THE LEGAL ENVIRONMENT OF SIDE PROJECT OWNERSHIP AND IT INNOVATION: EVIDENCE FROM THE ALCATEL V. BROWN CASE

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ABSTRACT

Working on side projects outside of a salaried job has become a growing trend for knowledge workers such as information technology (IT) professionals. Side projects are valuable opportunities for employees to learn new skills and develop creativity, yet it is not clear whether employees get to legally own their side projects. Little is known about how such ownership uncertainty affects employee innovation at work. In this work, we leverage an exogenous change in the legal arrangement of side project ownership − the *Alcatel v. Brown* case − to investigate whether firms' expanding control over side projects stimulates or hampers employees' innovation performance at work. We find that in states where firms have greater contractual power to own employees' side projects, the quantity of *firm-owned IT patents* decreased but surprisingly, the quality of such IT patents (measured by citations) improved following the legal change. Further investigation of employees' innovation behaviors suggests that such mixed findings are because employees focus on fewer technology domains and make more extensive exploitation of prior knowledge. Our work contributes to the information systems literature on IT innovations by uncovering nuanced effects of IP ownership of employee side projects.

Keywords: Employee innovation at work, side project, IT innovation, intellectual property, *Alcatel v. Brown*

THE LEGAL ENVIRONMENT OF SIDE PROJECT OWNERSHIP AND IT INNOVATION: EVIDENCE FROM THE ALCATEL V. BROWN CASE

In an information age where knowledge can be easily created and accessed, the locus of employee innovation lies not only in employees' day-to-day work but also beyond their workspace. Initiatives that employees work on beyond their employment scope and outside of normal work hours are referred to as side projects (Davis and Davis 2007; Davis et al. 2013; Mehra et al. 2011). Side projects are prevalent among information technology (IT) professionals. For example, Github, a major software code hosting service for both open-source and private software projects, has over 100 million users and 372 million repositories as of January 2023, many of which are for side projects (Lehechka 2020). A 2022 survey of 67,963 software developers by Stack Overflow indicates that 88% of them worked on side projects.[1] Side projects not only offer ample opportunities for employees to learn and practice new skills (Sonmez 2017), but also can be a source of groundbreaking innovation and new business opportunities (Burgelman 1983; Davis et al. 2013). For example, some of the most popular technology products and companies, such as Slack, Twitter, Craigslist, and Trello, started as side projects.

Despite the growing prevalence and importance of side projects among IT professionals, a major concern among those IT professionals employed by firms is the intellectual property (IP) ownership of side projects. Some employees believe that everything they create in their personal time belongs to themselves. However, that is not necessarily the case (Spolsky 2016). In the current U.S. legal system, ownership of side projects is ambiguous, as there are *no* federal laws that govern the IP rights (IPR) of side projects (Parker 1984). Whether an employee's side project is owned by the employee or her employer depends on two main factors (Chou and Adler 2014; Spolsky 2016). One is the employment contract between employees and firms, which usually

[1] The survey is available at https://survey.stackoverflow.co/2022/.

assigns the IPR of side projects to firms. The other is state-level statutes on employees' side project ownership, which determine the *enforceability* of employment contracts. Both factors result in complications and variations in the ownership of side projects across the U.S. For example, some states such as California, Delaware, and Minnesota have statutes that protect employees' ownership of their side projects, while other states such as Texas grant employers more contractual power over side projects. In a recent survey conducted among open source software (OSS) contributors, only less than half of the respondents said that they were free to work on OSS projects and that their employers would not lay any claim to the IP of their side projects (Nagle et al. 2020).

The impact of IPR legal regimes on innovation has been extensively discussed in prior literature (e.g., Contigiani et al. 2018; Gans et al. 2008; Marx 2011; Samila and Sorenson 2011). Notwithstanding the valuable insights from the prior work, to the best of our knowledge, little research has examined how the legal environment with respect to employees' side projects influences their innovation, especially their innovation performance at work. We refer to *employee innovation at work* as any innovation output produced by employees that is owned by their employers. On the one hand, by giving up the IPR of their side projects to employers, employees may receive more investments or other types of support (e.g., training and collaboration opportunities) from their employers (Hellmann 2007; Hellmann and Perotti 2011; Liebeskind 1997), thereby stimulating more innovative activities by employees (Mehra and Mookerjee 2012). On the other hand, the lack of IP protection for employees may reduce their incentive to innovate and capability to learn outside of the workplace, which hamper their innovation performance at work (Durcikova et al. 2011; Huang and Zhang 2016). Overall, the relationship between the IPR of side projects and employees' innovation performance at work remains theoretically unclear.

In this study, we address this gap by investigating how the legal environment that governs the

IPR of side projects affects employees' IT innovation at work. Specifically, we focus on U.S. state-level statutes regarding the IPR of side projects and exploit the ruling of *Alcatel USA, Inc. v. Evan Brown* (hereafter *Alcatel v. Brown*) as an exogenous treatment. *Alcatel v. Brown* is a well-known legal case in which a Texas court ruled that the firm Alcatel owned the IPR of all forms of employee innovation, even including an abstract idea its employee Evan Brown had for his side projects. As a result, firms gained more extensive contractual control over employees' creative activities, including their side projects. This case has become "a symbol of outrage" felt by employees who are required to give up their innovation to their employers (Lobel 2014a: 10) and serves as one of the most famous disputes on side project ownership (Lobel 2014b).

Alcatel v. Brown serves as a precedent for future court decisions nationwide, but its enforceability varies by state. Table 1 lists the eight states that do not follow *Alcatel v. Brown*. These states explicitly protect employees' claims for IPR of their side projects, invalidating the employment contracts that allow firms to claim ownership of employees' every innovation. We exploit this difference in legal regimes and implement a set of difference-in-differences (DID) techniques to investigate the effect of *Alcatel v. Brown* on employee innovation at work.

TABLE 1. STATES WITH STATUTES PROTECTING EMPLOYEES' IP OWNERSHIP OF SIDE PROJECTS

State	Enacted Year
California (CAL. LAB. CODE §2870 and §2872)	1979
Delaware (19 DEL. CODE §805)	1984
Illinois (765 ILL. COMP. STAT. ANN. 1062/2)	1983
Kansas (KAN. STAT. ANN. §44-130)	1986
Minnesota (MINN. STAT. §181.78)	1977
North Carolina (N.C. GEN. STAT. §66- 57.1)	1981
Utah (UTAH CODE ANN. 1953 §34- 39-3)	1989
Washington (WASH. REV. CODE §49.44.140-145)	1979

Our results show that in states where employees' IPR of side projects is not explicitly protected by state laws, innovation quantity, measured by the number of *IT patent filings owned by firms*, decreased after the ruling of *Alcatel v. Brown*. However, surprisingly, the quality of innovation, measured by the average citations received per patent, *increased*. We investigate what

explains this *quantity-quality tradeoff* and find that to produce IT patents, employees focus on fewer technology domains and exploit prior knowledge more extensively after *Alcatel v. Brown*.

Our research makes several important contributions. First, our work advances the information systems (IS) literature on IT workplaces and IT professionals (e.g., Levina and Xin 2007; Pawlowski and Robey 2004; Tambe and Hitt 2014; Venkatesh et al. 2017). We show that IT professionals are concerned about side project ownership, which has a significant impact on their innovation performance at work. By investigating the relationship between side project ownership and employee innovation at work, our study significantly advances prior IS literature on informal learning in IT industries (Cha et al. 2008; Mehra et al. 2011).

Second, our research contributes to the broad literature on innovation management. Extant research provides significant insights into how various legal regimes affect innovation, such as trade-secret protection (Contigiani et al. 2018) and non-compete covenants (Marx et al 2009; Samila and Sorenson 2011). The general conclusion is that employer-friendly policies adversely influence innovation. We depart from this literature by showing that despite the decline in IT patent quantity after the legal regime allows employers to have contractual control over side projects, it led to an improvement in innovation quality in IT patents by directing employees to concentrate on fewer technological domains and make greater use of prior knowledge. In other words, the change triggered by *Alcatel v. Brown* does not hamper IT innovation in all aspects, which has short-term and long-term implications. At first glance, this seems encouraging to firms and beneficial to employees. However, the narrower scope of innovation and the lack of exploitation of new prior knowledge might not be so desirable in the long run because firms and employees could be locked in existing IT competencies and practices and eventually lose sight of better alternatives and new possibilities, a phenomenon referred to as the "competency trap" (Levinthal and March 1993). This novel finding significantly advances the innovation

management literature, particularly along the line of how the IPR legal regime affects innovation.

LEGAL ENVIRONMENT OF SIDE PROJECT OWNERSHIP

Before *Alcatel v. Brown*

In the U.S., the common law is a body of unwritten laws based on legal precedents, which dictates adjudication processes in cases where a decision cannot easily be made based on existing statutes or written rules (Pound 1908). Since 1933, the state courts have followed early federal precedents and the common law to address cases on employee innovation (Paker 1984). The common law as to employee innovation can be simply stated as follows: (1) If there is an employment contract expressly stating that an employee's innovation belongs to an employer, the employer retains the ownership of whatever the employee invents during the employment. (2) Even in the absence of such a contract, the employer retains the employee's innovation if she is specifically employed to work on the innovation. (3) If the employee is not hired for specific innovation, in the absence of an employment contract, the employer has an implied "shop right" to own and use the innovation if she uses the materials, facilities, or time of the employer to create the innovation. According to the common law, employers can claim the ownership of employee innovation made during the employment period, including normal working hours and spare time.

While the common law provides some underlying principles, states differ when it comes to implementation. As mentioned above, the eight states in the U.S. in Table 1 have statutes to protect employee innovation from being claimed by employers. For example, California limits the enforceability of pre-innovation IP assignment agreements, which usually are an important part of any employment contract. California Labor Code §2870-2872 states that "(a)ny provision in an employment agreement that provides that an employee shall assign or offer to assign any rights in an invention to his/her employer shall not apply to an invention that the employee develops entirely on his or her own time without using the employer's equipment, supplies, facilities, or trade secret information… Any provision that purports to do so shall be unenforceable and against

the state's public policy." On the other hand, in the states without such statutes, employers can use written contracts to claim the ownership of employee innovation.

Alcatel v. Brown: Important Features

Alcatel v. Brown represents an important development milestone in the legal environment of side project ownership. Evan Brown was a software developer in Texas who claimed to have had an idea for software since 1975, long before he joined DSC Communications (subsequently acquired by Alcatel). When Brown mentioned his idea to Alcatel before any tangible solution was developed and attempted to negotiate a deal to share the profits of a potential solution with his employer, Alcatel instead fired him and sued him for full ownership of the idea in April 1997. The 219th Judicial District Court of Texas found in July 2002 that the idea falls under the terms of the employment agreement between Brown and Alcatel, which entitles Alcatel with the "full legal right, title and interests" in any innovations (Lai 2003; Lobel 2014a). Although Brown appealed the ruling, the state appeals court turned him down in June 2004.

The decision in *Alcatel v. Brown* was based on a contractual perspective. The court held that "the invention disclosure agreement between Brown and DSC was valid and enforceable." By signing the IP assignment agreement that covers "all inventions," which "include but [are] not limited to all matters subject to patent," Brown was obligated to fully disclose the idea to Alcatel. In other words, the court allowed the employer to use the IP assignment agreement in its employment contract, which requires employees to assign their future innovation rights to the employer as a condition of employment and to claim IP ownership of *all* forms of employee innovation, including even an immature idea for side projects (Lai 2003; Lobel 2014a). Lai (2003: 296-297) states that "[by] recognizing an employer's ownership of intellectual property that does not exist as defined by the law of copyright, patent, trademark, and trade secret, the court's decision [of *Alcatel v. Brown*] provides companies with a way to restrain the intellectual property market with all-encompassing invention disclosure agreements." Consequently, the ruling

substantially expanded firms' contractual controls over employee innovation (Lobel 2014a).

The ruling of *Alcatel v. Brown* has two important features, which exert a profound impact on the legal environment of side project ownership. First, the court ruled that an intangible idea of an employee is considered a form of IP. Prior to that, an abstract idea was not eligible for any of the four forms of IP—copyrights, patents, trademarks, or trade secrets—all of which require something tangible (Lai 2003, Lobel 2014a). Thus, employees did not need to worry about IP ownership unless their side projects became tangible innovations. However, following *Alcatel v. Brown*, *intangible* side projects became claimable by employers through employment contracts. As a result, employers gained the legal right to own it *at any stage* of side project development, and employees who test out early-stage ideas may risk losing the ownership of the ideas. Given that software innovations are often considered abstract (see *Alice Corp. v. CLS Bank International*), the implications of *Alcatel v. Brown* are significant for IT professionals.

Second, the ruling of *Alcatel v. Brown* has a retrospective effect, in that former employers can claim the IPR of any work developed while an employee was employed, even years after the employment concluded (see a later lawsuit of *DDB Technologies v. MLB Advanced Media*). Although most side projects do not become as well-known as Twitter or Gmail, a legal environment that does not support employees' right to claim ownership affects their motivation to work on these projects. Moreover, the court's adjudication on Brown's IP assignment agreement sets forth a precedent for future legal cases (Lai 2003) in the states following the common law (the ones not in Table 1), in which an employment contract has a compelling power on the IP ownership of employee inventions. We next discuss the scope of this legal case's influence.

The Influence of *Alcatel v. Brown* as a Precedent

Alcatel v. Brown is the first case with respect to side project ownership and has attracted considerable attention from both the public and academia (Lai 2003; Lobel 2014a). From a legal standpoint, however, the impact of *Alcatel v. Brown* as a precedent is not uniform throughout all

states. A precedent refers to a court's decision that is used to adjudicate subsequent cases involving the same or similar facts or issues (Fon and Parisi 2006). There are two types of precedents – binding precedents and persuasive precedents. *Binding* precedents serve as a mandatory authority in which courts are obliged to follow the decisions of higher courts in the same jurisdiction. In this principle of binding precedents, a state district court is required to follow decisions by the supreme or appeals courts in the same state or the federal courts that preside over the state. While court decisions in other states are not binding, they serve as *persuasive* precedents in influencing legal decisions (Oyen 2017). When there is no explicit statute or binding precedent to follow, a state court can base its decision on persuasive precedents from other states and utilize legal reasoning and interpretations of laws from these precedents. For instance, in *DOCRX, Inc. v. EMI Servs. of N.C., LLC*, the North Carolina Court of Appeals applied the appellate court decisions from Utah (*Bankler v. Bankler*), Montana (*Carr v. Bett*), and Colorado (*Craven v. Southern Farm Bureau Cas. Ins.*) as persuasive precedents because they address similar issues.

Given that the ruling of *Alcatel v. Brown* was made by the District Court of Texas and affirmed by the Appeals Court of Texas, this case is a binding precedent for Texas courts. Furthermore, it influences judicial decisions in the other 41 states and the District of Columbia (D.C.) as a persuasive precedent, as these jurisdictions do not have explicit statutes that delineate employee IPR. In other words, the courts in these states may follow the ruling of *Alcatel v. Brown* in adjudicating similar employer-employee IP disputes (Oyen 2017).

How persuasive precedents affect judicial decision-making has been extensively discussed in both legal and economics literature (e.g., Chen and Eraslan 2020; Dobbins 2010; Fon and Parisi 2006). IS scholars also leverage the persuasive authority of some legal cases to investigate how the legal environment affects innovative activities. For instance, Wen et al. (2013) utilize the filing of *SCO v. IBM* to explore the effect of IPR enforcement on OSS activities. Based on this discussion,

we argue that *Alcatel v. Brown* has an impact not only in Texas but also in the other states that do not have explicit protection statutes for employees' IP ownership of side projects.

THEORETICAL BACKGROUND AND RESEARCH QUESTIONS

Side Projects and Employee Innovation at Work

One of the main sources of IT innovation is employees' creative ideas (Gong et al. 2009). The source of employee creativity has been investigated extensively in prior literature. Prior studies have examined the relationship between employee creativity and personal characteristics (Oldham and Cummings 1996), organizational context (Gong et al. 2009), and workplace learning (Hirst et al. 2009). Firms are also advised to institute proper incentive structures (e.g., compensation, autonomy) to encourage employees to innovate (Hellmann and Thiele 2011; Samila and Sorenson 2011; Sauermann and Cohen 2010). Overall, most of the prior studies focus on employees' innovative activities *at work*.

While employees' innovative activities at work are important for firms, a growing stream of literature has recently investigated side projects, which are employee innovation *away from* the workplace. It is worth noting that some scholars (e.g., Davis et al. 2013) use such terms as "spare time invention" or "leisure time invention," all of which refer to works that employees invent outside of formal employment agreements. The motives for employees to work on side projects include learning new skills, developing new products or services, seeking future employment opportunities, or pure personal enjoyment. For example, IS scholars (e.g., Krogh et al. 2012; Roberts et al. 2006; Singh and Phelps 2013) have examined the motivations of OSS contributors and found that they are motivated to pursue OSS projects by a variety of factors including monetary rewards, career opportunities, reputation, and self-accomplishment.

Working on side projects costs employees time and energy, and as a result, they may deviate from their assigned innovative activities at work (Hellmann and Thiele 2011). But if managed well, side projects can benefit both employees and firms. Researchers find that employees' side

project ideas usually solve different problems from formal work tasks (Davis et al. 2013; Harhoff and Hoisl 2007). This provides an opportunity for employees to learn informally, improving their overall innovative capabilities (Singh et al. 2011). Firms benefit from the expansion of employees' knowledge base. Since the recombination of diverse knowledge and ideas is a source of successful innovation (Gruber et al. 2013; March 1991), employees can contribute to IT innovation to a greater extent when they work on different problems from assigned work in their side projects.

Side Project IPR and Employees' Innovation Performance at Work

Although working on side projects could benefit both firms and employees, the extent of such benefits depends on who owns the IPR of these projects (Lobel 2014b; Stone 2002). Our research question thus is: How does the legal environment of side project ownership influence *employees IT innovation at work (innovation quantity and quality)?* Specifically, when firms own the IPR of employee side projects, does it improve or hamper IT innovation at work?

Firms' claim to the IPR of side projects can promote employee innovation at work through two mechanisms. First, firms with more control rights over the IP of side projects are more likely to invest in their employees' skill and human capital development (Leiponen 2008; Levin et al. 1987) because their employees' innovation in the spare time is now considered part of the performance at work. Hellmann (2007) presents a nuanced picture of how a firm manages the assigned innovative work and side projects of its employees. According to Hellmann (2007), a firm faces a fundamental tradeoff between exploitation, which is the work on the firm's core tasks, and exploration, which refers to the work on employees' own ideas. Whereas the firm wants its employees to focus on the core tasks, the employees might be more interested in working on their own side projects because the projects offer greater *private* benefits. Hellmann (2007) shows that when the firm owns the IP of whatever the employees create, the firm should implement policies to strengthen the employees' human capital development and provide sufficient incentives for them so that all employees focus on their assigned tasks at work.

Second, compared to individual inventors, firms have greater advantages in financial and intellectual resources, networking environments, and collaborative infrastructures, all of which are key factors for fostering an innovative climate (Scott and Bruce 1994). For example, firms can assign more experienced employees to collaborate with those who are new to an innovation task (Samila and Sorenson 2011). Researchers find that compared to inventors who have a network of collaborators, those working alone, especially those without formal affiliations with organizations, are less likely to achieve breakthroughs or successful inventions (Singh and Fleming 2010). In our setting, when the IPR of side projects belongs to a firm, the variety and abundance of resources within the firm can stimulate and spur more IT innovations among employees.

Although the literature suggests a positive relationship between firms' ownership of side projects and employee innovation at work, there are other theoretical reasons to predict the opposite. First, firms' ownership of side project IPR hurts employees' *incentives* to do any form of innovation. Research shows that a climate of innovation (i.e., employees' belief that their creativity is encouraged in the workplace) and a climate of autonomy (i.e., employees' self-determination with respect to work procedures, goals, and priorities) are both positively related to employee innovation (Durcikova et al. 2011). When side projects are owned by firms, it raises concern among employees as to whether it is fair for the firms to claim rights to their work beyond the scope of employment. Due to lack of control over their own ideas, employees also feel uncertain about whether their ideas would receive enough attention from their collaborators. Moreover, when firms retain ownership of everything that employees create including side projects, employees may feel that their autonomy is lost in the processes of innovation. The concerns of unfairness, uncertainty, and loss of autonomy hinder employees' creativity, interests, and enthusiasm in their innovation activities at work (Durcikova et al. 2011).

Second, when firms own the IPR of side projects and can appropriate most value out of them,

employees are discouraged from working on side projects, undermining their *capability* to innovate at work. As stated above, working on side projects is regarded as a valuable opportunity for employees to learn and develop new IT skills. Prior literature has emphasized the role of such learning in employee innovation at work (Susomrith and Coetzer 2019). Learning outside of the workplace can also lead to higher job satisfaction and potential career advancement, which improves employees' innovation performance at work (Huang and Zhang 2016). The extent to which employees' skill sets gained in their spare time affect their innovation is particularly prominent in the IT field where knowledge and skills become obsolete very quickly. For example, working on OSS projects can improve software developers' technical skills (Singh et al. 2011), enhancing the productivity in their day-to-day work (Mehra et al. 2011; Mehra and Mookerjee 2012). Therefore, if employees are no longer interested in working on side projects, they would be less willing to upgrade their skill sets and become less productive in innovation at work.

Employees' innovation performance at work is a function of both their incentive and capability.[2] On the one hand, employees would be less incentivized to innovate if they expect to lose the ownership of their innovations eventually. Also, their capability to innovate is undermined because with reduced efforts for side projects, they are less likely to learn new skills, stay up-to-date in the field, and pursue explorations, actions that are critical for IT professionals. On the other hand, employees' capability to innovate can be bolstered when their firms provide more resources and networking opportunities and invest more in the skill development of employees. Due to these contrasting forces, it is theoretically unclear whether employees' innovation performance at work would improve or deteriorate after the legal change triggered by *Alcatel v. Brown*.

DATA, MEASURES, AND EMPIRICAL METHOD

We first describe our data sources. We use patents to measure innovation activities in our main

[2] We thank an anonymous reviewer for summarizing this point clearly.

models. Patents are one of the most widely used measures for innovation in many industries, including IT innovation (Chung et al. 2019; Park et al. 2007). We use patent data from the U.S. Patent and Trademark Office. We also use data from the Fung Institute for Engineering Leadership (FIEL) (Lai et al. 2011) to identify the inventors and assignees of each patent.

TABLE 2. EXAMPLE OF IT PATENTS

Patent No.	Inventors	Assignee	Sample
7735066	Brad A. Myers; Andrew J. Ko	Carnegie Mellon University	Not included
6424703	Ronald A. Katz	Ronald A. Katz Technology Licensing, L.P.	Not included
5636425	Norman D. Best		Not included
5267471	David W. Abraham; Martin P. O'Boyle	IBM Corporation	Included
8297520	Michael John Wakerly; Jonathan Wall	Google Inc.	Included
7559131	Thomas Lloyd Credelle; Glenn Gengel; Roger Green Stewart; William Hill Joseph	Alien Technology Corporation	Included

Our analyses focus on IT patents[3] filed by firms, which represent employees' innovation output within the scope of their employment. This is consistent with our goal of investigating how the legal regime of side project ownership influences employees' IT innovation at work. See Table 2 for examples. Typically, for patent applications filed in the name of firms, employees are listed as inventors, and their employers (i.e., firms) are listed as assignees. We exclude patents by individual inventors who are not employed by firms (e.g., Patent No. 5636425 in Table 2) and consider only patents with the complete assignee (firm) information (e.g., IBM for Patent No. 5267471 in Table 2). Considering some inventors may assign the patents to themselves or their self-owned firms, we exclude patents with assignees that include the inventor's names (e.g., Patent No. 6424703). Patents assigned to universities or governments are also excluded. In total, our sample includes 1,543,439 utility patent applications between 1992 and 2011. We also collect state/county-level demographical and economics data from the U.S. Census Bureau and the U.S. Bureau of Economic Analysis, respectively.

Next, we describe our variables and main models. We first construct both state-year level and

[3] The USPTO maps the patent classes based on the 2002 North American Industry Classification System. There are 180 patent classes/subclasses under the category of "Computer and Electronic Products," including hardware and software patents.

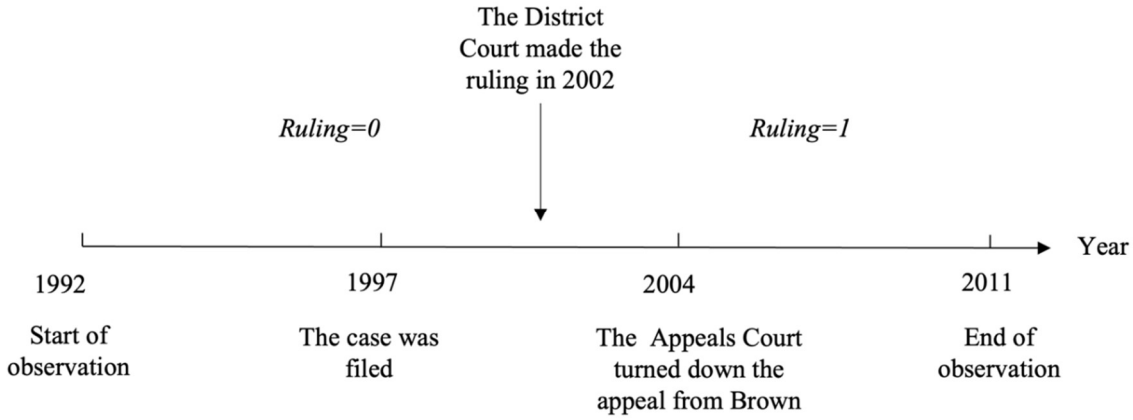
county-year level panel datasets that include the patent filings from 51 states in 1992–2011.[4] For the country-year level panel, we apply a coarsened exact matching (CEM) approach to match treated and control counties by county-level demographics and industry measures. We also develop an inventor-year level panel dataset for more in-depth investigations on innovation outcomes at the inventor level. We focus only on inventors who have IT patents and aggregate their patent records at the inventor-year level.[5]

Our dependent variables capture two aspects of employee innovation at work. $IT\,Patent\ Count_{it}$ measures the quantity of innovation and is computed as the log of firm-owned IT patent counts in unit i (i.e., state, county, or inventor) in year t. $IT\ Patent\ Citations_{it}$ for innovation quality is measured as average 5-year forward citations of firm-owned IT patents.

Our models have two independent variables to reflect the two differences in the DID design. Because *Alcatel v. Brown* serves as a precedent for the courts' decisions on future IP-assignment cases, we consider the ruling of *Alcatel v. Brown* as an exogenous shock. Figure 1 shows the timeline of *Alcatel v. Brown*. The first difference is $Ruling_t$, which equals one if the year t is after 2002 (i.e., the year of the ruling on *Alcatel v. Brown*). Thus, *Ruling* indicates whether the legal environment of side project ownership changed or not. The second difference is $NoStatutes_i$, which is equal to one if unit i is in a state that is in the treatment group (i.e., the states with no statutes to protect employees' IPR of side projects). Because the eight states in Table 1 limit the enforceability of employment contracts in the IP-assignment disputes, the ruling of *Alcatel v. Brown* does not serve as a precedent in these states. We thus designate the eight states to the control group. The other 42 states and D.C. are designated to the treatment group.

[4] We aggregate patents by filing years. A patent with multiple inventors from different states was counted multiple times. For example, if a patent was invented by two inventors from State A and State B, it was counted in both states.
[5] When some inventors had IT and non-IT patents, we also include their non-IT patents in the inventor-year level analysis. As a robustness check, we replicate our analysis in a sample of inventors who only worked on IT patents; our main results still hold.

FIGURE 1. THE TIMELINE OF *ALCATEL V. BROWN*



We include a set of controls at multiple levels. We capture time-varying observable heterogeneity across states and counties that may affect innovation outcomes with *Population, Employment, Income,* and *Wage*.[6] To control for state-level industry heterogeneity, we consider two variables – *IT Ratio*, the proportion of IT patents among all patents at the state-year level, and *Industry HHI*, or the industry Herfindahl–Hirschman index (HHI), which is calculated as the sum of the squares of the percentage of each industry's patents. We also measure inventors' experience (*Inventor Experience*) by the log of cumulative patent counts that an inventor filed previously. Our models include unit (i.e., state, county, or inventor) fixed-effects in the respective analyses to control for unit-level unobserved cofounders. The models control for year fixed-effects to capture the effects of nationwide policy changes, such as the Patent Reform Act of 2011 and the Patent Reform Act of 2005.

The formal DID specification is as follows.

$$IT\,Patent\ Count_{it} = \beta_{10} + \beta_{11} NoStatutes_i \times Ruling_t + Two\text{-}Way\ FE + Controls + \varepsilon_{it} \quad (1)$$

$$IT\,Patent\ Citations_{it} = \beta_{20} + \beta_{21} NoStatutes_i \times Ruling_t + Two\text{-}Way\ FE + Controls + \delta_{it} \quad (2)$$

We use $NoStatutes_i \times Ruling_t$ in Eq. (1) and (2) to examine the effect of *Alcatel v. Brown* on the

[6] Since the demographic variables are available at both the state and the county levels, we applied the county-level variables in the county-year level analysis and state-level measures in the other levels of analyses.

quantity and quality of IT patents, respectively.

RESULTS

Survey Results on Side Project Ownership and Employee Innovation

We conducted a survey to ensure that employees in the treated states are aware of the changes in the legal environment on side project ownership and that their motivation to innovate is affected by this legal regime. We recruited 104 respondents in IT industries at Amazon Mechanical Turk and surveyed these IT professionals' opinions on side project activities. We found that 92% of the respondents had ongoing personal side projects. The top three reasons for working on side projects were learning new skills (25%), career development (23%), and building networks (15%). 84% of the respondents agreed that working on side projects benefited their normal work.

We asked about their opinions on the IP assignment of side projects. Over half of them (53%) believed that employees should own the IPR of their side projects, and 22% suggested that employers and employees should share the IPR. When asked about their employers' IP policy, 47% of them stated that their employers allowed them to own their side projects under certain conditions. This finding was similar to a prior survey of OSS contributors (Nagle et al. 2020).

We also evaluated the respondents' knowledge of the legal regime of side project ownership. 79% of them stated that they were aware of state statues on the IPR of side projects (e.g., California Labor Code §2870-2872). 18% said that they were very familiar with the legal details. 65% of them claimed that they would work on more side projects if they lived in a state with statutes that protect the ownership of their side projects. When asked whether they were aware of *Alcatel v. Brown*, 58% of the respondents chose "Yes," and 77% said that they become more concerned about the IPR of side projects after learning about this case.

Main Results

We first test the *aggregate* effect of the *Alcatel v. Brown* ruling on employee innovation (IT patent count and citations) at both the state and the county levels. This helps paint a macro-level

picture of the impact of the legal case. Table 3 presents the estimation results. The coefficient of *NoStatutes*×*Ruling* in Model 1 (state-level) indicates that in the states with no statutes protecting employees' IPR of side projects (i.e., the treatment group), *Alcatel v. Brown* had a negative and significant effect on the total number of IT patents filed by firms. Specifically, the coefficient of *NoStatutes*×*Ruling* in Model 1 suggests that there was a 24.35% decrease in firm-owned IT patent filing counts in the treatment group after the ruling of *Alcatel v. Brown*.[7]

TABLE 3. EFFECT OF ALCATEL V. BROWN ON EMPLOYEE INNOVATION PERFORMANCE

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent Variable	IT Patent Count			IT Patent Citation		
Level of Analysis	State	County	Inventor	State	County	Inventor
NoStatutes×Ruling	**-0.279***	**-0.057****	**-0.020*****	**1.625***	**0.387***	**0.101*****
	(0.125)	(0.018)	(0.001)	(0.623)	(0.194)	(0.008)
Population	0.550	0.508***	0.233***	-1.811	-4.555***	1.760***
	(0.847)	(0.092)	(0.009)	(6.629)	(1.120)	(0.112)
Income	0.001	0.011***	8.59e-05*	-0.078	-0.122***	-0.008***
	(0.004)	(0.002)	(3.85e-05)	(0.041)	(0.027)	(0.0004)
Employment	1.006	0.157	-0.077***	-7.041	-8.569***	-1.570***
	(0.826)	(0.094)	(0.010)	(6.333)	(1.297)	(0.110)
Wage	0.409	-0.035	0.065***	-1.929	4.779***	0.034
	(0.249)	(0.063)	(0.003)	(2.656)	(0.864)	(0.039)
IT Ratio	3.243***	0.506***	0.218***	-0.988	3.849***	0.761***
	(0.348)	(0.077)	(0.003)	(1.668)	(0.675)	(0.034)
Industry HHI	6.84e-07	4.38e-07	2.88e-07***	1.02e-05	1.83e-05**	1.31e-06***
	(1.20e-06)	(4.64e-07)	(2.10e-08)	(6.54e-06)	(5.91e-06)	(2.42e-07)
Inventor Experience			0.058***			-0.535***
			(0.0004)			(0.007)
Constant	-23.90***	-6.232***	-3.529***	163.2*	72.52***	-3.709***
	(5.411)	(0.716)	(0.079)	(66.45)	(9.425)	(1.047)
Two-way FE	Yes	Yes	Yes	Yes	Yes	Yes
CEM Match	No	Yes	No	No	Yes	No
Observations	1,007	27,330	7,366,323	1,007	27,330	7,366,323
R-squared	0.985	0.821	0.233	0.857	0.230	0.120

Notes: (1) Robust standard errors clustered at the state/county/inventor level. *** p < 0.001, ** p < 0.01, * p < 0.05. (2) The variables used in CEM Match are county-level population, income, employment wage, IT ratio, and industry HHI.

Surprisingly, the positive and significant coefficient of *NoStatutes*×*Ruling* in Model 4 suggests that the average number of IT patent citations in the treated states increased by 1.625 following the ruling of *Alcatel v. Brown*. We employ a coarsened exact match (CEM) approach and replicate the analyses at the county level. The results in Models 2 and 5 are consistent at the county level. We

[7] $e^{-0.279}-1 = -0.2435$. Similar calculations are used in subsequent coefficient interpretations.

also conduct the inventor-year level analyses in Models 3 and 6. The coefficients of *NoStatutes*×*Ruling* once again indicate similar findings. Overall, Table 3 shows that the quantity of employee innovation at work decreased, but counterintuitively, its quality increased after the ruling of *Alcatel v. Brown*.

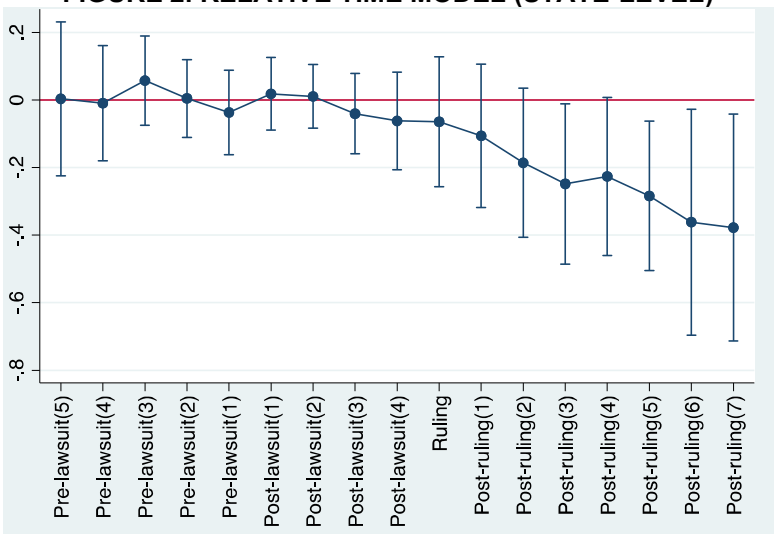
TABLE 4. ROBUSTNESS CHECKS

Concerns	Tests	Findings
The treated states are not comparable with the control states	Synthetic control method (Abadie et al. 2010)	The findings remain consistent.
Serial correlation in standard errors	Random treatment test	Placebo treatments yield no correlation with the estimated results.
The effect of other IP statutes	Control for the change of non-compete covenant enforceability	The results remain consistent.
	Control for the "inevitable disclosure" doctrine	The results remain consistent.
Alternative dependent variable	Using log(Citations)	The results remain consistent.
Alternative sample	Replication estimations using inventors who only work on IT patents	The results remain consistent.
Bias due to the use of a linear model	Estimations using Poisson	The results remain consistent.
Lack of analyses aggregated at other levels	Examination of patent filing activities of multi-location firms	IT patent filings of firms that branch in the treatment group declined and the average citation in the treatment group increased after the ruling.

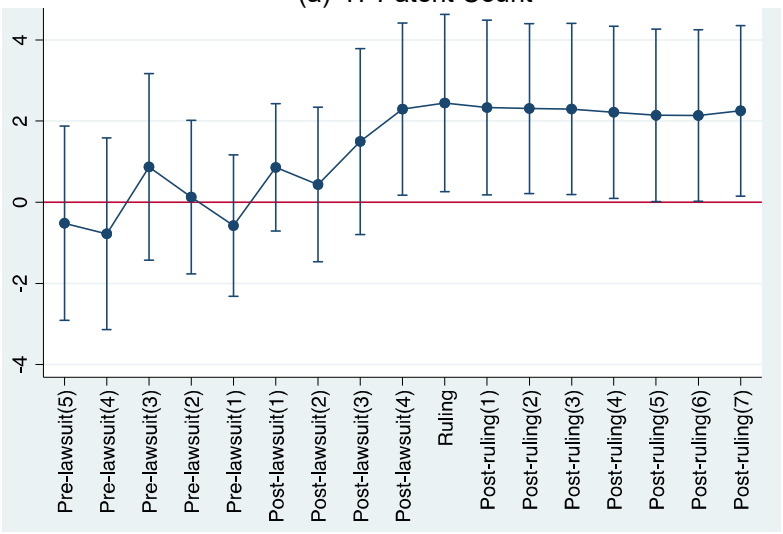
One important assumption that DID estimations need to meet is the parallel trend assumption, which requires that the pre-treatment trend in the treatment group be parallel to that of the control group *before* the treatment (*Alcatel v. Brown*). We employ a relative time model to formally assess the validity of this assumption and find that the parallel trend assumption holds (Figure 2).[8] We also run an extensive set of robustness checks, as in Table 4, to ensure that our results hold under several alternative specifications.

[8] The base for the relative time model (Figure 2) is the year before the lawsuit's filing year (1997). Since the lawsuit lasted for six years and sparked many debates among IT professionals, the effect of *Alcatel v. Brown* may show up before the ruling.

FIGURE 2. RELATIVE TIME MODEL (STATE-LEVEL)



(a) IT Patent Count



(b) IT Patent Citation

Effects on Employee Innovation Behaviors

How can we make sense of the mixed findings on employee innovation at work (a decrease in IT patent counts but an increase in citations)? We investigate what explains these contrasting findings. Since learning and practicing new skill sets is one of the advantages that employees gain from side projects, especially for IT professionals (Davis et al. 2013; Harhoff and Hoisl 2007; Mehra et al. 2011), we expect employees to adjust their innovation behaviors by focusing on different technology domains, affecting their innovation quantity and quality.

Two aspects of behaviors merit careful investigation. One is the extent to which employees diversify their innovation, as diversity and experimentation are central to successful innovation at

work (Ahuja and Lampert 2001; Burgelman 1983). The other is how employees use and recombine prior knowledge, which is key to creation of impactful innovation (Katila and Ahuja 2002). Employees have some "elbow room" to decide what technology domains to diversify into and what prior knowledge to utilize. To see if this is the case, we focus on the patent classes that employees work on and cite in their patents, respectively, with four additional dependent variables that measure different aspects of employees' innovation behaviors.

When it comes to the diversity of innovation, employees can choose to exploit by working on the same technology domains for years, or they can diversify by exploring onto new technology domains (March 1991). The former results in a specialized portfolio of innovation, while the latter leads to a diversified portfolio. We use two variables to measure the composition of employees' patent portfolio. First, *Ratio Explore New*$_{it}$ measures an inventor *i's* proportion of patent classes filed in new technology domains in year *t*. This variable equals to zero if all patents that inventor *i* filed in year *t* belong to the patent classes that she had previously worked on before year *t*. Second, *Specialization*$_{it}$ captures the level of technological specialization of inventor *i*'s patents filed in year *t*. We compute it as the Herfindahl concentration ratio across the patent classes that an inventor's patents covers each year – $\sum_j (\frac{N_{ijt}}{N_{it}})^2$, where N_{kt} denotes the total number of patent classes that inventor *i* files in year *t* and N_{ijt} is the number of patent classes that inventor *i* files in class *j* in year *t.* The larger this measure, the more specialized an inventor's patent portfolio is (fewer patent classes).

Table 5 presents the results with these measures. The coefficients of *NoStatutes*×*Ruling* in Models 7 and 8 indicate that following the ruling of *Alcatel v. Brown,* employees became less likely to work on novel technology domains that were new to them. In addition, they concentrate on fewer technology domains in a way to make their IT patent portfolios more specialized.

TABLE 5. EFFECT OF ALCATEL V. BROWN ON EMPLOYEES' INNOVATION BEHAVIORS

	Model 7	Model 8	Model 9	Model 10
Level of analysis: Inventor				
Dependent variable	Ratio Explore New	Specialization	Ratio Cite New	Citation Concentration
NoStatutes×Ruling	**-0.008****	**0.005****	**-0.009*****	**-0.014*****
	(0.003)	(0.005)	(0.003)	(0.002)
Population	-0.450***	-0.148***	-0.475***	0.176***
	(0.074)	(0.041)	(0.066)	(0.049)
Income	-0.005***	0.001	-0.005***	0.001*
	(0.001)	(0.0004)	(0.001)	(0.001)
Employment	0.258***	0.122**	0.317***	-0.172***
	(0.069)	(0.038)	(0.061)	(0.045)
Wage	-0.071***	-0.015	-0.091***	0.031*
	(0.019)	(0.010)	(0.017)	(0.013)
Inventor Experience	-0.361***	0.016***	-0.381***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
IT Ratio	-0.066***	-0.170***	-0.097***	-0.009
	(0.020)	(0.011)	(0.018)	(0.014)
Industry HHI	-1.96e-07*	-2.75e-08	-7.89e-08	1.77e-07***
	(8.39e-08)	(4.62e-08)	(6.72e-08)	(5.31e-08)
Patent Count			0.070***	-0.209***
			(0.001)	(0.001)
Constant	5.550***	1.608***	5.241***	-0.0605
	(0.543)	(0.294)	(0.482)	(0.377)
Inventor/Year FE	Yes	Yes	Yes	Yes
Observations	674,894	674,894	593,098	674,894
R-squared	0.507	0.370	0.606	0.561

Notes: (1) Robust standard errors clustered at the inventor level. *** p < 0.001, ** p < 0.01, * p < 0.05; (2) In Models 9, we included only the observations if the inventor cited any prior art in the year.

Alcatel v. Brown can also influence the way that employees utilize prior knowledge (i.e., citing previous work in patents). According to prior literature on open innovation (Laursen and Salter 2006), firms obtain knowledge not only from internal R&D but also from external sources such as OSS projects or side projects (Cassiman and Veugelers 2006; Mehra et al. 2011). Such external knowledge helps firms explore new technology domains and integrate them with internal knowledge (Grigoriou and Rothaermel 2017), facilitating knowledge recombination. We use two variables to measure employees' citation behaviors of prior patents, which documents the sources of their innovations and the pattern of utilizing existing knowledge. *Ratio Cite New*$_{it}$ is the proportion of new patent classes cited in inventor *i*' patents. *Citation Concentration*$_{it}$ measures the level of concentration of prior knowledge that inventors utilize to build their IT patent portfolios. Similar to *Specialist*$_{it}$, *Citation Concentration*$_{it}$ is constructed as a Herfindahl concentration ratio

across the patent classes that inventor *i* cites in his/her patents in year *t*.

Models 9 and 10 in Table 5 show how the ruling of *Alcatel v. Brown* impacts employees' citing pattern of prior patents. The coefficient of *NoStatutes*×*Ruling* in Model 9 shows that employees became less likely to cite prior patents from new technology domains following the ruling of *Alcatel v. Brown*. In Model 10, the coefficient of *NoStatutes*×*Ruling* is negative and significant, suggesting that following the legal change, employees cite patents from a more diverse set of technology domains.

It is intriguing to find that after *Alcatel v. Brown*, for a given IT patent, employees cited more broadly from patent classes that they are familiar with (Model 10), but they became less likely to cite from new patent classes that they did not cite previously (Model 9). This result suggests that a new knowledge source is not the only determinant of knowledge recombination, and other factors seem to drive them to cite from a broader knowledge pool (Karim and Kaul 2015; Katila and Ahuja 2002; Makri et al. 2010). One possible reason is that employees spent more time on each IT patent after the ruling of *Alcatel v. Brown*. Given the limited time and resources, the fewer technology domains employees work on (Models 7 and 8), the more effort they seem to exert on each innovation. This increases the scope of knowledge that employees draw from (Model 10). Another reason is that firms' increased control over side projects following *Alcatel v. Brown* addresses the potential mismatch between diverse knowledge sources, given that employees' spontaneous explorations with side projects are often not in line with the firms' core technology domains (Davis et al. 2013). This explains a decrease in citations from new technology domains but an increase in citation scope (Models 9 & 10). Increased knowledge synergies, firms' financial and intellectual resources, networking environments, and collaborative infrastructures all improve employees' capabilities of knowledge recombination (Carnabuci and Operti 2013; Karim and Kaul 2015), contributing to the increase in IT patent quality.

In summary, the above analyses indicate that firms' increasing control over the IP of employee side projects influences employees' innovation behaviors in significant ways, offering explanations for a decrease in quantity but an increase in quality of firm-owned IT patents we see in Table 3. First, after the ruling of *Alcatel v. Brown*, employees became less willing to experiment with novel technology domains (Model 7 in Table 5), which can be costly and time-consuming (March 1991). Instead, they became more specialized at work by focusing on fewer technology domains (Model 8). As a result, each innovation an employee works on would receive more time commitment, effort, and other resources from firms. This finding is consistent with prior literature that too much diversity often impedes innovation quality (Leten et al. 2007; Lettl et al. 2009). Second, in working on a more focused portfolio of IT patents, employees cite from a more diverse set of technologies that they are familiar with (Model 10).[9] This implies that employees navigate in a broader knowledge pool, leading to distinctive new knowledge recombination and enhancing the likelihood of successful recombination (Fleming and Sorenson 2001; Katila and Ahuja 2002). As a result, the innovation developed from such behaviors is more likely to speak to a broader set of other inventors and receive more citations from them. Overall, we find that following the legal change, employees leverage a *larger* knowledge base (Model 10) to work on a *smaller* set of innovations (Model 8). Thanks to two changes, the quality of employee innovation at work improves despite the decrease in quantity.

DISCUSSIONS AND CONCLUSION

In this study, we leverage the legal case of *Alcatel v. Brown* to investigate how the differences in state-level statutes regarding side project IPR affect employee innovation at work and obtain interesting and surprising findings. Our results show that in the states where the IPR of employee

[9] In addition to the citation concentration, we also consider the number of cited prior arts (i.e., backward citations). The results show that the number of backward citations increased after the ruling of *Alcatel v. Brown*.

side projects is not protected, *Alcatel v. Brown* had a significant deterrent effect on firm-owned IT innovation quantity (Table 3, Models 1-3) yet led to an improvement in IT innovation quality (Models 4-6). Such contrasting effects can be explained by the changes in employees' innovation behaviors. After the ruling of *Alcatel v. Brown*, employees sharpen the focus of their innovation portfolio by concentrating on fewer technology domains and avoiding exploration of new technology domains (Table 5, Models 7-8). At the same time, in pursuing innovations in fewer domains, they cite a broader range of prior knowledge (Model 10). The finding that they work on fewer technology domains, while leveraging a more diverse set of knowledge, explains the decrease in firm-owned IT patent counts but the increase in citations after the ruling of *Alcatel v. Brown*. With the changes in innovation behaviors, they produce fewer IT innovations but generate ones of higher quality.

Our work makes significant contributions to the IS literature on IT workplaces and IT professionals. Our work highlights the importance of side project ownership in the employer-employee relationship among IT professionals. Our results show that re-allocating the IP rights of side projects from employees to employers reduces the quantity of IT patents. However, contrary to our expectation, the overall quality of IT patents improves as employees become more concentrated in their technology domains and make intensive use of a broader knowledge base.

Second, our study makes important contributions to the literature on innovation management. There is a growing body of research that examines the impact of employer-friendly policies such as trade secrets protections (Contigiani et al. 2018) and non-compete covenants (Marx et al. 2009; Samila and Sorenson 2011) on innovation. However, to the best of our knowledge, there is little work that explores how the ownership of employees' side projects affects innovation at work. Our paper is among the first to investigate the effect of IP laws for side projects on employee innovation at work. Our results provide a new theoretical perspective that more employer-friendly

policies on employees' side project ownership are not always detrimental to innovation. To the best of our knowledge, we offer a novel and significant finding to the literature that increased employer control over employees' innovation leads to an increase in innovation quality.

Third, we contribute to the literature on side project activities (Davis et al. 2013; Hellmann 2007; Hellmann and Thiele 2011; Mehra et al. 2011). Our study is the first to examine the IP disputes of side projects between employees and employers and how the legal environment influences innovation at work. We find that side project activities help employees broaden their technology domains. However, we also find that limiting employees' IP rights on their side projects improves the quality of their innovation at work.

Our study also provides managerial insights on how to encourage employee innovation at work. A question that naturally follows is: Do our findings suggest that the ruling of *Alcatel v. Brown* enhances a firm's innovation performance? In the short term, this might be the case: by "forcing" employees to focus more on the firm's existing technology domains, the ruling led the firm to produce fewer yet higher-quality IT patents. Indeed, prior research suggests that greater technological diversity often decreases innovation quality by distracting inventors from their core technology domains (Leten et al. 2007). In the long run, however, this narrow focus on its dominant technology domains could be detrimental to firm growth: As it becomes increasingly locked in existing knowledge domains, the firm could lose sight of better alternatives and new possibilities (Ren and Guo 2011) and potentially fall into what Levinthal and March (1993) call a "competency trap." Therefore, we advise that it is desired to find a solution that meets the needs of employers and employees in a mutually beneficial manner. If employers and employees could find a way to cooperate on side projects, the overall quantity and quality of innovation can improve concomitantly in the presence of proper incentives and organizational support.

This paper also offers substantive implications for policymakers with respect to knowledge

creation and innovation in our society, since conflicts over IP ownership not only influence innovation in organizations but also pose cultural and ethical issues of trust, fairness, and justice. From the employees' perspective, whether a legal system encourages or hinders innovation is a critical question. Our findings echo previous studies that call for changes in the IP-related laws in the digital age (Stone 2002). As the current IP law does not explicitly protect abstract ideas, it often enables firms to over-exploit their employees' IPs through employments contracts. Policymakers should reconsider the scope of IP laws to provide more protection for employees.

We note several limitations in our analysis. First, we use IT patents as our primary measure of innovation. Not all innovations are patented, and there are other types of IT innovation (e.g., open innovation) that are not captured in our analyses. Second, we do not have detailed, granular data on individual side project activities that would have allowed us to examine the process of idea generation and value creation in a more in-depth manner. While the focus of our work is on examining the effect of changes in the legal environment on overall employee innovation at work, we could not examine how this change *directly* affects employees' subsequent devotion to side projects. Future researchers with access to detailed data could extend our work by investigating additional mechanisms. Third, in addition to *Alcatel v. Brown*, there might be other legal cases, decisions, and policies that could influence innovation. Future work can examine the effect of various IP policies on innovation from a more comprehensive and dynamic perspective.

Our work provides ample opportunities for future research directions. This study mainly focuses on inventors' innovation at work as a response to the changes in the legal environment of side project ownership. Future work can examine whether employees change their IP strategies or switch to other types of innovation activities, such as open innovation. Researchers can also conduct a more granular study at the firm level if such data is accessible. Some interesting questions include: How to develop an optimal IP allocation scheme for side projects that benefits

both employees and employers? What is the most effective way to manage employees' side projects and improve the overall innovation performance, both in quantity and quality? Further research on such topics would make significant contributions to a variety of disciplines such as IS, innovation, law, and economics.

REFERENCES

Abadie, A., Diamond, A., and Hainmueller, A. J. 2010. "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program," *Journal of the American Statistical Association* (105:490), pp. 493–505.

Ahuja, G., and Lampert, C. M. 2001. "Entrepreneurship in the Large Corporation: A Longitudinal Study of How Established Firms Create Breakthrough Inventions," *Strategic Management Journal* (22:6–7), pp. 521–543.

Burgelman, R. A. 1983. "A Process Model of Internal Corporate Venturing in the Diversified Major Firm," *Administrative Science Quarterly*, JSTOR, pp. 223–244.

Carnabuci, G., and Operti, E. 2013. "Where Do Firms' Recombinant Capabilities Come From? Intraorganizational Networks, Knowledge, and Firms' Ability to Innovate through Technological Recombination," *Strategic Management Journal* (34), pp. 1591–1613.

Cassiman, B., and Veugelers, R. 2006. "In Search of Complementarity in Innovation Strategy: Internal R&D and External Knowledge Acquisition," *Management Science* (52:1), pp. 68–82.

Cha, H. S., Pingry, D. E., and Thatcher, M. E. 2008. "Managing the Knowledge Supply Chain: An Organizational Learning Model of Information Technology Offshore Outsourcing," *MIS Quarterly* (32:2), pp. 281–306.

Chen, Y., and Eraslan, H. 2020. "Learning While Setting Precedents," *RAND Journal of Economics* (51:4), pp. 1222–1252.

Chou, K., and Adler, E. 2014. "Who Owns Employee Innovations?" (http://pnwstartuplawyer.com/).

Chung, S., Animesh, A., Han, K., and Pinsonneault, A. 2019. "Software Patents and Firm Value: A Real Options Perspective on the Role of Innovation Orientation and Environmental Uncertainty," *Information Systems Research* (30:3), pp. 1073–1097.

Collins, K. 2017. "Github Now Lets Its Workers Keep the IP When They Use Company Resources for Personal Projects," *QUARTZ*. (https://qz.com/937038/github-now-lets-its-workers-keep-the-ip-when-they-use-company-resources-for-personal-projects/).

Contigiani, A., Hsu, D. H., and Barankay, I. 2018. "Trade Secrets and Innovation: Evidence from the 'Inevitable Disclosure' Doctrine," *Strategic Management Journal* (39:11), pp. 2921–2942.

Davis, L., and Davis, J. 2007. "'Spare Time' Invention: What Is It, What Motivates It, and Why Does It Matter?," in *DRUID Summer Conference 2007*.

Davis, L. N., Davis, J. D., and Hoisl, K. 2013. "Leisure Time Invention," *Organization Science* (24:5), pp. 1439–1458.

Dobbins, J. C. 2010. "Structure and Precedent," *Michigan Law Review* (108:8), pp. 1453–1496.

Durcikova, A., Fadel, K. J., Butler, B. S., and Galletta, D. F. 2011. "Knowledge Exploration and Exploitation: The Impacts of Psychological Climate and Knowledge Management System Access," *Information Systems Research* (22:4), pp. 855–866.

Fleming, L., and Sorenson, O. 2001. "Technology as a Complex Adaptive System: Evidence from

Patent Data," *Research Policy* (30), pp. 1019–1039.
Fon, V., and Parisi, F. 2006. "Judicial Precedents in Civil Law Systems: A Dynamic Analysis," *International Review of Law and Economics* (26:4), pp. 519–535.
Gans, J. S., Hsu, D. H., and Stern, S. 2008. "The Impact of Uncertain Intellectual Property Rights on the Market for Ideas: Evidence from Patent Grant Delays," *Management Science* (54:5), pp. 982–997.
Gong, Y., Huang, J.-C., and Farh, J.-L. 2009. "Employee Learning Orientation, Transformational Leadership, and Employee Creativity: The Mediating Role of Employee Creative Self-Efficacy," *Academy of Management Journal* (52:24), pp. 765–778.
Grigoriou, K., and Rothaermel, F. T. 2017. "Organizing for Knowledge Generation: Internal Knowledge Networks and the Contingent Effect of External Knowledge Sourcing," *Strategic Management Journal* (38:2), Wiley Online Library, pp. 395–414.
Gruber, M., Harhoff, D., and Hoisl, K. 2013. "Knowledge Recombination Across Technological Boundaries: Scientists vs. Engineers," *Management Science* (59:4), pp. 837–851.
Harhoff, D., and Hoisl, K. 2007. "Institutionalized Incentives for Ingenuity-Patent Value and the German Employees' Inventions Act," *Research Policy* (36:8), pp. 1143–1162.
Hellmann, T. 2007. "When Do Employees Become Entrepreneurs?," *Management Science* (53:6), pp. 919–933.
Hellmann, T., and Perotti, E. 2011. "The Circulation of Ideas in Firms and Markets," *Management Science* (57:10), pp. 1813–1826.
Hellmann, T., and Thiele, V. 2011. "Incentives and Innovation: A Multitasking Approach," *American Economic Journal: Microeconomics* (3:1), pp. 78–128.
Hemetsberger, A., and Reinhardt, C. 2006. "Learning and Knowledge-Building in Open-Source Communities: A Social-Experiential Approach," *Management Learning* (37:2), pp. 187–214.
Hirst, G., van Knippenberg, D., and Zhou, J. 2009. "A Cross-Level Perspective on Employee Creativity: Goal Orientation, Team Learning Behavior, and Individual Creativity," *Academy of Management Journal* (52:2), pp. 280–293.
Huang, P., and Zhang, Z. 2016. "Participation in Open Knowledge Communities and Job-Hopping: Evidence from Enterprise Software," *MIS Quarterly* (40:3), pp. 785–806.
Karim, S., and Kaul, A. 2015. "Structural Recombination and Innovation: Unlocking Intraorganizational Knowledge Synergy through Structural Change," *Organization Science* (26:2), pp. 439–455.
Katila, R., and Ahuja, G. 2002. "Something Old , Something New : A Longitudinal Study of Search Behavior and New Product Introduction," *The Academy of Management Journal* (45:6), pp. 1183–1194.
Krogh, G. Von, Haefliger, S., Spaeth, S., and Wallin, M. W. 2012. "Carrots and Rainbows: Motivation and Social Practice in Open Source Software Development," *MIS Quarterly* (36:2), pp. 649–676.
Lai, J. C. 2003. "Alcatel USA , Inc . v . Brown : Does Your Boss Own Your Brain?," *The John Marshall Journal of Information Technology & Privacy Law* (21:3), pp. 295–324.
Lai, R., D'Amour, A., Yu, A., Sun, Y., Doolin, D. M., and Fleming, L. 2011. "Disambiguation and Co-Authorship Networks of the U.S. Patent Inventor Database (1975 - 2010)," *Harvard Dataverse*.
Laursen, K., and Salter, A. 2006. "Open for Innovation: The Role of Openness in Explaining Innovation Performance among U.K. Manufacturing Firms," *Strategic Management Journal* (27:2), pp. 131–150.
Lehechka, A. 2020. "Why You Should Create a GitHub Organization for Your Side Project," *Medium*. (https://medium.com/@ajlehechka/why-you-should-create-a-github-organization-for-

your-side-project-d7c941dbb45b).
Leiponen, A. 2008. "Control of Intellectual Assets in Client Relationships: Implications for Innovation," *Strategic Management Journal* (29), pp. 1371–1394.
Leten, B., Belderbos, R., and Van Looy, B. 2007. "Technological Diversification, Coherence, and Performance of Firms," *Journal of Product Innovation Management* (24:6), Wiley Online Library, pp. 567–579.
Lettl, C., Rost, K., and von Wartburg, I. 2009. "Why Are Some Independent Inventors 'Heroes' and Others 'Hobbyists'? The Moderating Role of Technological Diversity and Specialization," *Research Policy* (38:2), pp. 243–254.
Levin, R. C., Klevorick, A. K., Nelson, R. R., and Winter, S. G. 1987. "Appropriating the Returns from Industrial Research and Development," *Brookings Papers on Economic Activity* (3), pp. 783–831.
Levina, N., and Xin, M. 2007. "Comparing IT Workers' Compensation across Country Contexts: Demographic, Human Capital, and Institutional Factors," *Information Systems Research* (18:2), pp. 193–210.
Levinthal, D. A., and March, J. G. 1993. "The Myopia of Learning," *Strategic Management Journal* (14:S2), Wiley Online Library, pp. 95–112.
Liebeskind, J. P. 1997. "Keeping Organizational Secrets: Protective Institutional Mechanisms and Their Costs," *Industrial and Corporate Change* (6:3), pp. 623–663.
Lobel, O. 2014a. "The New Cognitive Property : Human Capital Law and the Reach of Intellectual Property," *Texas Law Review* (93), pp. 789–851.
Lobel, O. 2014b. "My Ideas, My Boss's Property," *The New York Times*. (https://www.nytimes.com/2014/04/14/opinion/my-ideas-my-bosss-property.html).
Makri, M., Hitt, M. A., and Lan, P. J. 2010. "Complementary Technologies, Knowledge Relatedness, and Invention Outcomes in High Technology Mergers and Acquisitions," *Strategic Management Journal* (31:6), pp. 602–628.
March, J. G. 1991. "Exploration and Exploitation in Organizational Learning," *Organization Science* (2:1), pp. 71–87.
Marx, M. 2011. "The Firm Strikes Back: Non-Compete Agreements and the Mobility of Technical Professionals," *American Sociological Review* (76:5), pp. 695–712.
Marx, M., Strumsky, D., and Fleming, L. 2009. "Mobility, Skills, and the Michigan Non-Compete Experiment," *Management Science* (55:6), pp. 875–889.
Mehra, A., Dewan, R., and Freimer, M. 2011. "Firms as Incubators of Open-Source Software," *Information Systems Research* (22:1), pp. 22–38.
Mehra, A., and Mookerjee, V. 2012. "Human Capital Development for Programmers Using Open Source Software," *MIS Quarterly* (36:1), pp. 107–122.
Nagle, F., Wheeler, D. A., Lifshitz-Assaf, H., Ham, H., and Hoffman, J. L. 2020. "Report on the 2020 FOSS Contributor Survey."
Oldham, G. R., and Cummings, A. 1996. "Employee Creativity: Personal and Contextual Factors at Work," *Academy of Management Journal* (39:3), pp. 607–634.
Oyen, T. 2017. "Stare Decisis." (https://www.law.cornell.edu/wex/stare_decisis).
Park, J., Shin, S. K., and Sanders, G. L. 2007. "Impact of International Information Technology Transfer on National Productivity," *Information Systems Research* (18:1), pp. 86–102.
Parker, H. D. 1984. "Reform for Rights of Employed Inventors," *Southern California Law Review* (57:4), pp. 603–630.
Pawlowski, S. D., and Robey, D. 2004. "Bridging User Organizations: Knowledge Brokering and the Work of Information Technology Professionals," *MIS Quarterly* (28:4), pp. 645–672.
Pound, R. 1908. "Common Law and Legislation," *Harvard Law Review* (21:6), pp. 383–407.

Roberts, J. A., Hann, I.-H., and Slaughter, S. A. 2006. "Understanding the Motivations, Participation, and Performance of Open Source Software Developers: A Longitudinal Study of the Apache Projects," *Management Science* (52:7), pp. 984–999.
Samila, S., and Sorenson, O. 2011. "Noncompete Covenants: Incentives to Innovate or Impediments to Growth," *Management Science* (57:3), pp. 425–438.
Sauermann, H., and Cohen, W. M. 2010. "What Makes Them Tick? Employee Motives and Firm Innovation," *Management Science* (56:12), pp. 2134–2153.
Scott, S. G., and Bruce, R. A. 1994. "Determinants of Innovative Behavior: A Path Model of Individual Innovation in the Workplace," *Academy of Management Journal* (37:3), pp. 580–607.
Shah, S. K. 2006. "Motivation, Governance, and the Viability of Hybrid Forms in Open Source Software Development," *Management Science* (52:7), pp. 1000–1014.
Singh, J., and Fleming, L. 2010. "Lone Inventors as Source of Breakthroughs: Myth or Reality?," *Management Science* (56:1), pp. 41–56.
Singh, P. V., and Phelps, C. 2013. "Networks , Social Influence , and the Choice Among Competing Innovations : Insights from Open Source Software Licenses," *Information Systems Research* (24:3), pp. 539–560.
Singh, P. V., Tan, Y., and Youn, N. 2011. "A Hidden Markov Model of Developer Learning Dynamics in Open Source Software Projects," *Information Systems Research* (22:4), pp. 790–807.
Sonmez, J. 2017. "A Software Developer's Guide to Side Projects." (https://simpleprogrammer.com/guide-side-projects/).
Spolsky, J. 2016. "Developers' Side Projects." (https://www.joelonsoftware.com/2016/12/09/developers-side-projects/).
Stone, K. V. W. 2002. "Knowledge at Work: Disputes Over the Ownership of Human Capital in the Changing Workplace," *Conn. L. Rev.* (34:3), pp. 721–764.
Susomrith, P., and Coetzer, A. 2019. "Effects of Informal Learning on Work Engagement," *Personnel Review* (48:7), pp. 1886–1902.
Svensson, L., Ellström, P.-E., and Åberg, C. 2004. "Integrating Formal and Informal Learning at Work," *The Journal of Workplace Learning* (16:8), pp. 479–491.
Tambe, P., and Hitt, L. M. 2014. "Job Hopping, Information Technology Spillovers, and Productivity Growth," *Management Science* (60:2), pp. 338–355.
Venkatesh, V., Windeler, J. B., Bartol, K. M., and Williamson, I. O. 2017. "Person–Organization and Person–Job Fit Perceptions of New IT Employees: Work Outcomes and Gender Differences," *MIS Quarterly* (41:2), pp. 525–558.
Wen, W., Forman, C., and Graham, S. J. H. 2013. "The Impact of Intellectual Property Rights Enforcement on Open Source Software Project Success," *Information Systems Research* (24:4), pp. 1131–1146.