

# The Consequences of Radical Patent Regime Change – A Natural Experiment

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IP Day – Boston University School of Law

July 2018



**Battle of Königgrätz**  
(Painting of Emil Hünten, about 1885)

# Summary

- ▶ Link between patent law, granting of patents, and innovation.
- ▶ New data on patents granted in German states before 1877.
- ▶ Natural experiment: Prussian annexations after the war of 1866.
  - ▶ Different patent systems before 1866.
  - ▶ Adoption of the Prussian patent law in annexed territories.
  - ▶ Advantage: timing and geography of patent law change is exogenous.
- ▶ Negative effect of patent law change on patents per capita.
- ▶ Positive effect on product innovation (proxy: world fair exhibits).

# Motivation

- ▶ Effect of (patented) innovations on growth.
  - ▶ United States: Akcigit et al. (2017).
  - ▶ Prussia: Cinnirella/Streb (JEconGrowth, 2017).
  - ▶ Imperial Germany: Donges/Meier/Silva (2017).
- ▶ Role of the patent law for the creation of innovation.
  - ▶ e.g. Mokyr (AER, 2009), Moser (AER, 2005).
- ▶ Debate to what extent patents reflect innovation.
  - ▶ e.g. Griliches (JEL, 1990), Moser (JLE, 2012; JEH, 2011).
- ▶ Part of a larger project on patents and innovation in the German states between 1843 and 1877 (founded by the DFG).

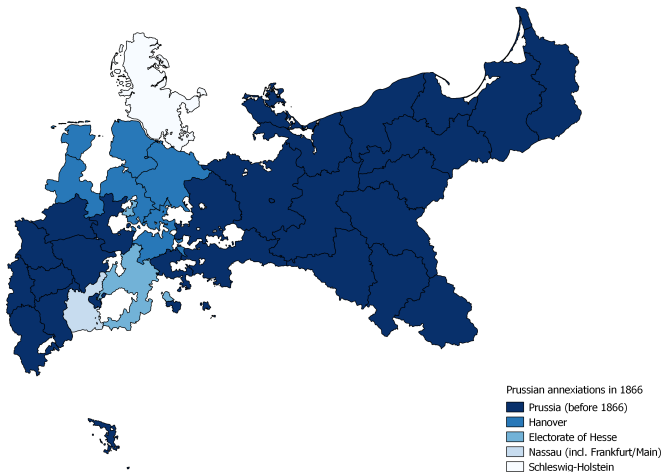
# Two Patent Law Harmonizations

- ▶ Significant differences in patent laws before 1877.
- ▶ Exogenous shocks that caused patent law harmonizations.
- ▶ **First harmonization: forced adoption of the Prussian patent law in states that were annexed in 1866.**
- ▶ Second ('semi-exogenous') harmonization: creation of the German patent law in 1877 as a result of the German unification.

# The Austro-Prussian War of 1866

- ▶ Political rivalry between Austria-Hungary and Prussia.
- ▶ Prussia and Austria-Hungary joined forces in the Second Schleswig war of 1864, which resulted in the annexation of Schleswig-Holstein.
- ▶ Disputes about Schleswig-Holstein caused a flare-up if the Austro-Prussian conflict and created a casus belli.
- ▶ War between Prussia and Austria-Hungary in June/July 1866.
- ▶ Small northern German states supported Prussia.
- ▶ Hanover, Saxony, and southern states supported Austria-Hungary.
- ▶ Prussian victory in July 1866 (after the battle of Königsgrätz).

# Prussian Annexations after the Austro-Prussian War



# Natural Experiment: Austro-Prussian War

- ▶ Annexations driven by strategic considerations.
- ▶ In the long-run, the war had no negative effect on the German economies (economic boom after 1866).
- ▶ Hardly any suppression of economic activity in annexed states.
- ▶ Institutional differences remain after 1866 (no introduction of the General State Laws for the Prussian States (*Allgemeines Landrecht*) in annexed territories.
- ▶ Immediate adoption of the Prussian patent system.
- ▶ Immediate dissolution of former patent authorities.



# The Prussian Patent System

- ▶ Patent system based on the *Publikandum* of 1815.
- ▶ Influenced by the free trade movement.
- ▶ No regional differences within Prussia (in contrast to civil law).
- ▶ Thorough technical examination with high rejection rates.
- ▶ Only novel inventions were patented.
- ▶ Strict definition of novelty.
- ▶ Possible patent term between 6 months and 15 years.
- ▶ In practice: patent term of 5 (1850s and 1860s) and 3 years (1870s).
- ▶ Very low patent costs (less than 2.0 Thaler).

# Former Patent Systems in Annexed Territories

- ▶ Annexed territories with patent laws: Kingdom of Hanover, Electorate of Hesse, Duchy of Nassau, Free City of Frankfurt.
- ▶ Technical examination in all territories but less restrictive than in Prussia (thus, lower rejection rates).
- ▶ Wider definition of novelty as in Prussia.
- ▶ Similar patent terms as in Prussia.
- ▶ Much, higher patent costs (Hanover: 6-31 Thaler, Hesse: 10-200 Thaler, Nassau: 25-34 Thaler, Frankfurt: 8,5 Thaler).
- ▶ Patents less valuable because of smaller market sizes.

# What Would We Expect after Annexation?

- ▶ Inventors should have larger incentives to file a patent in Prussia after 1866 since the market size increased (and thus the expected economic value of a patent), while patent costs decreased.
- ▶ On the other hand, since the Prussian patent office was more restrictive, we would expect a drop in the number of patents granted to domestic inventors from these new provinces.

# Patent Data

- ▶ Patent data for the period 1845-77.
- ▶ Based on (hand-written) patent lists that were mutually exchanged among the patent authorities of the Zollverein states.
- ▶ Information reported on the patent lists:
  - ▶ Date when the patent was granted and patent length.
  - ▶ Name, place of residence, and occupation of the patentee.
  - ▶ Short description of the patent.

Nr.	Erfinder	Datum	Patent	Gegenstand
des Patentes				
1.	Michaelis, David geb. 1784 in Wetzlar	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
2.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
3.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
4.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
5.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
6.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
7.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
8.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
9.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
10.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
11.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
12.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
13.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
14.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
15.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
16.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
17.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
18.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
19.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft
20.	Heinrich v. Heide in Berlin	1784	1784	Erfindung eines neuen Schloß- mechanismus, bei dem die auf den Schlüssel wirkende Kraft

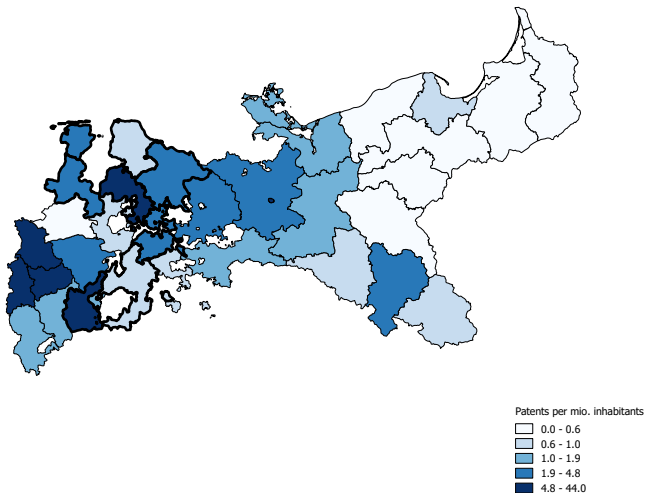
# Panel Data Set Construction

- ▶ Focus on **domestic** patents (= patents filed by domestic inventors).
- ▶ Yearly data for the period 1846-77.
  - ▶ 1846-65: Prussian lists for old Prussian provinces and lists from Hanover, Hesse, Nassau, and Frankfurt am Main.
  - ▶ 1867-77: Prussian lists for all territories.
  - ▶ 1866 excluded in the following.
- ▶ District-level data (Regierungsbezirke).
- ▶ Example (for the case of Hanover): for the period before 1866, we aggregate all patents granted by the Hanoverian administration to individuals or firms from Hanover; for the period after 1866, we aggregate all patents granted by the Prussian administration to individuals or firms located in districts that belonged to Hanover.

# Summary Statistics – Domestic Patents

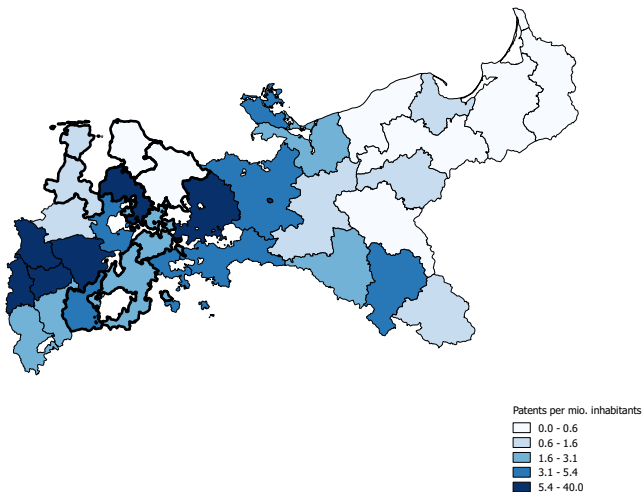
<b>Panel A: Patents per Million Inhabitants</b>						
	1846-65			1867-77		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Prussia (old provinces)	3.55	8.68	520	4.2	10.1	286
Hanover	4.8	7.57	120	2.05	3.89	66
Electorate of Hesse	0.94	1.45	20	2.06	3.47	11
Nassau (incl. Frankfurt/M)	5.85	3.03	20	5.19	4.26	11
<b>Panel B: Number of Patents</b>						
	1846-65			1867-77		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Prussia (old provinces)	2.17	4.41	520	3.74	10.47	286
Hanover	1.47	2.55	120	0.71	1.54	66
Electorate of Hesse	0.7	1.08	20	1.64	2.77	11
Nassau (incl. Frankfurt/M)	3.15	1.6	20	3.45	2.94	11

# Mean Number of Patents per Mio. Inhabitants, 1846-65





# Mean Number of Patents per Mio. Inhabitants, 1867-77



# Effect of Patent Law Change on Patents per Capita

	(1)	(2)
	FE	FE
	PPC	PPC
Prussian Patent Law	-2.45** (0.89)	-4.03** (1.59)
Zollverein		5.12*** (1.15)
Pop. Density		-0.63*** (0.05)
Coal Production		0.03 (0.12)
N	1,088	1,088
R <sup>2</sup>	0.17	0.19
Constant	Yes	Yes
District FE	Yes	Yes
Year FE	Yes	Yes
Cluster	Province	Province

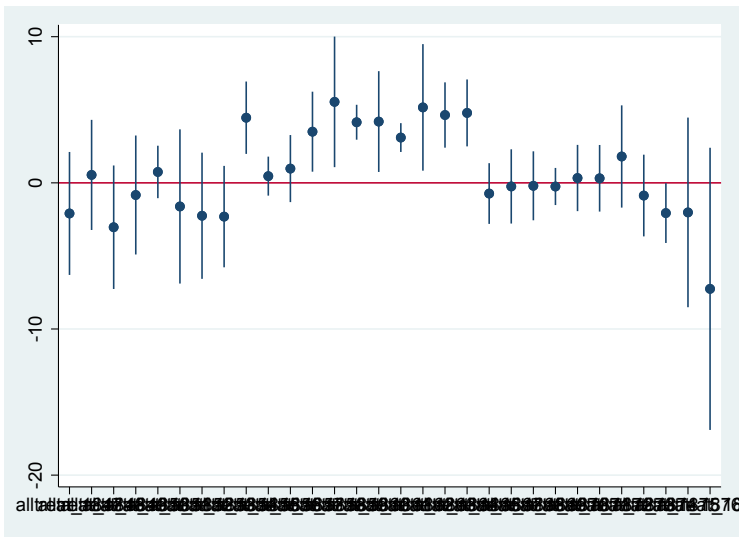
# Is this Effect Driven by Patent Law Change?

- ▶ Test whether the timing coincided with the patent-law change:

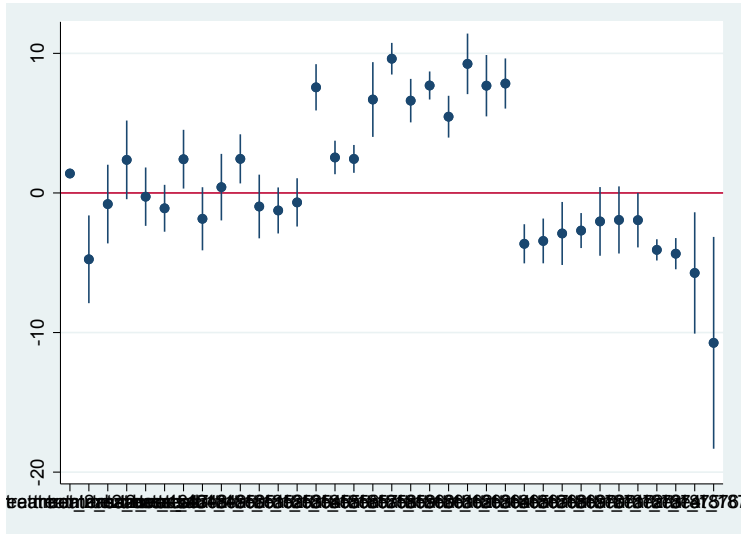
$$PPC_{it} = C + \sum_{t=1847}^{1865} \beta_t * Annexed Territory_i * T_t + \sum_{t=1867}^{1877} \beta_t * Annexed Territory_i * T_t + D_i + T_t + \epsilon_{it}$$

- ▶ Test for (a) the total sample (b) sample excluding Hesse-Nassau.

# Effect of Patent-Law Change – Total Sample



# Effect of Patent-Law Change – Ex. Hesse-Nassau



# Alternative Explanations

- ▶ Migration? – Patent lists provide no evidence that there was significant migration from annexed territories to Old-Prussia.
- ▶ Discrimination? – There is no evidence in the literature and from archival sources that the Prussian patent office discriminated against inventors from annexed territories after 1866.
- ▶ Economic Decline? – We find no evidence for a general economic downturn in annexed territories. The results are robust if steel and coal production per capita are included as controls.
- ▶ Additional robustness check: We test whether there was an effect on patents filed in third countries (Baden, Bavaria), where there was no patent law change. However, we find no significant change after 1866

## Effect on Innovation – 3 Possible Outcomes

- ▶ No effect of patent law change on innovation.
- ▶ **Positive** effect of patent law change on innovation, since the Prussian system was more restrictive and therefore allowed for a better diffusion of technology compared to countries that granted more patents.
- ▶ **Negative** effect of patent law change on innovation, since patents were necessary to found and finance enterprises (implicit or explicit collateral, licensing, trade in patents etc). The difficulties to get a patent in Prussia affected the firms (and individuals) ability to finance investment (and subsequent innovations) negatively.

# Data on World Fair exhibits

## [GERMANY]—HANOVER.

257

S.W. Transept and S.W. Transept Gallery.

### CLASS 30.

328 BÖHLER, F.—Household furniture of hart's horn, objects of ivory.

329 JACQUET, H. SON.—Fancy furniture of carved wood.

### CLASS 31.

330 LAUSBERG, C.—Metal caps for corks.

### CLASS 33.

331 GOLDSCHMIDT, M. SON.—Jewellery.

332 FRIEDMAN, J.—Gold and silver-smith's ware.

## HANOVER.

### CLASS 1.

341 GEORGE MARIA SMELTING WORKS, near Osnabrück.—Iron ores and pig-iron.

342 EGESTORFF, G. Linden, near Hanover.—Salt.

343 IN DER STROTH, H. Bentheim.—Jet coal.

344 MUNICIPALITY, Osnabrück.—Coal (Anthracite) from the Piesberg.

345 MOSQUA, Hildesheim.—Mill stones.

360 GUMMI-KAMM-Co. Harburg.—Combs of vulcanized caoutchouc.

361 HENNECKE, JAC. Goslar.—Oil and oil-cakes.

362 HURTZIG, BRÖS. Linden, near Hanover.—Manufactures of bleached and hardened caoutchouc.

363 TIEDGE, C. Hanover.—Pitch for chasing.

364 WILHARM & MÜLLER, Melle.—Machine-made corks.

### CLASS 7.

365 KNÖVENAGEL, A. Linden, near Hanover.—Wood-sawing machine.

366 VOIGTLÄNDER, F. Schladen.—Tobacco spinning machine.

### CLASS 8.

367 EGESTORFF, G. Linden, near Hanover.—Loc. mobil steam-engine, iron casts.

### CLASS 10.

368 EGESTORFF, A. Linden, near Hanover.—Asphalt.

369 HENNING, D. H. Limmer, near Hanover.—Asphalt and mineral tar.

370 HEYN, C. F. Lüneburg.—Statue of cement. Blocks united by cement.

371 MOSQUA, Hildesheim.—Cement.



# Data on World Fair Exhibits – 1862 and 1873

**Panel A: Exhibits per Million Inhabitants**

	1862			1873		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Prussia (old provinces)	3.81	9.86	468	6.67	13.78	468
Annexed territories	2.33	4.11	144	7.74	13.79	144

**Panel B: Number of Exhibits**

	1862			1873		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Prussia (old provinces)	2.56	6.80	468	5.60	12.68	468
Annexed territories	1.02	1.81	144	3.90	8.83	144

# Effect of Patent-Law Change on World Fair Exhibits

	(1)	(2)
	FE	FE
	EX	EX
Prussian Patent Law	2.41* (1.19)	2.72** (1.20)
Pop. Density		1.47*** (0.12)
Coal Production		0.03 (0.31)
N	1,292	1,292
R <sup>2</sup>	0.11	0.13
Constant	Yes	Yes
District FE	Yes	Yes
Year FE	Yes	Yes
Cluster	Province	Province

# Conclusion

- ▶ Link between patent law, granting of patents, and innovation.
- ▶ New data on patents granted in German states before 1877.
- ▶ Natural experiment: Prussian annexations after the war of 1866.
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