Drivers of Market Integration: Competing Customs Unions in 19th Century Germany

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What is Market Integration?

- “[…] an entire territory of which the parts are so united by the relations of unrestricted commerce that prices take the same level throughout with ease and rapidity.” (Cournot, 1838)
- Many different types of market integration in the field of historical and spatial economics
- Focus here: commodity market integration
  - Dynamics and formation of markets before the advent of the first information and transportation technologies
  - Assessment of institutional change and their impact on markets
  - Data availabiltiy
- Understanding the drivers of and effect from market integration are important for policy decisions regarding trade, currency, infrastructure etc. (Federico, 2024).

Motivations

- Historical: Evaluate customs reforms and competing customs unions
  - Literature has focused on Zollverein (1834-) and French liberalisation of certain territories during Napoleonic era (Albers and Pfister, 2023; Keller and Shiue, 2014; 2020)
  - Precursors to the Zollverein (1828-1834) have yet to be studied in detail
  - Steuerverein (1834-1852) has also not been empirically evaluated and is often forgotten
  - attribution of market formation to the studied institutions may well have arisen from prior integration within these other structures
- Economical: On market integration and institutions/agreements
  - Locally integrated regions aggregated together may not necessarily be integrated as a whole
  - plenty of studies on the trade increasing effects of modern FTAs and other policies, but methodologies and results are diverse (Jadhav and Ghosh, 2023; Kepaptsoglou et al. 2010)
  - effects of customs unions and other regional institutions on market integration are rare (Ogrokhina, 2015)
  - important to understand from a policy perspective for institutions, also in light of recent period of trade disturbances
  - econometric methods used to evaluate policies at this level still require some refinement and theory, start by analyzing using available tools
- **→ Establish the role of the competing unions in 1828-1834 and gain insights into the interplay of institutions and market formation**

Measuring Market Integration

- need to use proxy for the measurement on market integration
  - typical bilateral measures (Federico, 2024): absolute price gaps and absolute return gaps
  - motivation: these should be bounded, both from the Law of One Price, and expected co-movement of integrated markets (Engel and Rogers, 1996; Federico, 2024)
  - as integration increases, these bounds should decrease on average
  - in other words, we want to understand the determinants of the price differentials between regions and the differences in co-movement in prices
    - these differentials should be related to the costs of trade and other individual level propensities, such as direct transportation costs, political and institutional barriers, but also efficiency losses such as currency and measurement differences across space
- interest lies in the development of these measures over time and the effects of policies on them

Relationship to Trade

- trade and integration are strongly related to each other, methodology of price gap regression borrows heavily from the gravity model of trade (Anderson and Wincoop, 2003; Federico, 2024)
- there are two possible effects to consider for agreements (Viner, 1950):
  - Trade Creation → expect positive returns or effects on the policies
  - Trade Diversion → expect reduction between members and non-members
- expect similar dynamics in the market integration process:
  - removal of barriers to improve integration
  - creation of barriers to decrease integration

Historical Background before Confederation

- Until 1803/1806: Holy Roman Empire, a loose state formed by quasi-autonomous states numbering several hundreds
- Within this system, trade was severely hampered by borders, customs borders and points, lack of stable institutions
  - miriam Germanorum insanium (Roscher, 1870)
- Napoleonic France's influence: large consolidations in state borders, dissoultion of the HRE and full autonomy to the newly formed states, reforms conducted in some of these states
- 1815: Post Napoleon, redrawing of the maps → Creation of the German Confederation
  - customs policy not discussed in this initial stage
  - to be possible to be discussed at future meetings as stipulated in the Act

Historical Background Maps

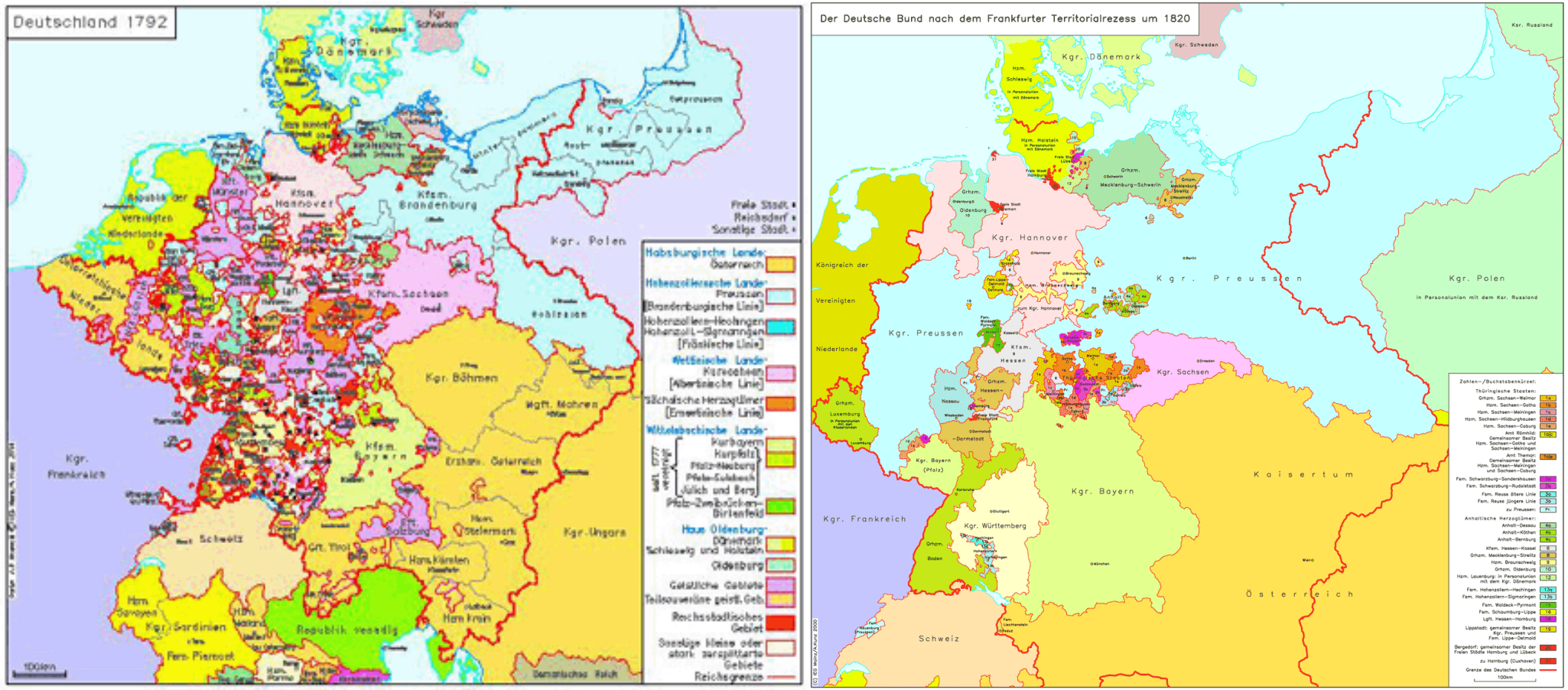


Figure 1: Map of the borders within the Holy Roman Empire in 1792 and within the German Confederation in 1820. Source: IEG-Maps by Kunz (2014), Maps 720 and 004

Historical Development Customs Unions in 19th Century Germany

- 1815: German Confederation Established
  - new borders enacted; large change in the geography of the region
  - various state level reforms prior and after, but no inter-state policies
- 1828: Establishment of 3 Competing Customs Unions
  1. Prussian-Hessian Customs Union (North)
  2. Bavarian-Württembergian Customs Union (South)
  3. Central German Commercial Union (Central)
- 1834: Holdouts and gradual cooperation
  1. Merging of North and South to form Zollverein
  2. Central evolves into Steuerverein
  - members from both the Steuerverein and non union states are absorbed into the Zollverein
- 1867/1871: North German Confederation and German Empire
  - some states, such as Hamburg or Bremen, were part of these new states, while being outside of the customs area until as late as 1888
  - other regions, such as Liechtenstein, were part of the customs area but not the political entity

Customs Development Maps

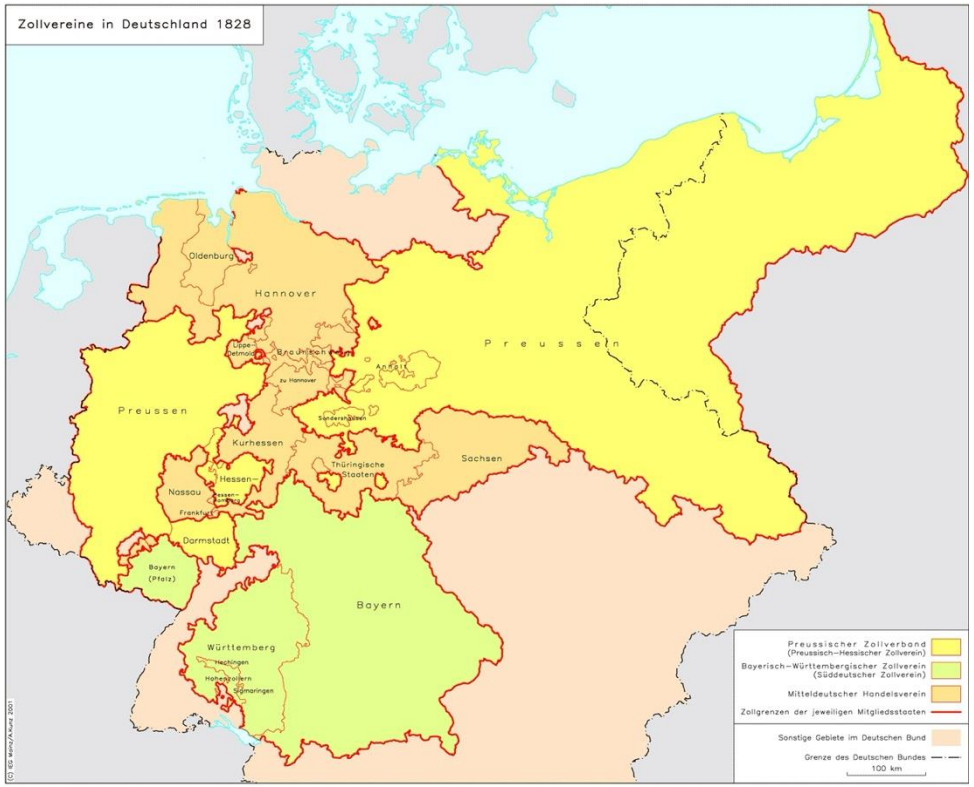


Figure 2: Map of the customs unions in 1828. Source: IEG-Maps by Kunz (2014), Map 071

Historical Development

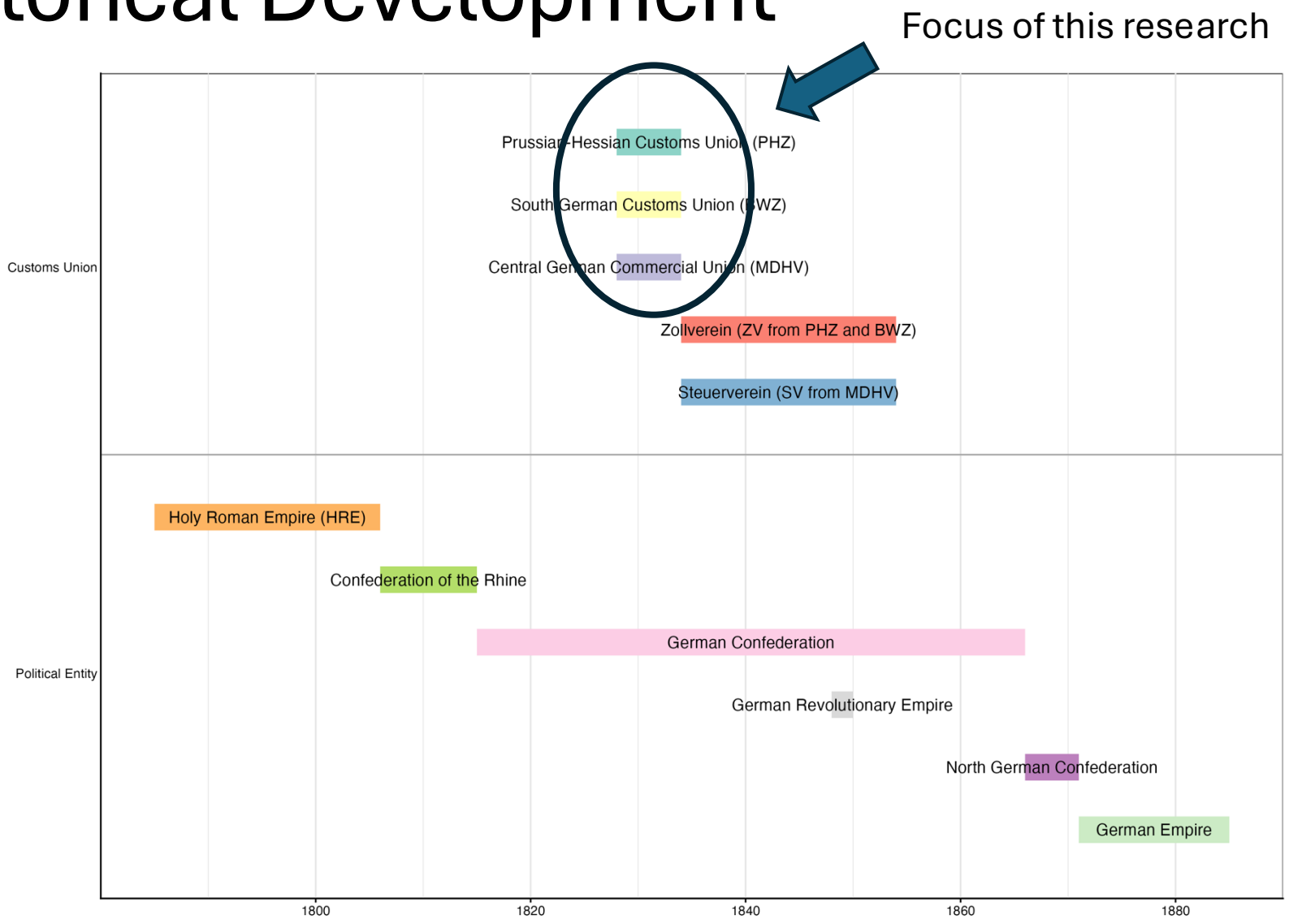


Figure 3: Timeline of the Customs Unions and Political Entities during the 19th century. Source: created by presenter

Empirical Findings

- Markets in Germany have integrated over the course of the 19th century (Keller and Shiue, 2014; Albers and Pfister, 2021; 2024)
- Yet they were not well integrated by the start of WW1 (Wolf, 2009)
- Not a contradiction: Relatively better does not mean good
- more broadly, general integration in Europe overall: Jacks (2005), Federico (2012), Chilosi (2013)
- Institutional of integration in Germany:
  - French institutional reforms (Keller and Shiue 2020): reforms ca. end of 18th century to early 19th century
  - Border consolidations (Albers and Pfister 2024): resulting from 1803, 1815 changes
  - Zollverein Customs Union (Keller and Shiue 2014): 1834- onwards;

1. Period of 1828-1834 important; experimental period of customs unions competition
2. 1834-1854: while late joining states into the Zollverein have been studied (Keller and Shiue, 2014), the states that made up the Steuerverein have not

Qualitative Results

- despite the chaos of customs policy at the time, there were local clusters of economic activity across states that suddenly found themselves on different sides of a customs border (Hahn, 1984)
- Friedrich List: “[Numerous barriers] cripple trade and produce the same effect as ligatures which prevent the circulation of blood” (List, 1927; translation Hirst, 1909)
- Goethe: ”[look forward to the day] Thalers and Groschens may have the same value throughout the country and my luggage may pass unopened through all 36 States” (from Eckermann, 1868)
- Mixed results about the efficacy and usefulness of these unions (Falke 1869 ; Weber, 1871)
  - Prussian-Hessian Customs Union:
    - many Germans considered it an obstacle in the way of economic unification (Henderson, 1939)
  - South German:
    - partial success (Henderson, 1939)
    - not as efficient as it’s Prussian counterpart (Linner 2014)
  - Central German:
    - “a contract without any positive content” (Linner, 2014)
    - “krankhafte unnatürliche Mißbildung” (Treitschke, 1913); “malicious and unnatural conspiracy against the fatherland” (Treitschke, 1896 in Henderson, 1939)
    - other negative assessments: Dumke (1984), Hahn (2012)
- expect effective unions to reduce within costs and increase across border costs (Kühne 1839)

Empirical Strategy

- Continue with the literature's approach, dyadic model of bilateral integration measure as the dependent variable

$$Integration_{i,j}^{t} = \alpha_1 State_{i,j}^{t} + \beta D_{i,j}^{t} + \Gamma X_{i,j}^{t} + \delta_{i,\mathrm{t}} + \delta_{j,\mathrm{t}} + \delta_{\mathrm{i,j}} + \epsilon_{i,j}^{t} (1)$$

- $D_{i,j}^{t}$ is a treatment or vector of treatments based on the dyadic customs union status of the city pair under observation
  - i.e. in the pooled specification, it will be equal to 1 if the two cities in question are in any customs unions
  - in the seperated spec, each customs union has one dummy associated with its membership
  - also interested in the "negative" effect of a customs union, that is the effect when only one city is part of a customs union (Viner, 1950)
- Capture the effects on the integration measure as city-pairs become members of the same or competing unions, or remain outside
- Include three-way fixed effects (Anderson and Wincoop, 2003)

Variables of Interest

- oftentimes, trade models or integration models will use a dummy variable for a shared policy or agreement
  - i.e. Keller and Shiue (2014) define the dummy of 1 to be both cities in the same union
  - Wolf (2011) uses a dummy of 1 for both countries in the same monetary area
  - Trade studies use the same idea for countries in the same agreement
- however, this observes only one of the possible effects of an agreement: the positive effect upon within members
- there is also the negative effect: with the agreement in place, locations either side of the newly defined border may experience effects
- additionally, bilateral relations are dependent on the partners relations with all other possible partners → multilateral resistance (Anderson and Wincoop 2001)
- in market integration, these considerations are often not taken into account

Data - Prices

- Price data on wheat, rye, barley oats
  - sources: Albers and Pfister (2024), Keller and Shiue (2007), Jacks (2005), Statistisches Landesamt (1873), Seuffert (1857), Vierteljahreshefte (1935), newspapers (various; access: Deutsches Zeitungsportal)
  - converted using historical sources on the metal content of coins, volume measures to standardise (Dittman, 1889; Gerhard und Kauffold, 1990; Jacks, 2004, 2005)
  - concentration of observations in the period 1800-1855 (unbalanced)
  - being actively added to as a separate project using recently digitized historical sources
- city characteristics data:
  - geographical data
  - state affiliation (large changes around late 18th and early 19th centuries due to meditisation)
  - customs union affiliation (None, 3 competing unions 1828-1833, 2 competing unions 1834-)
  - railway station and line history, relevant for 1835 onwards (Cima, 2008; Pengl et al. 2025)

Dyadic Data

- City-City dataset using the price data
  - 79 x 78 pairs of cities
  - many NAs, and interested not in the entire period, but useful for future studies
- Creation of price gaps using difference across cities in logarithmic price
  - measure the convergence of prices, the first condition of integrated markets
- Return Gaps as a measure of co-movement between areas (1 period less than the price gaps)
  - measure the co-movement of prices, the second condition (caveat: level dependent to a certain extent)
- dummies indicating shared customs union
- dummies indicating differing customs unions
- dummies indicating single membership to a union

Regression Notes

- Dyadic panel regressions are common in the trade literature but error structures and fixed effects are various
- Errors are particularly problematic; dyad clustering may not be sufficient to explain correlation (Aronow et al., 2015; Cameron and Miller, 2023)
  - Dyadic clustering can underestimate errors in these models
  - Use the clustered errors by above authors for inference to correct for this
- Similarly, fixed effects are also numerous
  - following trade literature, use “three way fixed effects”
  - most market integration studies neglect this but may induce OVB

Data – Price Data and Customs Unions Availability

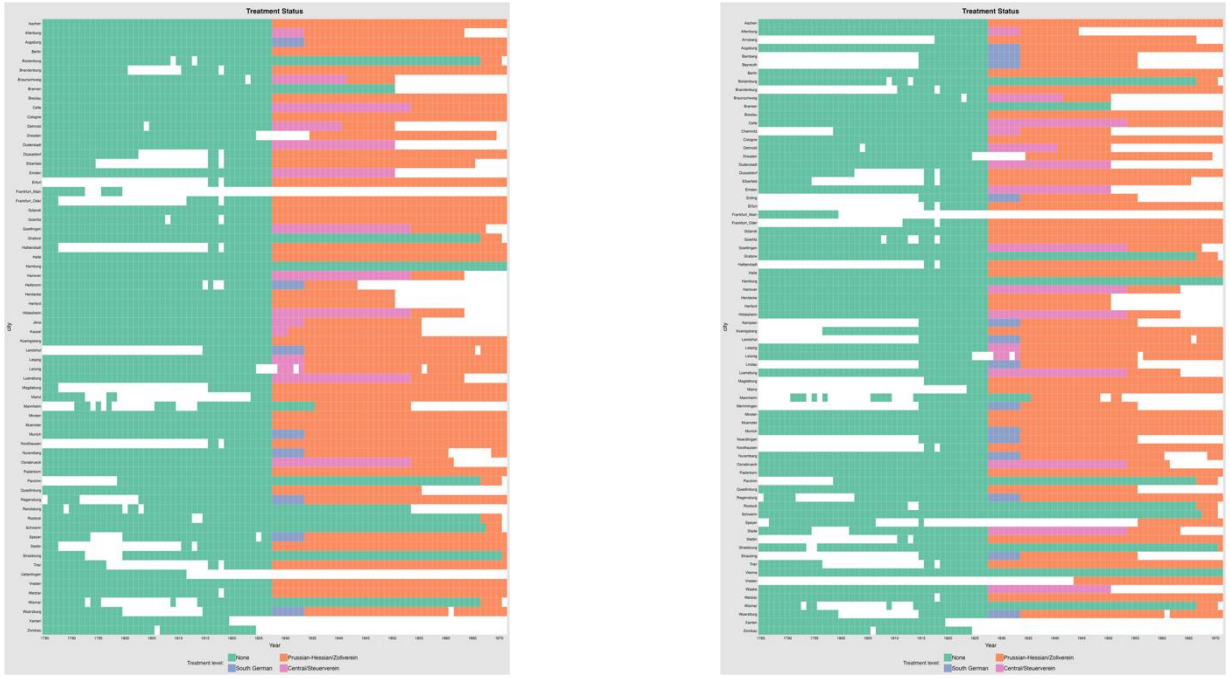
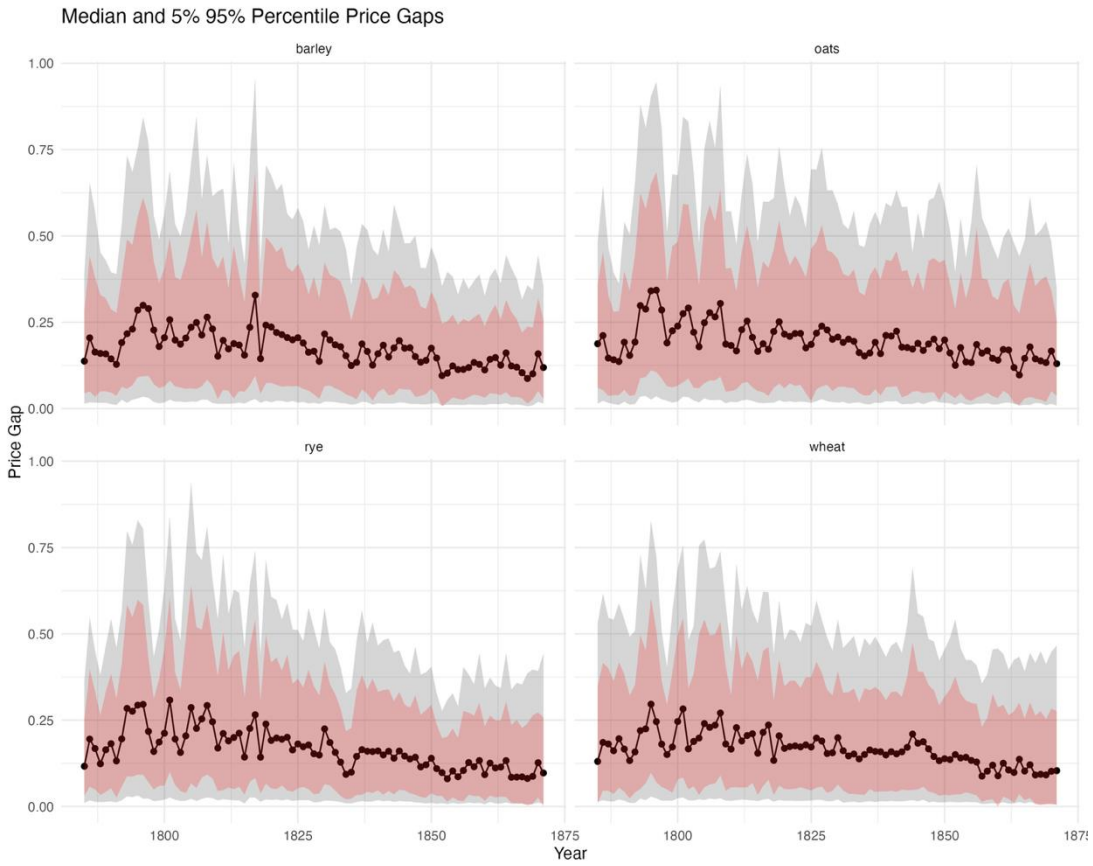


Figure 4. Data Availability and Customs Unions Membership data for each city. Plotted for the rye and wheat price series.

- green is the pre-customs unions period; here there were some institutional changes but not cross-state custom unions
- The Prussian-Hessian Customs Union and the Zollverein are coded as the same customs union, as the latter was created by the joining of the former with the South German Customs Union
- The Steuerverein is coded the same as the Central German Commercial Union, given that the former is a successor to the latter
- Despite missingness, there is variation in the pairings that can be studied

Data – Price Gaps and Return Gaps



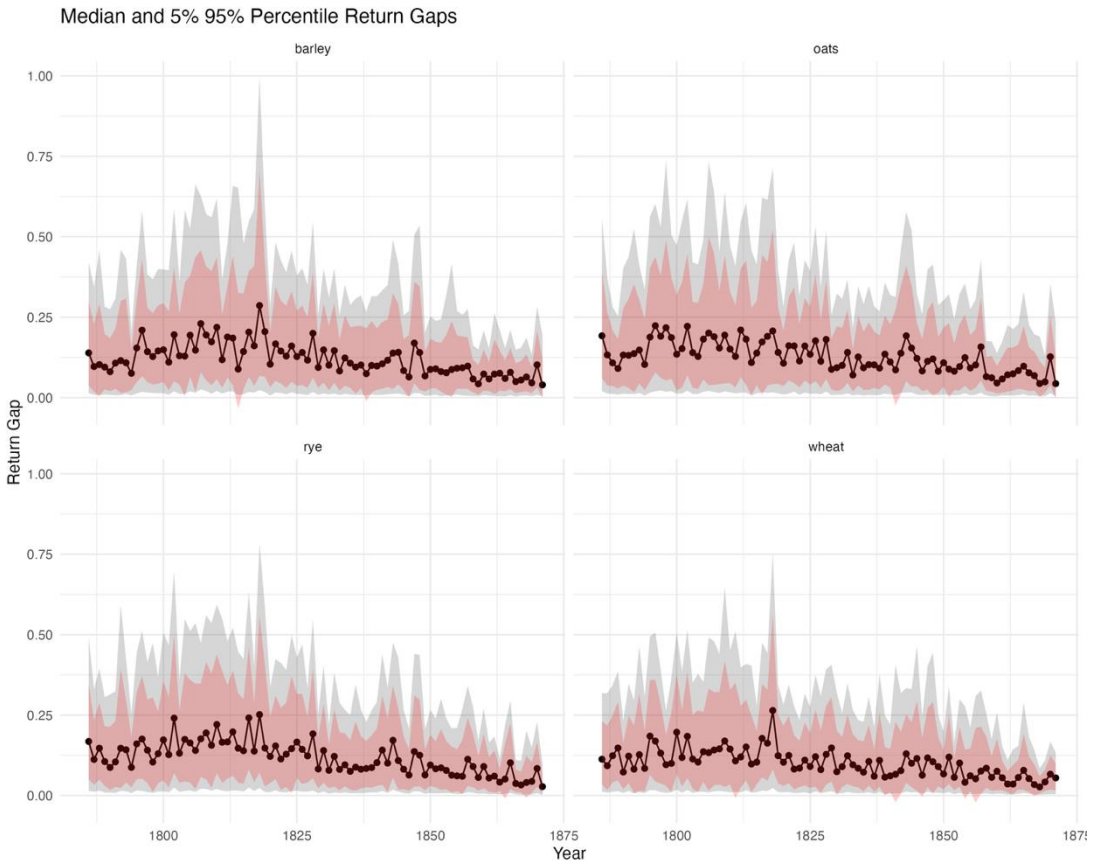


Figure 5. Cross-Sectional Median, 5 and 95 percentile Price and Return Gaps
Clear Downward Trend over time in all measures, with spikes occuring during documented wars and bad harvest periods (Albers and Pfister, 2024)

Methods - Pooling

- first, simplify by assuming a pooled structure; this gives the following characteristics
  - both cities in the same union ➔ Same
  - both cities in different unions ➔ Cross-Border
  - one city in a union and one city not in any union ➔ Cross-Border
  - neither city in any union (baseline)
- consider these to be 2 treatments and the control group

$$\mathrm{Gap}_{i,j}^{t} = \beta_1 Same_{i,j}^{t} + \beta_2 \mathrm{Cross}_{i,j}^{t} + \Gamma X_{i,j}^{t} + \delta_{i,\mathrm{t}} + \delta_{j,\mathrm{t}} + \delta_{\mathrm{i,j}} + \epsilon_{i,j}^{t} (2)$$

- Exclude any switchers for now
- Two treatments:
  - both cities being within customs unions (trade creation)
  - only one of the cities being within a customs union (trade diversion)
- Use 1815 as the baseline given the new “institutional order” after the Congress of Vienna

Pooled Results

	barley-price	barley-return	oats-price	oats-return	rye-price	rye-return	wheat-price	wheat-return
Cross Border	-0.028*	-0.006	-0.022+	0.007	-0.034***	-0.006	0.006	-0.001
	(0.013)	(0.009)	(0.012)	(0.008)	(0.009)	(0.008)	(0.012)	(0.005)
Same Union	-0.037*	-0.022*	-0.028*	-0.007	-0.052***	-0.019*	-0.012	-0.009
	(0.014)	(0.010)	(0.013)	(0.010)	(0.011)	(0.009)	(0.013)	(0.006)
Num.Obs.	52882	50160	47430	44972	68350	65238	85456	81140
R2	0.672	0.632	0.719	0.634	0.655	0.636	0.688	0.607
R2 Adj.	0.648	0.604	0.698	0.606	0.632	0.610	0.668	0.582
R2 Within	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.000
R2 Within Adj.	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.000
RMSE	0.11	0.09	0.10	0.09	0.10	0.09	0.09	0.08

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Standard errors clustered by city-pair. Fixed effects: city1-year, city2-year, dyad

Table 1. Coefficient Estimates and confidence intervals for the effects from Tables 2-4 summarized. Red uses the 1818-1854, while green and blue use the shown periods

Pooled Results Visualized

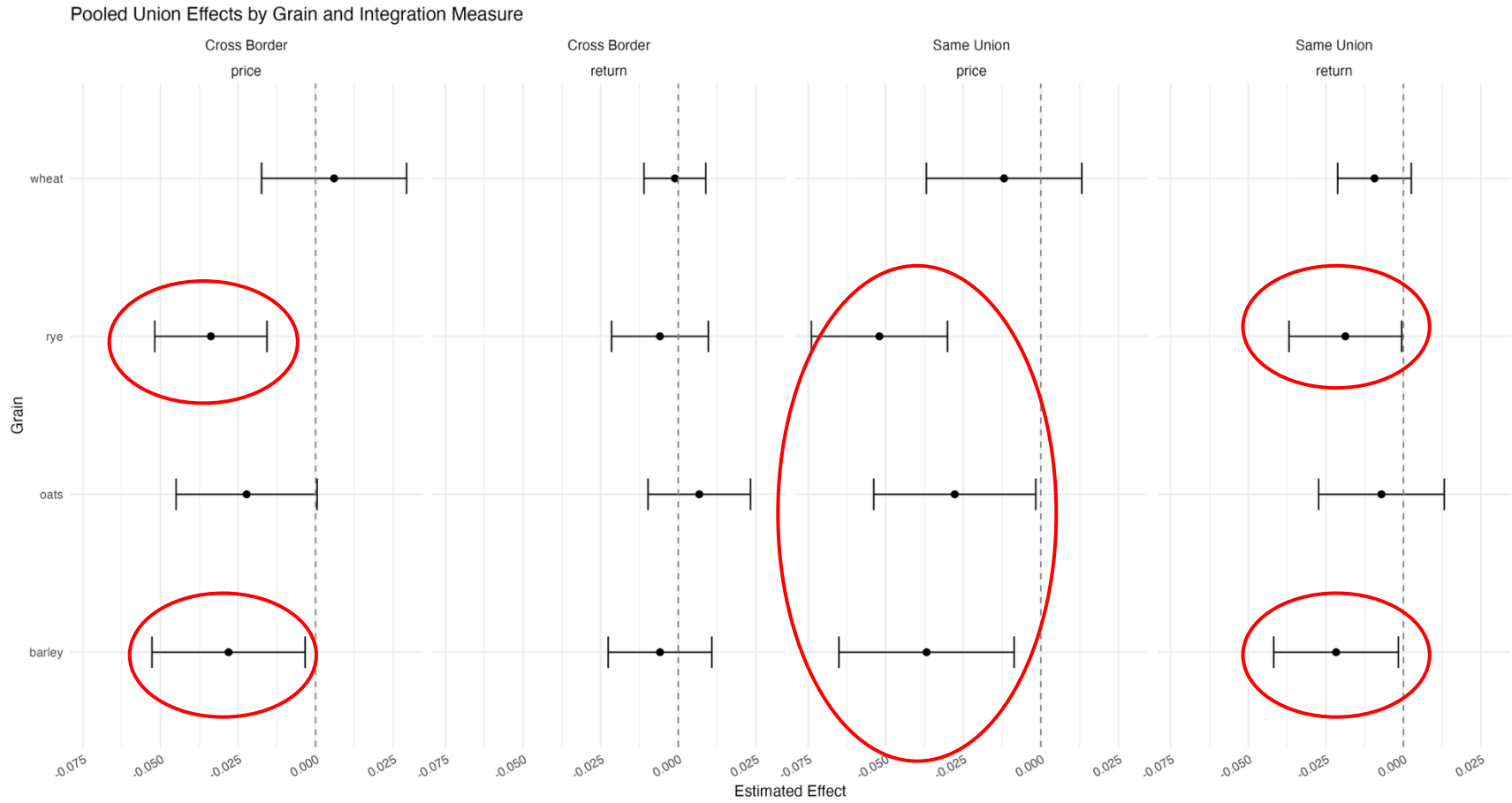


Figure 6. Estimated Coefficients from the pooled unions regression specification

Individual Unions

- For the period 1828-1833, there are effectively 3 customs unions with mutually exclusive membership of the states
  - Prussian-Hessian Customs Union (label: A/PHCU)
  - Bavarian-Württembergian Customs Union (label: B, also known as South-German Customs Union SGCU)
  - Central German Commercial Union (label: C, Mitteldeutscher Handelsverein MDHV)
- Combinations of interest:
  - (A,A), (B,B), (C,C) as the same union effects
  - (None, None) as the control group
  - Cross-Union effects are also of interest to measure any disruptions to trade

Individual Unions - Equation

$$Gaps_{i,j}^{t} =$$

$$\alpha_1 State_{i,j}^{t} + \beta_A bothA_{i,j}^{t} + \beta_B bothB_{i,j}^{t} + \beta_C bothC_{i,j}^{t} +$$

$$\beta_{AB} crossAB_{i,j}^{t} + \beta_{AC} crossAC_{i,j}^{t} + \beta_{BC} crossBC_{i,j}^{t} + \delta_{i,t} + \delta_{j,t} + \delta_{i,j} + \epsilon_{i,j}^{t} \quad (3)$$

- Capturing a treatment for each individual union as well as the cross union city-pairs (by construction, we cannot capture the effects of single union city pairs)
- understand the different effects of each union and their boundary interactions

Individual Unions Results

	barley-price	barley-return	oats-price	oats-return	rye-price	rye-return	wheat-price	wheat-return
PHCU	0.037*	-0.000	0.030*	-0.027**	0.035**	-0.008	-0.009	-0.005
	(0.018)	(0.008)	(0.015)	(0.009)	(0.011)	(0.008)	(0.013)	(0.005)
SGCU	0.018	0.038+	0.027	0.024	0.079***	0.021	-0.039**	-0.024***
	(0.024)	(0.021)	(0.025)	(0.020)	(0.020)	(0.022)	(0.014)	(0.007)
MDHV	0.026	-0.004	0.009	0.039**	0.033**	-0.015	0.032*	0.013
	(0.016)	(0.011)	(0.020)	(0.014)	(0.012)	(0.010)	(0.016)	(0.008)
PHCxSGCU	0.011	-0.027**	-0.013	-0.055***	-0.012	-0.019*	-0.026*	-0.019***
	(0.017)	(0.010)	(0.017)	(0.011)	(0.012)	(0.009)	(0.012)	(0.004)
PHCxMDHV	0.043**	0.002	0.024	0.011	0.034***	-0.015*	-0.005	-0.001
	(0.015)	(0.008)	(0.015)	(0.010)	(0.010)	(0.007)	(0.012)	(0.005)
SGCUxMDHV	-0.017	0.008	-0.035+	-0.013	-0.030*	-0.033**	-0.037**	-0.012*
	(0.017)	(0.011)	(0.018)	(0.012)	(0.012)	(0.010)	(0.012)	(0.005)
Num.Obs.	45266	43766	40708	39394	57692	55834	72166	70216
R2	0.678	0.636	0.734	0.614	0.681	0.660	0.727	0.627
R2 Adj.	0.653	0.607	0.713	0.583	0.658	0.635	0.708	0.601
R2 Within	0.003	0.003	0.004	0.008	0.008	0.002	0.003	0.001
R2 Within Adj.	0.002	0.003	0.004	0.008	0.008	0.001	0.003	0.001
RMSE	0.10	0.09	0.10	0.08	0.10	0.08	0.08	0.07

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Standard errors clustered by city-pair. Fixed effects: city1, city2, grain, year

Within Unions

Across Unions

Table 2. Individual Unions Regression Results. Neither city being in a union is the base case.

Discussion of the Results

- Markets integrated over the course of the 19th century
- Interpretations: negative coefficient exhibit integrative effects, insignificant are neutral and positive coefficients are active disintegrative processes
- As a whole: same union city-pairs exhibit more integration than non-union pairs
  - rye was a staple of the diet and along with wheat, “high” value, transported (Henning, 1996; Uebele 2011)
    - was the wheat market already integrated and stable? → large number of wheat dealers in Bavaria early 19th century (Keller and Shiue, 2014)
  - oats and barley were rather “low value” and consumed locally (Kopsidis, 2012)
    - unions may have had an outsized impact here as the markets are still disconnected
- cross-union pairs also tend to have negative effects
  - were the barriers not very effective?

Individual Unions Discusson

- Mixed results for the unions
  - Central German Commercial Union seems most stable
    - seems to have had “bad” effects on the markets involved
    - von Treitschke’s sharp characterizations (1896, 1913) may have some merit
  - South German and Prussian are unstable but can be interpreted as having been positive relative to no union
    - as precursors to the Zollverein, this might need to be taken into account when evaluating it → integrated regions merging to form a new union
- Across unions, things get more mixed
  - Central German and Prussian show some resistance → effective blocking between the two?
  - Prussia and South German show potential integrative effects → anticipation of their merger in 1834 playing out? (Hahn, 1984; Henderson, 1939)
  - South German and Central German is interestingly negative
    - this needs further study to understand the alignment of the factions and their relationship
    - generally, defense from a political perspective was against Prussian expansion

Why Non-Integrative Effects?

- if a union were ineffective, we would expect insignificant effects, but a positive coefficient is unexpected
- imposition of a new customs border between two city pairs can lead to diversion and this disintegrative effects
- but within a union, such a result is very counter-intuitive
- it is possible that the establishment of a union could have imposed bad institutions onto a newly included city, hampering trade (Hahn, 1984; 2012)
- furthermore, integration could be based on more local structures; in such a case, grouping cities across these clusters may lead to these stastical findings
- inefficiently run unions may increase transaction costs between members

Problems:

- Joining a customs union is likely to be endogenous
  - as with any treatment, if there is selection or endogeneity, the coefficient will be biased
  - typically solved by using an IV
    - Keller and Shiue (2014) do so by using distance to the coast as a primary instrument in evaluating a state's decision to join a customs union
- Reverse Causality
  - it can be argued either way that states formed unions to either enhance their trade with each other, or because they were already well aligned
  - economic alignment → political alignment as steps into unification process

Addressing Endogeneity

- arguments against endogeneity issue:
  - Historical literature states that the major determinants of customs unions decisions were
    1. Financial situation of the sovereign (Henderson, 1939)
    2. potential efficacy of the customs union (border/area ratio) (Dumke, 1984)
    - these are not related to the grain prices
  - Central German Union was a defensive union, South was wary of Prussia
    - political, not economical motivations
  - statistically, city-pair fixed effects controls for the level of the price gaps
    - any constellation of levels of price gaps is accounted for
- possible solutions (work in progress):
    - Use an IV based on this:
      - potential gain from customs union measure
      - difference between current customs area border/area and the prospective unions border/area inclusive the state under consideration
    - Consider “small” cities close to the border? i.e. limit the distance under observation
      - these are likely to have no decision making power and are thus ”randomly” within or outside a union

Summary

- Understanding the dynamics of market formation and integration is important both looking forwards and backwards
- Institutions can have effects on this process and customs unions are one such measure; both in current times and in the past, these treaties have been made and observed to have some effects on trade and market integration
- The “prototypical” customs union (Viner, 1950) is the Zollverein, which is considered to be a key pillar to the formation of the German Empire
  - The 1828-1834 period in German territories saw the emergence of 3 customs unions prior to the formation of the Zollverein to which German economic unification is ascribed
  - An evaluation of the role of these competing institutions has not been conducted
- This research tentatively finds that some of these precursor unions may have had an integrating effect
- One of the unions, the Central German Commercial Union, qualitatively, evaluated very negatively in light of its defensive role, is found to partially corroborate these ratings

Current Tasks

- Interpretation of findings thus far and deeper understanding of the functioning of the markets
- uncover more details on the treaty contents and trading behavior
  - Dumke (1984) gives tariff rates on some Prussian-Hessian Union years, but overall situation is not well known
- constructing the IV based on historical maps and documents
- additionally, looking into better estimators based on literature
  - Competing Unions (Wolf, 2011)
  - Synthetic Control Methodology on Free Trade Agreements (Hannan, 2017)
  - dyadic treatment of trade agreements (Hoshino and Yanagi, 2025)

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