

Time to Innovate

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Outline of Presentation

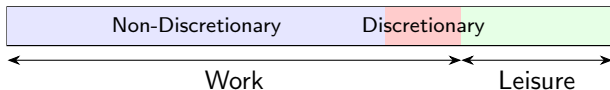
- 1 Introduction
- 2 Model
- 3 Institutional details
- 4 Research design and data
- 5 Results
- 6 Conclusion

Motivation

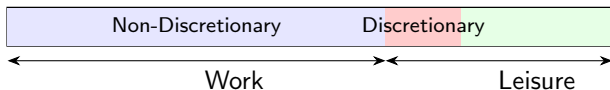
- "We encourage our employees, in addition to their regular projects, to spend **20% of their time** working on what they think will most benefit **Google**," co-founders Larry Page and Sergey Brin wrote in their 2004 IPO letter. "This empowers them to be more creative and innovative. Many of our significant advances have happened in this manner."
- Some of the most innovative companies
 - ▶ Implement such programs as **3M** (**15% rule**), **Linkedin** (**InCubator**), **Apple** (**Blue Sky**), and **Atlassian** (**Shiplt Days**)
 - ▶ Recognize the significance of discretionary time in fostering creativity and innovation.
- However, such practices are far from being a norm.
- No scientific evidence backing leisure time as an innovation driver.

Discretionary time

4 U.S. firms + 1 Australian firm



All Korean firms post-law

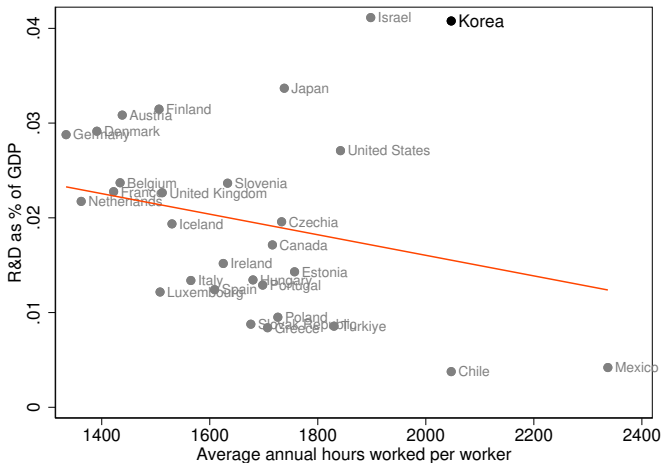


- Increased leisure time may lead to increased creativity during working hours via [rest](#), [recovery](#), or [off-hours idea generation](#).

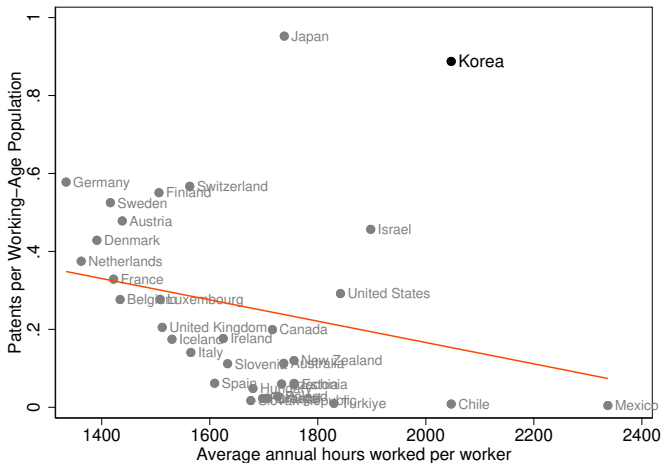
Summary

- Research question:
 - ▶ Does leisure time impact innovation?
 - ▶ The answer depends upon where leisure time (l) stands relative to its optimal level (l^*) \Rightarrow listen to data to confirm $l < l^*$ for most countries.
- Identification strategy:
 - ▶ Utilize a quasi-natural experiment where a law change sets a lower bound on l in an economy highly likely operating below l^* .
- Key results:
 - 1 \Downarrow Weekly working hours immediately post-law in 2018.
 - 2 \Uparrow Innovation output by the 2019 FY end, only in light manufacturing.
 - 3 More pronounced in est. tolerating low-performers and rewarding skill improvements over seniority (**complement**) and less pronounced in est. with flexible working days or hours (**substitute**).
 - 4 No changes in output, labor and capital input, or profitability.
 - 5 Pre-law sub-optimal time allocation is attributed to **structural inertia** and not to **agency conflicts**.

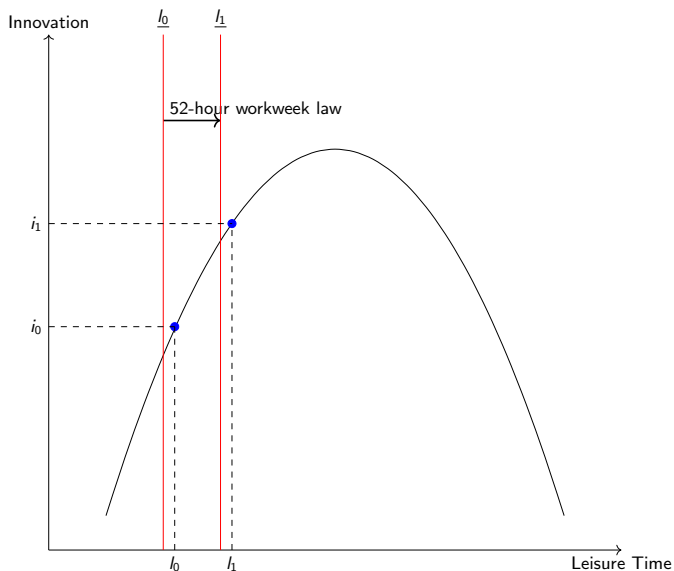
Time-innovation relationship across OECD member states



Time-innovation relationship across OECD member states



Time-innovation relationship across OECD member states



Contributions

1 Corporate innovation

- ▶ **Discretionary time** as a determinant of innovation.
- ▶ Enriches the nascent literature on employee-driven innovation: Chang et al. (2015), Hsieh et al. (2022), Hwang (2024)

2 Endogenous growth theory

- ▶ Foundations: Romer (1990), Aghion and Howitt (1992)
- ▶ Technological innovation via R&D (Hall and Lerner, 2010), legal institution (North, 1990), human capital (Lucas, 1988)

3 (Limits of) corporate governance

- ▶ Survey: Shleifer and Vishny (1997); Theory: Tirole (2001)
- ▶ Channels: board of directors (Adams, 2010), executive comp. (Bebchuk, 2003), internal control system (Jensen, 1993)
- ▶ Lack of economic theories guiding policies and practices

4 Labor economics

- ▶ Leisure as a substitute for consumption (Hicks, 1932) or its **indirect** driver via leisure-related spending (Gronau, 1977)
- ▶ Leisure **directly** affects consumption (Hwang and Kim, 2025)

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Labor-leisure choice model (Hicks, 1932)

- Employees maximize $u(c(l), l)$ s.t. $c(l) = w(t - l)$
- Firms maximize $\pi(n, l) = pq - wn(t - l) - rK$
- Functions and parameters:
 - ▶ c : consumption
 - ▶ w : wage rate per unit of time
 - ▶ t : total available time per employee
 - ▶ p : price of output
 - ▶ q : quantity of output
 - ▶ n : number of employees
 - ▶ r : cost of capital
 - ▶ K : capital stock
- ... written a century ago when labor competes with machines with limited capacities to innovate.

Labor-leisure choice model with leisure-driven innovation

- Employees maximize

$$u(c, l) \text{ s.t. } c = w(t - l) + b\delta l$$

- Firms maximize

$$\pi(n, l) = (1 + i(l))(pq - nw(t - l) - rK) - bn\delta l$$

- Additional functions and parameters:

- ▶ b : bonus per unit of leisure, leading to innovations
- ▶ δ : a share of leisure time l used to be innovative during work hours
- ▶ $i(l) = \lambda n\delta l$: innovation impact on profit

Labor-leisure choice model with leisure-driven innovation

Key findings:

- Proposition I: l_e^* is greater with innovation than without.
- Proposition II: l_f^* is greater with innovation than without if $\lambda > \underline{\lambda}$.
- Corollary I: The equilibrium leisure time l^* is higher with innovation than without for firms with $\lambda > \underline{\lambda}$.

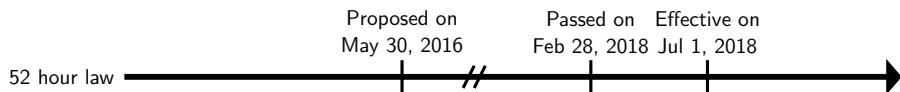
Testable predictions:

- 1 Innovation increases post-law only in establishments where $\lambda > \underline{\lambda}$.
- 2 Since λ is tricky to estimate and endogenously determined for each **establishment**, we estimate it at the **sector** level.

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52-hour workweek law



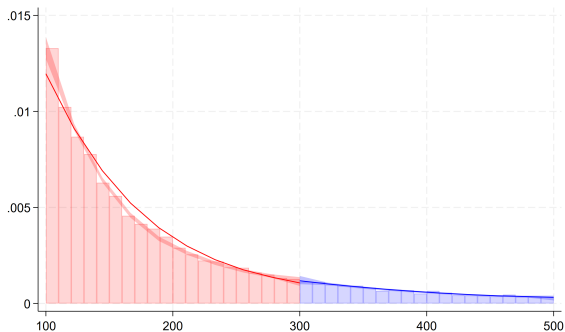
- Enforcement schedule:

- ▶ Year 0 (July 1, 2018): establishments with 300 or more employees
- ▶ year 1 (July 1, 2019): establishments with 300 or more employees in exempt sectors (**only non-manufacturing**)
- ▶ Year 1.5 (January 1, 2020): establishments with 50 to 299 employees
- ▶ Year 3 (July 1, 2021): establishments with 5 to 49 employees

52-hour workweek law

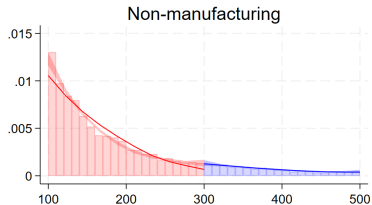
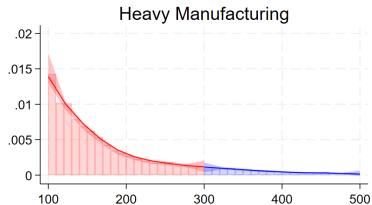
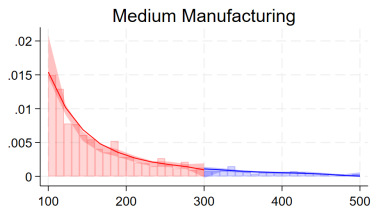
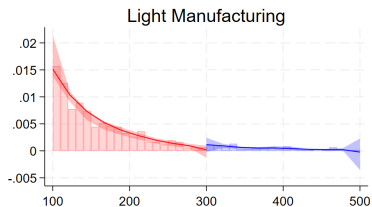
- Key features
 - ▶ Down from 68 (40 statutory + 12 overtime + 16 weekend hours) to 52.
 - ▶ Penalty for violation: up to 2 years in prison or a fine of \$20K.
- Strengths:
 - 1 Enacted for reasons unrelated to innovation, such as improving work-life balance, enhancing labor productivity, and creating jobs.
 - 2 Includes a grace period ≥ 1.5 years for smaller est. \Rightarrow RDD
 - 3 First of its kind since similar laws in the Netherlands (1996), Germany (1994), and Belgium (1971); followed closely by Japan (June 2018)
 - 4 Korea's great sectoral balance makes it an ideal setting to examine the law's influence across sectors.
- Weakness:
 - 1 The bill, supported by 122 out of 300 members of the National Assembly, might be anticipated to be enacted as early as May 2016
 - ★ Show continuity in outcomes before the law's **proposal**, not its **passage**.
 - ★ Carefully examine the behavior of **early compliers** and **defiers**.

Density test: population data, 2017



- McCrary (2008) density test with the bias-corrected Cattaneo et al. (2018) implementation.
- Source: [K-COMWEL](#) Employment and Industrial Accident Insurance data

Density test: population data, by sector, 2017



- Robust to 2015–2020 (Internet Appendix).

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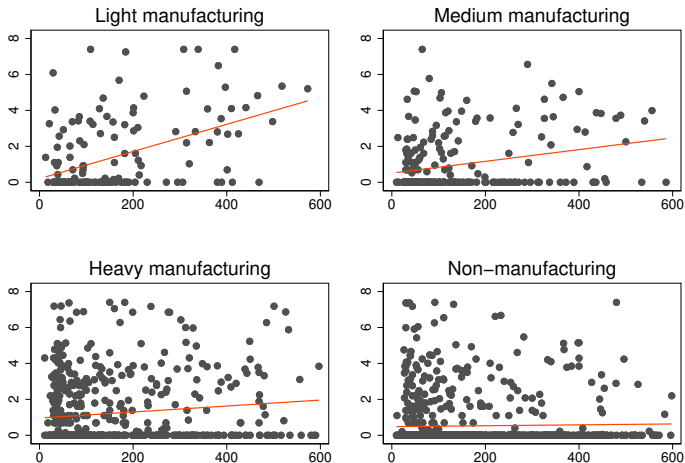
Cross-sectoral comparison

- Compare across **sectors** rather than **industries** or **establishments**.
 - ▶ The latter are more vulnerable to omitted variable bias.
 - ▶ To maintain at least 30 observations in the tightest bandwidth.
- Use **NAICS** over **SIC**.
 - ▶ Less prone to confounding factors, since Korea uses SIC.
 - ▶ Newer; may better reflect the current innovation landscape.
 - ▶ Offers better distributional balance across sectors.
- Aggregate non-manufacturing industries.
 - ▶ Establishments with over 300 employees are less common, especially in high- λ industries like IT.

	[30, 99]	[100, 199]	[200, 299]	[300, 399]	[400, 499]	[500, 599]
Light manufacturing	64 (2.9%)	44 (11.0%)	16 (17.2%)	18 (78.3%)	6 (31.6%)	3 (27.3%)
Medium manufacturing	109 (3.1%)	53 (8.6%)	23 (16.7%)	15 (25.9%)	12 (54.5%)	6 (30.0%)
Heavy manufacturing	296 (3.1%)	98 (5.7%)	46 (10.5%)	42 (24.1%)	38 (40.9%)	15 (27.3%)
Non-manufacturing	395 (1.2%)	160 (2.9%)	83 (5.4%)	54 (8.6%)	41 (11.2%)	14 (6.0%)

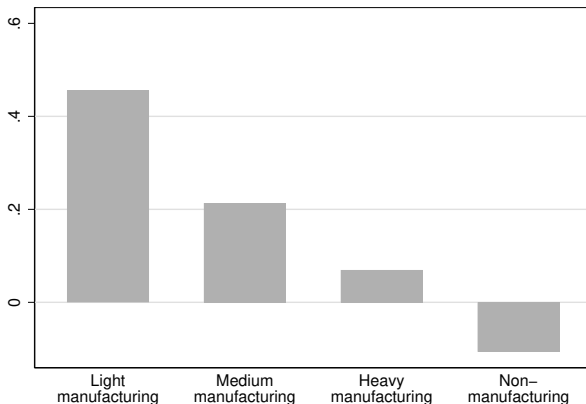
Labor-driven innovations across sectors

A. Unconditional pre-law (2015) relationships



Labor-driven innovations across sectors

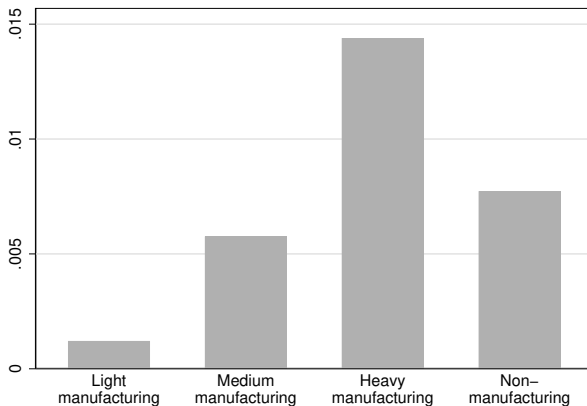
B. Conditional pre-law (2015) relationships



$$\ln(1 + IP) = \alpha + \lambda \ln(1 + \#Employees) + \beta \ln(1 + R\&D) + \gamma \ln(1 + PPE) + \epsilon$$

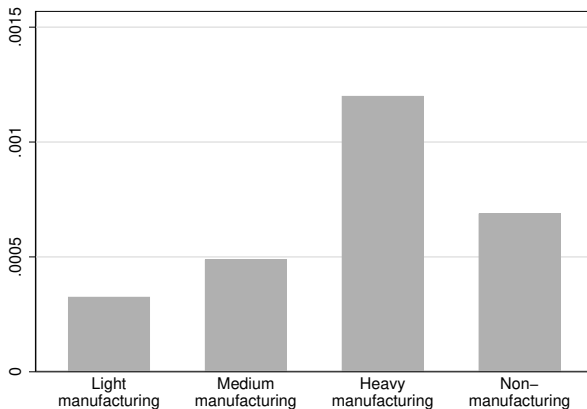
Innovation capital

A. Capitalized R&D / Total assets

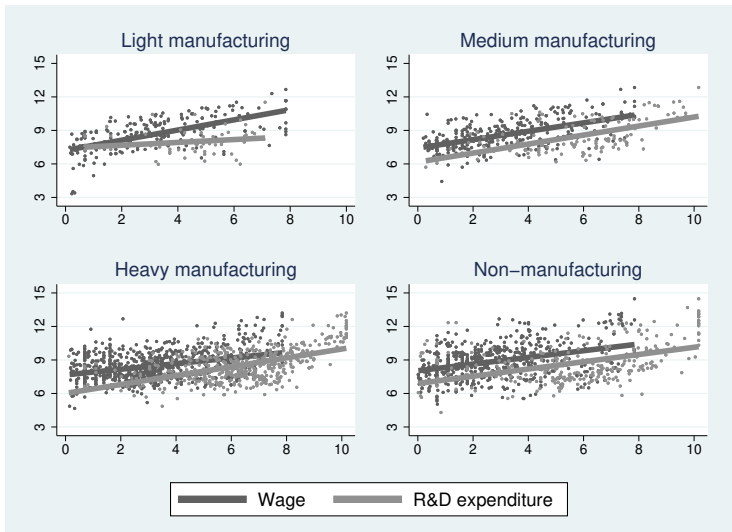


Innovation capital

B. Capitalized IPs / Total assets



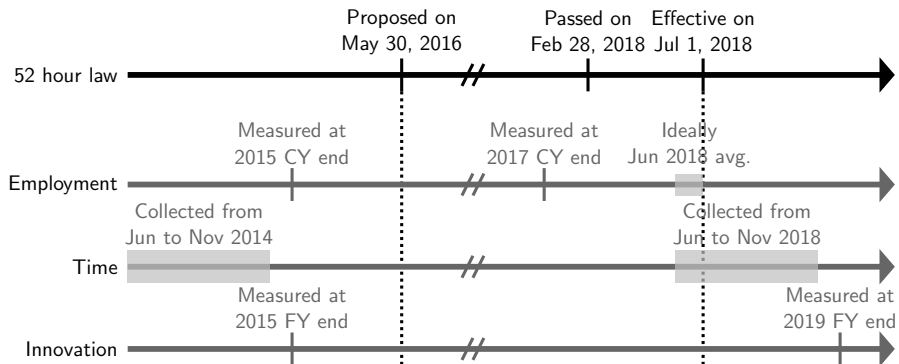
Innovation sensitivity to wage vs. R&D



Data

- Workplace Panel Survey (WPS)
 - ▶ Administered by Korea Labor Institute (KLI)
 - ▶ Sample period: 2015-2021
 - ▶ Observations: i) establishments with regular employees ≥ 30 ; ii) **randomly sampled** to constitute each stratum defined by 10 industry and 4 size group; iii) surveyed biennially.
 - ▶ Variables: **time**, **innovation**, employment, union, compensation, and financial status and performance.
 - ▶ Limitation: **anonymized** for confidentiality and cannot be merged with other data \Rightarrow 70-80% can be unmasked using accounting figures.
- Patent data from KIPRIS
 - ▶ Administered by Korean Intellectual Property Office.
 - ▶ Limitation: **cannot be merged with WPS data** as patent documents lack information on inventing establishments \Rightarrow used only for sector-level descriptive analysis.

Timeline for data collection



Sharp RDD

- Deterministic treatment:

$$T_{i1} = \begin{cases} 1 & \text{if } E_{i1} \geq 300, \\ 0 & \text{if } E_{i1} < 300. \end{cases}$$

- ▶ Assumption: $E_{i1} \neq h(E_{i0})$ (i.e. no early compliers or defiers)
- ▶ E_{i1} : pre-enforcement employee count (Dec. 31, 2017)
- ▶ E_{i0} : pre-proposal employee count (Dec. 31, 2015)
- ▶ **May be violated for tighter bandwidth**, if identifying assumptions that hold with E_{i0} do not hold as cleanly with E_{i1} .
- ▶ **Less problematic for wider bandwidths**, since the law applies **globally**, although RDD relies on local randomness near the cutoff.
- ▶ Higher **testing power** than fuzzy RDD, as the sample depends on E_{i1} .
- ▶ Suited for **cross-sectional analyses**, which are complex under a fuzzy RDD framework.

Sharp RDD

- Baseline model:

$$Y_i = \alpha_{j(i)} + \beta_0 + \beta_1 \mathbb{1}[E_i \geq 300] + \gamma' X_i + \epsilon_i$$

- ▶ i : establishment, $j(i)$: 2-digit SIC industry
- ▶ E_i : # employees (Dec. 31, 2017)
- ▶ Y_i : weekly work hours (June to Nov. 2018), capitalized IPs (FY 2019)
- ▶ X_i : size, age, employment, capitalized R&D, intangible assets, capital intensity, wage expenditure, union presence
- ▶ The estimation of β_1 adjusts for the probability of each observation being sampled using the cross-sectional weights provided by KLI.
- ▶ Bandwidth: +/- 300, +/- 200, +/- 100

Sharp RDD

- Extended specification for cross-sectoral comparison:

$$Y_i = \alpha_{j(i)} + \beta_0 + \beta_1 \mathbf{1}[E_i \geq 300] + \\ \beta_2 \mathbf{1}[E_i \geq 300] \times \mathbf{1}[s(i) = L] + \\ \beta_3 E_i + \lambda_{s(i)} E_i \times \eta_{s(i)} + \gamma' X_i + \epsilon_i$$

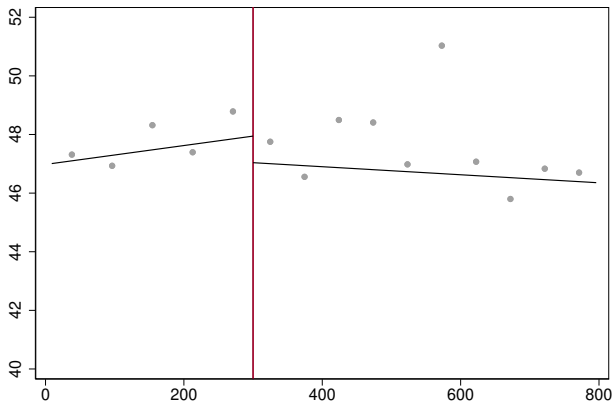
- $s(i) \in \{L, M, H, N\}$; L = light manufacturing (NAICS 31), M = medium manufacturing (NAICS 32), H = heavy manufacturing (NAICS 33), N = non-manufacturing (NAICS others)
- $\eta_{s(i)}$: sector-specific indicators
- Robust to including $X_i \cdot \eta_{s(i)}$ instead of X_i

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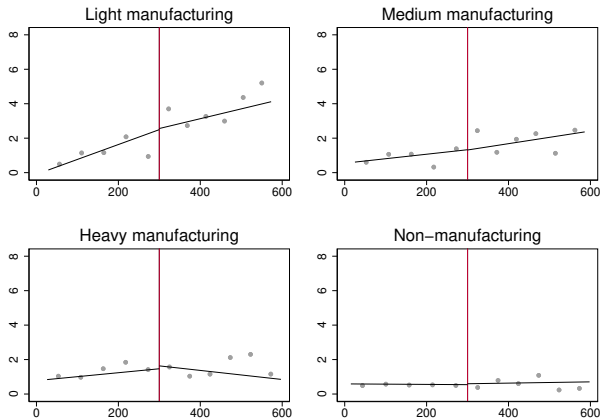
Pre-law continuity in outcomes

A. Weekly work hours in 2014



Pre-law continuity in outcomes

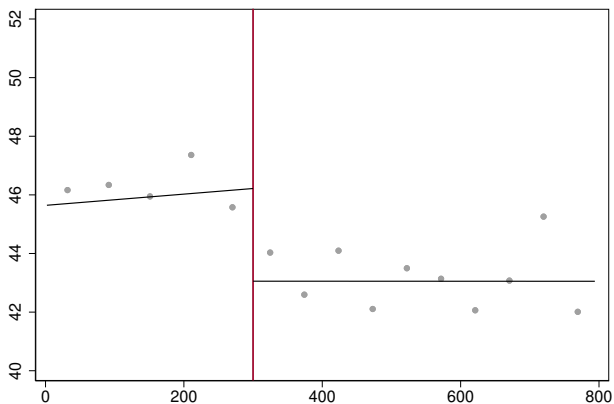
B. Innovation output across sectors in 2015



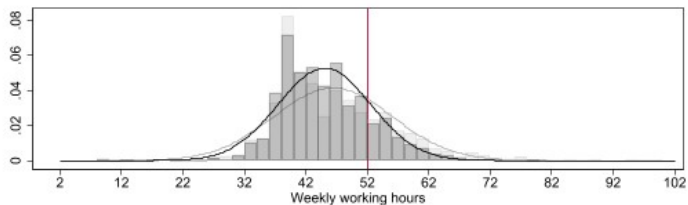
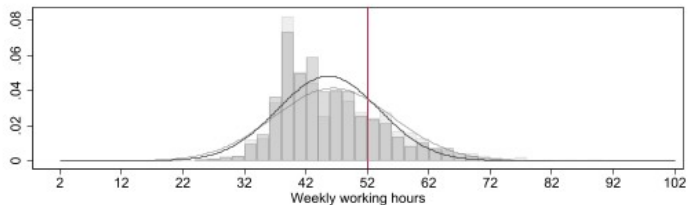
Pre-law continuity in covariates

	(1)	(2)	(3)	(4)	(5)	(6)
# Employees	[300,500)		[100,300)			
Variable	N	Mean	N	Mean	(2)-(4)	S.E.
<i>ln</i> (#Employees)	189	5.96	342	5.06	0.88***	0.03
<i>ln</i> (#Indirect employees)	189	1.26	342	0.83	0.48	0.33
<i>ln</i> (#Incoming skilled employees)	189	1.55	342	1.11	0.42*	0.25
<i>ln</i> (#Outgoing employees)	189	3.29	342	2.22	1.04***	0.21
<i>ln</i> (Capitalized IPs)	189	1.26	342	0.94	0.24	0.22
<i>ln</i> (Capitalized R&D)	189	1.17	342	1.26	-0.07	0.38
<i>ln</i> (Expensed R&D)	189	1.76	342	2.08	-0.25	0.35
<i>ln</i> (PPE)	189	8.80	342	8.63	0.06	0.35
<i>ln</i> (Software)	189	2.20	342	1.44	0.90**	0.41
<i>ln</i> (Assets)	189	10.82	342	10.20	0.47**	0.23
Capitalized R&D/Assets	189	0.01	342	0.01	0.00	0.01
Intangible assets/Assets	189	0.02	342	0.02	0.00	0.01
PPE/Assets	189	0.28	342	0.34	-0.06	0.04
EBIT/Assets	168	0.05	286	0.06	-0.01	0.01
EBIT/Sales	170	0.04	289	0.06	-0.01	0.01
Wage/Sales	189	0.34	342	0.31	0.05	0.04
Wage per employee	189	33.06	342	33.82	-2.47	3.28
Sales/Total work hours	155	0.20	280	0.20	-0.02	0.04
Union	189	0.37	342	0.34	0.01	0.06
Penalize low performers	189	0.08	342	0.16	-0.03	0.04
Reward skill improvements	188	0.25	335	0.30	-0.04	0.06
Flexible hours or days	189	0.04	342	0.06	-0.03	0.03
% Employees over 55	189	0.19	342	0.18	0.03	0.04
% Employees below 35	189	0.27	342	0.26	-0.00	0.03
Owner manager	189	0.61	342	0.73	-0.09	0.07
CEO being the largest shareholder	189	0.38	342	0.66	-0.23***	0.07
Business group affiliation	189	0.16	342	0.05	0.08	0.06
Foreign ownership	189	0.07	342	0.03	0.02	0.02
Largest shareholder ownership	153	57.78	284	61.57	-7.44**	4.32

Law's effect on weekly working hours



Law's effect on weekly working hours



Law's effect on weekly working hours

A. Intensive margin

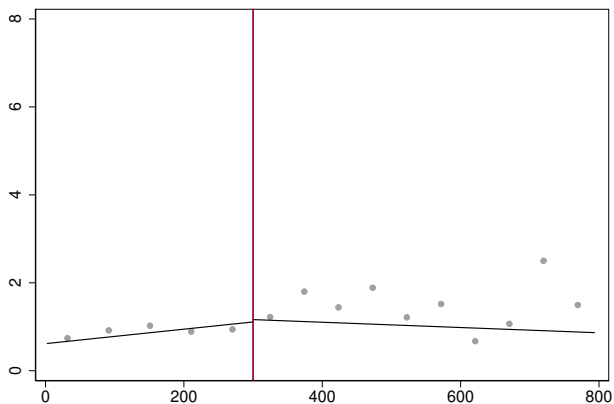
Dep. Var.	(1)	(2)	(3)	(4)	(5)	(6)
			Weekly work hours			
Bandwidth	± 300	± 200	± 100	± 300	± 200	± 100
$1[E \geq 300]$	-3.2926*** (0.789)	-3.9297*** (0.832)	-3.6570*** (1.377)	-2.0239** (0.819)	-2.9633*** (0.890)	-2.6679** (1.322)
$\ln(\text{Assets})$				-0.0428 (0.240)	0.0861 (0.523)	0.2467 (0.743)
Capitalized R&D/Assets				0.7124 (10.128)	13.8973 (16.953)	-7.8212 (31.534)
Intangible assets/Assets				5.5149 (10.268)	-8.9043 (13.271)	8.9131 (24.657)
PPE/Assets				2.2359* (1.186)	0.8878 (1.723)	5.0647 (4.484)
Wage/Sales				-2.5232* (1.497)	-1.4942 (2.734)	1.6154 (4.189)
Union				-0.5519 (0.727)	-1.0426 (0.966)	1.0752 (2.119)
2-digit SIC FE				✓	✓	✓
# Observations	1494	703	284	1494	703	284
Adjusted R^2	0.00486	0.0263	0.0325	0.143	0.169	0.206

Law's effect on weekly working hours

B. Extensive margin

Dep. Var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Overtime on weekdays			Occasional weekend work			Regular weekend work		
Bandwidth	± 300	± 200	± 100	± 300	± 200	± 100	± 300	± 200	± 100
1[$E \geq 300$]	-0.0035 (0.065)	-0.1182* (0.071)	-0.0615 (0.089)	0.0364 (0.070)	-0.0144 (0.073)	0.0782 (0.087)	-0.0445* (0.026)	-0.1179*** (0.042)	-0.1281* (0.046)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
2-digit SIC FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
# Observations	1494	703	284	1494	703	284	1494	703	284
Adjusted R ²	0.160	0.190	0.217	0.125	0.127	0.125	0.0642	0.0821	0.0627

Law's effect on capitalized IPs

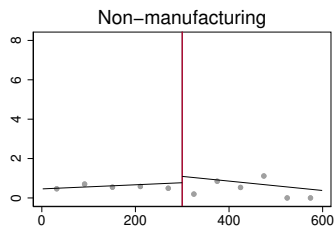
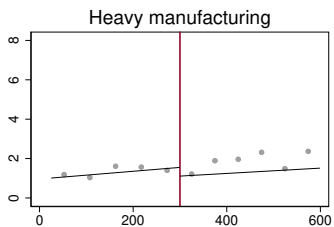
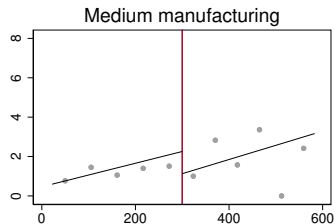
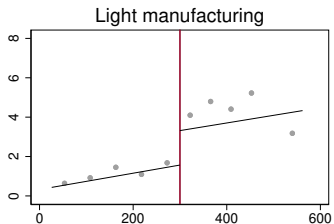


Law's effect on capitalized IPs

A. All sectors

Dep. Var.	(1)	(2)	(3)	(4)	(5)	(6)
	<i>ln</i> (Capitalized IPs)					
Bandwidth	± 300	± 200	± 100	± 300	± 200	± 100
$1[E \geq 300]$	0.3221 (0.246)	0.2246 (0.287)	0.0691 (0.382)	-0.0220 (0.241)	0.0262 (0.237)	0.1077 (0.380)
<i>ln</i> (Assets)				0.2410*** (0.062)	0.2559** (0.101)	0.4034** (0.190)
Capitalized R&D/Assets				8.7668*** (2.829)	10.6591*** (3.567)	16.9817* (9.197)
Intangible assets/Assets				0.5839 (1.345)	7.4860** (2.936)	0.7997 (3.774)
PPE/Assets				-0.2058 (0.257)	-0.1037 (0.455)	0.1324 (1.204)
Wage/Sales				-0.5626 (0.373)	-1.0632* (0.624)	-0.9566 (0.901)
Union				-0.1987 (0.179)	0.1875 (0.320)	0.1664 (0.466)
<i>ln</i> (#Employees) × $\eta_{s(i)}$				✓	✓	✓
2-digit SIC FE				✓	✓	✓
# Observations	1306	618	242	1306	618	242
Adjusted R ²	0.000491	0.000121	-0.00387	0.122	0.177	0.201

Law's effect on capitalized IPs



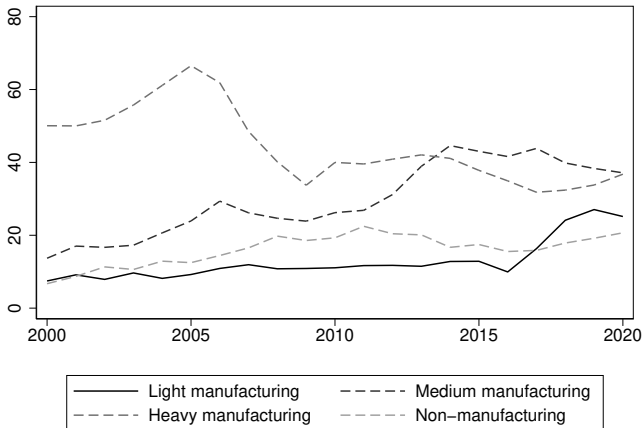
Law's effect on capitalized IPs

B. Across sectors

Dep. Var.	(1)	(2)	(3)	(4)	(5)	(6)
	<i>ln</i> (Capitalized IPs)					
Sample	Light manufacturing			All sectors		
Bandwidth	± 300	± 200	± 100	± 300	± 200	± 100
$1[E \geq 300]$	2.2187*** (0.545)	2.8308*** (0.726)	3.1643** (1.483)	-0.0358 (0.280)	-0.2070 (0.339)	0.5172 (0.649)
$1[E \geq 300] \times 1[s = L]$				2.3942*** (0.708)	3.0203*** (0.888)	2.6053* (1.378)
<i>ln</i> (#Employees) $\times \eta_{s(i)}$				✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
2-digit SIC FE	✓	✓	✓	✓	✓	✓
# Observations	129	72	28	1306	618	242
Adjusted R ²	0.511	0.377	0.420	0.123	0.181	0.260

- β_1 in columns 1-3 are insignificant from each of the other three sectors.

Patent applications per patenting firm across sectors



Robustness to alternative method I: Fuzzy RDD

- Probabilistic treatment:

$$P(T_i = 1|E_{i0}) = \begin{cases} f(E_{i0}) & \text{if } E_{i0} \geq 300, \\ g(E_{i0}) & \text{if } E_{i0} < 300, \end{cases}$$

- ▶ Does not require $E_i \neq h(E_{i0})$ (i.e., no early compliers or defiers).
- ▶ **Unbiased estimates** even with the tightest bandwidth.
- ▶ At the tightest bandwidth, however, the **sample size** drops below 30.
- ▶ **Cross-sectional tests** become difficult, as they involve 5 endogenous variables (i.e., 5 first-stage equations) and only 2 instruments.
- ▶ f and g are assumed to be first-order polynomials, although the results are robust to higher-order expansions.

Robustness to alternative method I: Fuzzy RDD

- First stage:

$$T_{i1} = \zeta_{j(i)} + \alpha_0 + \alpha_1 T_{i0} + \alpha_2 \tilde{E}_{i0} + \alpha_3 T_{i0} \tilde{E}_{i0} + \xi_i$$

- Second stage:

$$Y_{i1} = \zeta_{j(i)} + \beta_0 + \beta_1 T_{i1} + \beta_2 \tilde{E}_{i0} + \beta_3 T_{i1} \tilde{E}_{i0} + \xi_i$$

- ▶ The same first stage is set up for $T_{i1} \tilde{E}_{i0}$.
- ▶ i : establishment, $j(i)$: 2-digit SIC industry
- ▶ Y_i : weekly work hours (June to Nov. 2018), capitalized IPs (FY 2019)
- ▶ E_{i0} : # employees on Dec. 31, 2015
- ▶ E_{i1} : # employees on Dec. 31, 2017
- ▶ $T_{it} = \mathbb{1}[E_{it} \geq 300]$
- ▶ $\tilde{E}_{it} = E_{it} - 300$

Robustness to alternative method I: Fuzzy RDD

Sample	(1)	(2)	(3)	(4)	(5)	(6)
	Light manufacturing					
	± 300			± 200		
Bandwidth	First-stage		Second-stage	First-stage		Second-stage
Dep. Var.	T_1	$T_1 \times \widetilde{E}_0$	$\ln(\text{Cap. IPs})$	T_1	$T_1 \times \widetilde{E}_0$	$\ln(\text{Cap. IPs})$
T_1			4.8883*** (1.138)			5.7505** (2.459)
$T_1 \times \widetilde{E}_0$			-2.6637* (1.567)			-3.1134 (2.360)
T_0	0.6629*** (0.201)	0.0155 (0.022)		0.5467** (0.262)	0.0528 (0.058)	
$T_0 \times \widetilde{E}_0$	0.5340 (0.418)	1.0250*** (0.017)		0.4327 (0.529)	1.0767*** (0.065)	
\widetilde{E}_0	0.0347 (0.034)	-0.0122 (0.012)	-0.0002 (0.374)	0.1848 (0.179)	-0.0638 (0.064)	-0.7378 (1.694)
2-digit SIC FE	✓	✓	✓	✓	✓	✓
F-statistics	44.76	3007.04		4.16	1712.85	
# Observations	124	124	124	56	56	56

Robustness to alternative method II: DiD

- Light manufacturing:

$$Y_{it} = \alpha_{j(i)} \times \theta_t + \beta_0 T_{i0} \times Post_t + \epsilon_{it}$$

- All sectors:

$$Y_{it} = \alpha_{j(i)} \times \theta_t + \beta_0 T_{i0} \times Post_t + T_{i0} \times Post_t \times \mathbb{1}[s(i) = L] + \epsilon_{it}$$

- ▶ θ_t : year fixed effects
- ▶ $Post_t$: 1 for 2019 and 0 for 2015 and 2017
- ▶ $\alpha_{j(i)} \times \theta_t$ control for time-varying industry-specific trends in Y_{it} .

Robustness to alternative method II: DiD

Dep. Var.	(1)	(2)	(3)	(4)
	<i>ln</i> (Capitalized IPs)			
Sample	Light manufacturing		All sectors	
Bandwidth	± 300	± 200	± 300	± 200
$T_0 \times \text{Post}$	2.4224* (1.275)	3.5458*** (1.113)	-0.1233 (0.133)	-0.3228 (0.233)
$T_0 \times \text{Post} \times 1[s = L]$			2.5457** (1.273)	3.8686*** (1.125)
Establishment FE	✓	✓	✓	✓
2-digit SIC \times Year FE	✓	✓	✓	✓
# Observations	172	76	1,970	796
Adjusted R ²	0.327	0.364	0.604	0.653

Cross-sectional tests

- Innovation incentives as a complement:
 - ▶ More pronounced when tolerance for ST failure (not penalize low performers) or rewards for LT success (raise pay based on skill improvements over seniority) are in place.
- Other forms of slack as substitutes:
 - ▶ Less pronounced when flexible hours or days are in place.

Output, input, and profitability

- Recall $\pi(n, l) = pq - wn(t - l) - rK$
- Production output: $\uparrow l \Rightarrow \downarrow q?$ No
- Labor input: $\uparrow l \Rightarrow \uparrow n?$ No
 - ▶ No increase in direct or indirect employment
 - ▶ No change in employee composition via inflows or outflows
- Capital input: $\uparrow l \Rightarrow \uparrow K?$ No
 - ▶ No increase in labor-replacing capital (PPE), expensed R&D, capitalized R&D
 - ▶ An economy-wide increase in labor-augmenting capital (software)
- Profitability: $\uparrow l \Rightarrow \downarrow \pi?$ No
 - ▶ No decrease in ROA or profit margin

Frictions behind suboptimal pre-law time allocation

- Lack of theories on leisure time as a driver of innovation
- (Economy-level) cultural or institutional traits - not testable
- (Firm-level) structural inertia in organizations - supported
 - ▶ % employees below 35, % employees over 55
- (Firm-level) agency conflicts - not supported
 - ▶ Largest shareholder ownership, largest shareholder = CEO, owner manager, business group affiliation, foreign ownership
- Additional factors yet to be explored.
- Further rigorous research on these frictions is needed.

Outline of Presentation

- 1 Introduction
- 2 Model
- 3 Institutional details
- 4 Research design and data
- 5 Results
- 6 Conclusion**

Summary

- Utilize a cap on non-discretionary (labor) time introduced in an economy with high innovative capabilities and low discretionary time to examine the potential of discretionary time as an innovation driver.
- Show an immediate decline in labor time only for businesses subject to the cap, followed by a surge in innovation output in 1.5 years only in a sector with the greatest innovation-labor sensitivity.
- This increase is without a loss of profitability, and is conditional on employees' innovation incentives in place, and is less pronounced in establishments with flexible working hours or days.
- The sub-optimal pre-cap time allocation between labor and leisure is attributed to structural inertia and not to agency conflicts.

Implications for stakeholders

- Firms with high innovation-labor sensitivity:
 - ▶ Further reduce working hours or implement "XX% rules."
 - ▶ Lessons may well apply to those with a high reliance on employee-driven innovations but small employment size - thus not testable in this paper (e.g., IT).
- Investors:
 - ▶ Buy high-innovation-labor-sensitivity firms with shorter working hours.
 - ▶ Pressure portfolio companies to reduce or flexibilize working hours.
- Lawmakers:
 - ▶ Korea: Tighten the cap. It is 40 hours or less in other civil law countries
 - ▶ U.S., Israel, Mexico, Chile, and Costa Rica (countries with long hours): Introduce a cap.
- Administrations:
 - ▶ Enforce the cap, if any.
 - ▶ Reform working hours and incentive schemes.