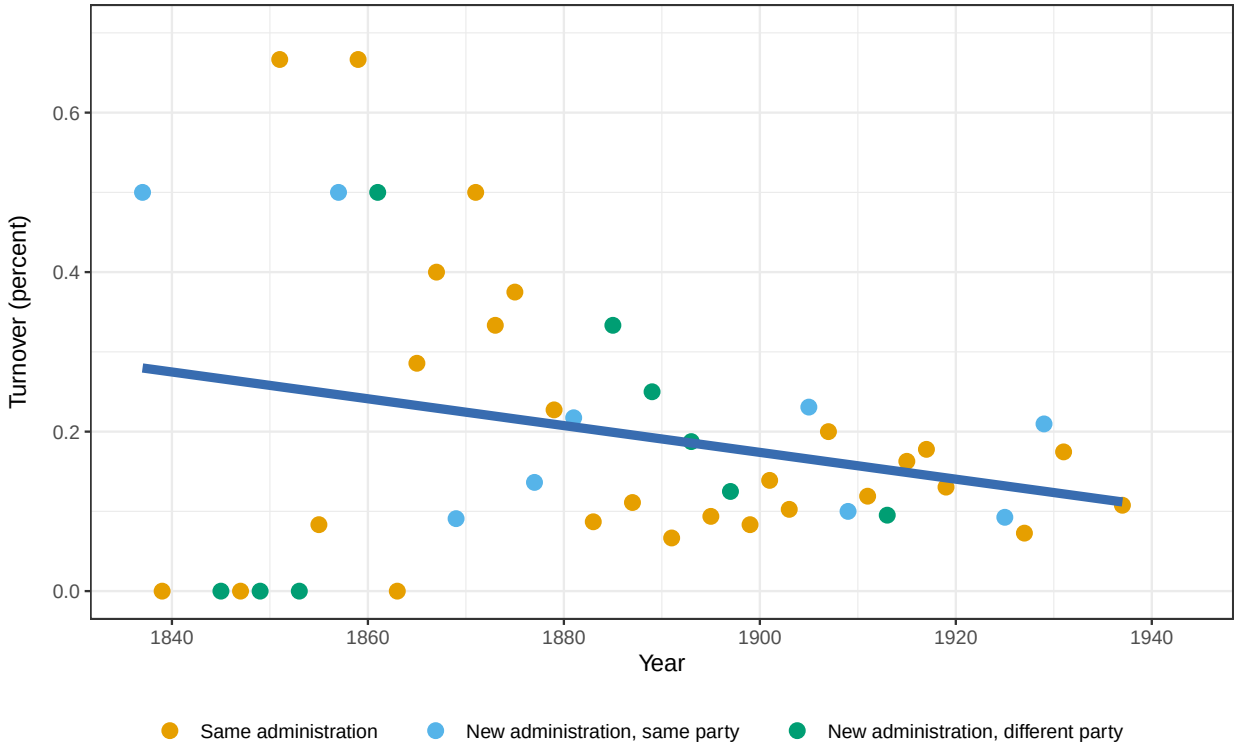
[25]Data are missing for the years 1841, 1843, 1923, 1925, 1933, and 1935. The *Official Register* did not list examiners' names in 1841, was not printed in 1923, and does not appear to be available for 1935.

[26]There were six examiners in 1853 and twelve in 1861.

in 1853, and Millard Fillmore's Patent Office had the same examiners in 1851 as Zachary Taylor's had in 1849.[27] As the nineteenth century progressed, however, turnover rates fell quite consistently. In the post-Reconstruction period, turnover rates exceeded 30 percent only once: in the period between 1883 and 1885, when Republican Chester Arthur was succeeded by Democrat Grover Cleveland. Not only did the average rates of turnover fall, but the variation in turnover rates also narrowed in the latter half of the nineteenth century. In the eighteen biennia before 1877, the standard deviation in turnover rates was 0.25; but in the 27 biennia between 1877 and 1937, the standard deviation in turnover was 0.06. Overall, therefore, the data shown in Figure 5 suggest that a more professionalized and stable Patent Office emerged in the second half of the nineteenth century and persisted through at least the first third of the twentieth century.

[27] Fillmore was Taylor's Vice President and became President upon Taylor's death in 1850.

Figure 5: Turnover among patent examiners, 1837–1937



Points indicate the level of turnover among examiners in the patent office, measured by the proportion of examiners in year t that remained employed as examiners in year $t + 2$, subtracted from one. The curve is the fitted bivariate regression line (b = -.002, $p < .08$). Data on patent examiners come from biennial issues of the *Official Register of the United States*, 1837 to 1937.

The declining turnover rates documented in Figure 5 suggest greater stability in membership and consistency in patent review along with reduced opportunities for political control of patenting activity. Along with the findings in Table 1 and 2, these data provide evidence consistent with the hypothesis that expertise helps to insulate an organization's decisions from political influences.

We test this hypothesis more formally using the data on patent examiners. To establish a plausible relationship between a state's presidential voting patterns and patent office decision making, we collected data on the home states of patent office personnel and test whether states who supported the current president are more likely to have representation among patent office

personnel. These data were collected from biennial issues of the *Official Register of the United States* for the years 1852 to 1938. Unfortunately, these data were unavailable for a subset of the years under study and are currently missing for the years 1907 to 1924 (inclusive), 1935, and 1936.

We use these data to create an indicator, *State examiner*, that takes a value of one if a state has at least one examiner in the patent office, and zero otherwise. Overall, this variable has a value of one for 23 percent of the state-year observations. We estimate models similar to those shown in the analyses above, where the key independent variable is *President won state*. If states that supported the president are more likely to have representation in the patent examiner's office, we expect this variable to be positively signed. We also estimate models while controlling for state population (logged). As above, state and year fixed effects are included in all models and we estimate an additional specification that accounts for linear trends within states. Standard errors are clustered on state.

The results are shown in Table 3. The coefficients for *President won state* are consistently positive and are statistically significant ($p < .05$) in two of the three models. These results indicate that supporting the current president is associated with a four to five percentage point increase in the probability that a least one patent examiner is from that state. The findings establish a plausible connection, therefore, between a state's voting patterns in presidential elections and its representation among administrative decision makers.

We now use this measure to evaluate whether having representation among the patent examiners is associated with increased patenting rates. To do so, we estimate similar models as in Table 1 and where we also include the indicator for *State examiner*. Table 4 shows the results. The coefficient for *State examiner* is consistently positive. The coefficient estimate in model (1) is large in magnitude and statistically significant; however, its magnitude declines in models (2) and (3), likely due to confounding with population, and the estimates fall short of statistical significance at conventional levels. Nevertheless, the estimates reasonably suggest that a state's presence among the patent examiners is associated a three to four percent increase in patenting

Table 3: State Presidential Election Vote Share and Presence in the Patent Office, 1851-1938

	(1)	(2)	(3)
President won state	0.048*	0.046	0.047*
	(0.024)	(0.023)	(0.022)
Population (logged)		0.229*	0.067
		(0.080)	(0.122)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	3,592	3,592	3,592

Robust standard errors clustered on state are in parentheses. Dependent variable is an indicator for whether a state has at least one official in the office of patent examiners in a given year. * $p < 0.05$.

activity. Moreover, the inclusion of the *State examiner* variable attenuates the magnitude of the *President won state* coefficient. In combination, then, the results in Table 4 provide suggestive evidence consistent with the hypothesis that patronage and professionalization produced the link between election results and patenting rates.

Conclusion

More than six decades ago, Herbert Kaufman (1956, 1060) characterized the Progressives' vision for bureaucratic reform as the quest for *neutral competence*, in which administration would be performed "expertly" and according to "explicit, objective standards rather than to personal or party or other obligations and loyalties." An important literature examines the actualization of the Progressive vision, describing the conditions under which and mechanisms through which the modern administrative state developed. To date, however, it has been less clear how the transformation of American bureaucracy—its institutional structure, relationship with political principals, and professionalization (e.g., Bensel 1990; Carpenter 2001; Gailmard and Patty 2013; Moe 1989; Skowronek 1982)—affected the qualitative nature of the outputs it produced.

Table 4: State Presence in the Patent Office and Patenting Activity, 1851-1938

	(1)	(2)	(3)
President won state		0.008	-0.009
		(0.024)	(0.025)
Population (logged)		1.316*	1.774*
		(0.092)	(0.124)
State examiner	0.187*	0.036	0.030
	(0.060)	(0.029)	(0.016)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	3,498	3,498	3,498

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

We have established new empirical findings that link politics and administration in the context of patenting activity. To the extent that innovation is a prerequisite for economic growth (Schumpeter 1954), our results suggest that, at least in the mid-nineteenth century, political control of patent administration had important implications for economic activity across states. This finding highlights the ways that the national government, if indirectly, could shape local economies even without direct intervention. Along with other research on the nature of the state in earlier periods of American history (e.g., John 1995; Skocpol 1992), our results suggest that the impact of state on society was considerably greater than Tocqueville recognized. Our findings, moreover, extend those from research that characterizes the mid-nineteenth century as regime of party patronage (e.g., James 2006) and demonstrates how party competition affected the administrative outputs produced by the executive branch.

Our findings have several other important implications, both empirical and theoretical. First, our analysis locates the timing of administrative transformation—at least, within the patent office—somewhat earlier than other accounts (Carpenter 2001; Skowronek 1982). Based on both employ-

ment patterns and the relationship between electoral politics and administrative behavior, we find evidence that suggests that the federal bureaucracy exhibited characteristics of professionalization as early as Reconstruction. This time period corresponds with the dramatic expansion of the state's reach through, for instance, pensions for veterans and their kin (Skocpol 1992) and (short-lived) efforts to support the integration of newly-freed Blacks into society (Rogowski 2018). Second, our findings highlight the role of *internal* reforms adopted within the bureaucracy. While firms apparently lobbied Congress for civil service reform within the patent office during the 1860s, legislators declined to act (Mashaw 2012, 394). Instead, the patent office adopted its own personnel reforms, implementing examination requirements more than a decade before the Pendleton Act was passed. While changes to the electoral environment later in the nineteenth century may have affected Congress's incentives to increase the bureaucracy's administrative capacities (Kernell and McDonald 1999), internal administrative reform was possible—and, we show, effective—even absent congressional activity. Third, despite the perennial salience of patent reform proposals, our measure of political alignments indicates that patenting activity appears to be largely insulated from politics in the contemporary era, and has been for the last century and a half.

We conclude by noting several limitations of our findings and opportunities for further research. First, the dependent variable throughout our analysis is the aggregate number of patents issued to residents of a particular state. While this specification allows us to explore variation in patenting activity using the most comprehensive data available, it does not allow us to study the specific decisions made by patent office examiners. It is possible, for instance, that the rates and/or scientific merit of patent applications may also vary across states in ways correlated with political conditions. Identifying the microfoundations of the aggregate patterns shown in our analysis by, for instance, studying individual decisions issued by bureaucrats, is an important task for future research. Second, our state-level measure of political alignment is relatively crude, and thus raises questions about potential mechanisms that produce the relationships observed in the

data. During the patronage era, for instance, our data do not allow us to explore whether and how examiners might use an applicant's state of residence as a heuristic when evaluating the request for a patent. Moreover, this raises the possibility that other factors beyond geography may structure patterns of bureaucratic responsiveness to political forces. Third, and finally, while the patent office is a substantively important case of its own, it is not immediately clear whether the historical patterns in political responsiveness would apply directly to other agencies and bureaus. Instead, additional research would be useful to examine how patterns of political control varied with the institutional characteristics of agencies and the nature of their administrative tasks.

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ONLINE APPENDIX

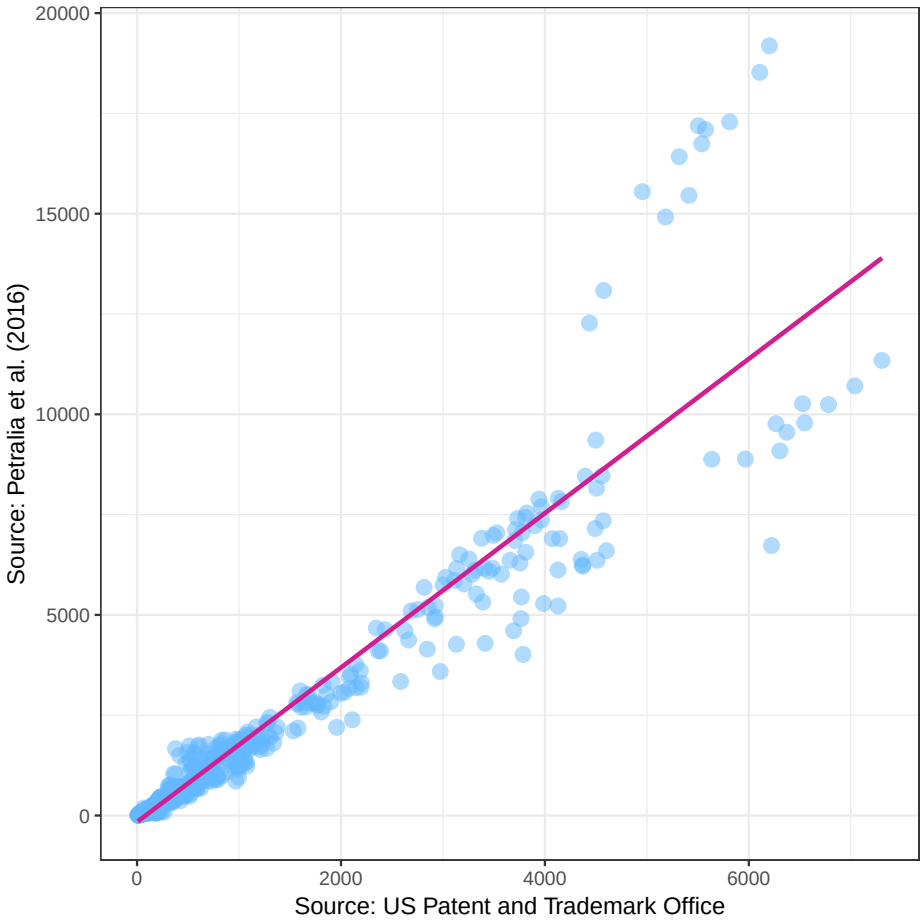
Robustness Checks and Supplementary Analyses for

Politics and Administration:
Evidence from the U.S. Patent Office, 1837-2015

Contents

A.1 Correlation between data sources

Figure A.1: Correlation between patent measures, 1963–1975



Points indicate the number of patents granted to residents of each state and year between 1963 and 1975. Data on the x-axis are from the United States Patent and Trademark Office (2015) and data on the y-axis are from Petralia, Balland, and Rigby (2016). The correlation between the measures in level form is $r = 0.94$. The correlation between the measures in logged form (not shown) is $r = 0.99$.

A.2 Robustness: Data sources

Table A.1: Patenting Activity and State Presidential Election Results, 1837-1975

	(1)	(2)	(3)
President won state	0.118*	0.086*	0.049*
	(0.038)	(0.022)	(0.022)
Population (logged)		1.208*	1.293*
		(0.102)	(0.144)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	5,769	5,769	5,769

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

Table A.2: Patenting Activity and State Presidential Election Results, 1837-2015

	(1)	(2)	(3)
President won state	0.100*	0.078*	0.063*
	(0.036)	(0.020)	(0.016)
Population (logged)		1.189*	1.321*
		(0.094)	(0.168)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	7,769	7,769	7,769

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

Table A.3: Patenting Activity and State Presidential Election Results, 1837-1975

	1837-1868	1869-1932	1933-1975
President won state	0.321*	-0.004	-0.026
	(0.072)	(0.021)	(0.031)
Population (logged)	1.446*	1.213*	0.694*
	(0.452)	(0.096)	(0.252)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
Observations	919	2,756	2,094

Robust standard errors clustered on state are in parentheses. * $p < 0.05$.
Dependent variable is the logged number of patents in each state by year.

A.3 Robustness: Measurement strategies

Table A.4: Patenting Activity and State Presidential Election Vote Share, 1837-2015

	(1)	(2)	(3)
President's vote share	0.176	0.084	0.044
	(0.102)	(0.081)	(0.068)
Population (logged)		1.189*	1.320*
		(0.093)	(0.169)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	7,653	7,653	7,653

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

Table A.5: Patenting Activity and State Presidential Election Vote Share, 1837-2015

	(1)	(2)	(3)
President's vote share	2.503*	2.590*	2.259*
	(0.862)	(0.643)	(0.457)
President's vote share × President's vote share	-2.336*	-2.517*	-2.220*
	(0.838)	(0.628)	(0.462)
Population (logged)		1.190*	1.313*
		(0.094)	(0.166)
Constant	0.770	-14.305*	-23.754*
	(0.413)	(1.239)	(2.916)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	7,653	7,653	7,653

Robust standard errors clustered on state are in parentheses.
Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

Table A.6: Patenting Activity and State Presidential Election Results, 1837-2015 (Excluding states without raw vote shares)

	(1)	(2)	(3)
President won state	0.082*	0.061*	0.052*
	(0.035)	(0.019)	(0.015)
Population (logged)		1.188*	1.316*
		(0.094)	(0.168)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	7,653	7,653	7,653

Robust standard errors clustered on state are in parentheses.
Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

Table A.7: Patenting Activity and State Presidential Election Results, 1837-2015

	(1)	(2)	(3)
Swing state	0.056	0.032	0.037
	(0.037)	(0.025)	(0.020)
Solid state	0.071	0.050*	0.045*
	(0.038)	(0.024)	(0.021)
Population (logged)		1.188*	1.318*
		(0.093)	(0.169)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	7,653	7,653	7,653

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

A.4 Model Specifications and Extensions

Table A.8: Patenting Activity and State Presidential Election Results, 1837-2015 (Balanced Panel)

	(1)	(2)	(3)
President won state	0.113	0.106*	0.056
	(0.077)	(0.043)	(0.031)
Population (logged)		1.489*	1.860*
		(0.114)	(0.323)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	3,043	3,043	3,043

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

Table A.9: Patenting Activity and State Presidential Election Results, 1837-2015

	South			Non-South		
	(1)	(2)	(3)	(4)	(5)	(6)
President won state	0.075	0.043	0.014	0.043	0.023	0.023
	(0.085)	(0.070)	(0.050)	(0.046)	(0.025)	(0.018)
Population (logged)		1.023*	0.959*		1.223*	1.368*
		(0.098)	(0.171)		(0.109)	(0.184)
State Fixed Effects	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
State-Specific Trends			✓			✓
Observations	1,900	1,900	1,900	5,869	5,869	5,869

Robust standard errors clustered on state are in parentheses. * $p < 0.05$.

Dependent variable is the logged number of patents in each state by year.

Table A.10: Patenting Activity and State Presidential Election Results, 1837-1946

	(1)	(2)	(3)	(4)	(5)
President won state	0.016*	0.018*	0.018*	0.018*	0.016*
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Population (logged)	0.036*	0.024*	0.019*	0.018*	
	(0.007)	(0.005)	(0.004)	(0.004)	
log(Patents), one lag	0.968*	0.717*	0.690*	0.694*	0.699*
	(0.005)	(0.025)	(0.030)	(0.031)	(0.031)
log(Patents), two lags		0.261*	0.191*	0.172*	0.164*
		(0.025)	(0.032)	(0.032)	(0.035)
log(Patents), three lags			0.101*	0.080*	0.081*
			(0.023)	(0.033)	(0.031)
log(Patents), four lags				0.036	0.004
				(0.024)	(0.027)
log(Patents), five lags					0.045*
					(0.016)
Constant	-0.201	-0.453*	-0.169	-0.018	0.021
	(0.155)	(0.100)	(0.100)	(0.120)	(0.099)
Year Fixed Effects	✓	✓	✓	✓	✓
Observations	7,719	7,669	7,619	7,569	7,519

Robust standard errors clustered on state are in parentheses. * $p < 0.05$.

Dependent variable is the logged number of patents in each state by year.

Table A.11: Patenting Activity and State Presidential Election Results, 1840-2000

	(1)	(2)	(3)	(4)	(5)	(6)
President won state	0.067*	0.046*	0.183*	0.066*	0.045*	0.162*
	(0.021)	(0.022)	(0.046)	(0.021)	(0.022)	(0.054)
Income (thousands)		0.040*	0.046*			
		(0.013)	(0.013)			
Years of schooling					0.267*	0.273*
					(0.068)	(0.067)
Population (logged)	1.165*	1.115*	1.118*	1.164*	1.054*	1.060*
	(0.095)	(0.083)	(0.081)	(0.095)	(0.086)	(0.086)
President won state × Income (thousands)			-0.007*			
			(0.002)			
President won state × Years of schooling						-0.017*
						(0.007)
Constant	-13.402*	-12.940*	-13.071*	-13.384*	-12.286*	-12.432*
	(1.221)	(1.051)	(1.023)	(1.222)	(1.085)	(1.084)
State Fixed Effects	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Observations	6,905	6,905	6,905	6,930	6,930	6,930

Robust standard errors clustered on state are in parentheses. * $p < 0.05$.

Dependent variable is the logged number of patents in each state by year.

Table A.12: Patenting Activity and State Presidential Election Results, 1837-1946

	(1)	(2)	(3)	(4)
President won state	0.073*	0.050	0.074*	0.050
	(0.024)	(0.026)	(0.024)	(0.025)
Population (logged)	1.286*	1.622*	1.294*	1.620*
	(0.109)	(0.141)	(0.110)	(0.141)
House committee	0.071*	0.031		
	(0.032)	(0.022)		
Senate committee	-0.008	0.031		
	(0.034)	(0.026)		
Either chamber			0.033	0.033
			(0.029)	(0.019)
State Fixed Effects	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓
State-Specific Trends		✓		✓
Observations	4,347	4,347	4,347	4,347

Robust standard errors clustered on state are in parentheses. * $p < 0.05$.
Dependent variable is the logged number of patents in each state by year.

Table A.13: Patenting Activity and State Presidential Election Results, 1837-2015

	(1)	(2)	(3)
Percentage of seats, president's party	0.017	0.001	-0.007
	(0.038)	(0.026)	(0.025)
President won state		0.059*	0.049*
		(0.022)	(0.017)
Population (logged)		1.188*	1.325*
		(0.092)	(0.167)
State Fixed Effects		✓	✓	✓
Year Fixed Effects		✓	✓	✓
State-Specific Trends				✓
Observations		7,677	7,677	7,677

Robust standard errors clustered on state are in parentheses.
Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

Table A.14: Patenting Activity and State Presidential Election Results, 1837-2015

	(1)	(2)	(3)
Majority of seats, president's party	0.010	-0.011	-0.019
	(0.027)	(0.022)	(0.021)
President won state		0.082*	0.072*
		(0.024)	(0.020)
Population (logged)		1.189*	1.320*
		(0.094)	(0.168)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	7,769	7,769	7,769

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

Table A.15: Patenting Activity, State Presidential Election Results, and Partisan Control of Government, 1837-2015

	(1)	(2)	(3)
President won state (unified)	0.154*	0.098*	0.098*
	(0.058)	(0.024)	(0.024)
President won state (divided)	0.029	0.019	0.019
	(0.037)	(0.020)	(0.020)
Population (logged)		1.321*	1.321*
		(0.167)	(0.167)
State Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
State-Specific Trends			✓
Observations	7,769	7,769	7,769

Robust standard errors clustered on state are in parentheses. Dependent variable is the logged number of patents in each state by year. * $p < 0.05$.

A.5 Robustness: Eras of Patenting Activity

Table A.16: Robustness to period definitions

Time period	Start year ± 5 years	End year ± 5 years
1837–1868	—	0.258, 0.330
1869–1932	-0.004, 0.001	-0.028, -0.007
1933–1980	-0.019, 0.009	-0.026, -0.016
1981–2015	0.021, 0.026	—

Table provides the range of coefficient estimates when the start and end years of each period are changed by ± five years.

Table A.17: Patenting Activity and State Presidential Election Results, 1840-2000

	1840-1868	1869-1932	1933-1980	1981-2000
President won state	0.277*	-0.008	-0.023	-0.012
	(0.066)	(0.021)	(0.030)	(0.043)
Population (logged)	1.004*	1.211*	0.710*	1.706*
	(0.331)	(0.083)	(0.184)	(0.402)
Real income (2000, in thousands)	-0.054	0.047*	0.029*	-0.006
	(0.036)	(0.014)	(0.010)	(0.006)
Years of schooling	1.095*	0.129	0.272*	-0.096
	(0.211)	(0.069)	(0.130)	(0.148)
State Fixed Effects	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓
Observations	832	2,729	2,344	1,000

Robust standard errors clustered on state are in parentheses. * $p < 0.05$.
Dependent variable is the logged number of patents in each state by year.