

The Reign of the Great Banks:

Financial Development and Firms' Real Economic Activity in Imperial Germany

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¹*Politecnico di Milano*

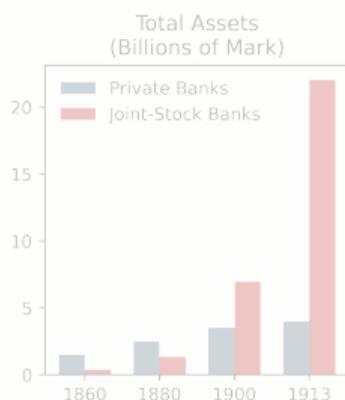
²*Uppsala University*

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Research Objective & Motivation

We study the real effects of financial development on firms' economic activity, exploring **the evolution of the banking landscape** in Imperial Germany, 1896-1914.

Imperial Germany (1871-1918) as a real world lab for financial development:

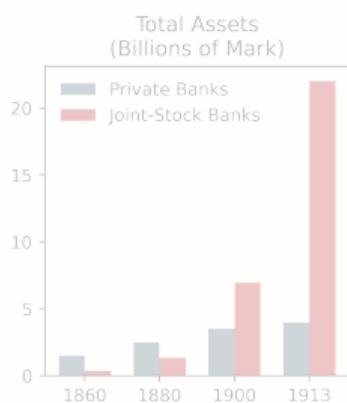


- Period of rapid industrialization & globalization.
- General incorporation legislation.
 - ⇒ Surge in demand for credit.
- Foundation of *Reichsbank* acting as “lender of last resort” (James, 1997).
- Emergence of large joint-stock credit banks.
 - ⇒ High credit volumes
 - ⇒ *Long-term* credit

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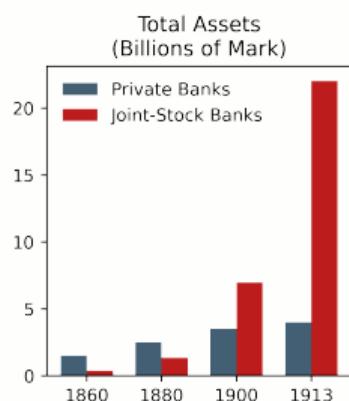


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Period 1896 - 1914: The Expansion of the *Great Banks*

The second half of the empire's life (1896-1918) is of particular interest:

- Established institutions; overall economic growth & moderate volatility.
- With the exception of the 1900-1902 crisis.
- This crisis triggered a transformation of the banking sector.

Before the crisis

- Eight *Great Banks* had emerged, providing a range of financial services.
- Strong within-country heterogeneity of financial development.

After the crisis

- Disproportional growth in importance of the *Great Banks* through...
 - ... geographic expansion.
 - ... increased control over the industry and the financial sector.
- → Reduction in financial development heterogeneity.



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Potential Economic Mechanisms

A priori, the effects of the banking sector's transformation on firm-level activities are not clear:

- (1) Financial development through the *Great Bank's* expansion might increase access to finance.
 - Proximity to banks facilitates financing and spurs firm performance.
(Tilly, 1967; Beck et al., 2019; Bellucci et al., 2019; Herpfer et al., 2023)
 - “Enabling vs. disciplining effect” of financing constraints on investment and firm output.
(Manso, 2011; Garicano & Steinwender, 2016; Cerqueiro et al., 2017)
- (2) The *Great Bank's* dominance spread business know-how but also concentrated power:
 - By enforcing their dominant position, banks may exert downward pressure on loan conditions, hampering firm performance. (Rice & Strahan, 2010; Cornaggia et al., 2015)
 - Strategic investors can significantly enhance business operations, e.g., by providing advice, monitoring, networking etc. (Hellmann & Puri, 2002; Davis et al., 2014; Bernstein et al., 2016)

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This Paper...

... examines the effects of financial development on real economic activities using a well-suited historical setting and unique data.

- Leverage novel data constructed using the latest AI technology developments:
- Firm information and financial data on the universe of German joint-stock companies
 - Hand-collect geolocations of (firms and) banks on the branch level, consistently over time.
 - Previously unexploited information on fiscal agencies (so-called “Zahlstellen”) providing a unique firm-bank link.
 - ⇒ Unique data on 7,646 firms and the eight *Great Banks* for the years 1896–1914.

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Preliminary Results

1. Descriptive findings:

- First firm-level statistics on majority of joint-stock companies in Imperial Germany, 1896–1914.
- First quantitative analysis of the banking sector's transformation following the 1900–1902 crisis.
 - Geographic *Great Bank* branch network.
 - Firm-bank network.
 - Peripheral states experience most pronounced changes.

2. Econometric analyses:

- Financial development of the banking sector increased firm debt financing.
- Firms that benefit from financial development exhibit significantly higher growth rates than the comparison group.

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Agenda

1. Data and Sample Construction
2. The Banking Sector's Transformation: Context and Descriptive Findings
3. Empirical Strategy and Preliminary Results
4. Summary, Outlook, and Conclusion

Empirical strategy



Variation over time

- We exploit changes in the firms' geographic proximity to the *Great Banks* over time (*EEA* scores)

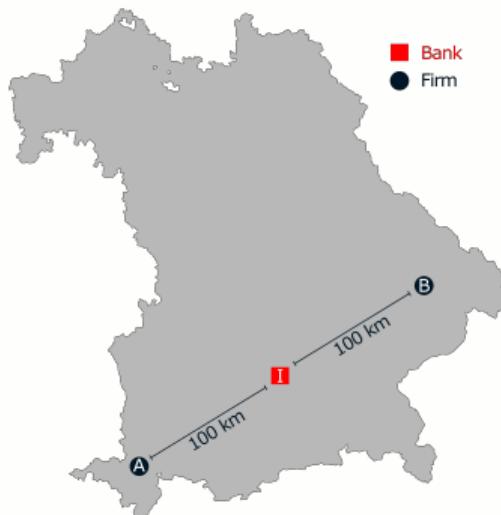
Endogeneity issues

- *Great Banks* do not randomly expand
 - Exclusion of direct firm-bank links
 - Exclusion of firms in the neighborhood of branches
 - Second source of variation

Cross-sectional variation

- We exploit industry dependence on external financing.

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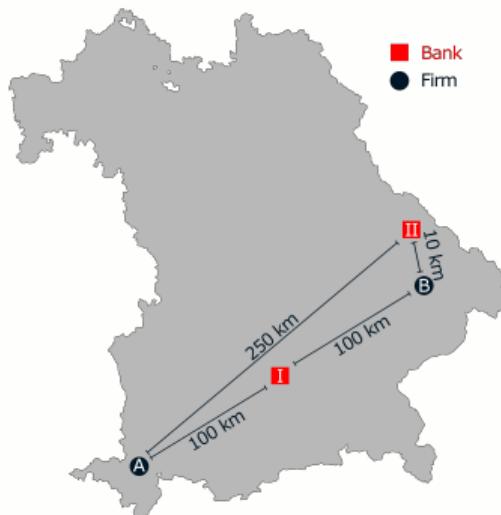
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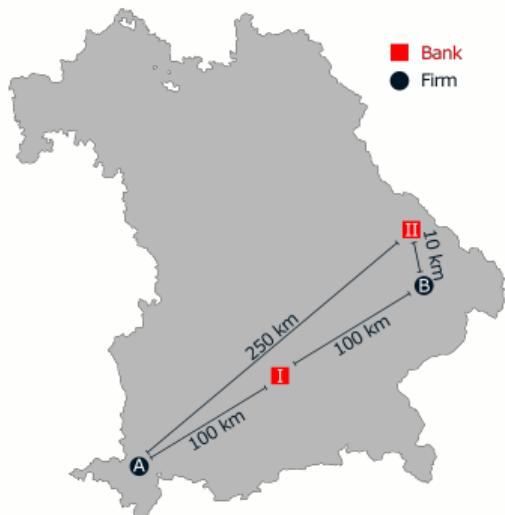
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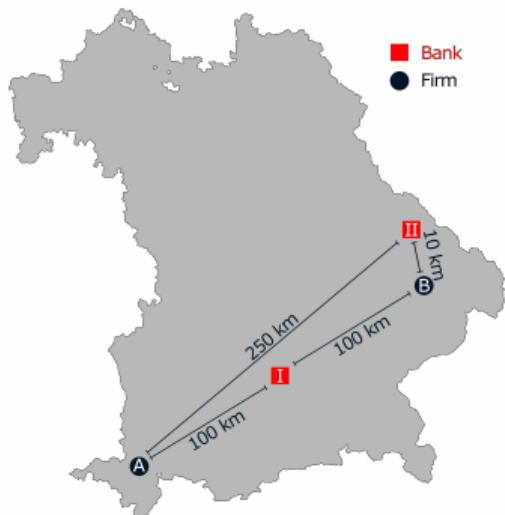
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Defining the Exposure Variable

- Banks at medium distance are just as important as banks in the neighborhood.
- Unlike in modern times, banks at large distances are unlikely relevant.

To incorporate these points, we compute an Exposure to Economic Activity (*EEA*) score:

$$EEA_{it} = \sum_{b \in B_t} \omega_b (1 + r)^{-\delta_{ib}}$$

Where:

- B_t is the set of all branches of *Great Bank* in year t .
- δ_{ib} is the distance (in km) between firm i and bank branch $b \in B$.
- The parameter $r \in (0, 1]$ captures the importance of distant branches for a firm's EEA score.
- The parameter ω_b captures how much bank b contributes to a firm's EEA score.

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EEA Score Intuition

Baseline Specification

- **Goal:** Estimate the causal effect of financial development on firms' real economic activity

$$Y_{it} = \beta_0 + \beta_1(EEA_{it} \times FinDep_i) + Z_{it} + \lambda_t + \varphi_i + \varepsilon_{it}$$

- We consider firms debt financing, growth, and profitability as dependent variables (Y_{it}).
- $EEA = 1$ if firm i 's EEA score is above the Q50 EEA score measured in 1901, and zero otherwise.
- $FinDep = 1$ if firm i operates in capital-intensive sectors (e.g., Mining, Chemicals, Transportation)
 - We control for firm and year fixed effects (λ_t and φ_i) and firm-level controls (Z_{it}).
 - Standard errors are clustered on the firm level; ε_{it} is the error term.

Importantly: direct firm-bank links are excluded, i.e., firms with a *Great Bank* as main lender and firms within 10km distance of a *Great Bank*. The sample is all post-crisis years, 1902–1914.

Financial Development and Debt Financing

Dep. Variable	Debt-to-Asset Ratio		
	(1)	(2)	(3)
$EEA \times FinDep$	0.040*** (0.012)	0.030*** (0.010)	0.021** (0.009)
EEA	-0.023*** (0.009)	-0.023*** (0.007)	-0.016** (0.007)
$FinDep$	-0.104*** (0.011)		
Minimum Dist. (km)	10	10	10
Year FE		✓	✓
Firm FE		✓	✓
Firm-Level Controls		✓	
Y	0.496	0.496	0.496
N	18837	18837	18837

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- Post-crisis shifts in regional exposure to *Great Banks* raise debt financing of *FinDep* firms.
- The treatment effect (0.021) is economically significant, suggesting a 4.3% debt-ratio increase.

Financial Development and Debt Financing

Dep. Variable	Debt-to-Asset Ratio						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$EEA \times FinDep$	0.040*** (0.012)	0.030*** (0.010)	0.021** (0.009)	0.022** (0.010)	0.021** (0.010)	0.022** (0.011)	0.034** (0.014)
EEA	-0.023*** (0.009)	-0.023*** (0.007)	-0.016** (0.007)	-0.019*** (0.007)	-0.018** (0.008)	-0.027*** (0.008)	-0.033*** (0.010)
$FinDep$	-0.104*** (0.011)						
Minimum Dist. (km)	10	10	10	20	30	40	50
Year FE		✓	✓	✓	✓	✓	✓
Firm FE		✓	✓	✓	✓	✓	✓
Firm-Level Controls		✓	✓	✓	✓	✓	✓
Y	0.496	0.496	0.496	0.495	0.495	0.494	0.492
N	18837	18837	18837	16444	14009	11846	9203

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- The treatment effect (0.021) is economically significant, suggesting a 4.3% debt-ratio increase.
- There are geographical spillovers of up to 50 km.
- However, the effect vanishes with increasing distance to closest *Great Bank*.

Financial Development and Debt Financing

Dep. Variable	Debt-to-Asset Ratio									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$EEA \times FinDep$	0.040*** (0.012)	0.030*** (0.010)	0.021** (0.009)	0.022** (0.010)	0.021** (0.010)	0.022** (0.011)	0.034** (0.014)	0.010 (0.020)	0.012 (0.042)	-0.022 (0.090)
EEA	-0.023*** (0.009)	-0.023*** (0.007)	-0.016** (0.007)	-0.019*** (0.007)	-0.018** (0.008)	-0.027*** (0.008)	-0.033*** (0.010)	-0.016 (0.015)	-0.014 (0.025)	-0.035 (0.038)
$FinDep$	-0.104*** (0.011)									
Minimum Dist. (km)	10	10	10	20	30	40	50	60	70	80
Year FE		✓	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE		✓	✓	✓	✓	✓	✓	✓	✓	✓
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Financial Development and Real Economic Activity

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	(1)	(2)	(3)	(4)	(5)
<i>EEA × FinDep</i>	0.021** (0.009)	0.078*** (0.025)	0.005 (0.011)	0.186** (0.087)	0.004 (0.003)
Minimum Dist. (km)	10	10	10	10	10
Year FE	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓
Firm-Level Controls	✓	✓	✓	✓	✓
Ȳ	0.496	14.244	0.473	12.201	0.028
N	18837	18837	18837	18837	18837

- Firms that raise debt financing after post-crisis shifts in regional exposure to *Great Banks* exhibit significant higher asset and revenue growth than control group firms.
- No such effects are discovered for profitability and fixed assets.

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Split Sample Regressions

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$EEA \times FinDep$	0.021** (0.009)	0.027** (0.012)	-0.007 (0.015)	0.186** (0.087)	0.373*** (0.133)	-0.094 (0.107)
Minimum Dist. (km)	10	10	10	10	10	10
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Firm-Level Controls	✓	✓	✓	✓	✓	✓
Ȳ	0.496	0.493	0.500	12.201	12.022	12.374
N	18837	9061	9545	18837	9061	9545

- Debt financing and revenues increase more strongly for firms exposed to relatively low degrees of ex-ante exposure to other joint-stock banks.
⇒ Supports “Access to Finance”-argument.
- No such difference can be found for total assets.

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Outlook

- Several small (but important) data issues will keep us occupied. Most importantly, we plan to add firm-level patent information.
- We plan to augment the current data by utilizing person-level information to further enhance firm-bank network construction.
- This allows us to also investigate a further dimension → *Great Banks* as strategic investors.

Thanks a lot for listening!

Appendix

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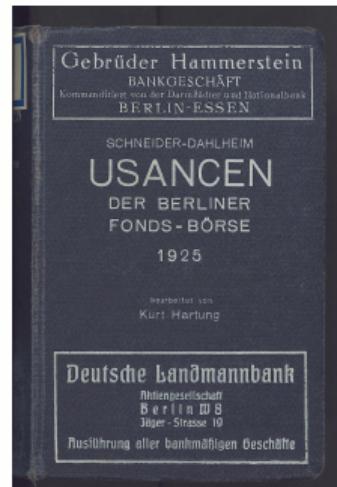
Data Sources

We extract information from different sources

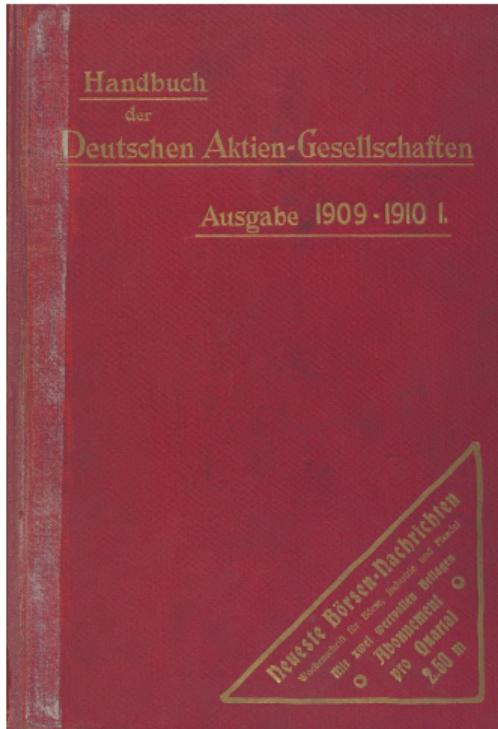
1. Handbuch der Deutschen Aktiengesellschaften (HdAG)
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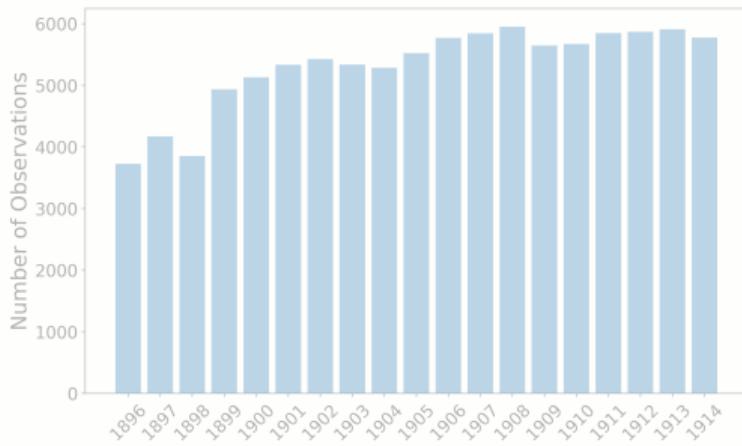
Jahrgang 1910 Band 11			
Kurszettel der Berliner Börsen-Zeitung Berlin, 26. Juli 1910			
<small>Kurszettel der Berliner Börsen-Zeitung Berl. Börsen-Nachrichten Wochenschrift für Börsen-Märkte und Handel mit 300 Zeichnungen 300 Karten 250 etc.</small>			
<small>Arbeitsblätter für die Betriebswirtschaft und Betriebslehre</small>			



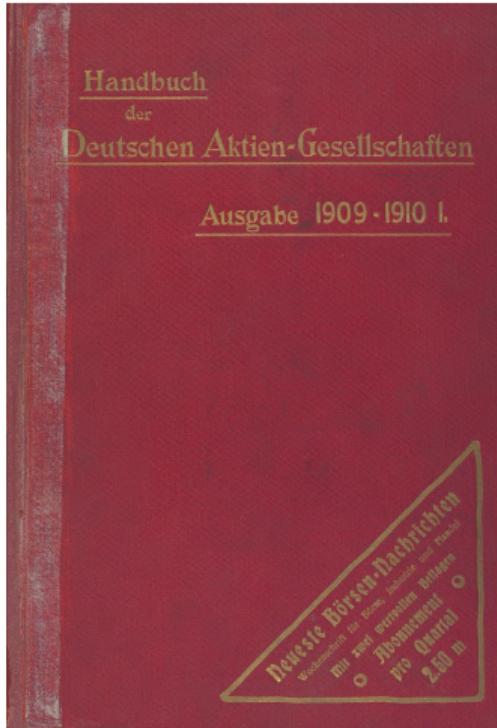
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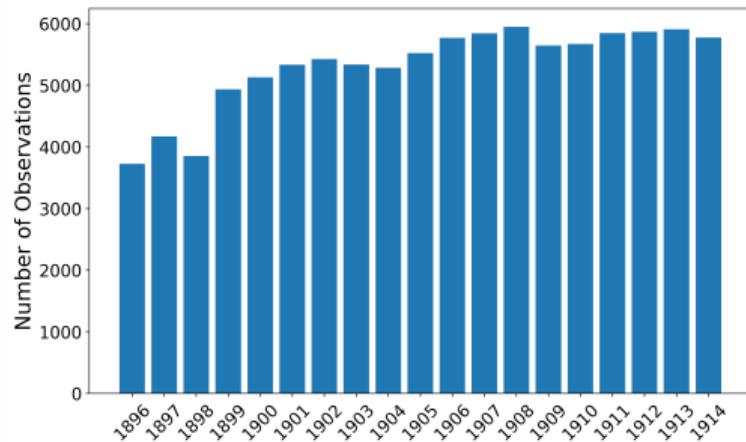
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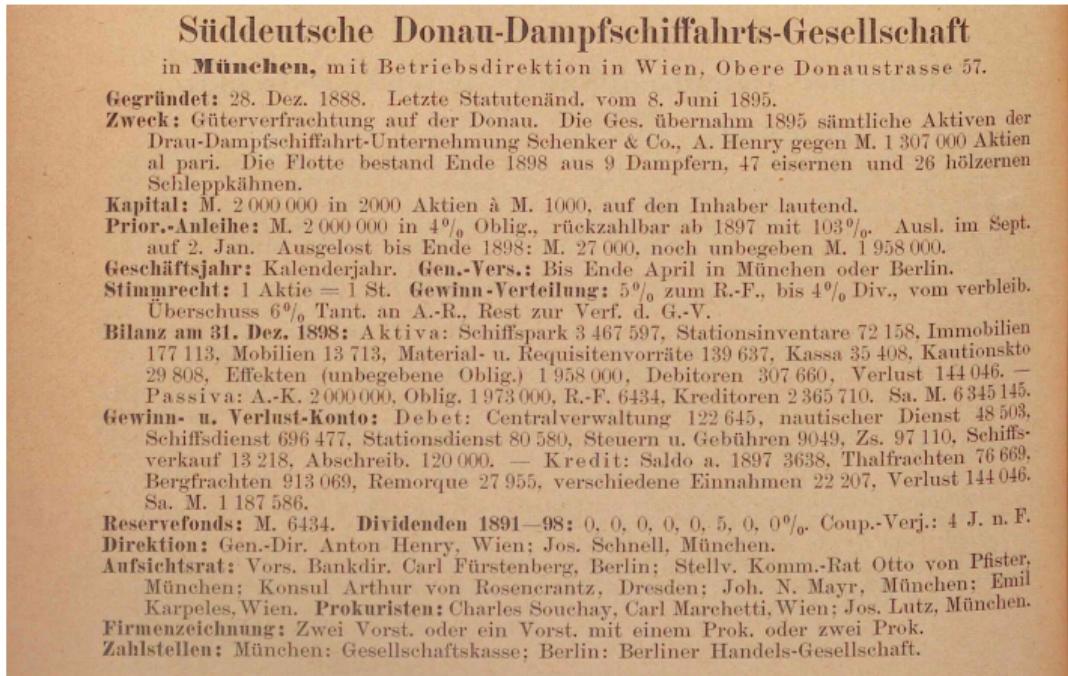
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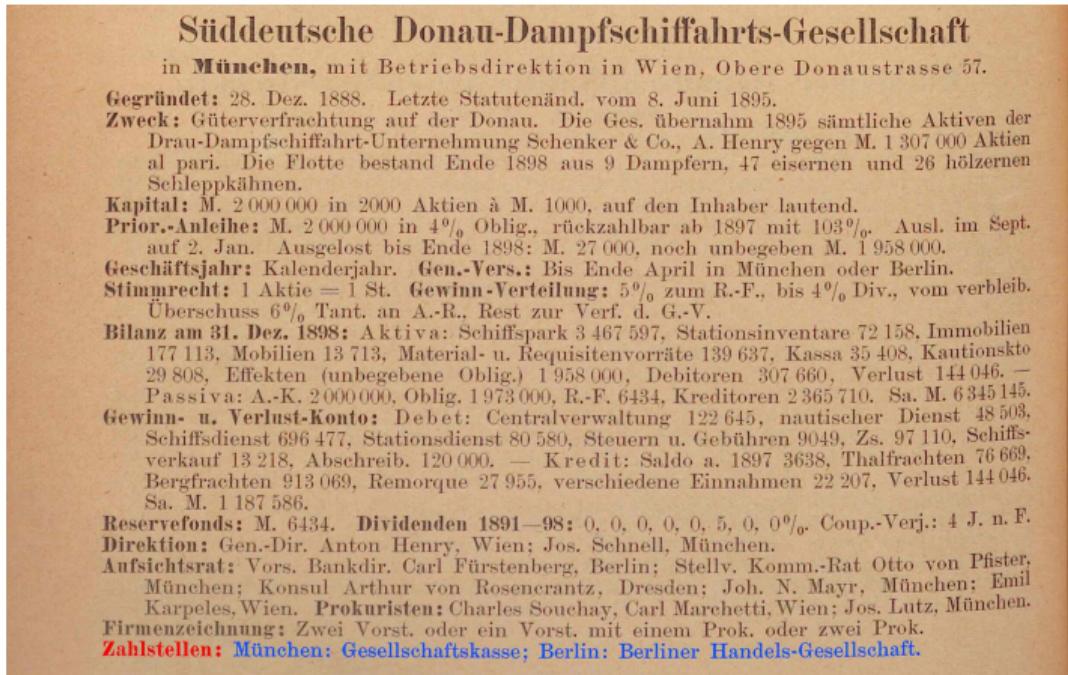
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Optical Character Recognition (OCR)

- Project partner UB Mannheim
- incl. scanning, pre-processing, line straightening
- Tesseract 5.x



Input & derived Layer

- OCR Output to PostgreSQL instance
- Line type classification
- Collapsing to firm-year level



Linking Layer

- Introduce panel ID to cross-sectional data
- NeerMatch (Machine Learning Similarity Encoding Matching)
- Firms & persons



Combination & export layer

- Parsing
- Harmonization



Tesseract

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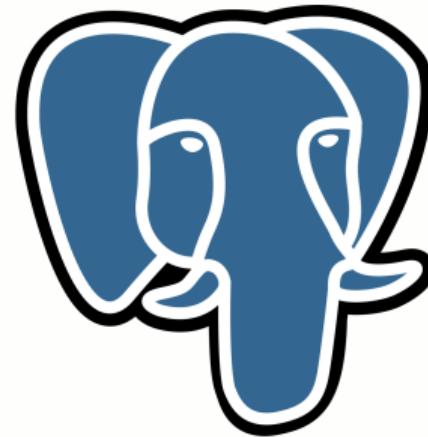
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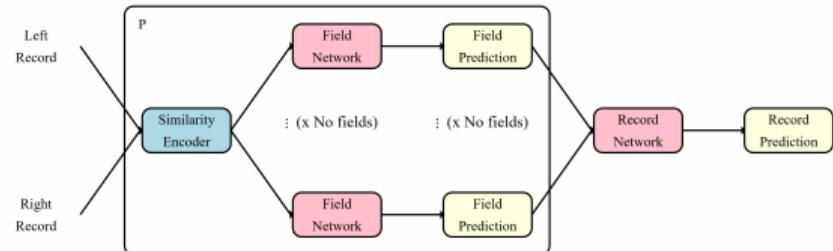
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Sample Generation and Description

- Following this procedure, we obtain 100,996 firm-year entries for 1896–1914.
 - We drop observations with missing assets and those with inconsistent balance sheet sums.
 - As a precautionary step, we exclude observations with likely OCR errors and singletons.
 - We manually checked location and industry information.
- Final data: 61,460 observations, 7,646 individual firms, 24 states, 49 industrial sectors.

Variable	Obs.	Mean	SD	Q25	Median	Q75
<i>TotalAssets</i> (in million M.)	61460	3.92	5.41	0.90	1.94	4.23
<i>AssetGrowth</i>	51904	0.04	0.10	-0.01	0.01	0.07
<i>PPE</i> (in million M.)	61460	1.26	1.57	0.23	0.68	1.58
<i>Tangibility</i>	61460	0.44	0.28	0.21	0.45	0.65
<i>DebtRatio</i>	61460	0.50	0.21	0.36	0.50	0.64
<i>CashRatio</i>	61460	0.04	0.07	0.00	0.01	0.05
<i>Depreciation</i> (in million M.)	61460	0.06	0.10	0	0.02	0.07
<i>Profitability</i> (RoA)	61460	0.03	0.05	0	0.02	0.05
<i>Age</i>	61460	17.36	13.13	7	14	26

State	Obs.	in Percent
<i>Preußen</i>	31274	50.89
<i>Sachsen</i>	6619	10.77
<i>Bayern</i>	5756	9.37
<i>Baden</i>	2619	4.26
<i>Elsaß-Lothringen</i>	1993	3.24
<i>Hamburg</i>	1952	3.18
<i>Württemberg</i>	1942	3.16
<i>Bremen</i>	1506	2.45
<i>Braunschweig</i>	1478	2.40
<i>Hessen</i>	1054	1.71

Quality Check: Estimating a Capital Structure Equation

Dep. Variable	Debt-to-Asset Ratio	
	(1)	(2)
log(Revenue)	0.021*** (0.001)	0.016*** (0.001)
Tangibility	0.014* (0.007)	0.022*** (0.007)
CashRatio	-0.067*** (0.018)	-0.089*** (0.017)
Profitability	-0.303*** (0.022)	-0.247*** (0.022)
Year FE		✓
Firm FE	✓	✓
R ² (adjusted)	0.706	0.720
N	60587	60587

- As a validation check, we estimate a common capital structure equation (Frank & Goyal, 2008):

$$\text{Debt} = f(\text{FirmSize}, \text{Collateral}, \text{Cash}, \text{Profitability})$$

- All coefficients show the expected sign, emphasizing the validity of the data.

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2. The Banking Sector's Transformation: Context and Descriptive Findings
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Institutional Context

Political, financial economic integration

- Foundation of the German Empire (1871)
- Unified Commercial (HGB) and Civil Code (BGB) (1900)
- Establishment of the *Reichsbank* (1876)
- Monetary union with introduction of the *Mark* (1871-1876)

Major pieces of legislation

- General incorporation & end of concession system (1870)
- 1884 Corporations Act: Strengthening Banks' Systemic Role
(Burhop et al., 2018)



Increased Demand for (long-term) financing

- Emergence of modern industrial enterprises (Fohlin, 2007)
- Rapid economic growth
- Globalization required large-scale, fixed investment

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Different Types of Banks

Private Bank

- Operating locally since the late 18th century.
- Predominantly invested in low-risk securities.
- Provision of short-term finance & investment banking services.

Cooperatives

- Emerged in the 1850s.
- Urban regions: short-term credit to private small businesses.
- Rural areas: long-term credit to the agricultural sector.

Joint-Stock Credit Banks

- Initially founded to increase the capital base.
- Universal banking: wide array of services Levine 2005
- Provision of long-term credit to the industrial sector.



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- Need for risk diversification & chance to further increase dominance
→ Geographic expansion
- "The reign of the banks over the industrial capital" (Hilferding, 1910)

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- Holding about 50% of all the joint-stock banks' assets in 1900.
- "reigned over the Berlin Stock Exchange" (Kocka, 1975, p.100).
- Used proxy voting rights to appoint board members, allowing them to actively shape company policies and strategies (Guinnane, 2002).

Crisis of 1900-1902 as catalyst:

- Need for risk diversification & chance to further increase dominance
→ Geographic expansion
- "The reign of the banks over the industrial capital" (Hilferding, 1910)

List of *Great Banks*

- Deutsche Bank
- Dresdner Bank
- Disconto Gesellschaft
- Darmstädter Bank (BfHI)
- Berliner Handelsgesellschaft
- Commerz- und Disconto-Bank
- Nationalbank für Deutschland
- Schaaffhausen'scher Bankverein

The Great Banks' Ties to the Industry

Closeness to industry: “*German banks [...] established the closest possible relations with industrial enterprises [, accompanying them] from the cradle to the grave, from establishment to liquidation throughout all the vicissitudes of its existence.*”
(Gerschenkron, 1962, p.14)

Control over industry: “*Banks acquired a formidable degree of ascendancy over industrial enterprises, which extended far beyond the sphere of financial control into that of entrepreneurial and managerial decisions.*” (Gerschenkron, 1962, p.14)

Exertion of control:

- Supervisory board meetings (up to monthly)
- Investment, production, and personnel decisions

Anecdote

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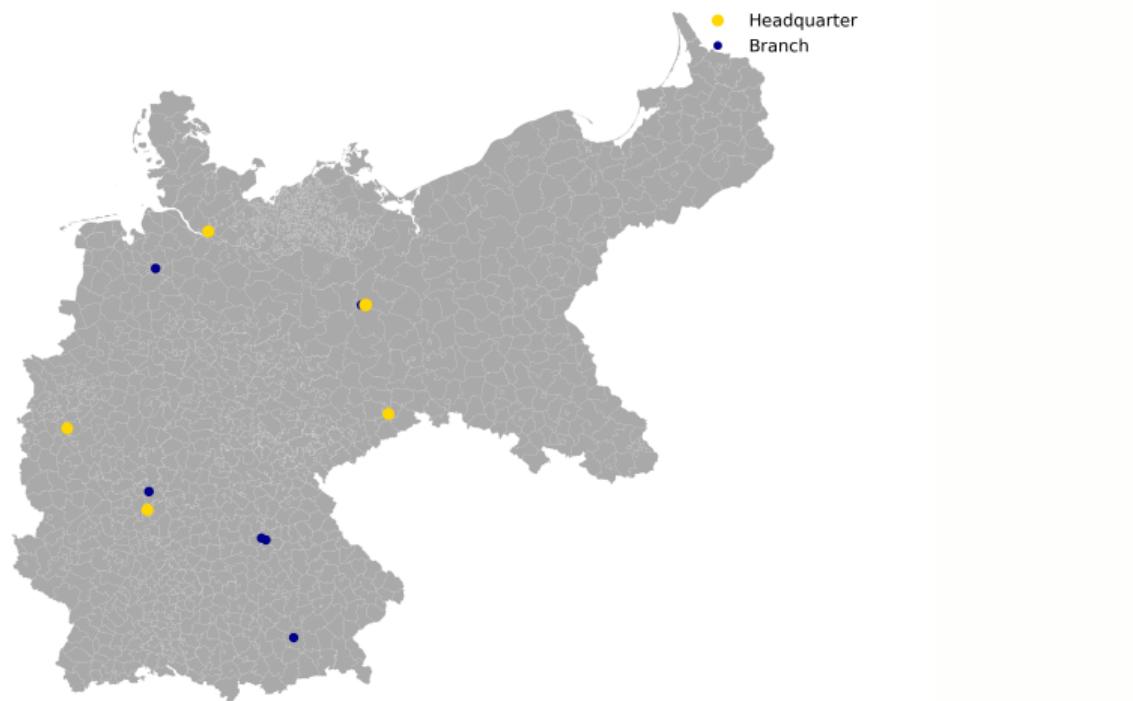
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Anecdote

The Transformation of the Banking Sector in Imperial Germany

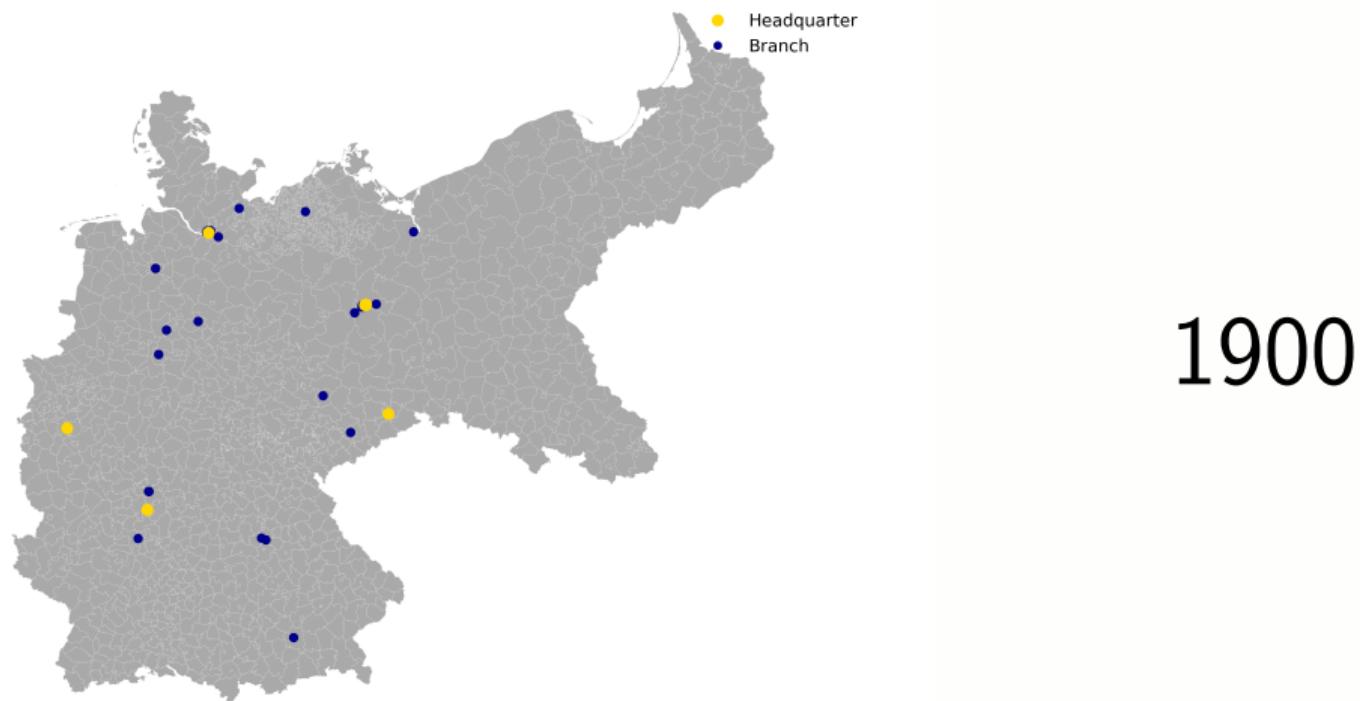
Evidence on the expansion of the Great Banks across Imperial Germany (1896–1914)



1896

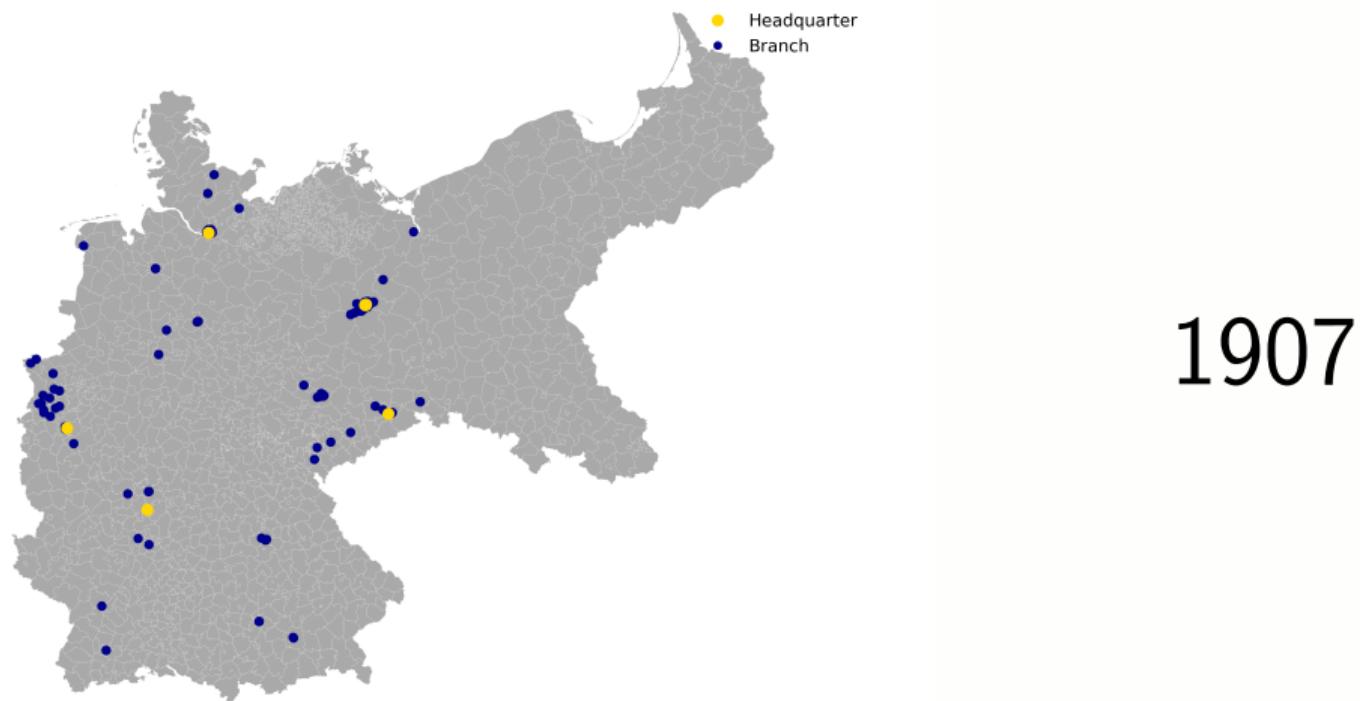
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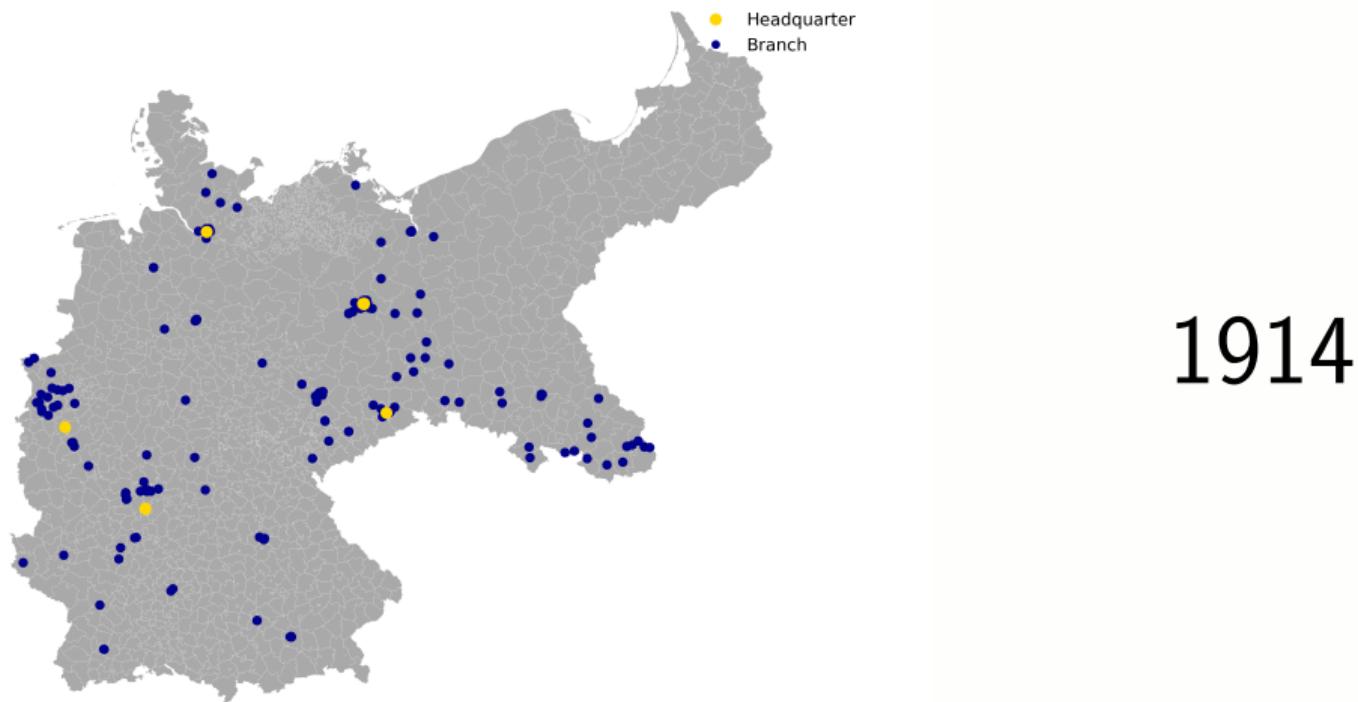
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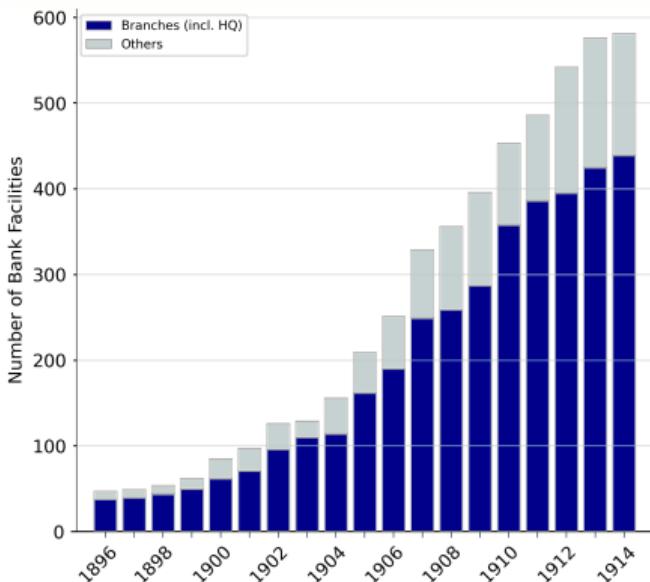
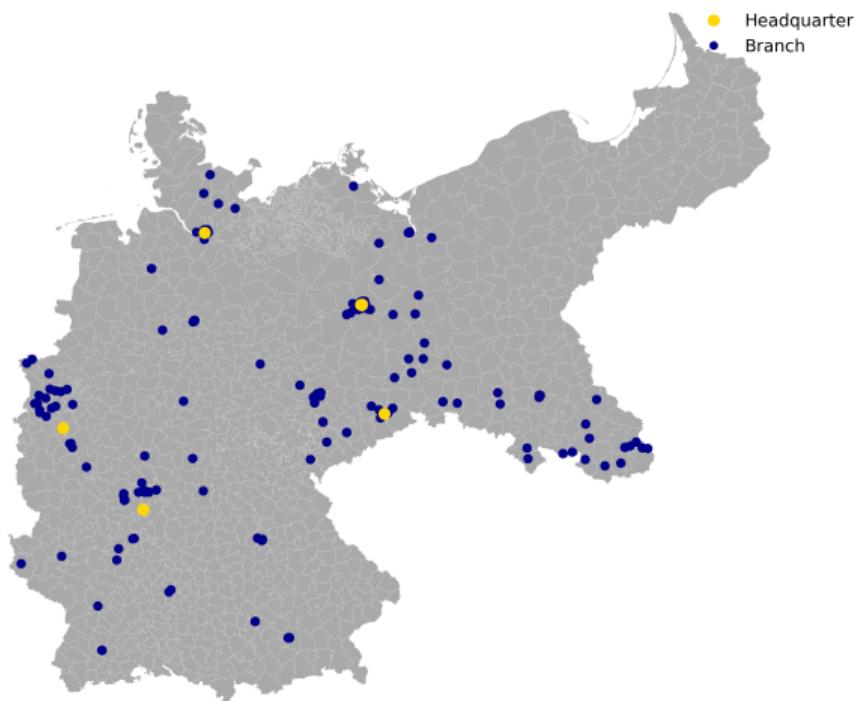
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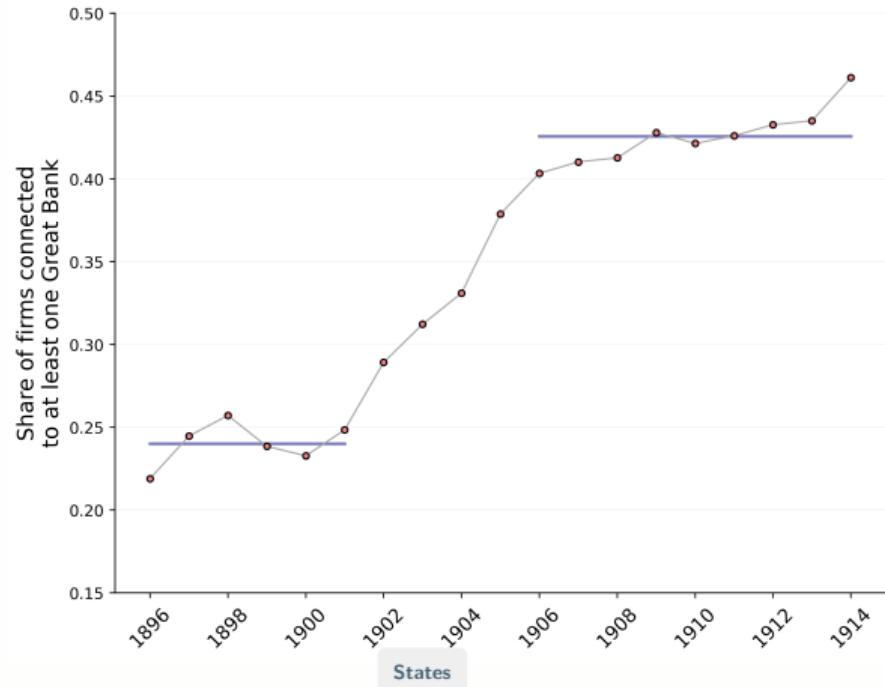
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The Transformation of the Banking Sector in Imperial Germany

The number of firms linked to the Great Banks surged, especially since the early 1900s.

[...] the fiscal agencies [“Zahlstellen”] supply a means whereby the industrial connections of the great banks may be measured.” (Riesser, 1911, p.370)



PE firms implement three sets of changes (S. N. Kaplan & Strömberg, 2009)

- Financial engineering
 - Management incentives via stock and options (S. Kaplan, 1989a)
 - Debt restructuring to reduce *Free Cash Flow Problems* and increase interest tax shield (Jensen, 1986; S. Kaplan, 1989b)
- Governance engineering
 - Control over the firms' board
 - Active governance through frequent meetings (Acharya et al., 2013)
 - Personnel decisions (management replacement and board composition) (Acharya et al., 2013; Hellmann & Puri, 2002)
- Operational engineering (Gompers et al., 2015)
 - redefining the company's strategy / business model
 - cost reduction, etc.

The new role of the *Great Banks*: The case of Mannesmannröhren-Werk AG



MANNESMANN

- Founded in 1890 in Berlin, the company's home bank had been *Deutsche Bank*
- After the economic crisis of 1900, Deutsche Bank "essentially took over the firm":
(Gall et al. 1995; Guinnane 2002)
 - Reorganized management board.
 - Directed investment decisions.
 - Business restructuring in 1908.
- Mannesmann first developed into Germany's leading industrial-pipe producer and subsequently became one of Germany's largest steel producer.
- Geographic proximity as key driver to exert control: both Mannesmann and Deutsche Bank were headquartered in Berlin.

Sectoral Distribution of Sample Firms

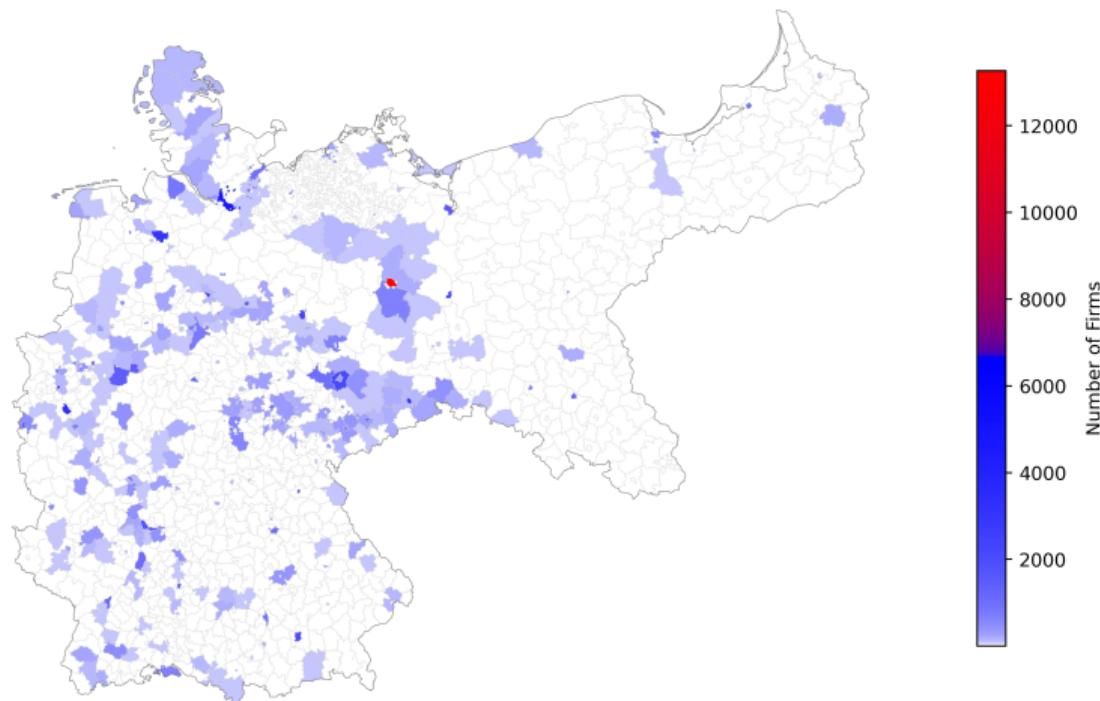
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Sector	Obs.	Percent	Median Firm Size (in Million Marks)
Breweries	7680	12.50	2.01
Textiles	5626	9.16	2.63
Machinery, Foundries & Steel	4977	8.10	2.07
Building Materials & Industrial Minerals	4430	7.21	1.35
Credit Banking	3792	6.17	5.63
Mining & Metals	3522	5.73	4.70
Construction Finance & Real Estate	2857	4.65	2.16
Sugar Production	2833	4.61	1.23
General Transportation	2502	4.07	1.94
Chemicals & Plastics	2329	3.79	2.23
Metal Industry	2012	3.27	1.79
Electrical Equipment & Utilities	1671	2.72	2.88
Utilities	1618	2.63	0.40
Railways	1515	2.47	2.26
Paper Production	1469	2.39	1.88
Printing & Publishing	1422	2.31	0.76
General Food & Beverage	1243	2.02	1.18
Steamship & Harbor Services	1187	1.93	1.74
General Banking	1151	1.87	2.27
Mills & Bakeries	1057	1.72	1.45

Geographic Distribution of Sample Firms

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State	Obs.	in Percent
Preußen	31274	50.89
Sachsen	6619	10.77
Bayern	5756	9.37
Baden	2619	4.26
Elsaß-Lothringen	1993	3.24
Hamburg	1952	3.18
Württemberg	1942	3.16
Bremen	1506	2.45
Braunschweig	1478	2.40
Hessen	1054	1.71
Anhalt	551	0.90
Oldenburg	502	0.82
Mecklenburg-Schwerin	340	0.55
Sachsen-Meiningen	305	0.50
Reuß jüngerer Linie	297	0.48
Sachsen-Altenburg	294	0.48
Lübeck	284	0.46
Sachsen-Coburg-Gotha	175	0.28
Schwarzburg-Sondershausen	158	0.26
Lippe	146	0.24
Mecklenburg-Strelitz	141	0.23
Schwarzburg-Rudolstadt	117	0.19
Reuß älterer Linie	72	0.12
Waldeck und Pyrmont	12	0.02





The financial system' five main functions (intermediaries & markets):

1. Production of ex-ante information about investment opportunities.
2. Ex-post monitoring of investments.
3. Trading, diversifications, and management of risks.
4. Mobilization and pooling of savings.
5. Exchange of goods and services.
 - Source Levine (2005)

- A notable body of research **qualitatively** investigates the Banking-Growth-Nexus in Imperial Germany. (Jeidels, 1905; Hilferding, 1910; Riesser, 1911; Gerschenkron, 1962; Kindleberger, 2015)
- Only few **quantitative** studies exist:
 - Burhop (2006) Time series analyses of aggregate capital stock and financial depth show that the *Great Banks* influenced economic development between 1851 and 1882 but not in later periods.
 - Becht & Ramirez (2003) Steel and mining firms with close links to the *Great Banks* were less liquidity constraint in the early 20th century.
 - Fohlin (1998) Investment of firms connected to the *Great Banks* is more sensitive to internal liquidity than for others.
 - Fohlin (2007) No correlation between firm performance and connection to the *Great Banks*.

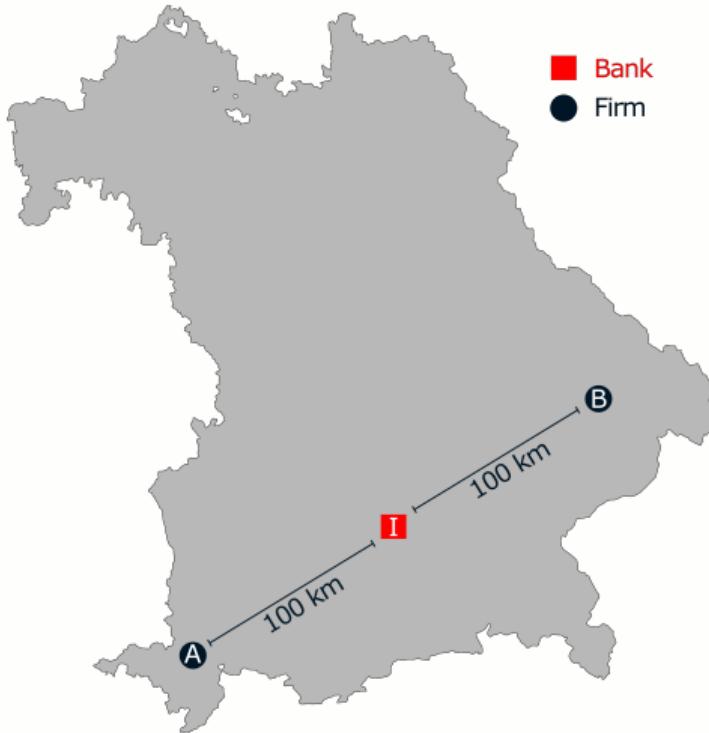
The *EEA Score's* Intuition

$$EEA_{it} = \sum_{b \in B_t} \omega_b (1 + r)^{-\delta_{ib}}$$

We assume:

$$r = 0.03 \text{ (Liebald, 2024)} \quad \& \quad \omega = (B - b + 1)/B$$

The *EEA Score's* Intuition

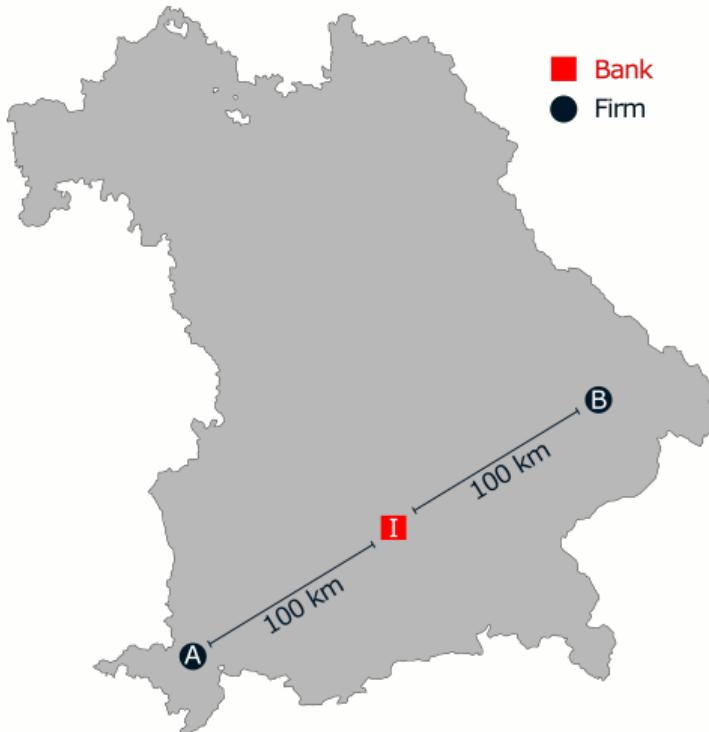


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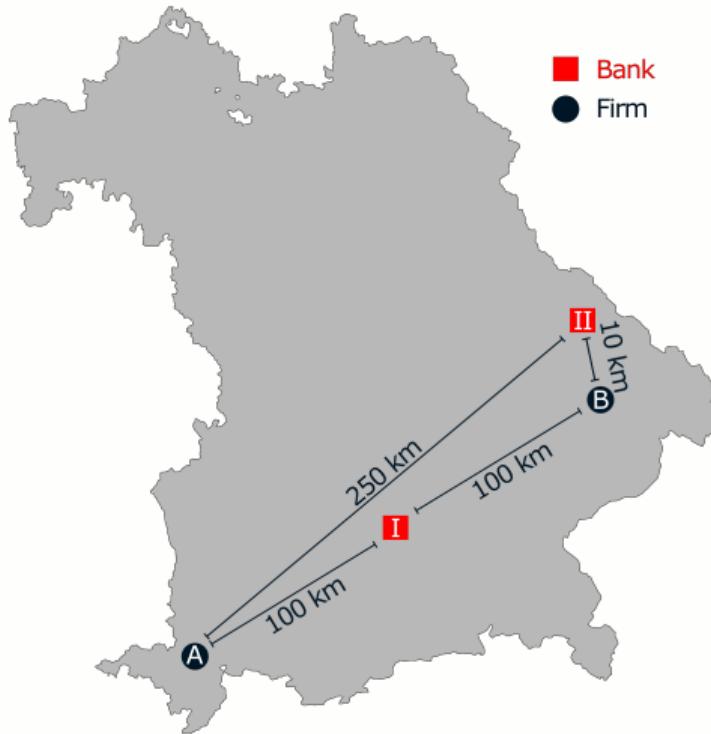
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Firm A: $EEA_{t=1} = 1(1.03)^{-100} = 0.052$

Firm B: $EEA_{t=1} = 1(1.03)^{-100} = 0.052$

The *EEA Score's* Intuition



■ Bank
● Firm

$$EEA_{it} = \sum_{b \in B_t} \omega_b (1 + r)^{-\delta_{ib}}$$

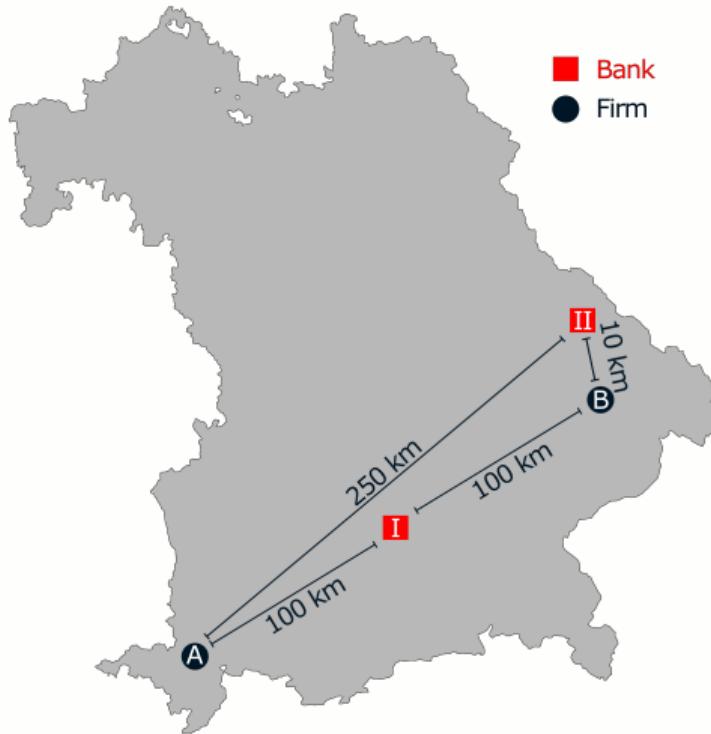
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We assume:

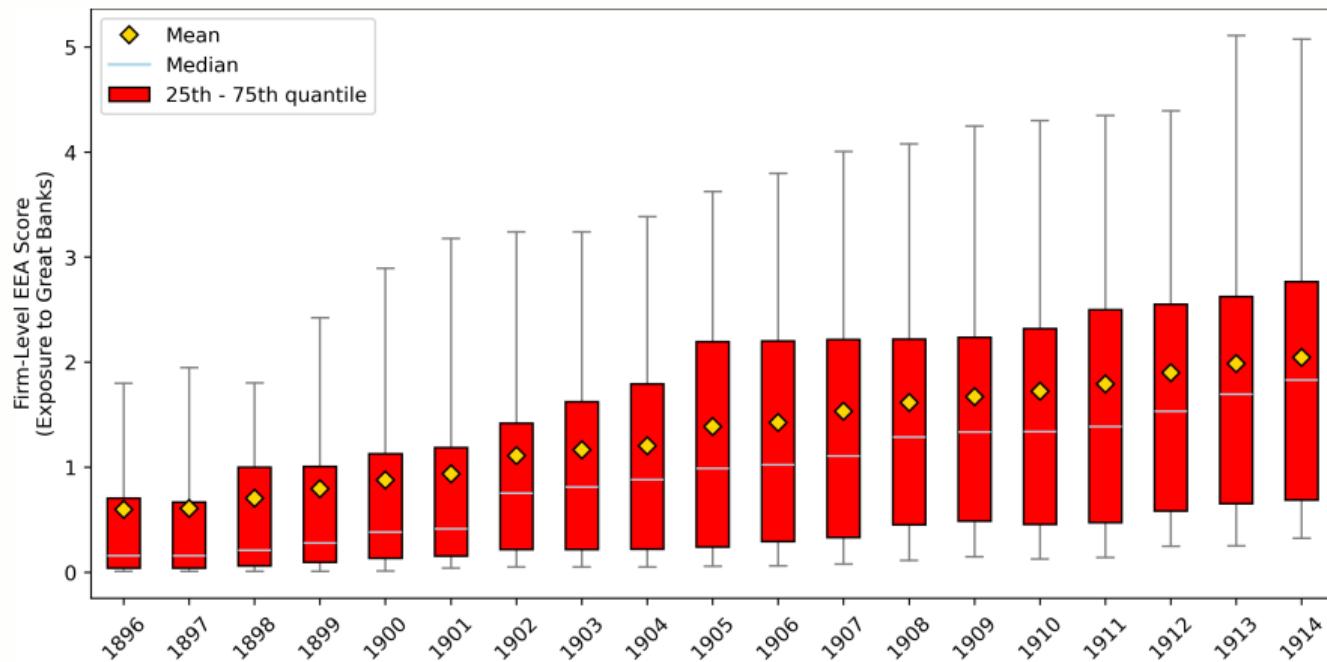
$$r = 0.03 \text{ (Liebald, 2024)} \quad \& \quad \omega = (B - b + 1)/B$$

Firm A: $EEA_{t=2} = 1(1.03)^{-100} + \frac{1}{2}(1.03)^{-250} = \mathbf{0.053}$

Firm B: $EEA_{t=2} = 1(1.03)^{-10} + \frac{1}{2}(1.03)^{-100} = \mathbf{0.796}$

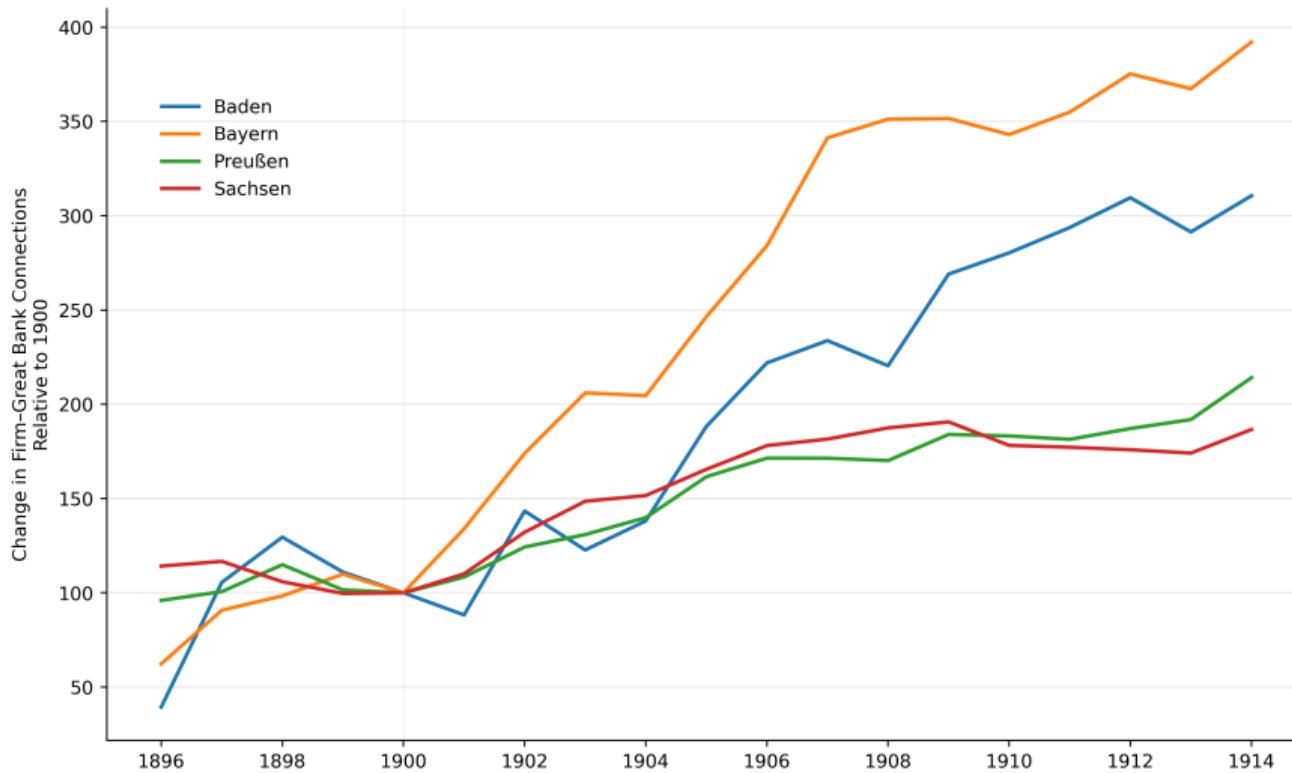
Exposure to *Great Banks* Over Time

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Great Bank-Firm Links Across States

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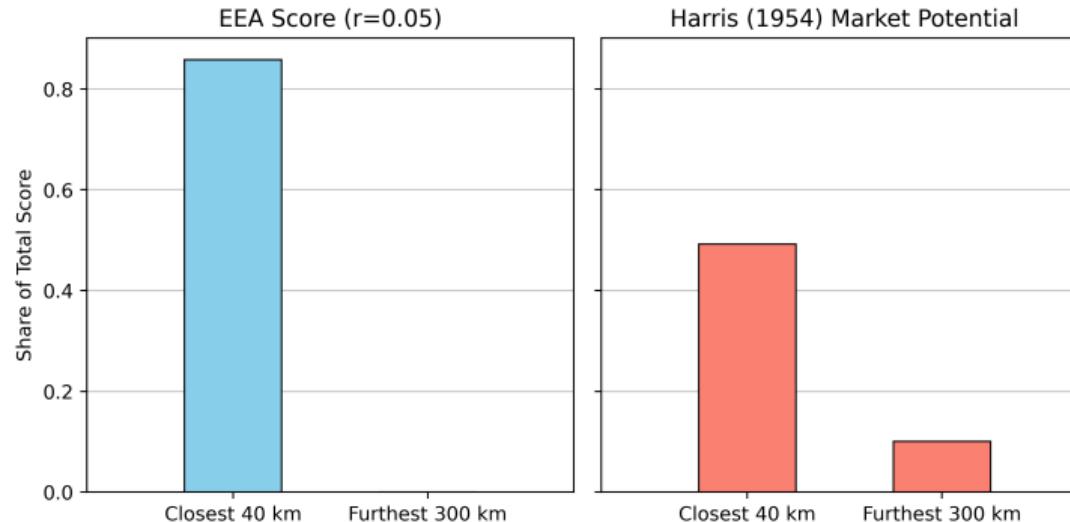


Exponential vs. Power-Law Decay

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$$EEA_i = \sum_{b \in B_t} (1 + r)^{-\delta_{ib}}$$

$$MP_i = \sum_{b \in B_t} \frac{M_b}{\delta_{ib}^\alpha}$$



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