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Employee Mobility and Innovation

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This study aims to investigate the effect of employee mobility constraint through inevitable disclosure doctrine (IDD) adoption by U.S. state courts on firms' innovation. IDD adoption serves as an exogenous shock on the labour market and industry competition from which this study expects the negative effect on firms' innovation comes. This study uses U.S. firms and measures innovation using R&D expenditure and patent registration and citation. This study finds that employee career constraints through IDD adoption reduces industry competition. The deteriorating effect of IDD enactment on innovation is not only for the initial adoption period but also for at least one year ahead. The negative impact of employee mobility constraint is due to the decrease in market competition. This research suggests that the relaxation of market monitoring on managers will decrease the performance of the firm.

Key words: *Employee Career Constraint, Innovation, Competition, Patent.*

Introduction

The mobility of key employees among firms offers a way of dispersion of ideas and information (Arrow, 1962, p. 615) because knowledge spillover from non-protected intellectual property is more accessible and cheaper (Gangopadhyay & Mondal, 2012). Innovation through investment in research and development (R&D) would be the result of the dispersed ideas or information, especially when the technology is a complement rather than a substitute (Png, 2015). However, the mobility of key employees might be restricted by the adoption of non-competition regulations, such as inevitable disclosure doctrine (IDD). While innovation is the most critical driver to win the competition and achieve long term business growth, generating knowledge to boost innovation may be affected by IDD implementation.

IDD is a U.S. legal doctrine that prevents an employee from getting a new job that will inevitably require the employee to disclose the knowledge of the former employer's trade secrets. The implementation of IDD in a particular state depends on the decision taken by the court when it settles a case of "actual or threatened misappropriation" of trade secrets. Once the court applies IDD to resolve the legal case involving trade secrets, IDD would be applied to the entire state, and firms have the right to sue any former employees who get new employment that might threaten the firms' trade secrets. However, some state courts do not apply the IDD to protect the mobility right of the employees. Therefore, the implementation of IDD varies across states and might exogenously shock the labour market and industry competition.

None of the previous studies examine the effect of IDD staggered adoption on the firm-level innovation. Therefore, this paper aims to investigate the impact of an exogenous shock in employee mobility through IDD on the firm's innovation. The effect of IDD adoption on innovation could be explained by two arguments. First, once IDD relaxes the competition level, it directly affects managers in relaxing the innovation tension. Since Schumpeter's Capitalism, Socialism, and Democracy, literature has recognised the direct effect of competition on innovation (Arrow, 1962; Loury, 1979; Utterback & Suárez, 1993). Second, corporate governance literature acknowledges that product market competition mitigates managerial slack and improves firm performance (Giroud & Mueller, 2010, 2011). Since innovation is risky, this study conjectures that IDD adoption will impede firms' innovation because IDD reduces product market competition levels and market disciplinary power.

By using the difference-in-differences (DiD) setting, this paper examines the effect of IDD implementation on firms' investment in innovative projects. This study uses R&D expenditure as the innovation input measure and patent application and citation as the output of productive innovation. This study acquires the 1976-2006 patent data from the NBER database and the corresponding financial data from Compustat, resulting in 44,433 observations with 4,759 firms.

This study reveals some interesting findings. First, there is no positive effect of innovation level on IDD implementation, suggesting that IDD enactment is proper for our natural experimental setting. Second, this study finds that IDD implementation positively inflates the competition level within industry *measured by the Herfindahl*-Hirschman *index* (HHI) based on 48 Fama-French industry classification, four digits SIC based HHI, and NAICS based product-substitutability. This finding confirms the argument that the competition mechanism would be able to explain the effect of IDD ruling on firms' innovation. Third, the results show that IDD adoption significantly decreases the firm's investment in R&D through which the innovation is created. Fourth, this study finds significant decreases in patent applications and citations as companies prefer to keep the R&D investment output as trade secrets rather than as a patent. Finally, the effect of IDD ruling is not limited to the contemporaneous innovation level, but also on the future firms' innovation.

The following contributions are noteworthy in this study. This paper will be beneficial to the policymaker in evaluating the effect of trade secret regulation. This paper provides evidence about the economic consequences of employee mobility ruling in light of the firm's innovation.

Employee career constraint through IDD reduces the industry competition level and provides less incentive to innovate. The findings are also consistent with the argument proposed by some law professors in opposition to the over-protected trade secrets act of 2015 (Goldman et al., 2015). The findings of this study support the notion that when business is protected from market disciplining mechanisms such as product competition, then innovation will be lower (Atanassov, 2013). Less competitive industries fail to control managers to take riskier value-creating investment and maximise shareholders' value (Giroud & Mueller, 2010, 2011).

This paper highlights the role of law in influencing the firm's investment behaviour. Some regulations have a positive effect on innovation, as indicated by Acharya, Baghai, and Subramanian (2014), Brown, Martinsson, and Petersen (2013), and Moser (2005). However, this paper argues that some rulings, such as IDD, may adversely affect business innovation. This paper extends the horizon of the investment literature that is mainly dominated by market effect (see for example Fang, Tian, and Tice (2014), and Lerner, Sorensen, and Stromberg (2013)) or economic development (see for instance Hsu, Tian, and Xu (2014) and Amore, Schneider, and Žaldokas (2013)).

The rest of the paper will be organised as follows. Part two discusses the institutional background of IDD and the framework of this research. Section three explains the research method, including the DiD approach. Part four presents the findings of the test, and part five provides a conclusion and recommendation.

Literature Review

Inevitable Disclosure Doctrine

IDD prevents an employee from working for former employer's competitors or any employment when the new job would unavoidably divulge the former employer's trade secrets. The IDD legal doctrine is based on the interpretation of the trade secrets act that allows courts to protect trade secrets from any "actual or threatened misappropriation." One possible misappropriation[1] is when a key employee holds the same position or work function at the rival company that would *inevitably* lead to revealing of former employer's secrets (Wiesner, 2012). The IDD is applied by the court in the jurisdiction where the former employee worked irrespective of the presence of employment agreement or the location of new employment (Callen, Fang, & Zhang, 2016).

After the lawsuit case between PepsiCo, Inc v. Redmond in 1995, IDD gained popularity. However, the implementation of IDD varies across states since its recognition depends on court enforcement. When the court applies the doctrine for a particular case, the ruling is applied to

[1] Two types of misappropriations are (1) improper means and (2) disclosure (Wiesner, 2012).

the entire state and becomes common law. On the other hand, when the court rejects the IDD for the subsequent trial, the new ruling will be applied. Some state courts argued that the doctrine should be used even without bad faith, but other states preferred to protect employee mobility rights (Wiesner, 2012). Eighteen U.S. states courts enacted the IDD in different years from 1919 to 2006, and three other states adopted and subsequently rejected the IDD. Appendix 1 shows the adoption years of the IDD for these states.

Employee Mobility and Innovation

Innovation is essential for economic growth. The legal institutions of an economy have an impact on fostering innovation. Since human capital is one of innovation input, any legislation that affects human resources may affect the firm's innovation as well. Acharya, Baghai, and Subramanian (2014) find that when the states provide more job security to employees through the adoption of wrongful discharge laws, firm innovation rises, as shown by the increase of the patent application and citation number. The importance of job security to motivate innovation is also underlined by Manso (2011) besides the compensation scheme.
The implementation of IDD is problematic. On one side, it protects intellectual property rights or other business secrets. Such protection is essential for the business and plays a vital role in our modern history (Moser, 2005, 2013). The protection of trade secrets leads to higher R&D investment (Png, 2015) and patent citation (Zhao, 2006). Qiu and Wang (2018) find that the implementation of IDD as a trade secrets protection ruling increases firms' investment in knowledge assets, including R&D expenditure.

On the other hand, IDD reduces employee mobility (Png & Samila, 2013). Many law studies argue that the IDD adoption would bear adverse effects (see, for instance, Taylor (2006) or Whaley (1998)). In this notion, Fulghieri and Sevilir (2011) suggest that promoting employee mobility is essential to improve innovation, although it also leads to a higher level of competition. Marx, Strumsky, and Fleming (2009) show that the enforcement of the non-compete agreement attenuates the mobility of employees with firm-specific skills. The implementation also impedes employment growth, entrepreneurship, and patent ownership (Samila & Sorenson, 2011). These studies conclude that IDD adoption will reduce the supply of experienced workers in the market. As a result, firms face a higher cost to acquire skilled workers from the market; then the demand will be lower. Therefore, the authors argue that the labour market will find its new lower equilibrium point without affecting innovative behaviour.

As this study could not expect the new equilibrium of the labour market will change the investment decision in an innovative project, this study turns to the other effect of IDD enactment that is product market competition relaxation, as proposed by previous studies (Klasa et al., 2018; Lin, Wei, & Wu, 2016). This study argues that IDD implementation impairs industry competition and provides less disciplinary forces to managers. Given that the

innovation through R&D is very critical in the competitive environment (Furman, Porter, & Stern, 2002; Porter, 1992), firms will reduce R&D activity in the less competitive environment as operational uncertainty and market disciplinary power go down. Therefore, this study conjectures that IDD adoption will reduce the firm's investment in innovation projects.
The increase of trade secrets protection through IDD may provide less incentive for the company in patenting the invention. Patents have finite economic life, are limited to specific innovations that meet particular standards, require publication (Png, 2015) and are costly (de Rassenfosse & van Pottelsberghe de la Potterie, 2013). The U.S. authority has enacted an act that allows the competitor to challenge a firm's patent in the pharmaceutical industry, and it threatens the economic benefits of the patent (Hemphill & Sampat, 2012). Therefore, applying and maintaining a patent is less favourable, and the increase of trade secrets protection through IDD will encourage firms to keep the innovation in secrecy rather than to patent it.

Hypothesis: Employee mobility constraint through the adoption of IDD decreases the firm's innovation

Research Method

Sample Selection

Firm-year patent and citation data was retrieved from the National Bureau of Economic Research (NBER) that was created by Hall, Jaffe, and Trajtenberg (2001). This database covers patent application and citation from 1976 to 2006. It contains more than 3.2 million global observations and around 1.4 million patent applications and citations data from U.S. firms. The financial data of U.S. industry firms were obtained from Compustat. After merging the patent database and Compustat, the surviving observations were 44,433 firm-years, covering 50 states and one District of Columbia, and include 4,759 unique firms. The regional economic factors such as GDP, population, and personal income per state-year were retrieved from the Bureau of Economic Analysis U.S. Department of Commerce[2]. The limited years of observation in this study are due to the availability of patent data provided for the public.

Measuring Innovation

Previous studies have used two proxies to measure firm innovation. The first is R&D expenditure that captures the investment in promoting innovation. The R&D serves as an observable input of innovation though it does not capture the innovation achieved. It is the best proxy to reveal the change of investment decision in an innovative project due to exogenous shock. This study uses the natural logarithm of one plus R&D expenditure (***LnXRD***) to measure

[2] https://www.bea.gov/itable/iTable.cfm?ReqID=70&step=1#reqid=70&step=1&isuri=1

the innovation input by following Acharya and Xu (2017), Kumar and Li (2016), and Sunder, Sunder, and Zhang (2017).

This study uses patent applications and citations following Hall, Jaffe, and Trajtenberg (2001) and Aziza and Arifb (2020) to measure the output of innovative effort. This study obtains the U.S. patent application and citation from NBER Patent Citation Data File that covers annual data including patent number, application year, patent citation number, and patent assignee ID from 1976 to 2006. The author assigns the gvkey (Compustat firm I.D.) to each patent assignee I.D by following the merging procedure provided in the NBER Patent Project website[3]. The author uses patent application year instead of granting year to date the patent data since it captures the actual time of innovation (Fang, Tian, & Tice, 2014; Griliches, Pakes, & Hall, 1986; Sunder, Sunder, & Zhang, 2017). After assigning gvkey and year for each patent assignee, the author calculates the patent application (***LnPat***) and citation (***LnCite***) for each firm-year.

Difference-in-Differences Design

This study uses difference-in-differences (DiD) design to test whether the IDD adoption impedes the firm's innovation level. Specifically, the DiD model is as follows:

$$Innovation_{i,t} = \alpha_0 + \alpha_1 IDD + \alpha_2 controls_{it} + year_t + industry_i + \varepsilon_{i,t} \text{ ....(2)}$$

Where $Innovation_{it}$ is firm i's innovation level at time t measured by the current and future R&D investment, patent applications, and patent citations. IDD equals one if the firm headquarters in the state where the IDD has been recognised in year t, and zero otherwise. Appendix A shows three states adopted and subsequently rejected the IDD. For these states, the value of 1 is given only during the adoption period.

The natural experiment used by this study provides causal inference between the shock of product market competition (IDD) and the firm's innovation. The implementation of IDD is used as the treatment that randomly assigns the sample over multiple years from 1919 for New York to 2006 for Kansas. The focus of this study is the DiD coefficient α_1, and the author hypothesises that α_1 to be negative. The coefficient captures the effect of IDD ruling on a firm's innovation input and output by controlling the impact of other changes contemporaneous with the adoption of the IDD on innovation. The authors follow the suggestion of Bertrand, Duflo, and Mullainathan (2004) to include industry and firm fixed effects to control endogenous variation across time and industry.

[3] https://sites.google.com/site/patentdataproject/Home

Following prior literature (Callen, Fang, & Zhang, 2016; Fang, Tian, & Tice, 2014; Teha & Keeb), this study uses some control variables. The firm-level control variables include natural logarithms of market value, leverage ratio, profitability, firm's property, plant, and equipment, capital expenditure, firm's value, and external finance reliance. These variables empirically show the characteristics of innovative firms. The authors also include product market competition, defined as the *Herfindahl*-Hirschman index (HHI) of 48 Fama-French industry classification, to control the change of industry competition after IDD implementation. This paper also uses the natural logarithm of gross domestic products, population, and personal income as the control variables at the state level. The definition of variables used in the model is presented in Appendix 2.

Results and Discussion

Descriptive Statistics

Table 1 presents descriptive statistics for the key variables of interest used in the regression models. All variables are winsorised at the top and bottom 1% to minimise the effect of outliers. About 22.85% of the observation has a nonzero patent, which is comparable to Fang, Tian, and Tice (2014) and Tian and Wang (2014). The IDD mean and standard deviation of this paper is similar to the statistics reported in Klasa et al. (2018) and Callen, Fang, and Zhang (2016).

Panel B presents the number and percentage of firms with and without patent by industry. This study uses the Fama-French 12-industry classification obtained from Kenneth French's data library[4] to simplify 399 four-digits SIC codes in our sample. All 12 sectors have firms with patents during our sample period. About 63.6% of firms in the consumer durables industry, such as automotive, T.V., furniture, and household appliances, have the nonzero patent. Consistent with Fang, Tian, and Tice (2014), the financial industry has the least number of firms with the nonzero patent.

Table 1: Descriptive Statistics

Panel A: Summary Statistics								
Variable	n	Mean	S.D.	Min	25%	Mdn	75%	Max
IDD	44,385	0.44	0.5	0	0	0	1	1
$\boldsymbol{LnPat_t}$	44,385	0.51	1.16	0	0	0	0	5.13
$\boldsymbol{LnPat_{t+1}}$	44,310	0.49	1.14	0	0	0	0	5.08
$\boldsymbol{LnCites_t}$	44,385	0.65	1.6	0	0	0	0	6.96
$\boldsymbol{LnCites_{t+1}}$	44,310	0.61	1.57	0	0	0	0	6.93
LnXRD	44,385	0.97	1.62	0	0	0	1.51	6.43
$\boldsymbol{LnXRD_{t+1}}$	44,358	1.01	1.65	0.00	0.00	0.00	1.59	6.50

[4] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

LNMV	44,385	5.23	2.32	0.49	3.47	5.22	6.89	10.63
ROA	44,385	0.01	0.51	-4.02	0.04	0.12	0.18	0.49
LEV	44,385	0.25	0.3	0	0.05	0.2	0.36	2.39
HHI-FFI	44,385	0.19	0.15	0.02	0.09	0.14	0.24	1
SIZE	44,385	5.32	2.42	0.11	3.52	5.35	7.04	11.17
Q	44,385	2.57	4.57	0.58	1.05	1.4	2.28	43.36
KZINDEX	44,385	-9.5	38.35	-292.23	-5.71	-0.91	0.83	51.25
CAPXTA	44,385	0.06	0.06	0	0.02	0.04	0.08	0.37
PPETA	44,385	0.31	0.25	0	0.1	0.24	0.46	0.92
LNGDP	44,385	12.49	1.02	9.86	11.82	12.55	13.22	14.44
LNPRSNINC	44,385	10.09	0.45	8.57	9.85	10.21	10.42	10.95
LNPOP	44,385	16.04	0.85	13.08	15.48	16.16	16.73	17.4

Panel B: Number and Percentage of Firms With and Without Patents by Fama-French Industry Classification

No	**Industry**	**Firms with Patents**		**Firms without Patents**		**Total**
1	Consumer Nondurables (Food, Tobacco, Textiles, Apparel, Leather, Toys)	62	36.3%	109	63.7%	171
2	Consumer Durables (Cars, TV's, Furniture, Household Appliances)	63	63.6%	36	36.4%	99
3	Manufacturing (Machinery, Trucks, Planes, Office Furniture, Paper, Com Printing)	195	57.2%	146	42.8%	341
4	Oil, Gas, and Coal Extraction and Products	28	15.9%	148	84.1%	176
5	Chemicals and Allied Products	53	49.1%	55	50.9%	108
6	Business Equipment (Computers, Software, and Electronic Equipment)	332	51.9%	308	48.1%	640
7	Telephone and Television Transmission	12	12.0%	88	88.0%	100
8	Utilities	40	19.0%	171	81.0%	211
9	Wholesale, Retail, and Some Services (Laundries, Repair Shops)	39	11.8%	292	88.2%	331
10	Healthcare, Medical Equipment, and Drugs	230	51.8%	214	48.2%	444
11	Finance	49	3.1%	1556	96.9%	1605

12	Other (Mines, Construction, Building Management, Trans, Hotels, Bus Service, Entertainment)	118	22.1%	415	77.9%	533
	Number of firms					4,759
	Total Observation (firm-year)	10,154	22.85%	34,279	77.15%	44,433

The Validity of the Experiment

The validity of our natural experiment relies on the hypothesis that the adoption of IDD will affect the R&D expenditure and patenting activity. However, one would argue that the adoption of IDD was driven by the intensity of R&D and patenting activity in a state; hence, the higher the R&D and patenting activity in a state, the higher the probability to adopt IDD. To overcome the argument, the author conducts a validity test using the probit model. Specifically, the author predicts the adoption of IDD using ***LnPat***, ***LnCites***, and ***LnXRD***. The author includes state-level GDP, personal income, and population in the natural log form to control for the effect of contemporaneous regional economic factors. If the adoption of IDD in a state depends on the innovation level of firms located in the respective state, then the authors expect the coefficient regression of ***LnPat***, ***LnCites***, and ***LnXRD*** would be positive and significant.

Table 2: Validity of the Experiment

Panel A: Innovation and IDD Adoption			
	(1)	(2)	(3)
Variables	***IDD***	***IDD***	***IDD***
$\boldsymbol{LnXRD_t}$	-0.0035**		
	(0.0014)		
$\boldsymbol{LnPat_t}$		0.0009	
		(0.0019)	
$\boldsymbol{LnCites_t}$			-0.0003
			(0.0014)
LNGDP	-0.1879***	-0.1868***	-0.1874***
	(0.0238)	(0.0238)	(0.0238)
LNPRSNINC	0.4979***	0.4961***	0.4962***
	(0.0243)	(0.0243)	(0.0243)
LNPOP	0.2257***	0.2242***	0.2248***
	(0.0237)	(0.0237)	(0.0237)
Observations	44,433	44,433	44,433
R-squared	0.0908	0.0907	0.0907

Panel B: IDD Adoption and Competition			
Variables	***HHI-FFI***	***HHI-SIC***	***DIFFNAIC***
IDD	0.0029***	0.0043**	0.0144***
	(0.0006)	(0.0021)	(0.0047)
Constant	0.2733***	0.5744***	1.2046***
	(0.0027)	(0.0088)	(0.0195)
Control	Yes	Yes	Yes
Fixed effect	Year & Industry	Year & Industry	Year & Industry
Observations	44,433	44,433	44,204
R-squared	0.3501	0.1100	0.0058
Number of FF Industry	48	48	48

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2 panel A shows the result of the probit model. The coefficient of ***LnPat*** and ***LnCites*** is not significant; hence the adoption of IDD is not conditional on patent application and citation intensity of firms located in the respective state. ***LnXRD*** is significant at 95% confidence interval, but the coefficient is not positive and close to zero (-0.0092). Other control variables have significant explanatory power to the adoption of IDD. Overall, the validity test reveals that the adoption of IDD does not depend on the innovation level of firms.

Employee Mobility and Industry Competition

This study runs OLS regression with industry competition as the dependent variable and IDD adoption as an explanatory variable to validate the argument that IDD enactment impedes firms' innovation through the relaxation of industry competition. This study measures industry competition as HHI of 48 Fama-French industry classification, HHI of 4-digit SIC codes, and product substitutability. HHI is measured using this following equation:

$$HHI_{jt} = \sum_{i=1}^{N_j} S_{ijt}^2 \quad (3)$$

Where S_{ijt} is the market share of firm *i* in industry *j* in year *t*. Market share is computed based on company sales. This index is higher for the lower competitive industry. The second proxy of market concentration is product substitutability or well known as the price-cost margin. In a competitive industry and higher product substitutability, firms with particular operating costs have less flexibility to price the product because firms will consider the competitor's product price in setting the sales price. Therefore, the smaller the ratio, the higher the price competition intensity. The ratio is the fraction of sales and operating costs at the industry level. The author adopts this following equation from Karuna (2007) to measure product substitutability:

$$DIFF_{jt} = \frac{\sum_{i=1}^{N_j} Sales_{ijt}}{\sum_{i=1}^{N_j}(COGS_{ijt}+SGX_{ijt}+DEPR_{ijt}+DEPL_{ijt}+AMORT_{ijt})} \qquad \text{...(4)}$$

Where i indexes firm, j indexes NAICS industry classification, t indexes year. The ratio is calculated as sales divided by operating cost, which includes the cost of goods sold, selling, general, and administrative expense, depreciation, depletion, and amortisation expense.
Table 2 panel B reports the result of the OLS regression. The author includes industry and year fixed effect to control unobserved heterogeneity across time and industry. All coefficients of the competition measure are positive and significant, suggesting that the IDD inflates all competition indexes or reduces industry competition level. This finding confirms our conjecture that IDD implementation affects a firm's innovation through the relaxation of competition intensity.

IDD and Firm Innovation

Table 3 provides the result of the DiD regression model (2). After including firm and state-level control variables, the coefficients of IDD are negative and significant at 1% level. The results show that IDD implementation negatively affects innovation after controlling other factors. The results confirm the hypothesis that the employee mobility constraint through IDD implementation demotivates firms to invest more in the innovation project. As IDD enactment constraints employee mobility, protects trade secrets, and reduces competition tension, firms are less incentivised to do more R&D and patenting the results.

Table 3: IDD and the contemporaneous firm innovation

	(1)	(2)	(3)
Variables	***LnXRD***	***LnPat***	***LnCites***
IDD	-0.0806***	-0.0212***	-0.0613***
	(0.0116)	(0.0076)	(0.0119)
HHI-FFI	0.0192	-0.1625***	-0.7103***
	(0.0827)	(0.0541)	(0.0849)
LNMV	0.2305***	0.0110**	0.0212***
	(0.0076)	(0.0050)	(0.0079)
ROA	-0.2859***	-0.0317***	-0.0943***
	(0.0159)	(0.0105)	(0.0164)
PPETA	-0.4649***	0.2076***	0.2977***
	(0.0368)	(0.0242)	(0.0379)
LEV	-0.0755***	0.0118	-0.0278

	(0.0213)	(0.0139)	(0.0219)
CAPXTA	0.6962***	0.1276*	0.4365***
	(0.1084)	(0.0711)	(0.1114)
Q	-0.0067***	0.0101***	0.0142***
	(0.0019)	(0.0013)	(0.0020)
KZINDEX	0.0012***	-0.0001	-0.0003*
	(0.0001)	(0.0001)	(0.0002)
SIZE	0.1597***	0.0749***	0.0943***
	(0.0078)	(0.0051)	(0.0080)
$\boldsymbol{LnXRD_t}$		0.4623***	0.4887***
		(0.0031)	(0.0049)
LNGDP	0.3764***	0.0469	-0.2503***
	(0.0586)	(0.0384)	(0.0602)
LNPRSNINC	0.4048***	0.0221	0.4881***
	(0.0718)	(0.0471)	(0.0738)
LNPOP	-0.3520***	-0.0403	0.2487***
	(0.0584)	(0.0383)	(0.0600)
Constant	-2.8954***	-0.1127	-4.8863***
	(0.8615)	(0.5643)	(0.8848)
Year/Industry fixed effect	Yes	Yes	Yes
Observations	44,433	44,433	44,433
R-squared	0.3452	0.5241	0.4103

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Most of the control variables have significant coefficients and take on the signs hypothesised by literature. ***LnXRD*** is included as a control variable for estimating the effect of IDD on ***LnPat*** and ***LnCites*** because ***LnXRD*** is an input for firms' innovation. The relationship between ***LnXRD*** as input and ***LnPat*** as innovation output is positively significant, indicating that firms with higher R&D are more likely to patent the innovation. Firms also will receive more citations when R&D activity is higher as the coefficient of ***LnXRD*** in column 3 is positive and significant. All models use year and firm fixed effects to control any unobserved variation in the sample. Therefore, the impact of IDD ruling on firms' innovation is not biased by omitted variables.

The effect of IDD ruling is not necessarily only on the contemporaneous firms' innovation. Table 4 shows that the effect of IDD adoption on future firms' innovation still pronounces with consistent signs. This study measures the future innovation as *t+1* ***LnPat***, ***LnCites***, and ***LnXRD***. The staggered IDD adoption still negatively affects the lead of R&D expenditure. It indicates that firms will reduce their future R&D expenditure in response to the shock of knowledge spillover and industry competition. Further, the increase of secret protection through IDD provides less incentive for the firm to patent the innovation.

Table 4: IDD and the future firm innovation

	(2)	(4)	(6)
Variables	$LnXRD_{t+1}$	$LnPat_{t+1}$	$LnCites_{t+1}$
IDD	-0.0830***	-0.0282***	-0.0610***
	(0.0117)	(0.0077)	(0.0118)
HHI-FFI	0.0587	-0.2627***	-0.7189***
	(0.0840)	(0.0552)	(0.0845)
LNMV	0.2522***	0.0164***	0.0212***
	(0.0078)	(0.0052)	(0.0079)
ROA	-0.2110***	-0.0125	-0.0872***
	(0.0163)	(0.0108)	(0.0164)
PPETA	-0.4979***	0.2021***	0.2742***
	(0.0375)	(0.0247)	(0.0377)
LEV	-0.0811***	0.0086	-0.0336
	(0.0218)	(0.0143)	(0.0219)
CAPXTA	0.7109***	0.1910***	0.5353***
	(0.1104)	(0.0726)	(0.1111)
Q	-0.0000	0.0125***	0.0140***
	(0.0020)	(0.0013)	(0.0020)
KZINDEX	0.0009***	-0.0001	-0.0003**
	(0.0002)	(0.0001)	(0.0002)
SIZE	0.1439***	0.0681***	0.0894***
	(0.0079)	(0.0052)	(0.0080)
$LnXRD_t$		0.4317***	0.4531***
		(0.0032)	(0.0049)
LNGDP	0.3857***	0.0294	-0.2831***
	(0.0596)	(0.0392)	(0.0599)
LNPRSNINC	0.4156***	0.0512	0.5099***
	(0.0730)	(0.0480)	(0.0734)
LNPOP	-0.3602***	-0.0229	0.2813***
	(0.0594)	(0.0391)	(0.0598)
Constant	-2.9726***	-0.3907	-5.1584***
	(0.8756)	(0.5758)	(0.8806)
Year/Industry fixed effect	Yes	Yes	Yes

Observations	44,358	44,358	44,358
R-squared	0.3483	0.4941	0.3955

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusion

This research aims to examine the effect of employee mobility constraint through inevitable disclosure doctrine (IDD) adoption on firms' innovation. This study conjectures that the staggered IDD adoption across U.S. states from 1919 to 2006 reduces industry competition intensity and firms' motivation to innovate. This study uses a difference-in-differences setting to examine the hypothesis and find that IDD adoption impedes contemporaneous and future innovation levels.

This study provides empirical evidence of employee career constraint effects, and it is beneficial for the regulatory body. Regulation should create a conducive business environment to increase innovation that is essential for economic growth. Protecting trade secrets through constraining employee mobility loosens competition strength and demotivates business to innovate. The paper suggests that IDD adoption has departed from the optimum point of regulation effect on innovation as business competition has a non-linear effect on innovation (Aghion et al., 2005). This study also complements the previous literature on the unintended and adverse consequences of IDD adoption.

Appendix 1 UTSA and IDD Adoption Years by State

No.	State	Abb.	Adoption Years of IDD	No.	State	Abb.	Adoption Years of IDD
1	Alabama	AL		27	Nebraska	NE	
2	Alaska	AK		28	Nevada	NV	
3	Arizona	AZ		29	New Hampshire	NH	
4	Arkansas	AR	1997	30	New Mexico	NM	
5	California	CA		31	North Dakota	ND	
6	Colorado	CO		32	Ohio	OH	2000
7	Connecticut	CT	1996	33	Oklahoma	OK	
8	Delaware	DE	1964	34	Oregon	OR	
9	District of Columbia	DC		35	Pennsylvania	PA	1982

10	Florida	FL	1960-2001	36	Rhode Island	RI	
11	Georgia	GA	1998	37	South Carolina	SC	
12	Hawaii	HI		38	South Dakota	SD	
13	Idaho	ID		39	Tennessee	TN	
14	Illinois	IL	1989	40	Utah	UT	1998
15	Indiana	IN	1995	41	Vermont	VT	
16	Iowa	IA	1996	42	Virginia	VA	
17	Kansas	KS	2006	43	Washington	WA	1997
18	Kentucky	KY		44	West Virginia	WV	
19	Louisiana	LA		45	Wisconsin	WI	
20	Maine	ME		46	Wyoming	WY	
21	Maryland	MD		47	New Jersey	NJ	1987
22	Michigan	MI	1966-2002	48	Texas	TX	1993-2003
23	Minnesota	MN	1986	49	North Carolina	NC	1976
24	Mississippi	MS		50	Massachusetts	MA	1994
25	Missouri	MO	2000	51	New York	NY	1919
26	Montana	MT					

Sources: Cross (2010), Goldman et al. (2015), Klasa et al. (2018), Parker and Justice (2014), Png (2015), and Risch (2015)

Appendix 2 Variable Definition

Variable	Definition
LnXRD $_{t+n}$	$LnXRD_t$ and $LnXRD_{t+1}$ denote the natural logarithm of one plus R&D expense at the end of fiscal year t and t+1, respectively.
LnPat $_{t+n}$	$LnPat_t$ and $LnPat_{t+1}$ denote the natural logarithm of one plus number of the patent filed and eventually granted at the end of fiscal year t and t+1, respectively.
LnCites $_{t+n}$	$LnCites_t$ and $LnCites_{t+1}$ denote natural logarithm of one plus number of patent citations at the end of fiscal year t and t+1, respectively.
IDD	1 for the state that adopts inevitable disclosure doctrine during the adoption period, 0 otherwise
HHI-FFI	*Herfindahl*-Hirschman *index of 48 Fama-French industry classification*
HHI-SIC	*Herfindahl*-Hirschman *index of four-digit SIC industry*
DIFFNAIC	Product substitutability measured as sales divided by operating cost for each north America industry classification. Operating cost is the sum of the cost of goods sold, selling, general, and administrative expense, and depreciation, depletion, and amortisation expense

LNMV	Natural logarithm of the market value of equity at the end of the fiscal year
ROA	Return on assets measured as operating income before depreciation scaled by the book value of total assets.
PPETA	Property plant and equipment scaled by the book value of total assets.
LEV	Leverage measured as the book value of debt scaled by the book value of total assets.
CAPXTA	Capital expenditure scaled by the book value of total assets.
Q	Market-to-book ratio measured as the market value of equity plus book value of assets minus book value of equity minus deferred tax and scaled by the book value of total assets.
KZINDEX	Financial constraint measured as [–1.002Cash flow + 0.283Q + 3.139Leverage – 39.368Dividends – 1.315Cash holdings]
SIZE	Natural logarithm of total assets
LNGDP	Natural logarithm of the state's gross domestic product
LNPRSNINC	Natural logarithm of the state's personal income
LNPOP	Natural logarithm of the population in the state

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