The Role of Labor Flexibility in the Pursuit of Innovation Strategies by Established Japanese Companies

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Does labor flexibility benefit innovation?

Merits

- Easier reallocation to more dynamic sectors
- More incentives to take risks
- Job matches → productivity
- “Fresh blood” inflow

Demerits

- Stronger labor protection → higher wages and productivity
- Development of firm-specific skills
- Trust → productivity
- Innovation requires long-term incentives, not short-term punishments

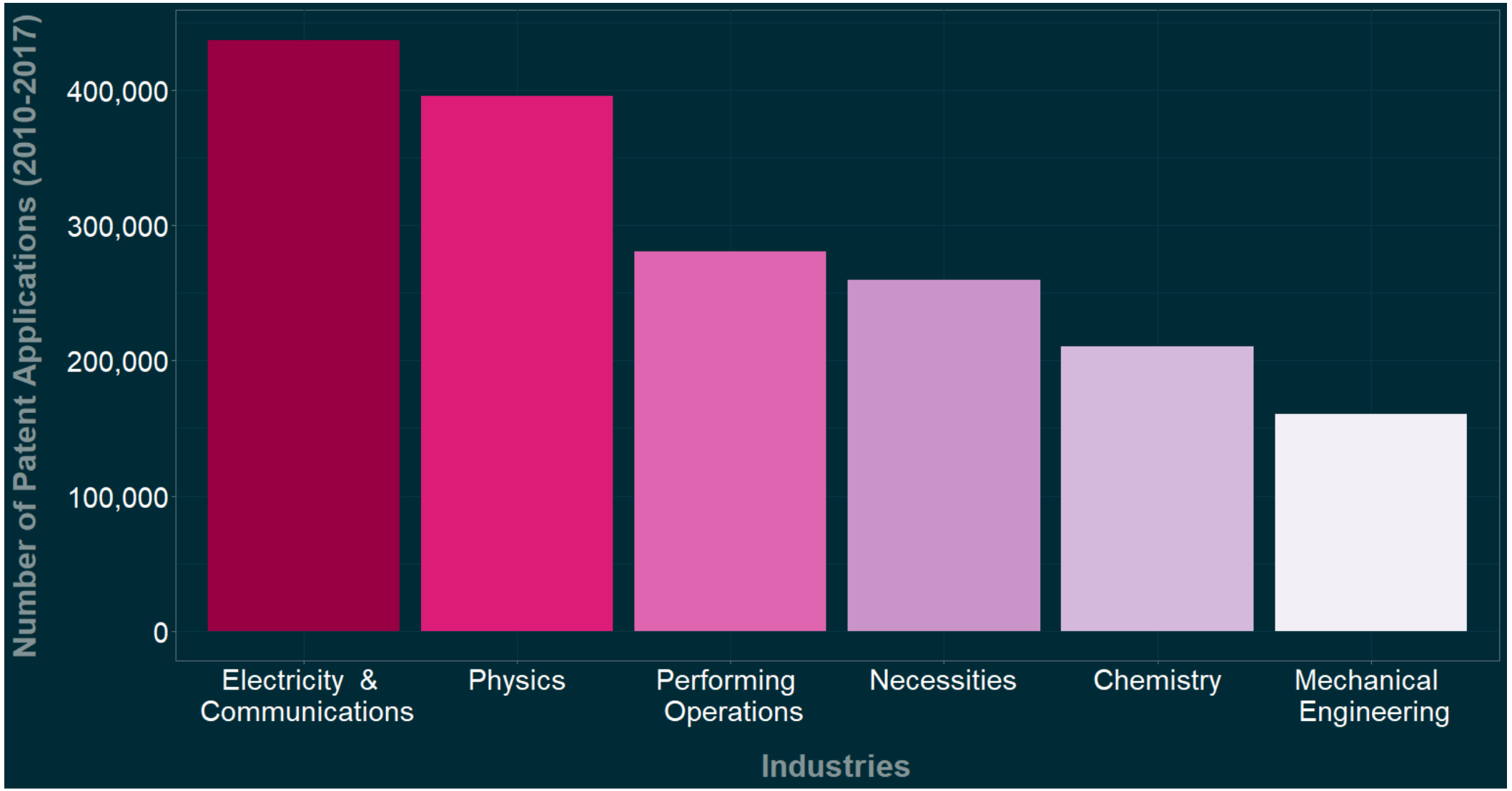
  (Kleinknecht et al., 2014)

Focus & Literature gap

- Focus on numerical labor flexibility :
  - "addresses the variation of quantity of labor input" (Arvantis, 2005),
  - "reflects the ability of firms to use the external labor market to replace regular employees and/or to use temporary employees on fixed-term and part-time contracts, often through temporary employment agencies" (Kato & Zhou, 2018).

- Literature gap:
  - previous studies on this topic have mostly concentrated on European cases. Only Kato & Zhou (2018) have recently conducted the study on Japan's startup companies
  - Kato & Zhou (2018) innovation proxy is a dummy variable (yes/no), mine is the number of applications and citations

Distribution of patent applications across industries in Japan



Methodology

(Sub-) Industries analyzed:

1) Electricity and Communications → “Semiconductors”

2) Necessities → “Games”

Sources:

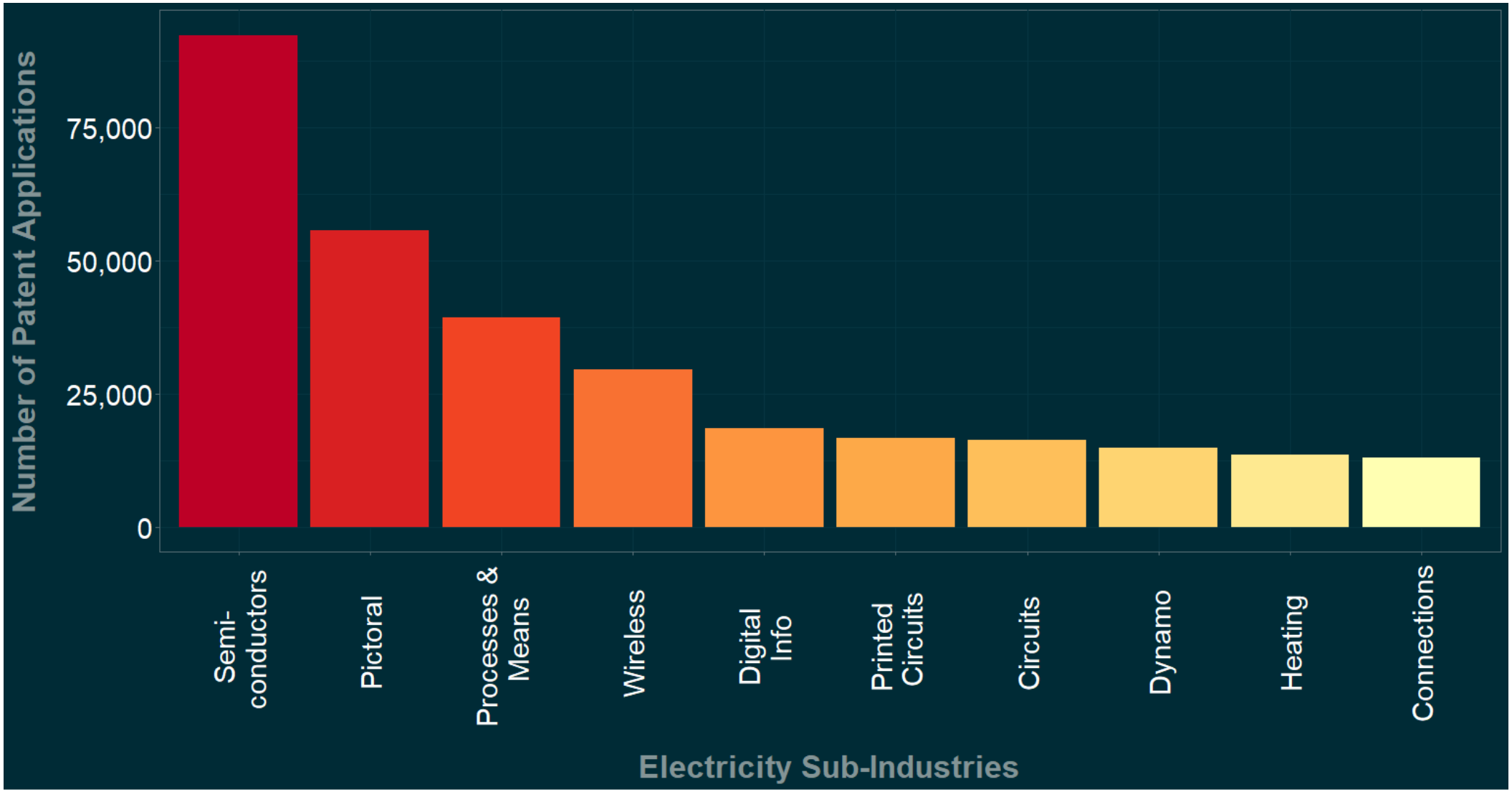
- The Institute of Intellectual Property Patent Database (IIP-DB): patent application data. Companies having > 5 applications (Lechevalier et al., 2010)

- Nikkei NEEDS Financial Database: corporate data

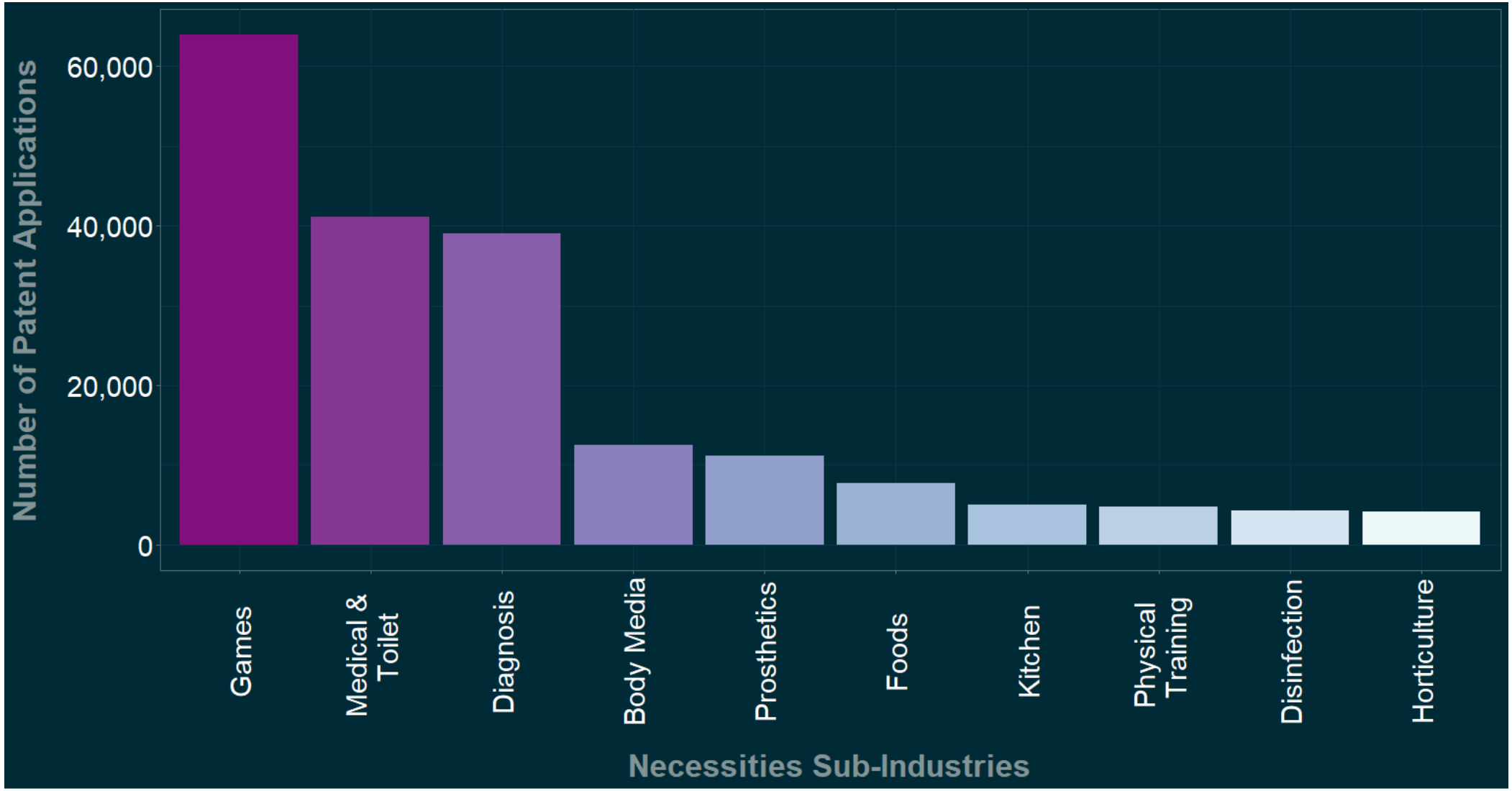
Innovation proxy (dependent variable):

- Patent applications: “represent the development of new and technically feasible devices” (Kato & Zhou, 2018) – **quantity aspect**
  + patent citations – **quality aspect** (Acharya, Baghai et al., 2010)

“Electricity” subindustries with most patents



“Necessities” subindustries with most patents



Companies with highest numbers of patent applications

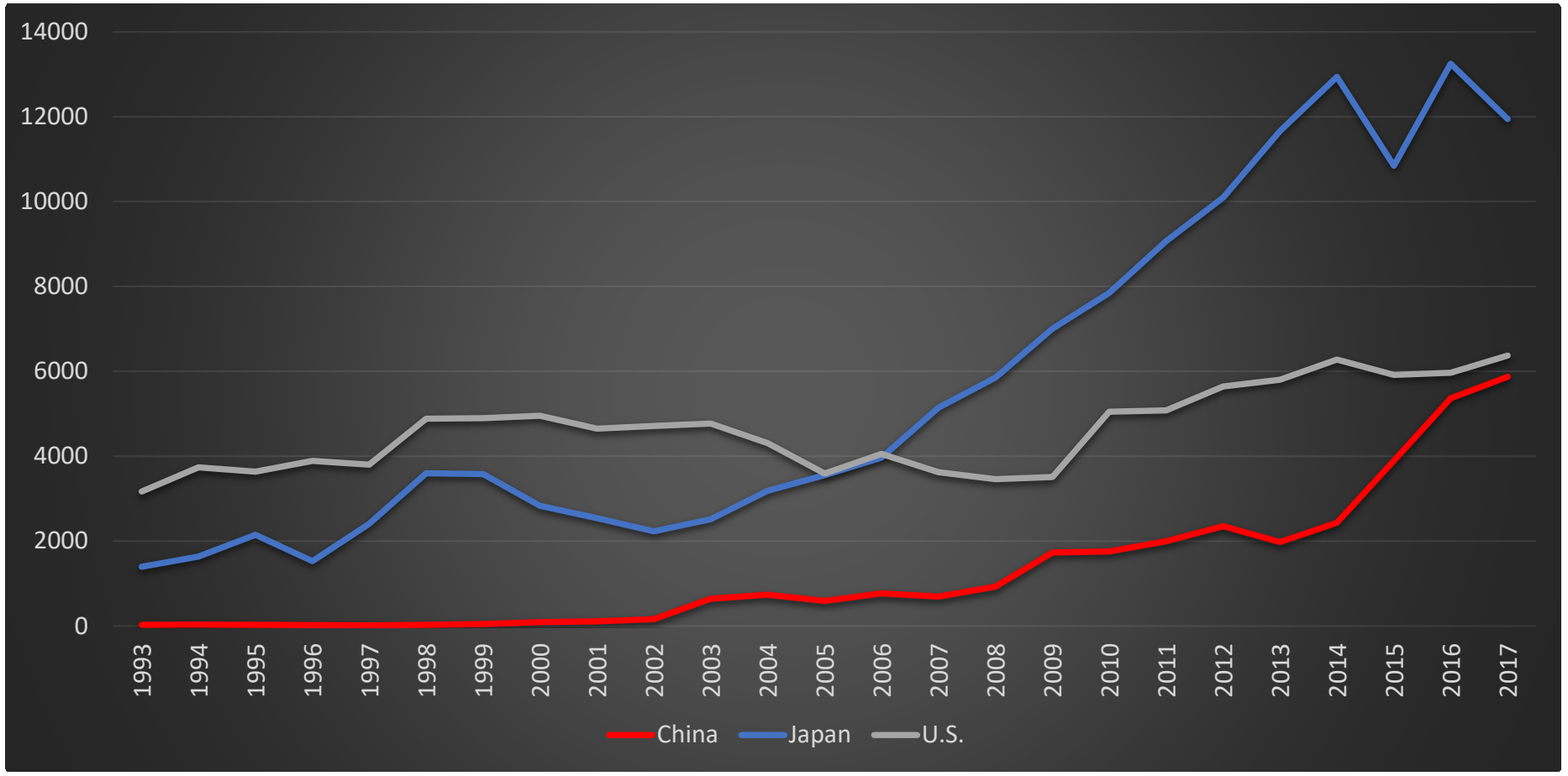
Electricity & Communications

- Panasonic: 15009
- Toshiba: 14028
- Mitsubishi Electric: 13219
- Canon: 13165
- Toyota Motor: 10150
- Sharp: 8874
- Fujitsu: 8075
- Sony: 7530

Necessities

- Sankyo: 9168
- Sega Sammy Holdings: 3896
- Universal Entertainment: 2886
- Heiwa: 2434
- Terumo: 2272
- Fujishoji: 2253
- Iseki: 1859
- Unicharm: 1441

Number of Patent Grants in Games & Furniture Industry



Possible conceptualization

- "Visible" vs "invisible" innovations (Kusunoki, 2006)
- Visible – overcoming commoditization along established lines. Value results from function
- Invisible:

  – "Rather than boosting existing dimensions, it paints an entirely new picture of how, why, and to whom a new product or service should appeal" (ibid). Value ~ function is unclear

  – "Once a company succeeds in establishing a new product concept, it is often able to produce powerful loyalty and brand effects that trump dimensional superiority" (ibid).

  – Importance of product-customer interaction

- Japan is relatively **weak** in knowledge-based industries: **games** as an exception (Aoyama & Izushi, 2003)
- Japan's **dual labor market** → possibility of transition from non-regular to regular employment is only 1.7 to 10.3 percent. **Gaming industry** as an exception (Casper & Storz, 2016)

“Semiconductors” Sub-Industry – Descriptive

Variable	N	Missings (%)	SD	SE	Median	Trimmed Mean	Range	Skewness
Patents + Citations	1176	14.29	386.49	11.27	58.5	102.86	3927 (0-3927)	4.72
Age	1360	0.87	29.95	0.81	75	76.91	164 (1-165)	-0.14
Regulars	1353	1.38	70619.07	1919.88	18740	28056.7	384322 (264-384586)	2.56
Nonregulars	481	64.94	0.07	0	0.14	0.14	0.49 (0.01-0.49)	1.21
R&D Intensity	1354	1.31	0.05	0	0.04	0.04	0.46 (0-0.46)	3.53
Internationalization	1321	3.72	0.29	0.01	0.55	0.56	3.28 (0.04-3.32)	4.07
Total Assets	1359	0.95	4875077	132242.7	675301	1035005	50297864 (10385-50308249)	5.3
Process Innovation	1258	8.31	13.64	0.38	1.68	1.92	423.6 (0.02-423.62)	24.02
Labor Intensity	851	37.97	0.09	0	0.08	0.09	0.77 (0-0.77)	1.97
Employment Growth	1255	8.53	0.14	0	0.02	0.02	4.51 (-0.35-4.17)	19.63

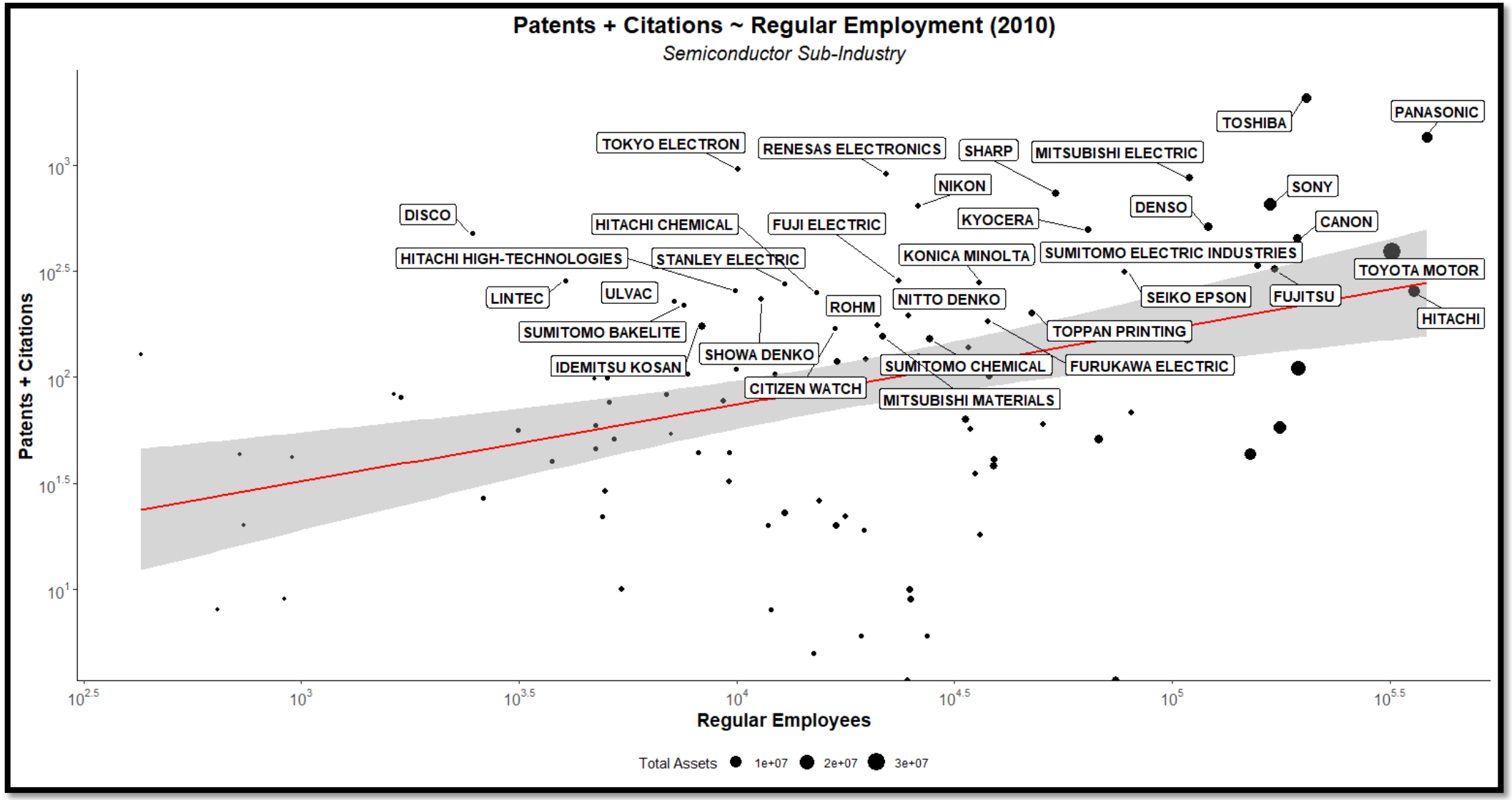
“Games” Sub-Industry – Descriptive

Variable	N	Missings (%)	SD	SE	Median	Trimmed Mean	Range	Skewness
Patents + Citations	1044	14.29	130.25	4.03	1	6.61	1315 (0-1315)	5.6
Age	1196	1.81	34.67	1	63	60.65	142 (1-143)	0.19
Regulars	1176	3.45	74940.55	2185.31	6670.5	22759.56	384583 (3-384586)	2.47
Nonregulars	511	58.05	0.13	0.01	0.16	0.18	0.58 (0-0.59)	1.27
R&D Intensity	1088	10.67	0.05	0	0.04	0.04	0.39 (0-0.39)	3.07
Internationalization	843	30.79	0.22	0.01	0.48	0.48	0.9 (0-0.9)	-0.05
Total Assets	1178	3.28	5148945	150018.8	296640.5	886483.6	50308212 (37-50308249)	5.08
Process Innovation	1092	10.34	14.71	0.45	1.74	2.09	423.59 (0.03-423.62)	21.98
Labor Intensity	641	47.37	0.16	0.01	0.09	0.1	2.08 (0-2.09)	5.95
Employment Growth	1089	10.59	0.35	0.01	0.02	0.03	7.51 (-0.84-6.67)	11.86

“Semiconductors” Sub-Industry – Correlations

	Patents + Citations	Age	Regulars	Nonregulars	R&D Intensity	Internationalization	Total Assets	Process Innovation	Labor Intensity	Employment Growth
Patents + Citations		0.02	**0.372*** **	-0.017	0.181***	-0.007	0.157***	0.002	-0.015	0.025
Age			0.135***	0.063	-0.223***	-0.223***	0.007	0.043	-0.133***	-0.042
Regulars				0.025	0.080**	0.009	**0.767*** **	0.232***	-0.215***	-0.014
Nonregulars					-0.191***	-0.111*	0.120**	0.003	0.185**	0.087
R&D Intensity						0.347***	-0.028	-0.024	0.038	-0.003
Internationalization							0.072**	0.028	0.090**	0.014
Total Assets								0.311***	-0.222***	-0.022
Process Innovation									-0.207***	-0.021
Labor Intensity										-0.023
Employment Growth										

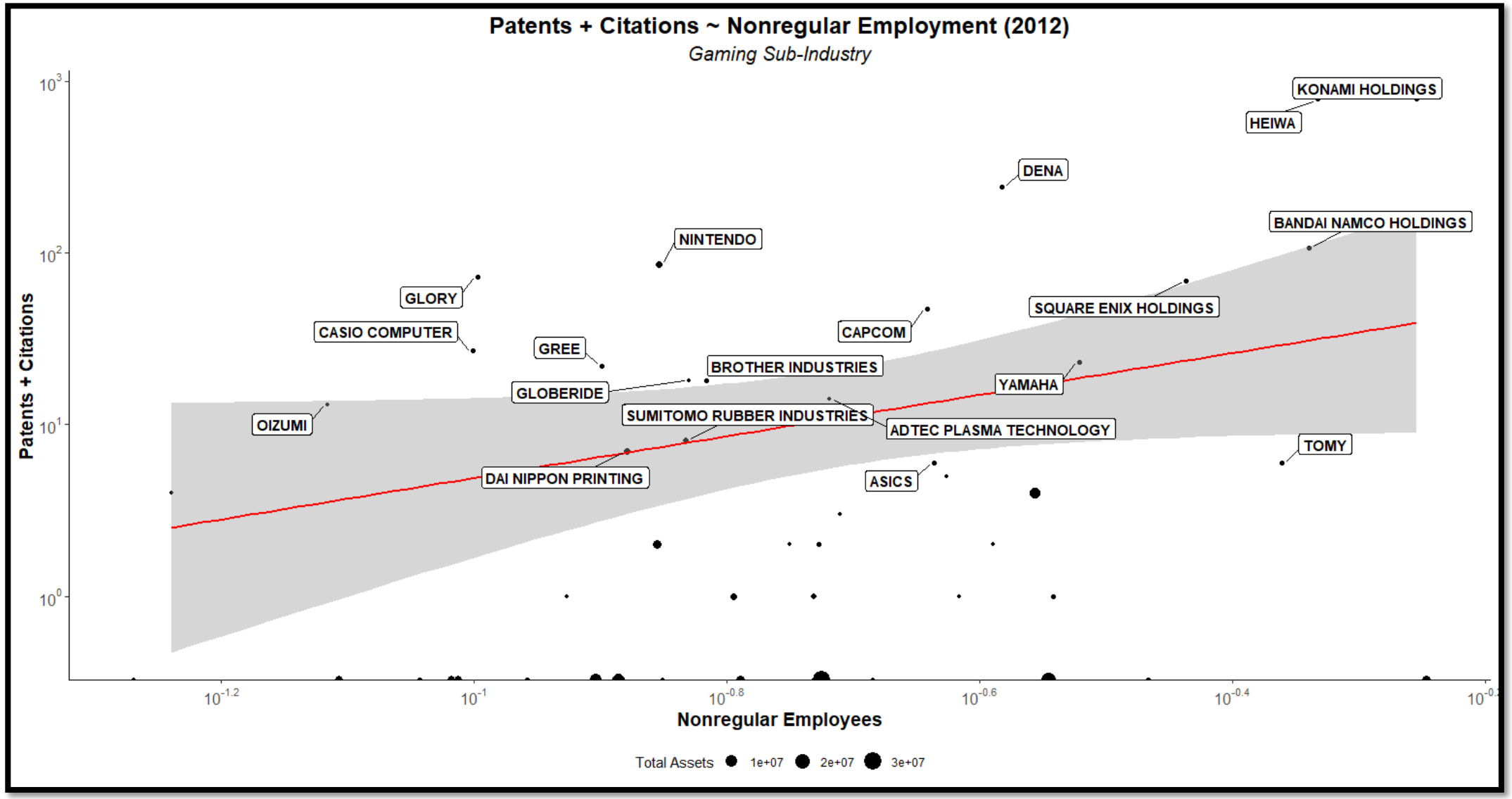
Patents ↔ Regular Employment ("Semiconductors")



“Games” Sub-Industry – Correlations

	Patents + Citations	Age	Regulars	Nonregulars	R&D Intensity	Internationalization	Total Assets	Process Innovation	Labor Intensity	Employment Growth
Patents + Citations		-0.068*	**-0.128*** **	**0.452*** **	0.225***	-0.108**	-0.092**	0.012	-0.140***	0.048
Age			0.259***	-0.225***	-0.127***	0.186***	0.086**	0.064*	-0.257***	-0.174***
Regulars				-0.078	0.006	0.296***	**0.775*** **	0.218***	-0.162***	-0.083**
Nonregulars					-0.017	-0.176**	0.028	-0.023	-0.225**	-0.032
R&D Intensity						0.065	-0.041	-0.005	-0.091*	-0.035
Internationalization							0.292***	0.165***	-0.143**	-0.133***
Total Assets								0.307***	-0.155***	-0.052
Process Innovation									-0.170***	-0.028
Labor Intensity										0.217***
Employment Growth										

Patents ↔ Non-Regular Employment ("Games")



Variables Selection → Operationalization

- Process innovation: Investment / Capital Stock (Brouwer & Kleinknecht, 1997; Sterlacchini, 1998; Fukao, Ikeuchi et al., 2017)
- Internationalization: Exports / Sales
- R&D Intensity: R&D / Sales
- Labor Intensity: Labor Costs / Fixed Assets

Regression results ("Semiconductors")
Dependent variable: Patents + Citations

Independent Variables	Fixed Effects – Time	Random Effects	Fixed Effects – Time (2)	Random Effects (2)
Regular Employees	**0.002*****	0.001*	**0.0004*****	**0.001*****
Non-Regular Employees			**114.734****	8.669
R&D Intensity	**810.913*****	288.18	**614.197*****	**777.505*****
Internationalization	22.052	-198.865***	**-41.451*****	**-56.614*****
Total Assets	**34.546*****	66.454***	7.132	-0.485
Process Innovation	**-11.794*****	-6.627**	**-1.252****	**-3.702*****
Age	-18.681	**-122.066*****	**-21.797*****	**-38.396****
Constant	========== ==========	-123.75	========== ==========	203.775*
Observations	1,005 (97 companies; 2005 – 2018)	1,005 (97 companies; 2005 – 2018)	299 (55 companies; 2010 – 2018)	299 (55 companies; 2010 – 2018)
Adjusted R^2	**0.242**	**0.042**	**0.207**	**0.159**
Note:	***p<0.1; **p<0.05; ***p<0.01**			

Regression results ("Games")
Dependent variable: Patents + Citations

Independent Variables	Fixed Effects – Time	Random Effects	Fixed Effects – Time (2)
Regular Employees	-0.0001	-0.0001	**-0.0003*** **
Non-Regular Employees	**310.648*** **	198.375***	
R&D Intensity	**225.587*** **	39.554	802.370***
Total Assets	0.445	2.295	3.382
Process Innovation	0.19	-0.41	**1.370** **
Age	0.138	-0.107	-0.072
Employment Growth	==========	==========	23.078
Constant	==========	-32.131	==========
Observations	280 (53 companies; 2010 – 2018)	280 (53 companies; 2010 – 2018)	745 (81 companies; 2010 – 2018)
Adjusted R^2	**0.245**	**0.043**	**0.084**
Note: *p<0.1; **p<0.05; ***p<0.01			

Tentative conclusions

Semiconductors

- Crucial role of **R&D** for innovation, which is linked to **Product Innovation** (Fukao et al., 2017) (→)
- Negative role of **Process Innovation** (→)
- (→) **Regulars** (and, possibly, **Non-Regulars**) play an important role (Vivarelli, 2015) (←)----------
- (←) Positive impact of both **innovation output (Patents)** and of **innovation input** (**R&D**) on employment
- Positive role of size (**Total Assets)**
- **Larger** and **younger** companies are more innovative

Games

- Important role of **R&D** for innovation (Aoyama & Izushi, 2003)
- Crucial role of numerical labor flexibility, measured as **Non-Regulars' proportion**
- Investment in fixed assets (→ **Process Innovation**) – important for services (Brouwer & Kleinknecht, 1997) (→)
- (→) **Adjustment of regulars** (Vivarelli et al., 1996) (←)----------
- (←) Negative impact of **innovation output (Patents); ** positive impact of **innovation input** (**R&D**) on employment *(separate)* (Vivarelli et al., 1996)

Additional Findings

- **Older** manufacturing firms struggle to innovate (Anderson & Eshima, 2013)
- **Younger** manufacturing firms employing **non-regulars** innovate more
- **Internationalization** is associated with less innovation for manufacturing companies employing **non-regulars**

THANK YOU FOR YOUR ATTENTION