Railways and the European Fertility Transition

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Question and Motivation

Question

Did railways affect fertility in Europe during the continent's fertility transition?

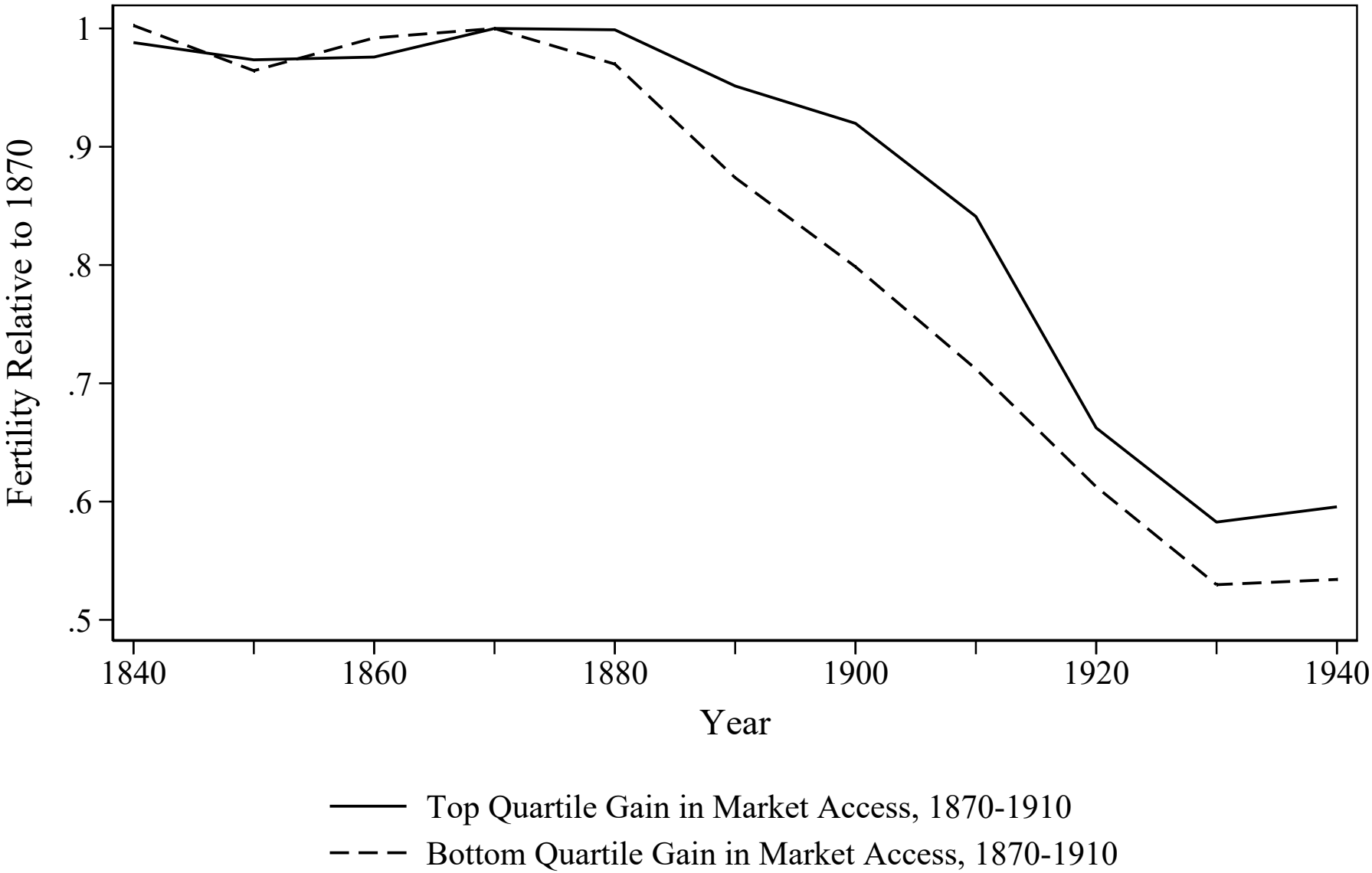
Motivation

- Europe's declining fertility in the long nineteenth century (e.g. crude birth rates fell in the UK by 33%, 1880-1910) was necessary for modern economic growth (Crafts and Mills, 2020; Galor and Weil, 1999).
- Europe's railway network more than doubled in length between 1870 and 1910 (Martí-Henneberg, 2013).
- If railways increased urbanization or the returns to child quality, they may have sped up the decline in fertility...
- ...but if railways increased incomes or the returns to child labor they may have slowed the decline in fertility.

This Paper

- We create an unbalanced panel of locations (∼NUTS 3 regions) combining data on fertility from the Princeton European Fertility Project and railways from Martí-Henneberg (2013).
- We show, in a regression with fixed effects for locations and decades, that market access slowed the fertility decline.
  - A one standard deviation increase in market access predicts fertility is greater by 0.14 standard deviations.
- We use access to markets more than 500km away as an instrument for market access, confirming our OLS results.
- Results are consistent with children as a normal good:
  - Greater nuptiality of women aged 20-24 is an intermediate mechanism.
  - Income per capita rises in locations that gain market access.
  - Effects are greatest in ultimately developed locations where schooling and female labor force participation lagged.
- Results are robust to tests of the parallel trends assumption, to exploiting within-country variation, and other checks.

In a Nutshell



Contribution

- To the literature on fertility transitions (e.g. Aaronson et al, 2014; Bleakley and Lange, 2009):
  - Guinnane (2011): "Despite at least one hundred years of academic and official interest in the decline of fertility, this question is not one for which economists have a clear, empirically well-founded explanation."
  - Europe's fertility transition may have been due to economic motives (Becker and Lewis, 1973; Fernihough, 2017) or culture (Beach and Hanlon, forthcoming; Spolaore and Wacziarg, 2022)...or both...or neither...
  - Railways provide (hopefully) a window into both economic and cultural explanations.
- To the literature on railroads (e.g. Fogel, 1964; Donaldson, 2018):
  - There is an extensive literature on how railroads have shaped economic geography, structural transformation, etc...
  - The literature on human capital outcomes is smaller (e.g. Andersson et al. 2023; Zimran 2020), and multi-country studies with meso-level data are rare.
  - The closest paper, Guldi and Rahman (2022), finds that market access reduced fertility via specialization in the United States.
  - We focus on Europe, introduce novel market access measures and an instrumental variables approach, and find different results through other mechanisms.

Empirical strategy

$$Fertility_{ld} = \beta \ln(MarketAccess)_{ld} + x_l' \eta_d + \delta_l + \eta_d + \epsilon_{ld} \quad (1)$$

- $Fertility_{ld}$ is a measure of fertility in location l in decade $d \in 1840, ..., 1940$.
  - Generally I_f, a ratio between 0 and 100 of fertility to the highest ever recorded.
- $\ln(MarketAccess)_{ld}$ is a measure of how connected location l is to other locations in decade d.
  - In our baseline, this only changes over time due to the spread of the railway.
- As an instrumental variable, we compute $\ln(DistantMarketAccess)_{ld}$ using only markets at least 500km away (Chan, 2023).
- x_l is time-invariant controls, usually geographic, interacted with decade fixed effects η_d.
- δ_l and η_d are fixed effects for location and decade.
- We cluster standard errors by location.

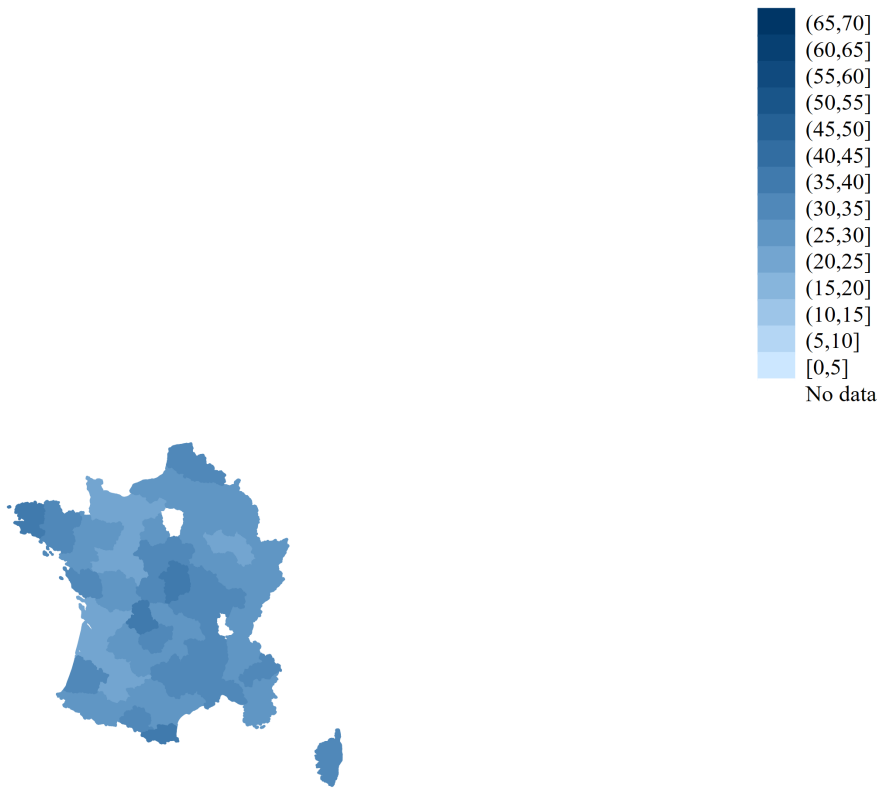
Data: Fertility

- Data come from the Princeton project on the decline of fertility in Europe (Coale and Watkins, 1986).
- These cover 1229 European "provinces and smaller districts" between 1787 and 1970.
- The main fertility measure we use is I_f, the ratio of births to a "maximum" measured using data on Hutterites:

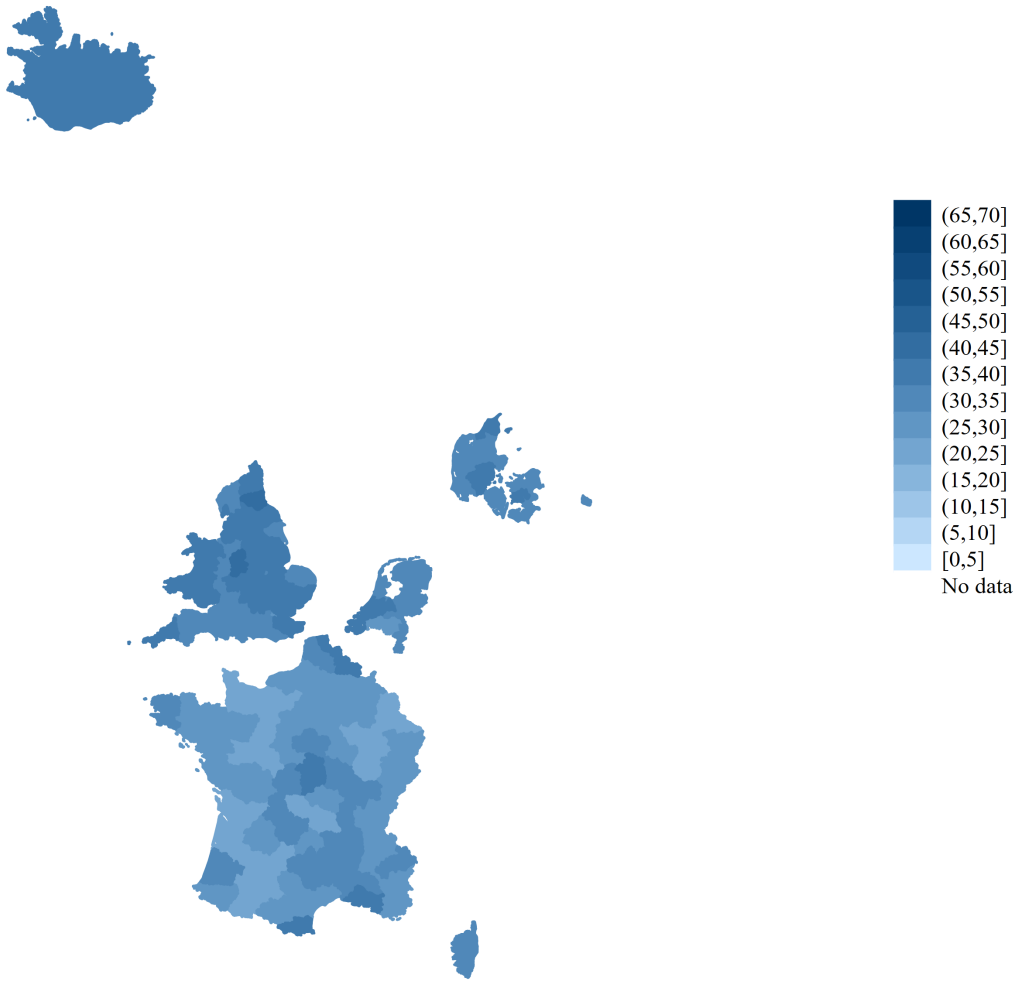
$$I_f = \frac{B_f}{\sum_a f_a h_a}$$

- Here:
  - B_f is all births.
  - a is an age bin (e.g. 25-29).
  - f_a is the number of women in age bin a.
  - h_a is the Hutterite fertility rate in age bin a.
- The data also report analogous rates of marital fertility (I_g) and non-marital fertility (I_h).
- These data are extremely unbalanced, and so we collapse them to a decadal panel by averaging over observations in a decade.
- We multiply I_f and other fertility measures by 100 for coefficient interpretability.

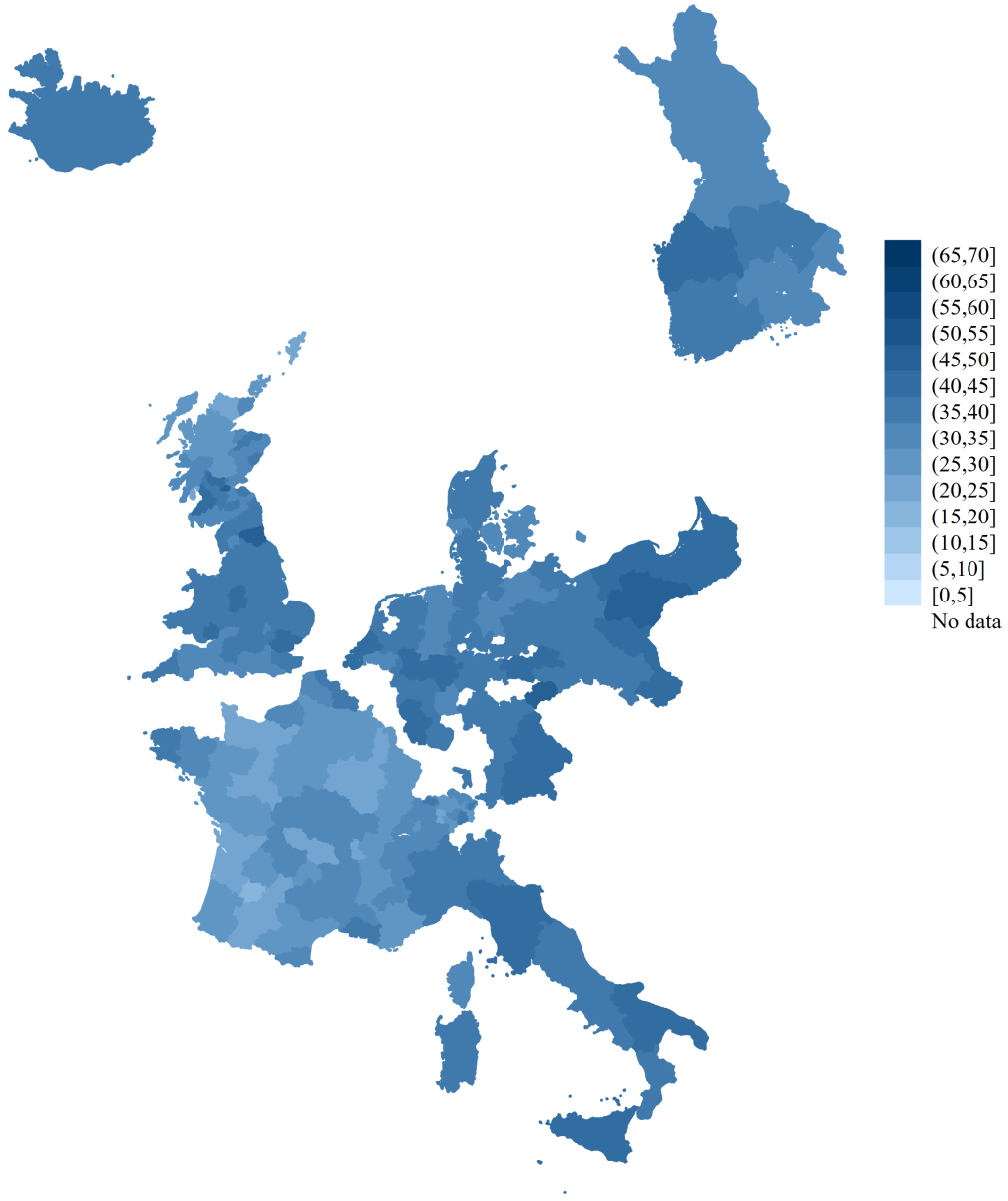
Fertility (I_f): 1840



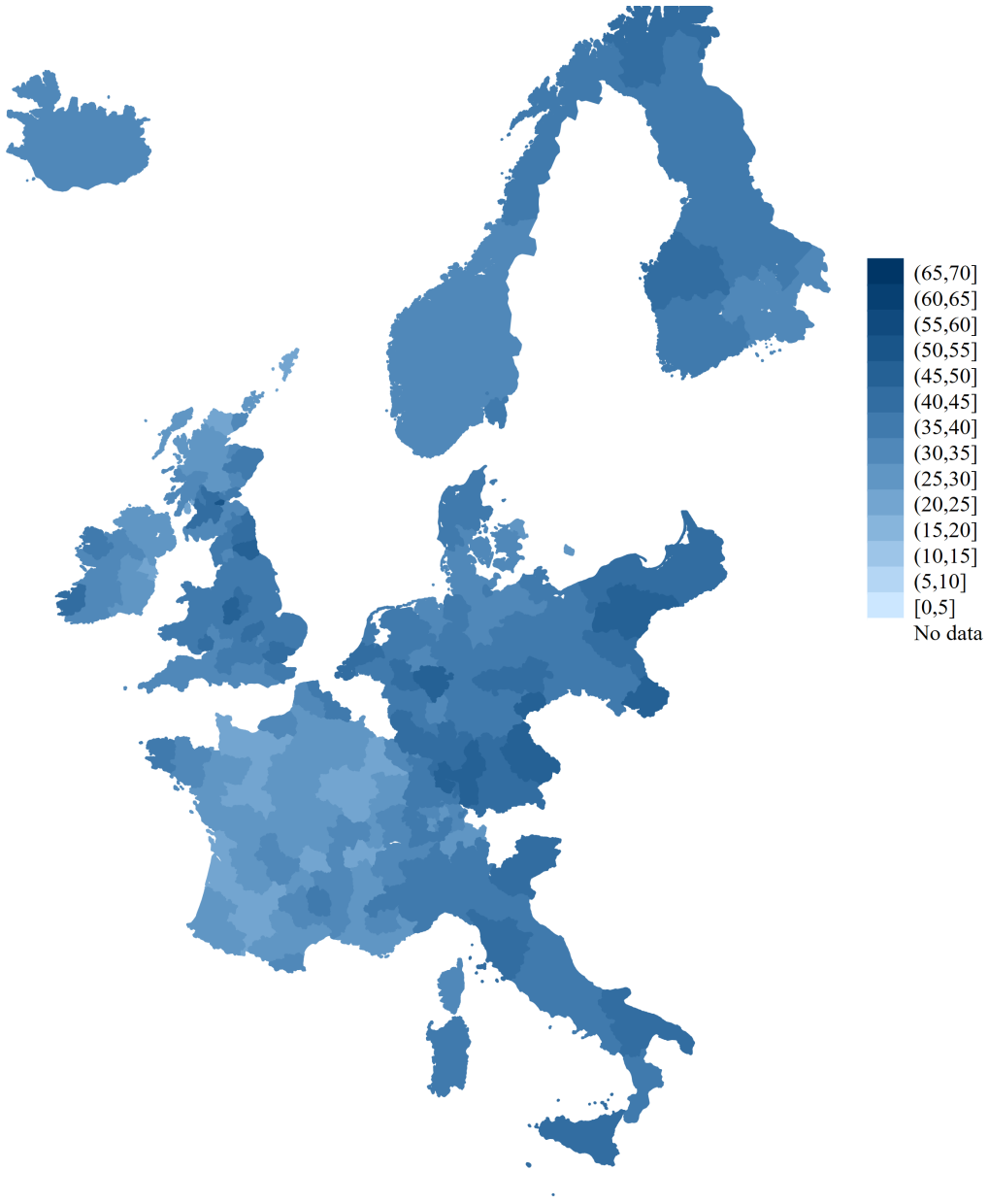
Fertility (I_f): 1850



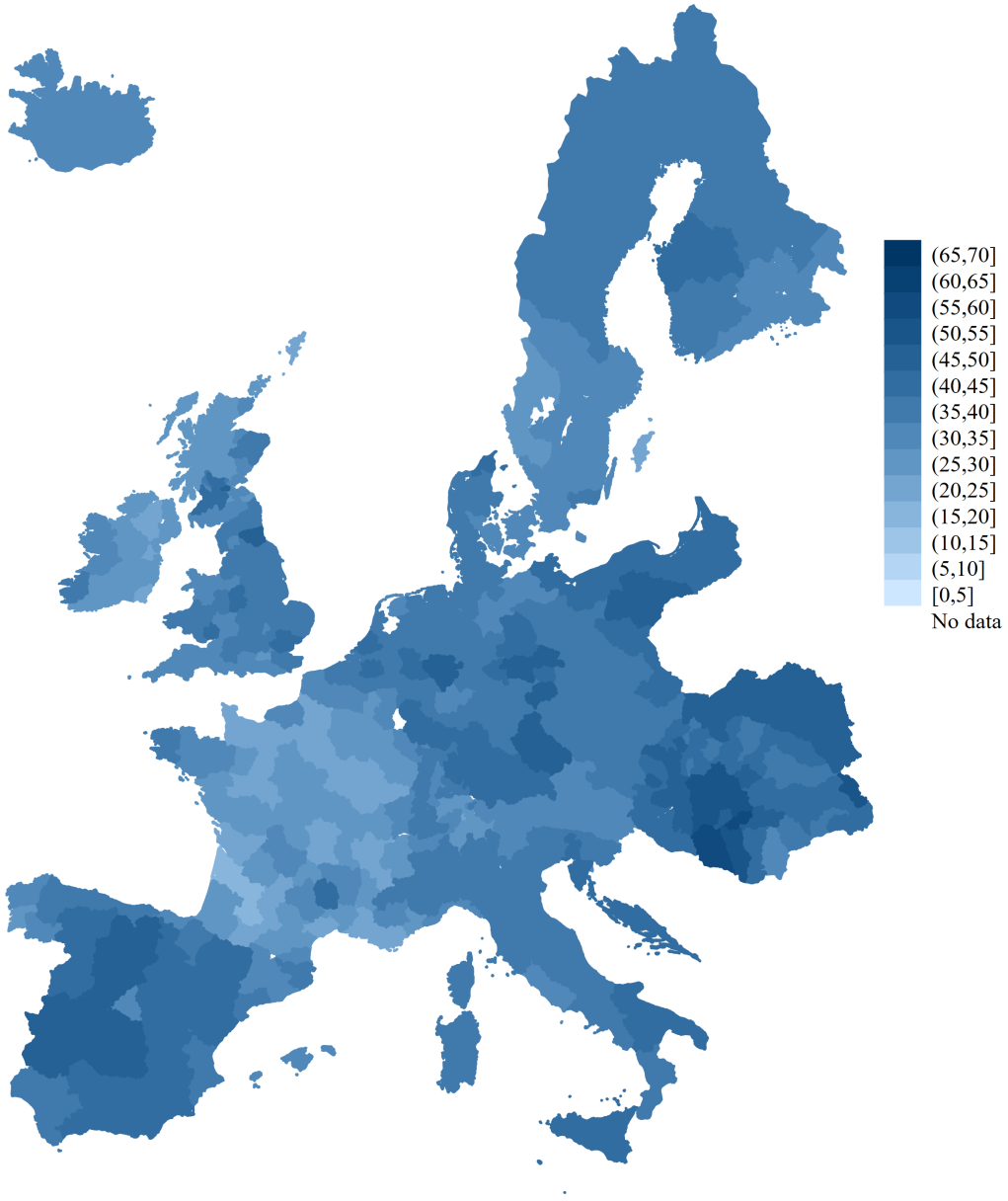
Fertility (I_f): 1860



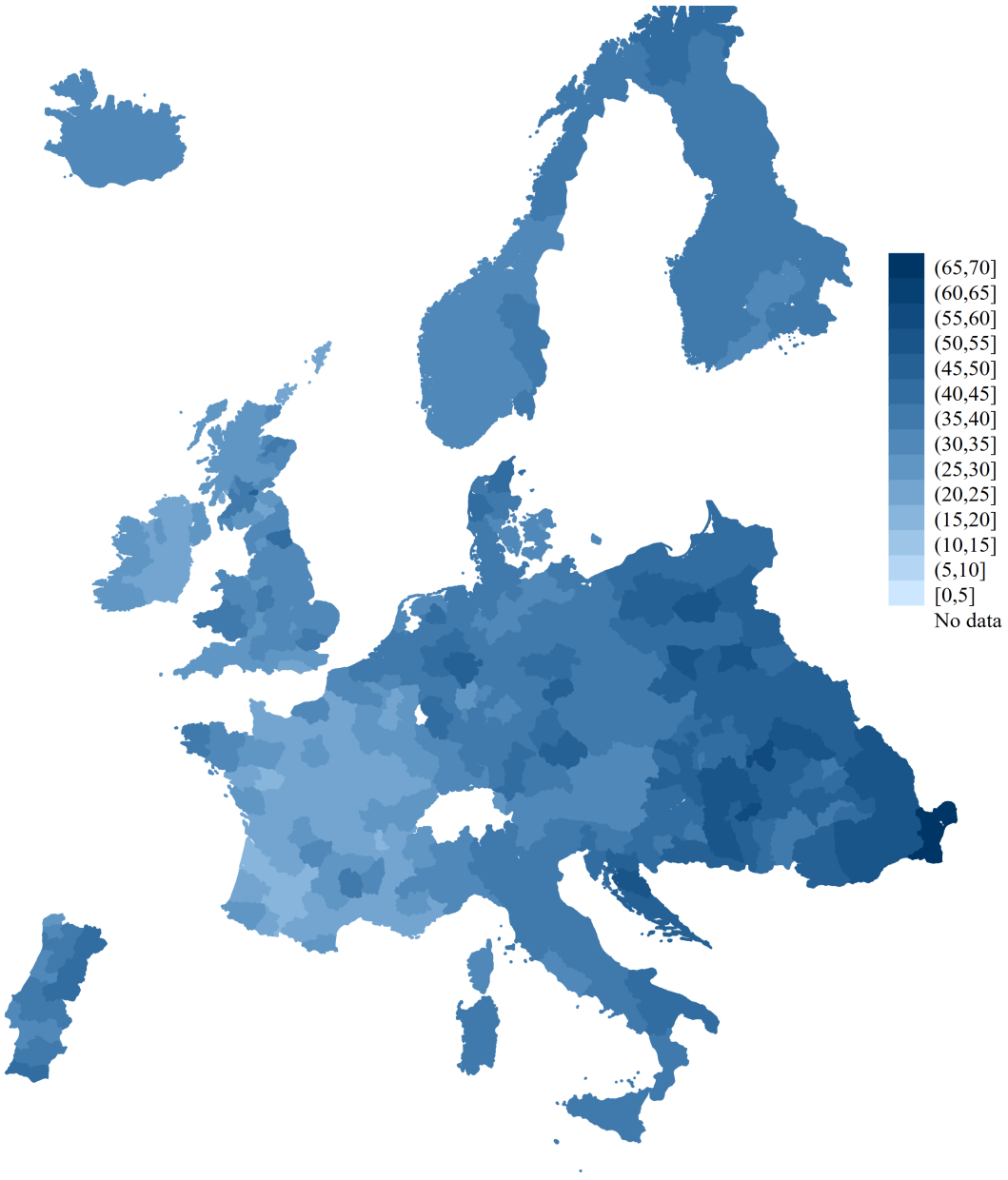
Fertility (I_f): 1870



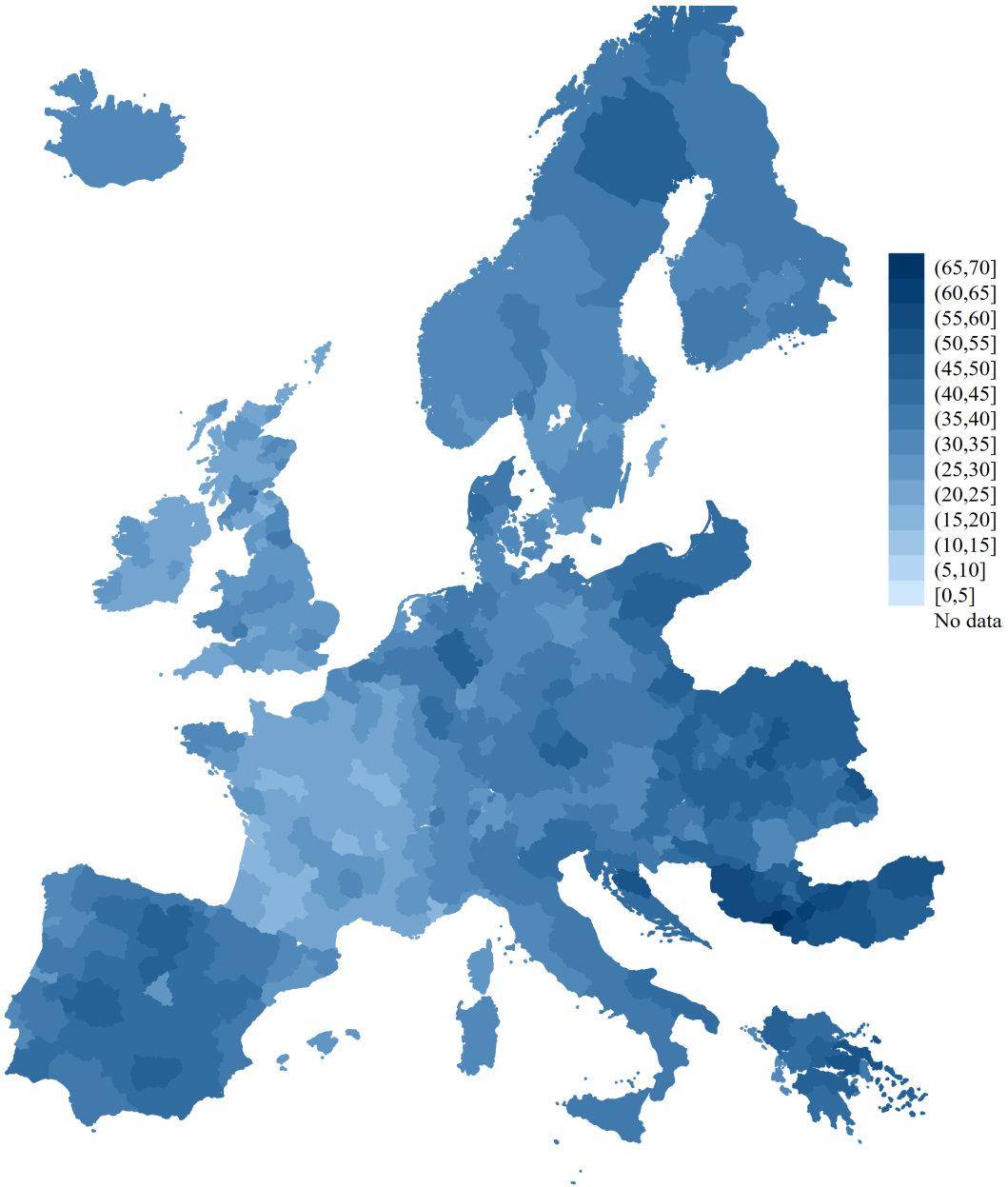
Fertility (I_f): 1880



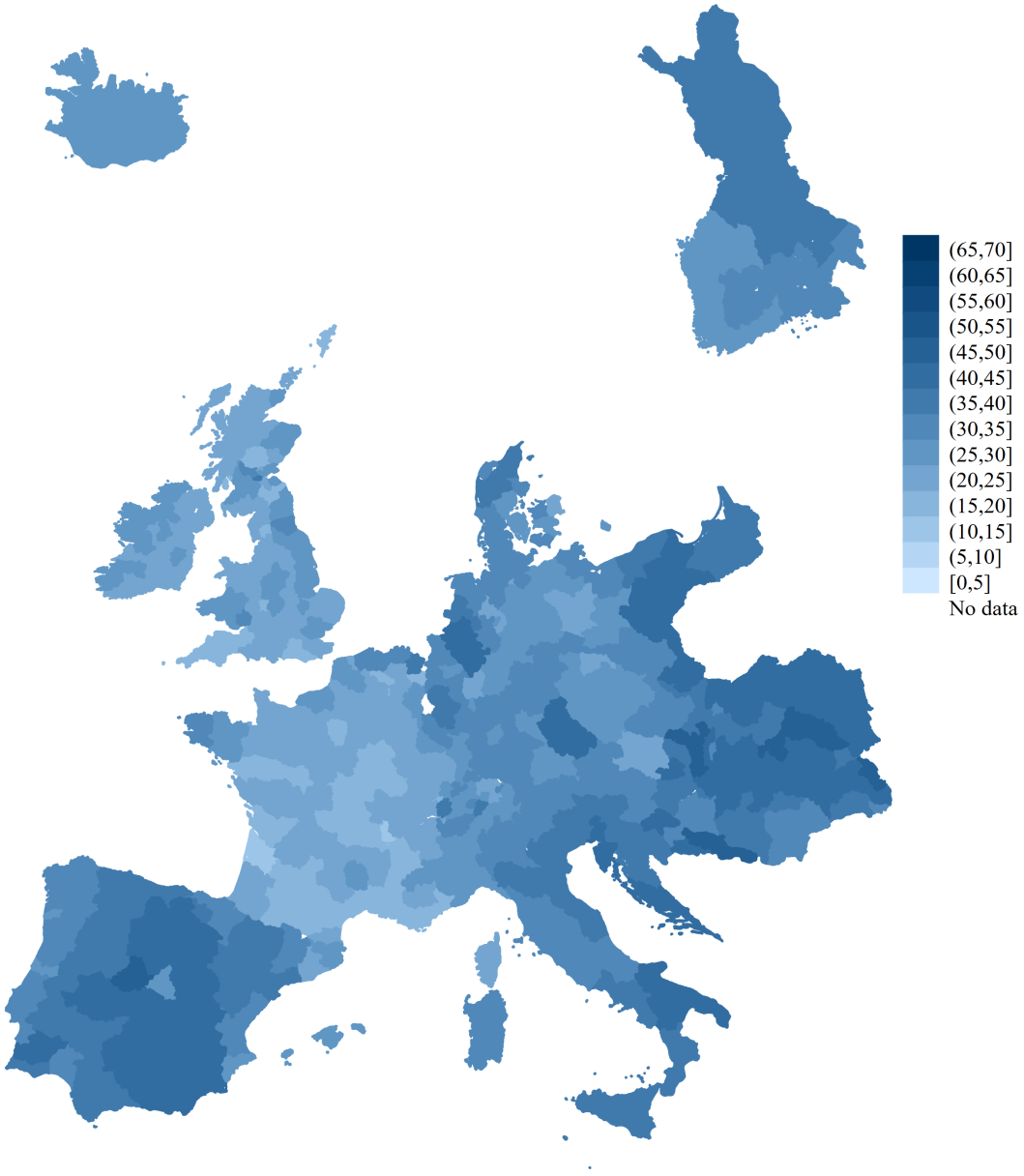
Fertility (I_f): 1890



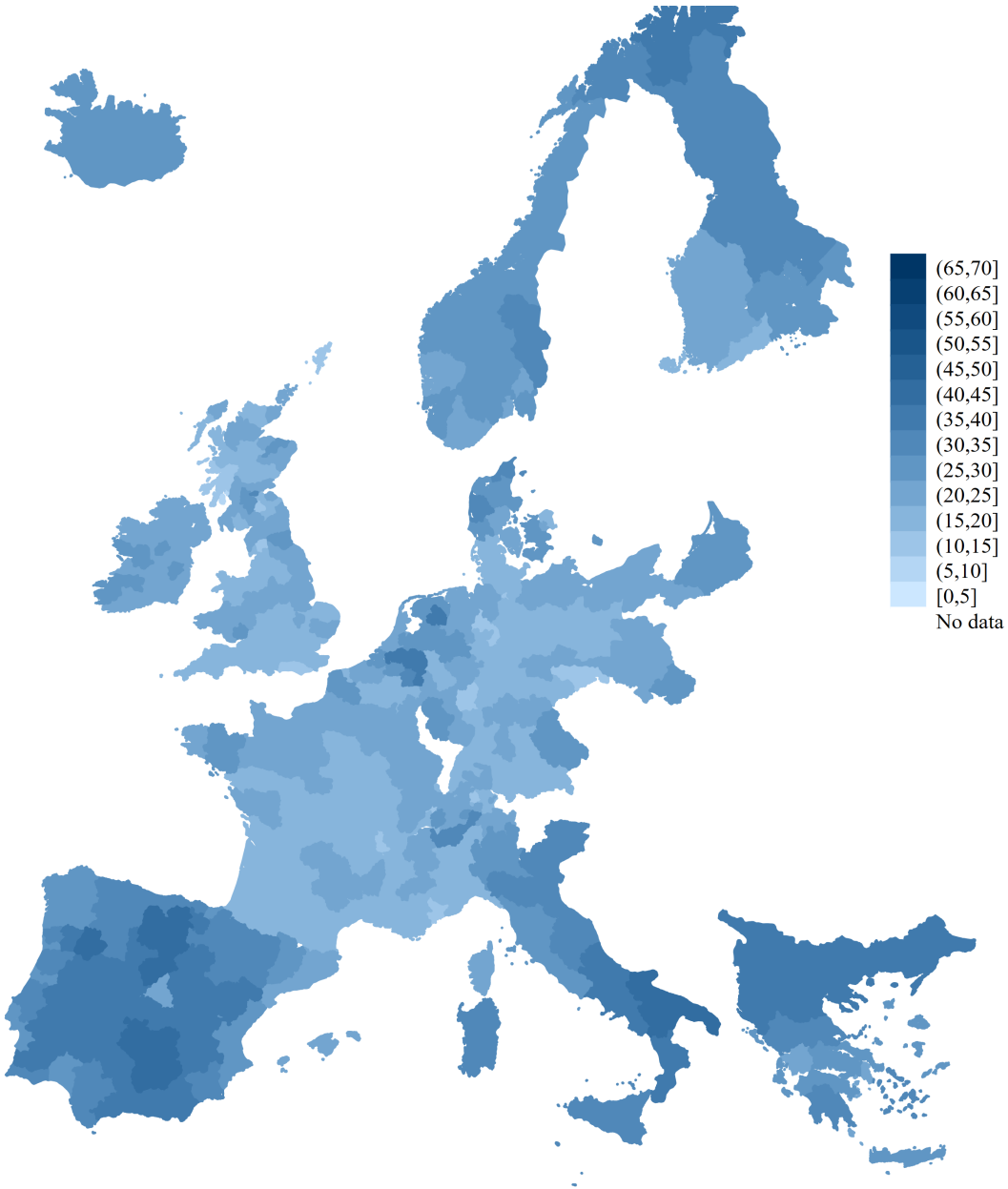
Fertility (I_f): 1900



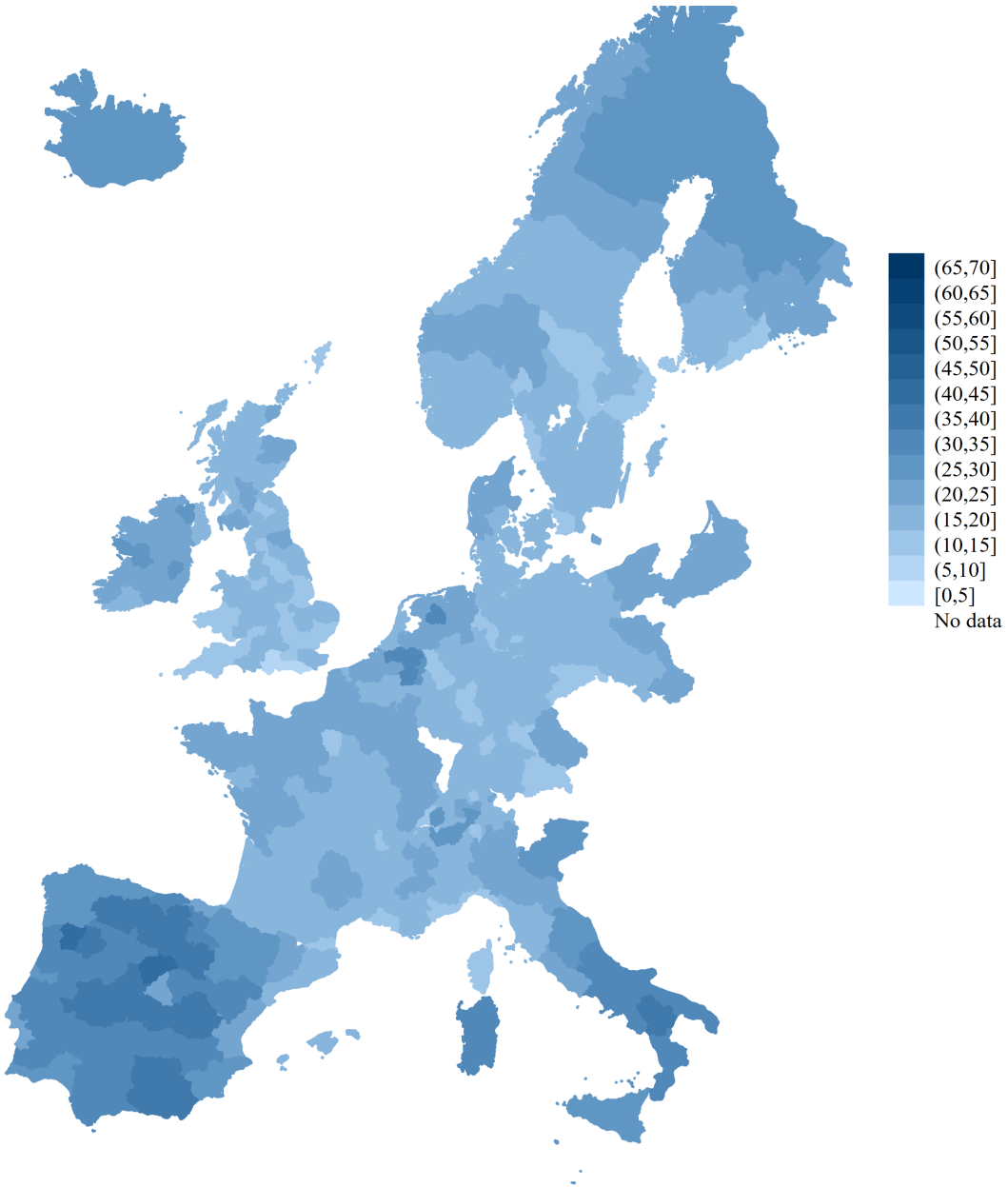
Fertility (I_f): 1910



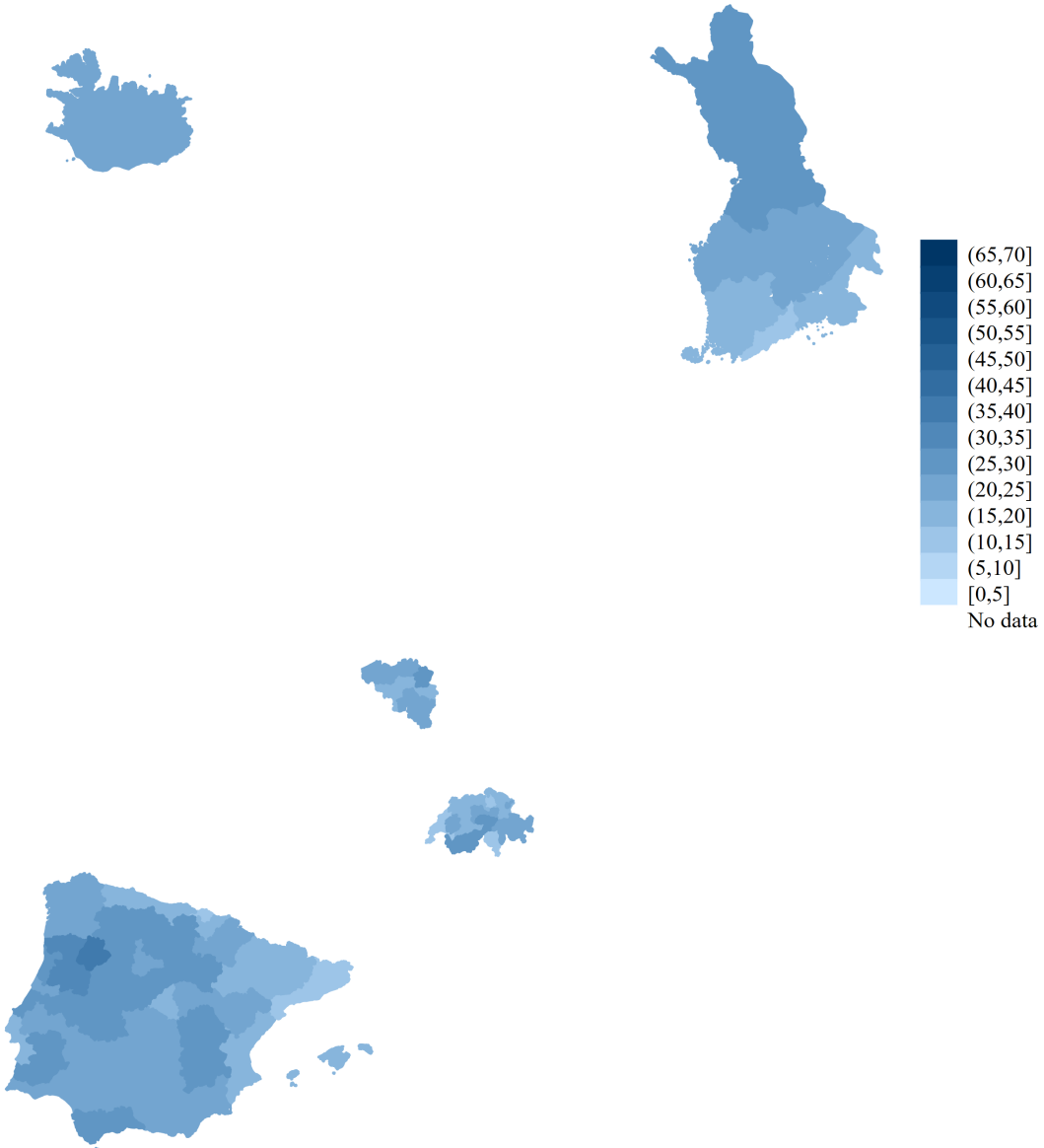
Fertility (I_f): 1920



Fertility (I_f): 1930



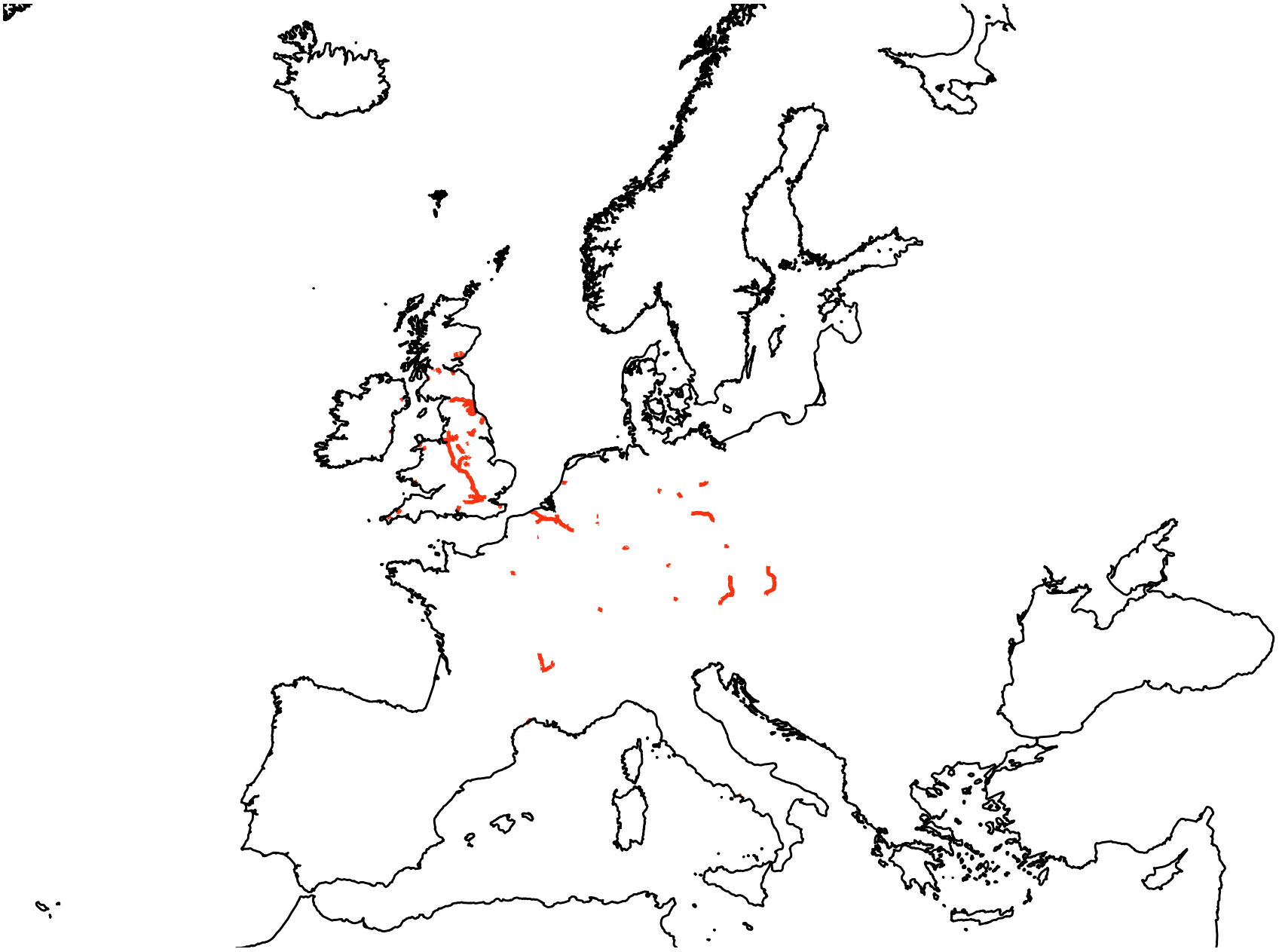
Fertility (I_f): 1940



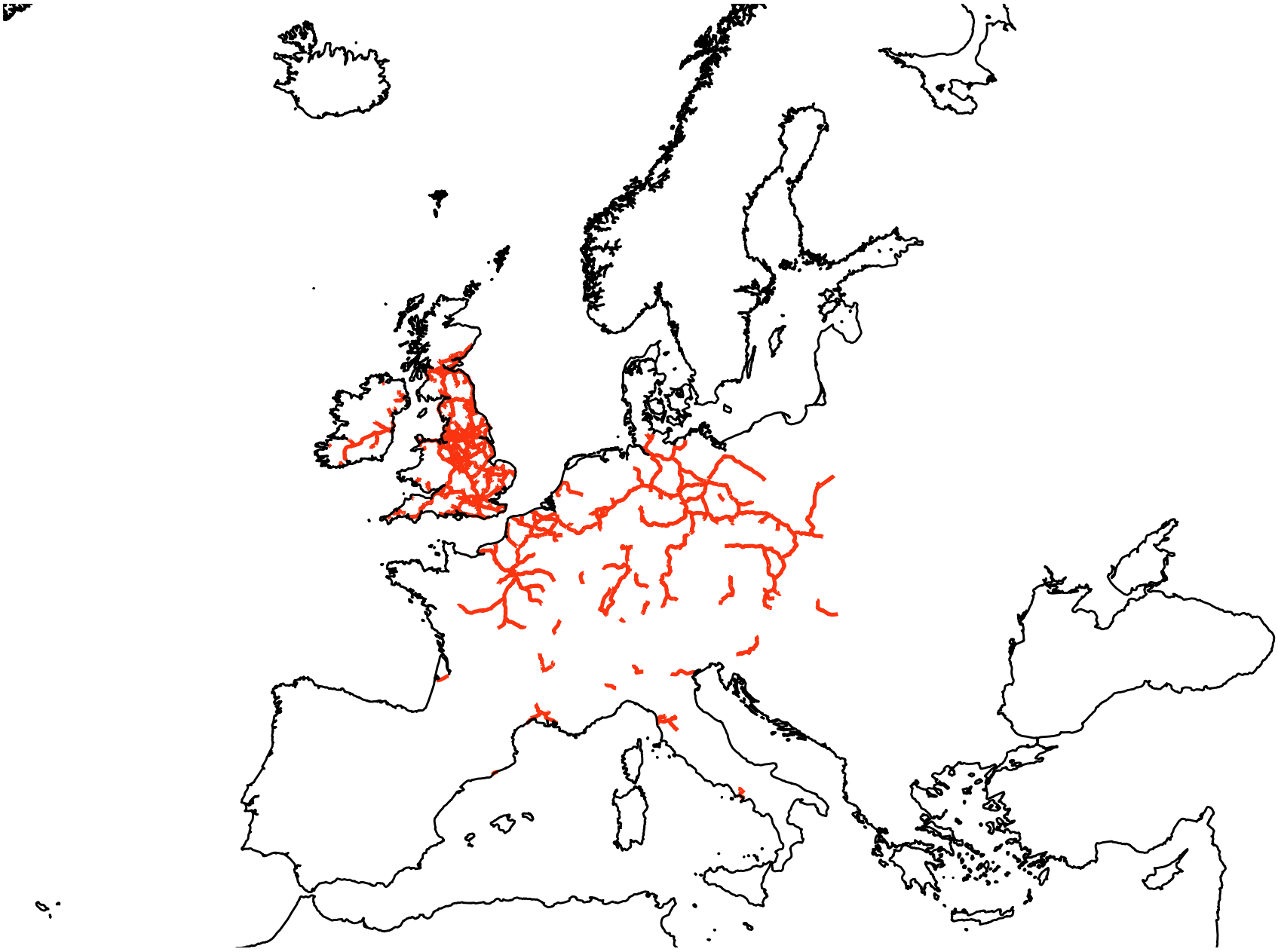
Data: Railroads

- Data on railways are taken from Martí-Henneberg (2013).
- He constructs a polyline shapefile of active railways in Europe west (roughly) of Minsk, every decade from 1840-2010.
- We merge the fertility and rail data using polygon maps of $\sim$ NUTS3 units from Max Planck Institute for Demographic Research (MPIDR, 2013).
  - Series 0 (one of 3 series reported in the fertility data) maps almost perfectly 1:1 with the MPIDR map for 1900.
  - Our unit of observation in our regression analysis will be MPIDR polygon $\times$ decade.
- These polygons are also used to compute geographic control variables.

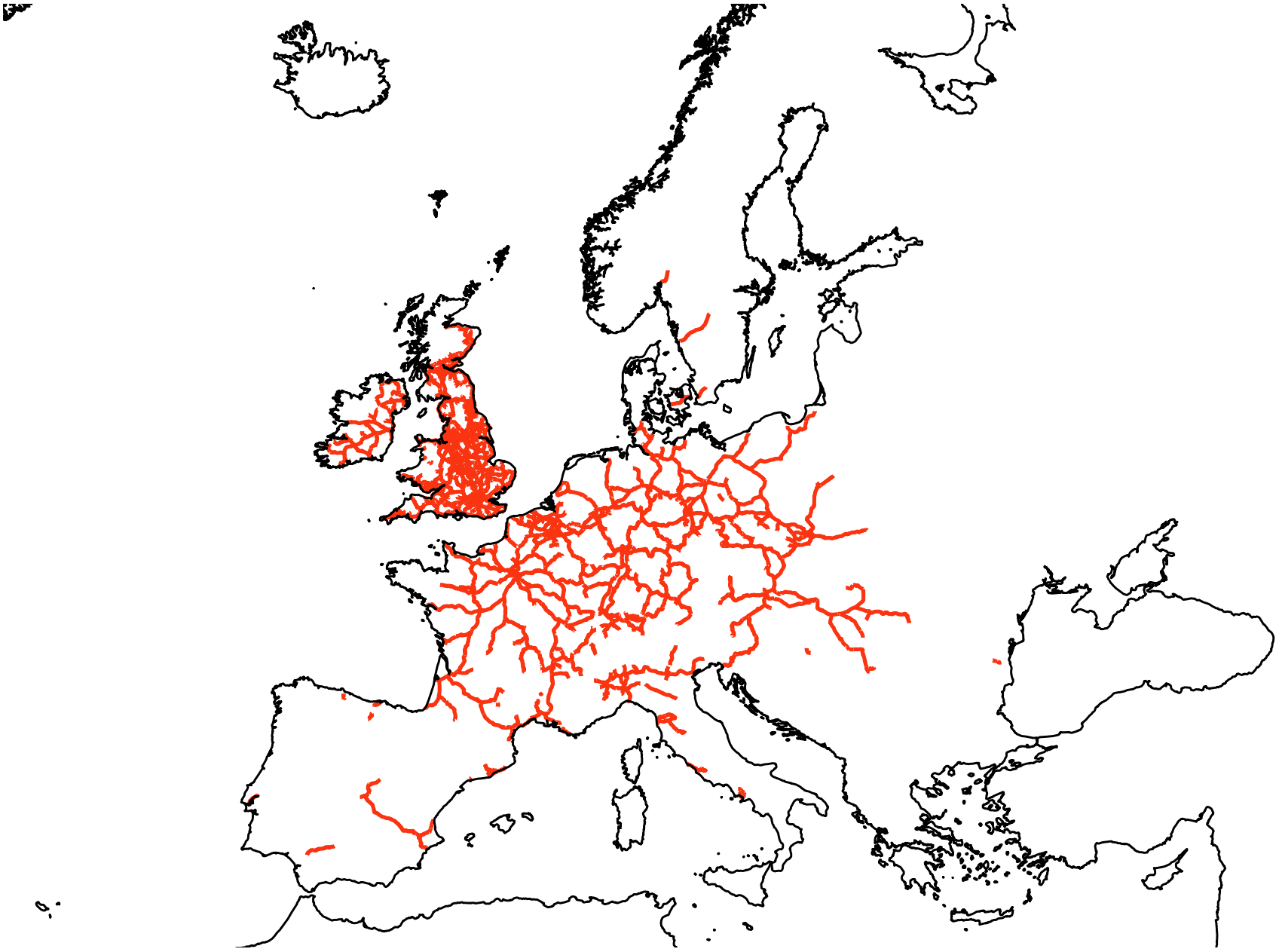
Railroads: 1840



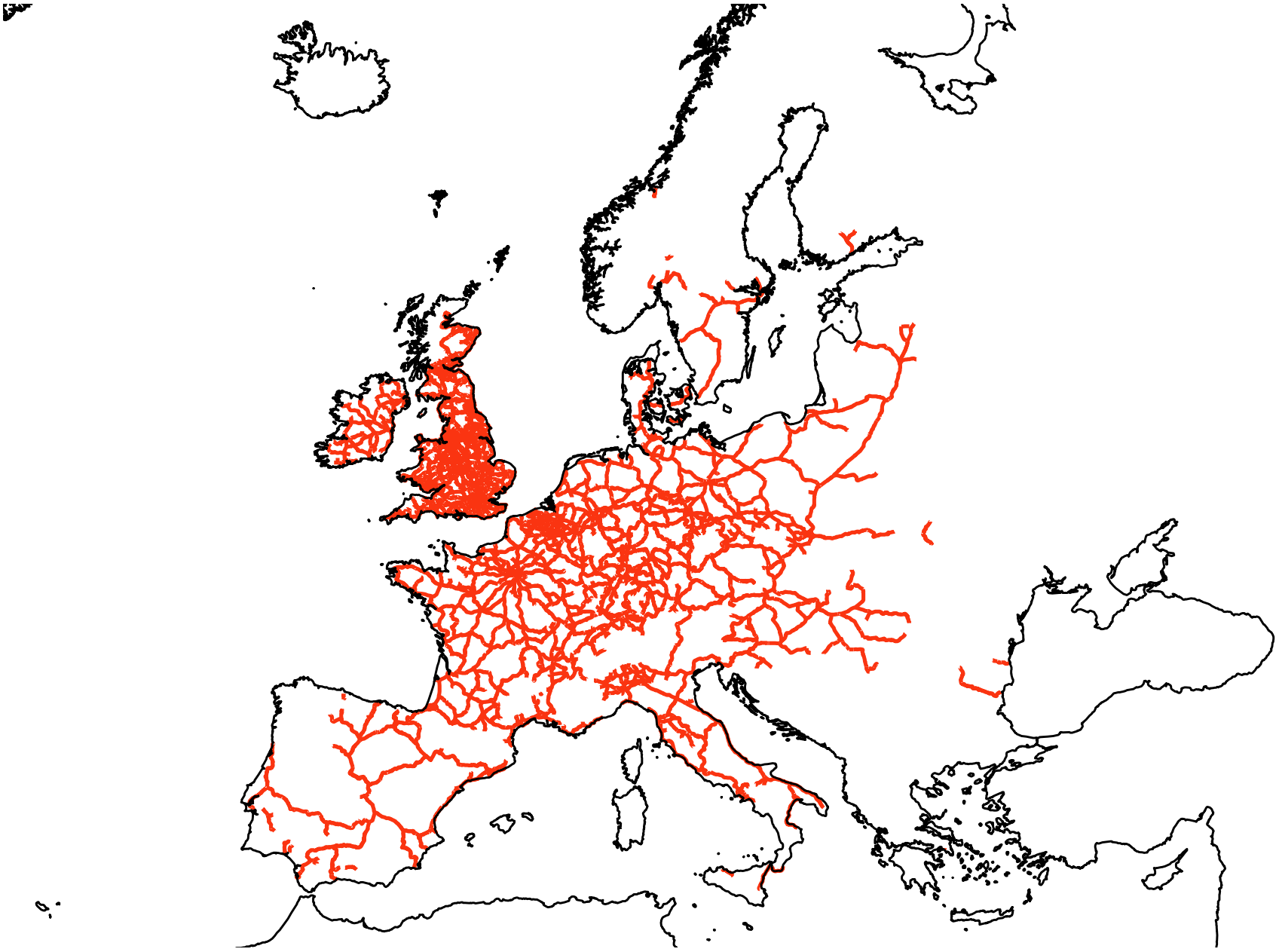
Railroads: 1850



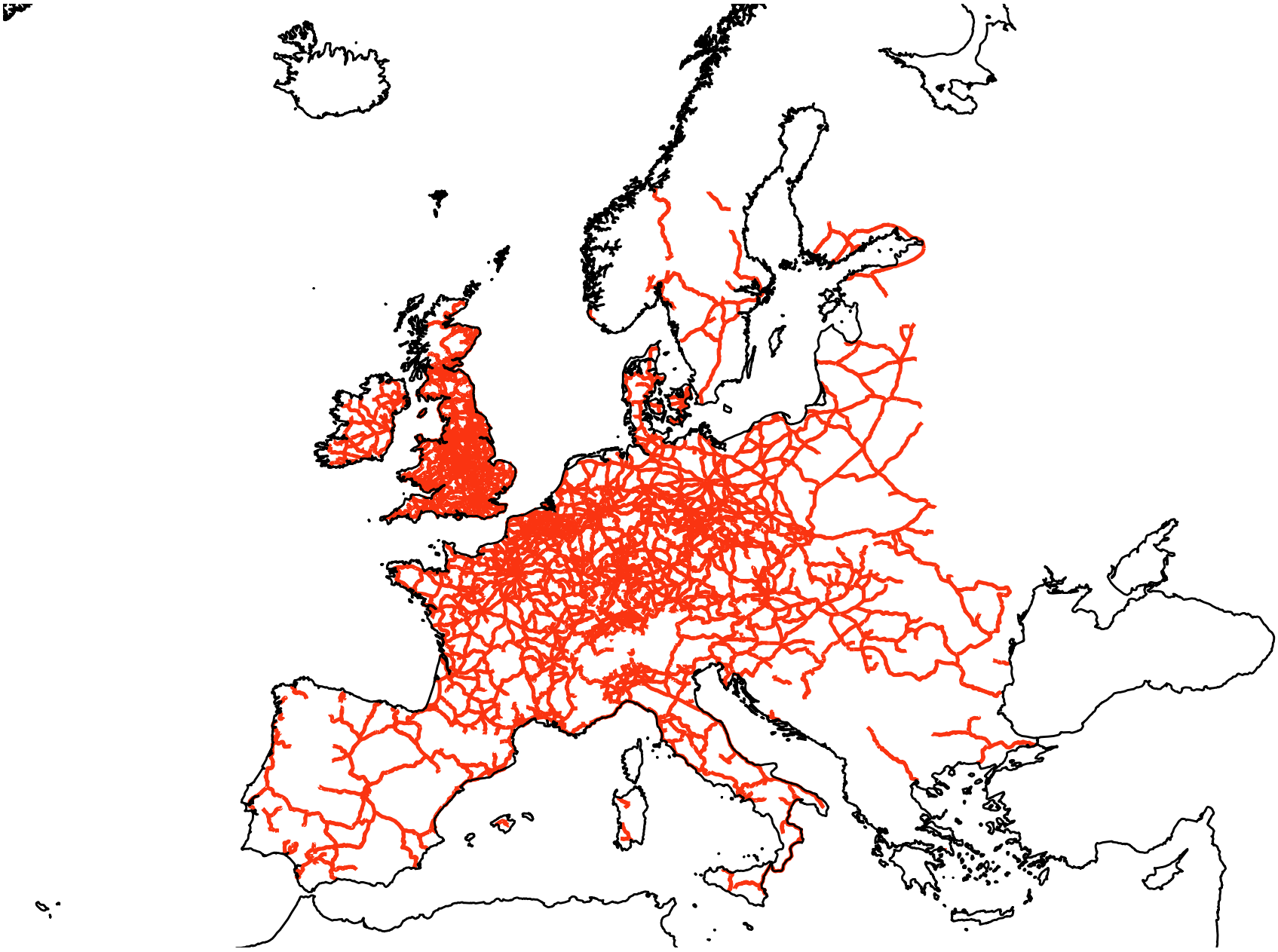
Railroads: 1860



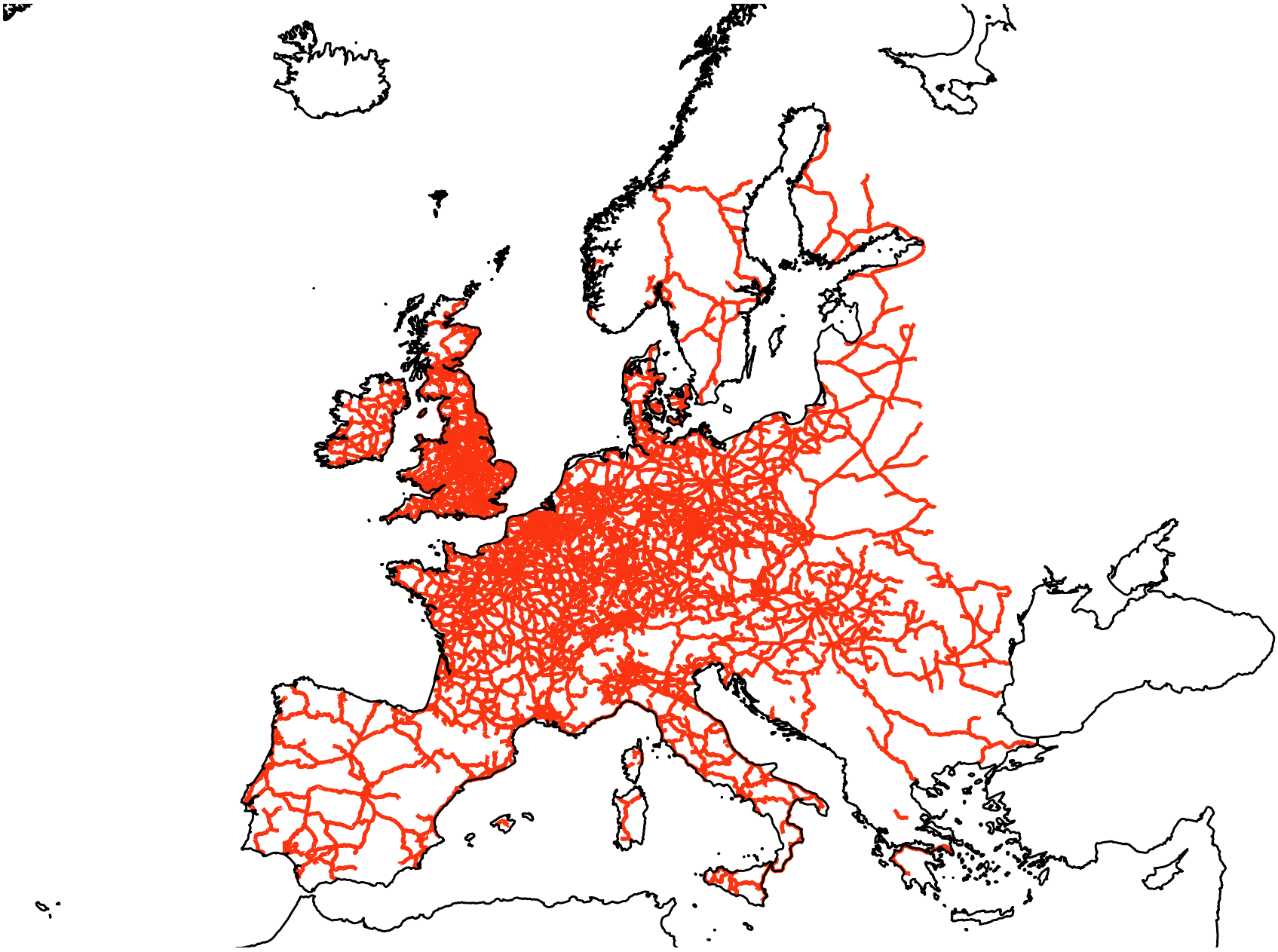
Railroads: 1870



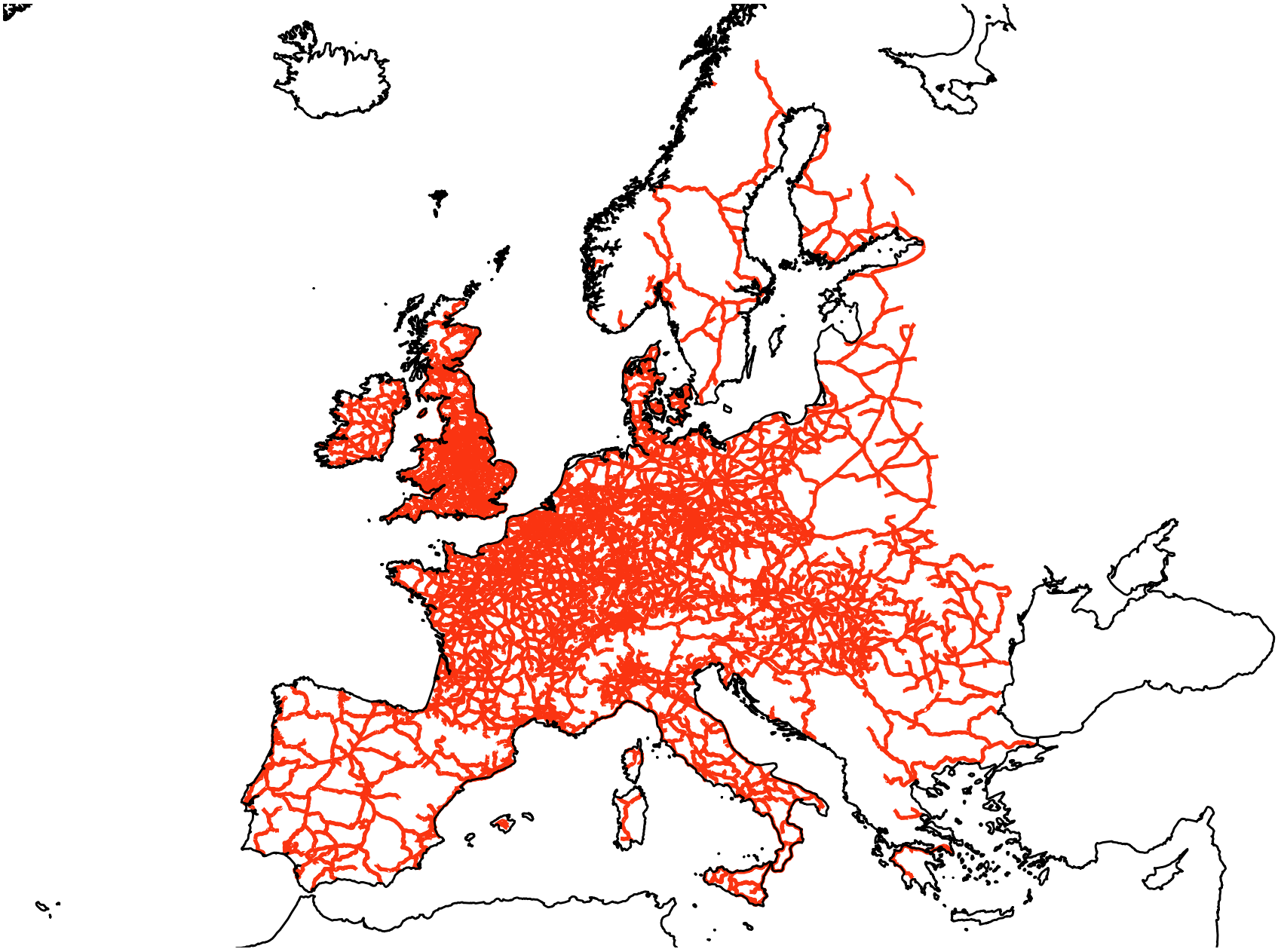
Railroads: 1880



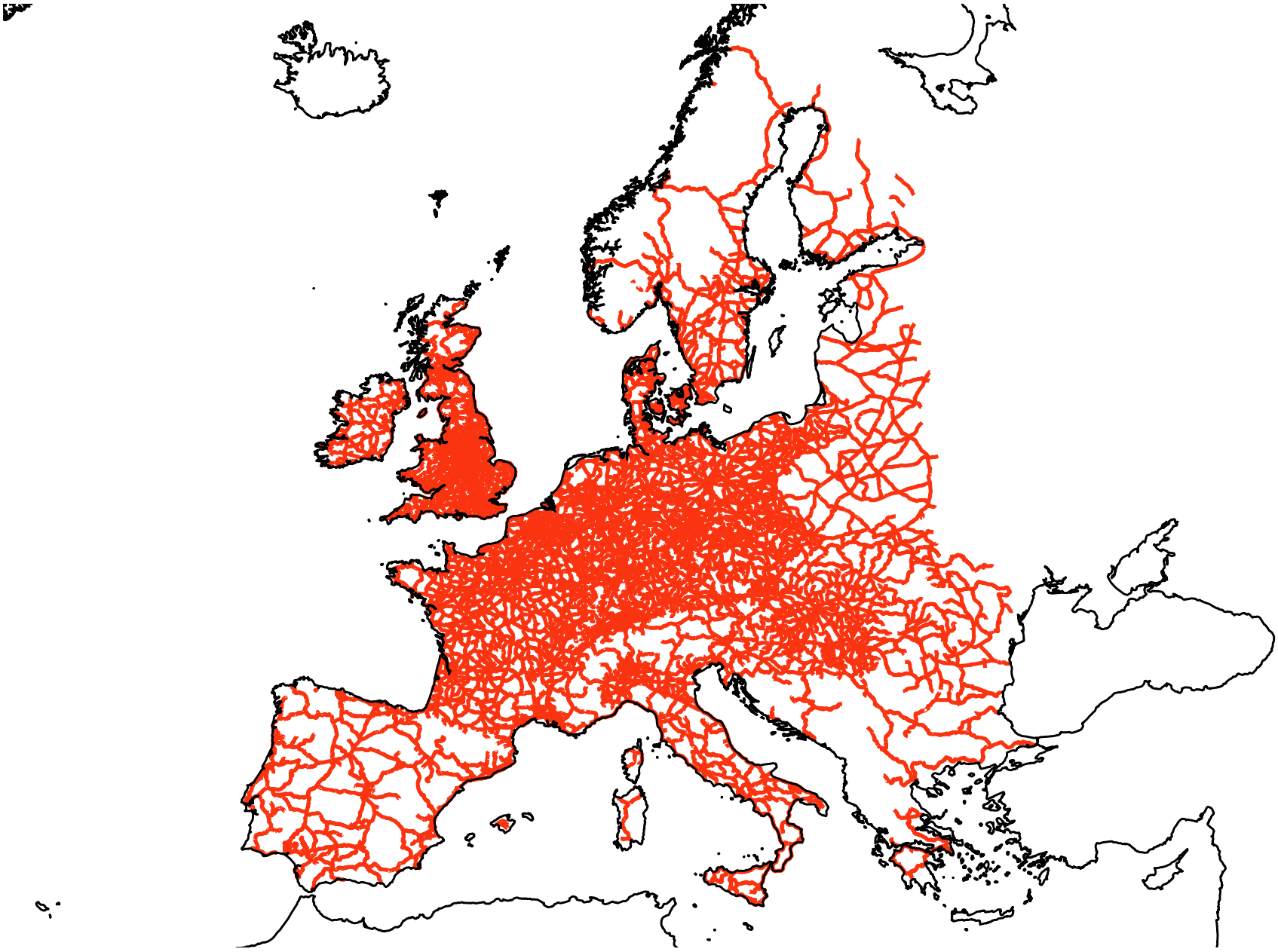
Railroads: 1890



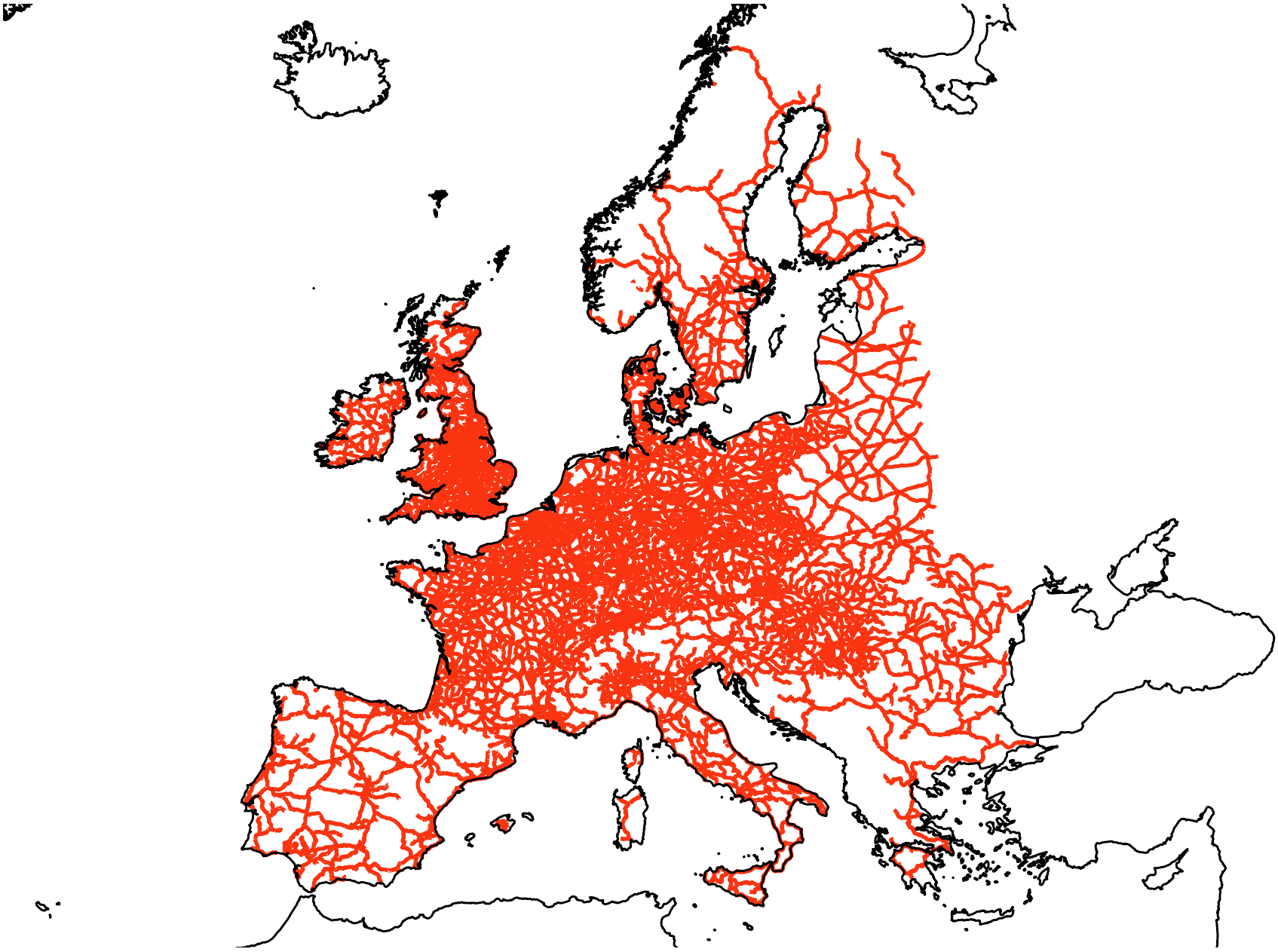
Railroads: 1900



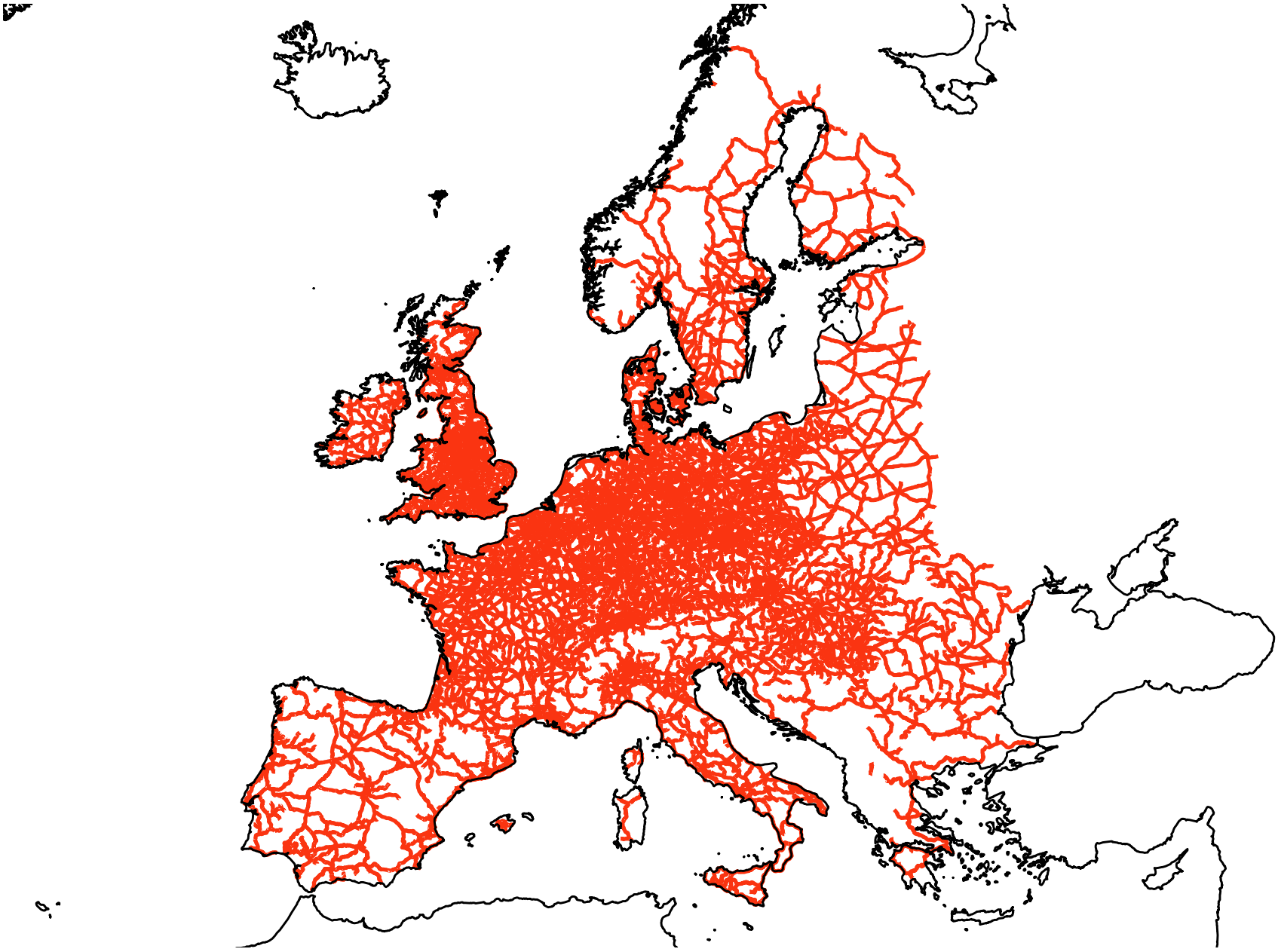
Railroads: 1910



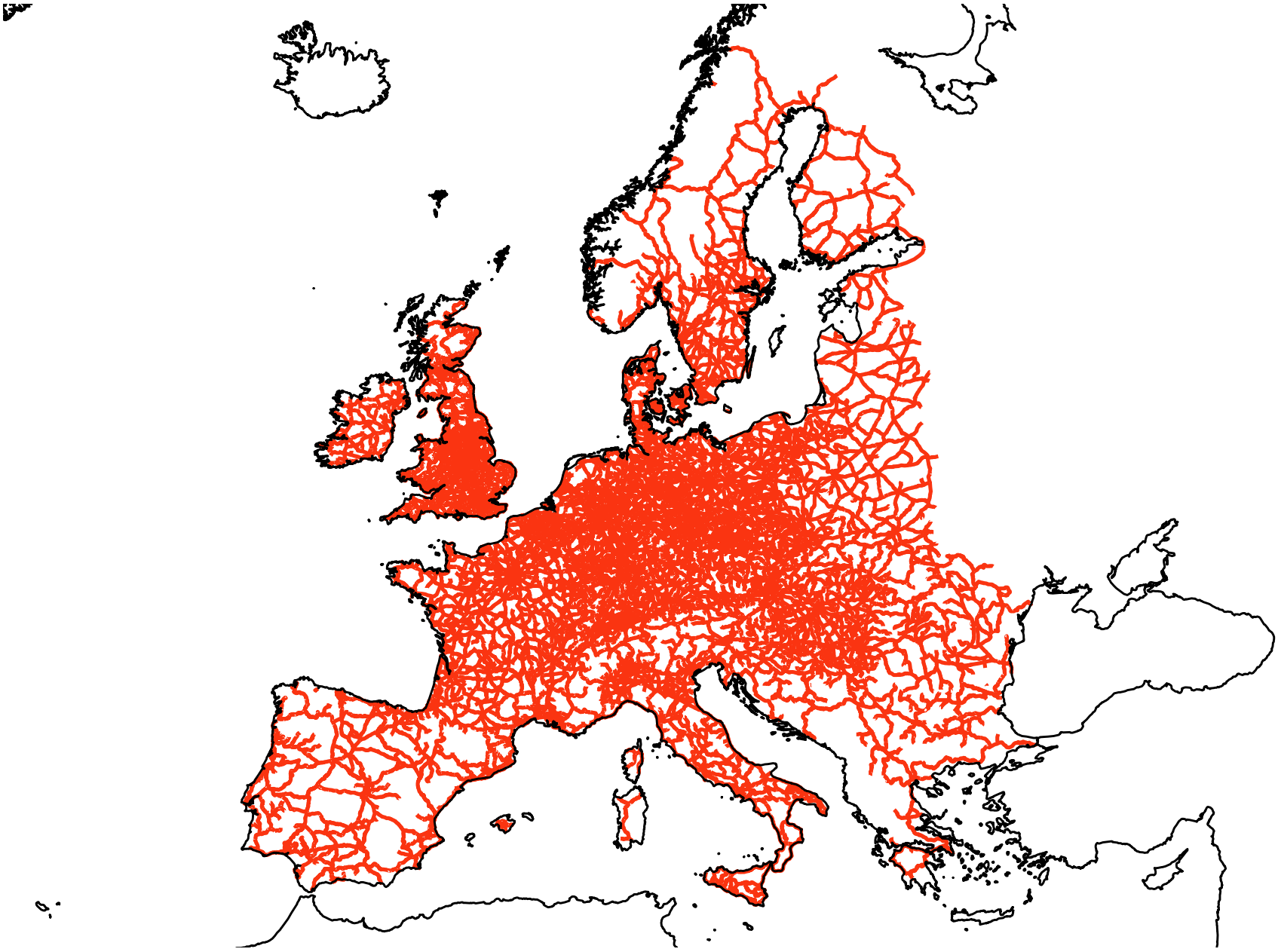
Railroads: 1920



Railroads: 1930



Railroads: 1940



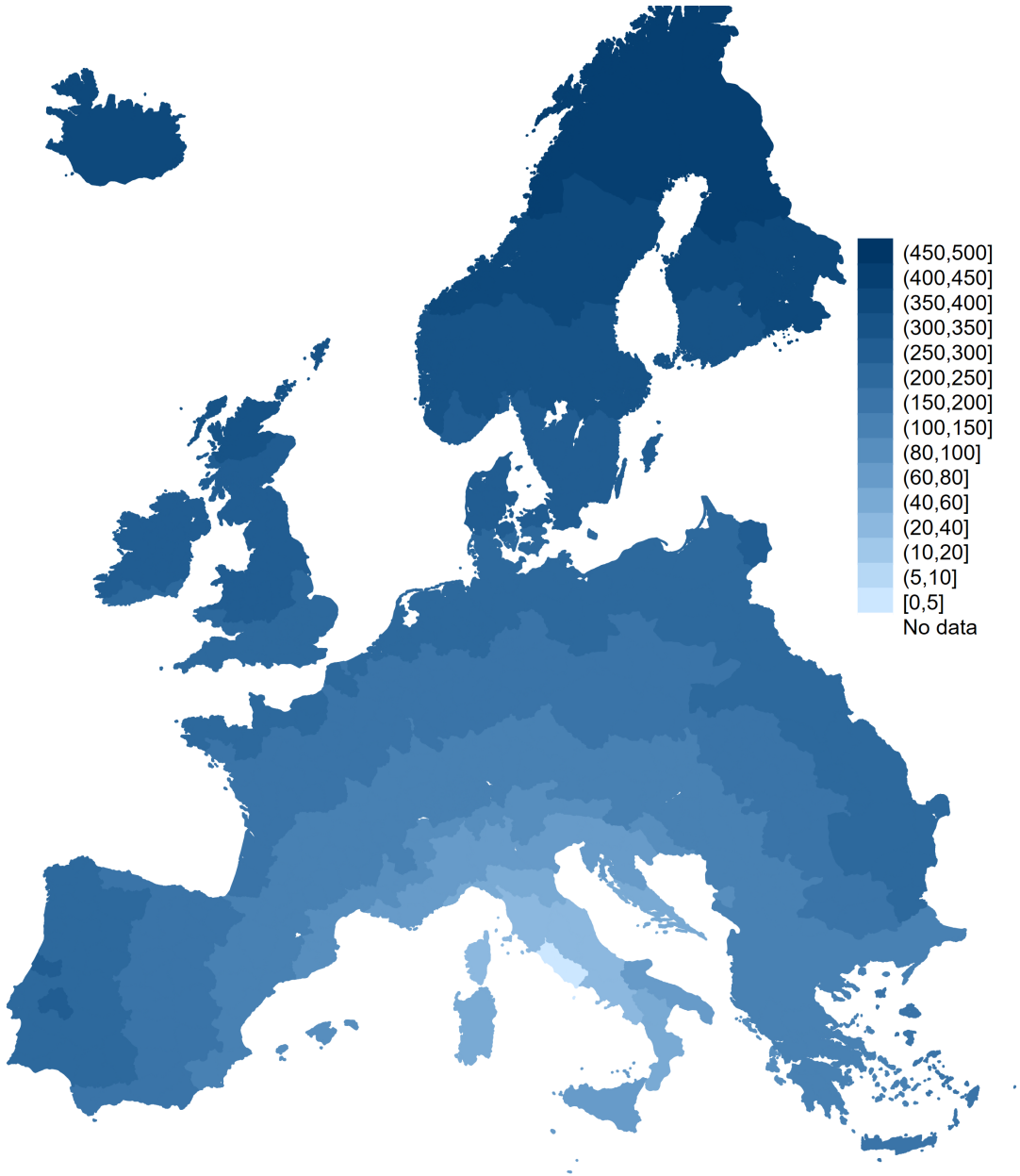
Data: Market Access

- We follow Donaldson and Hornbeck (2016) and use market access (MA_{ld}) to measure a location's l's exposure to other markets in decade d:

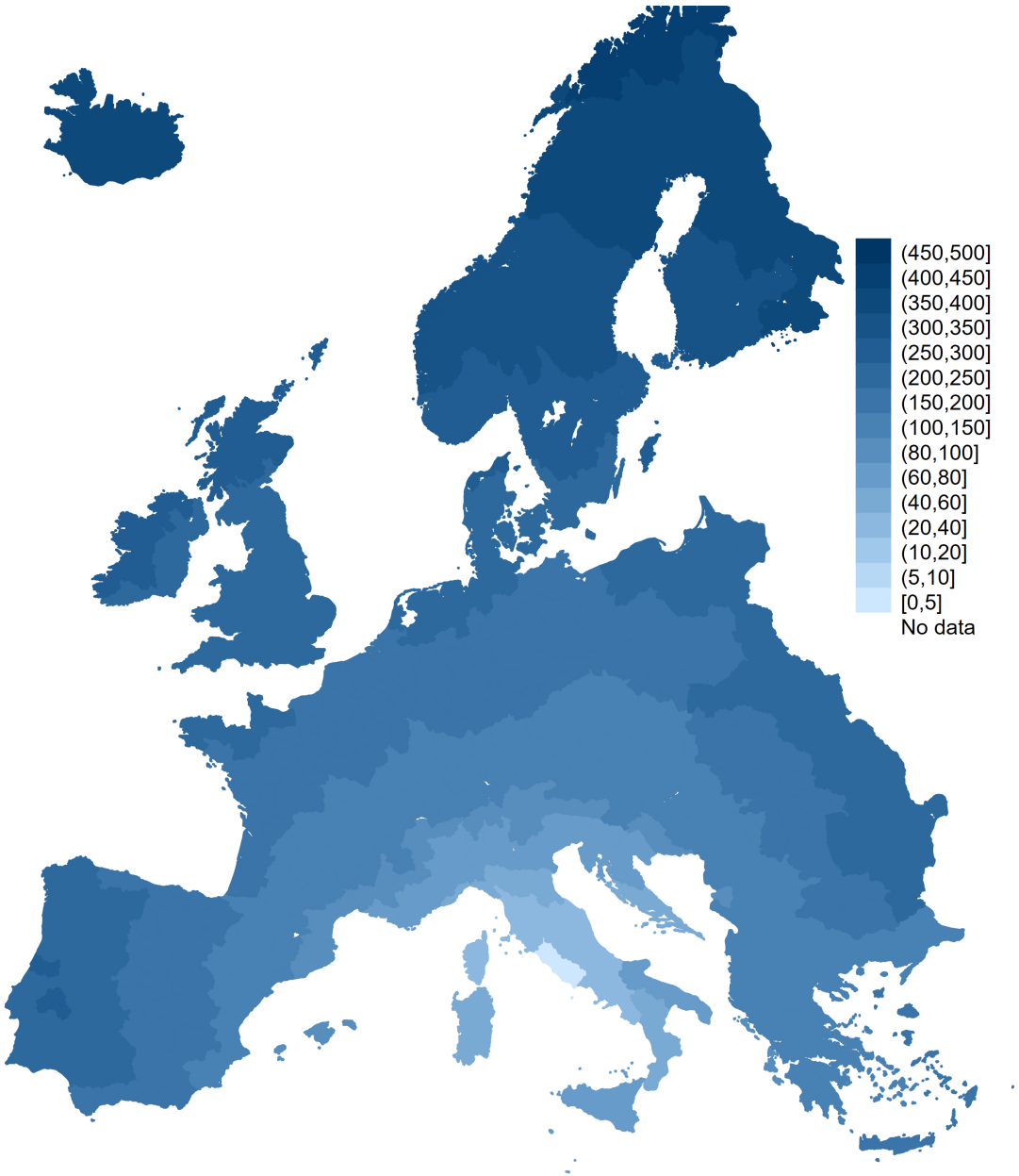
$$MA_{ld} = \sum_{l'} \frac{P_{l'd}}{\tau_{ll'd}^{\theta}}$$

  - $P_{l'd}$ is population of location l' in decade d.
  - $\tau_{ll'd}$ is the travel cost from the centroid of l to the centroid of l' in decade d.
  - θ is the trade elasticity. We use 8.22 in our baseline.
- For $P_{l'd}$, we use populations from the HYDE database in 1830 as our baseline (Klein Goldewijk et al., 2013).
- To compute τ:
  - We construct a $0.1^{\circ} \times 0.1^{\circ}$ grid.
  - We use the Özak (2018, 2010) Human Mobility Index for non-rail travel times.
  - We use 60 km per hour as the travel time by rail.
  - $\tau_{ll'd}$ is the time taken by the fastest route from l to l' given the rail network in decade d.
- Our instrument, distant market access, excludes l' within 500km of l.

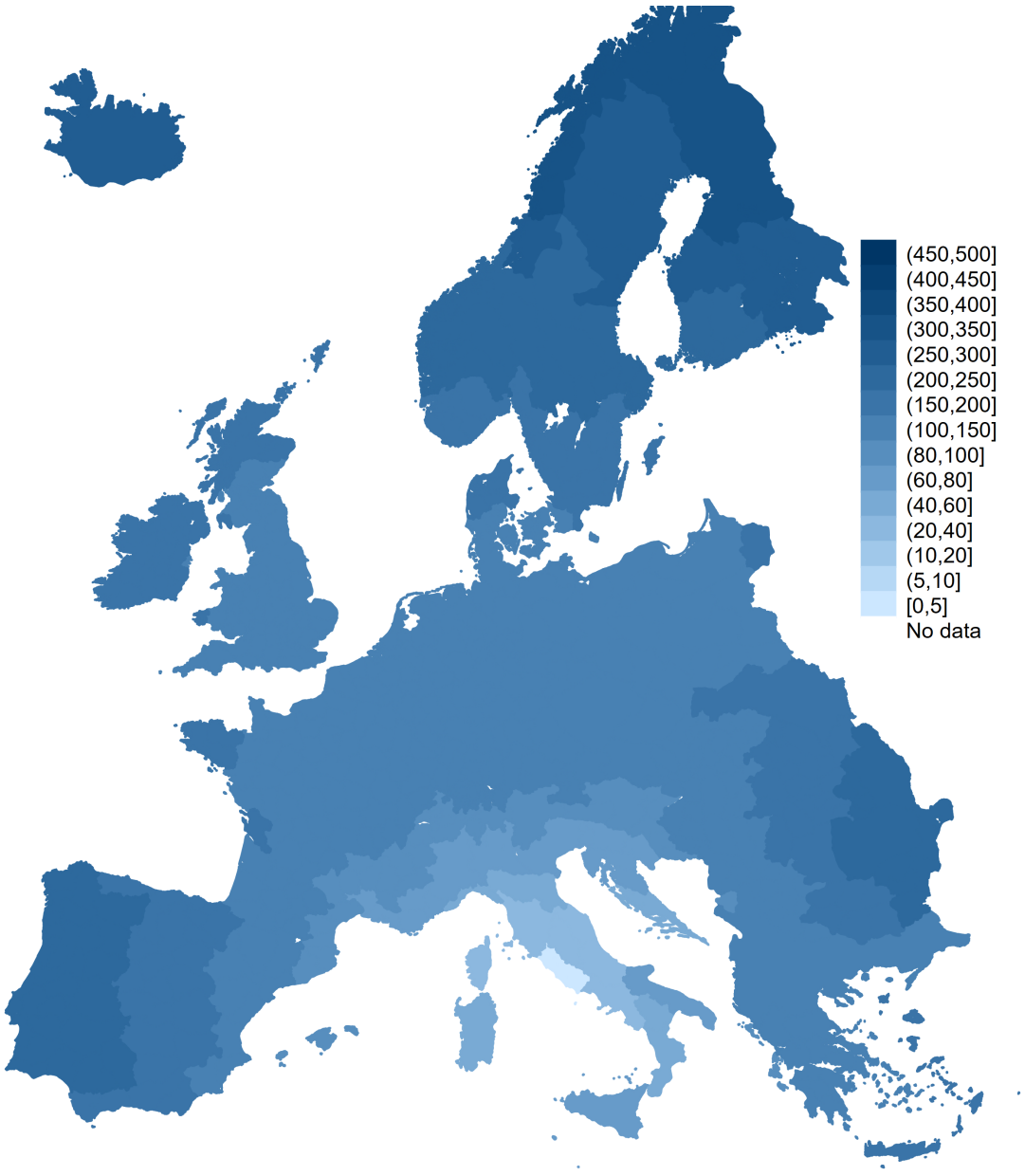
Hours to Rome: 1830



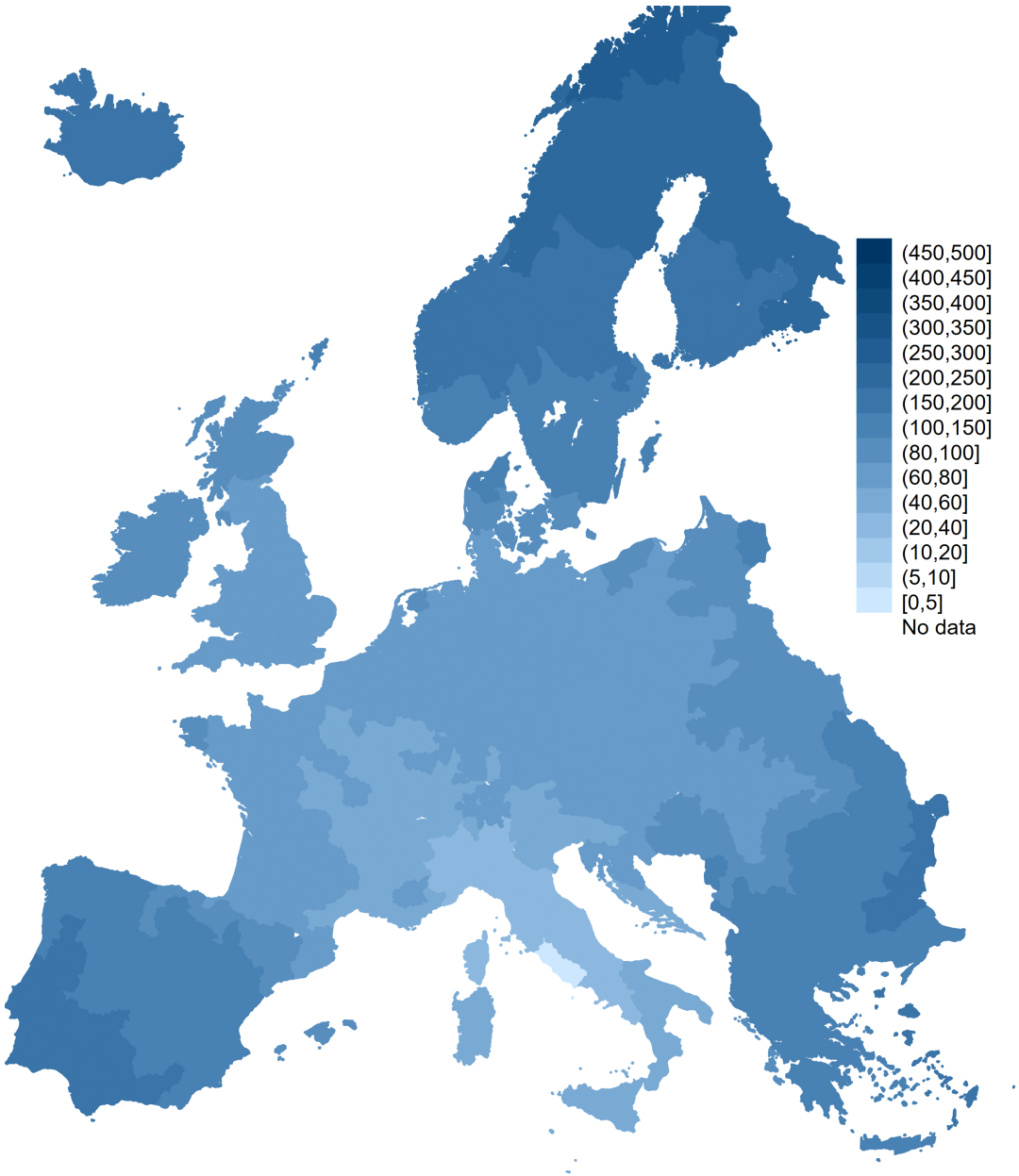
Hours to Rome: 1840



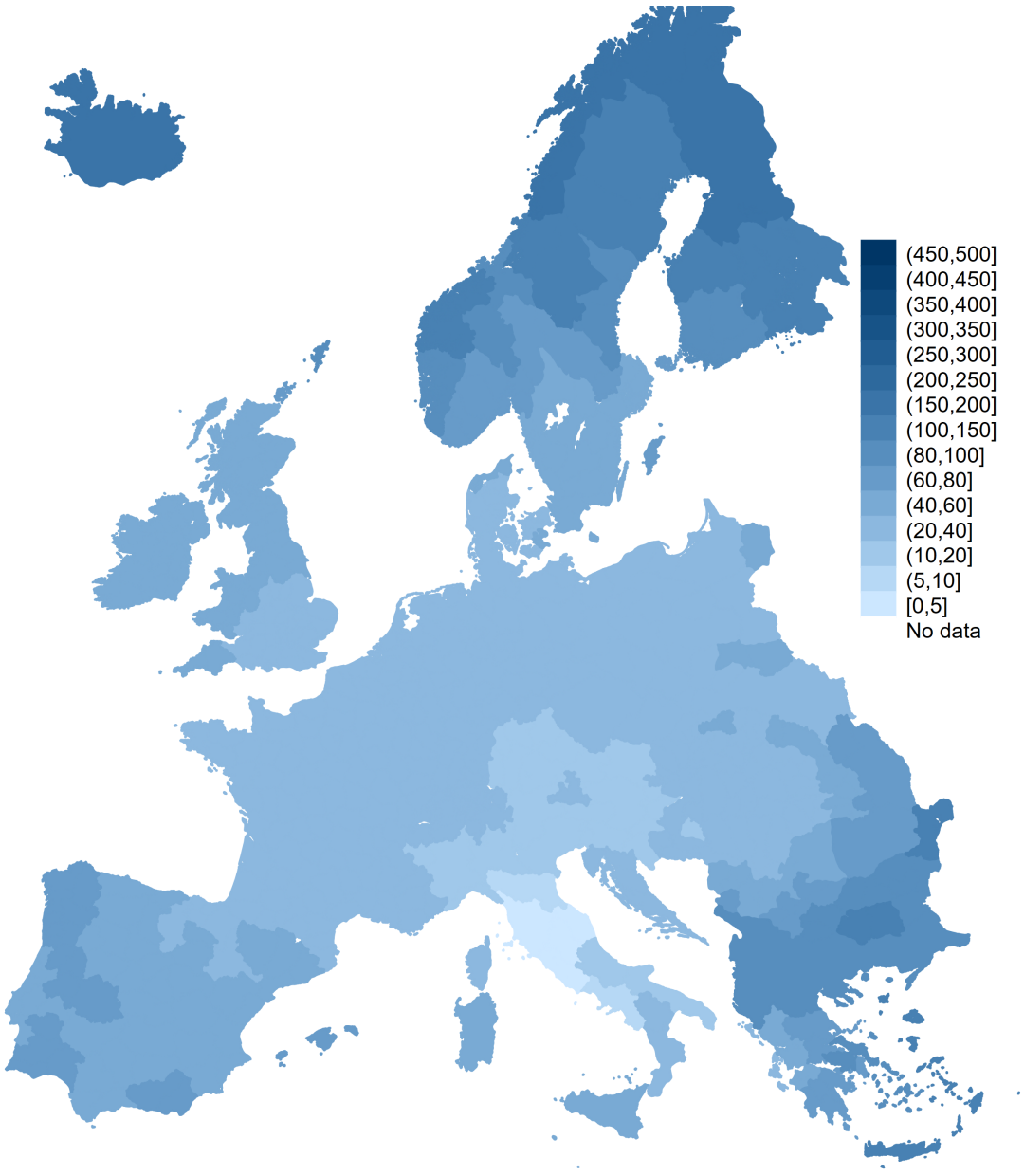
Hours to Rome: 1850



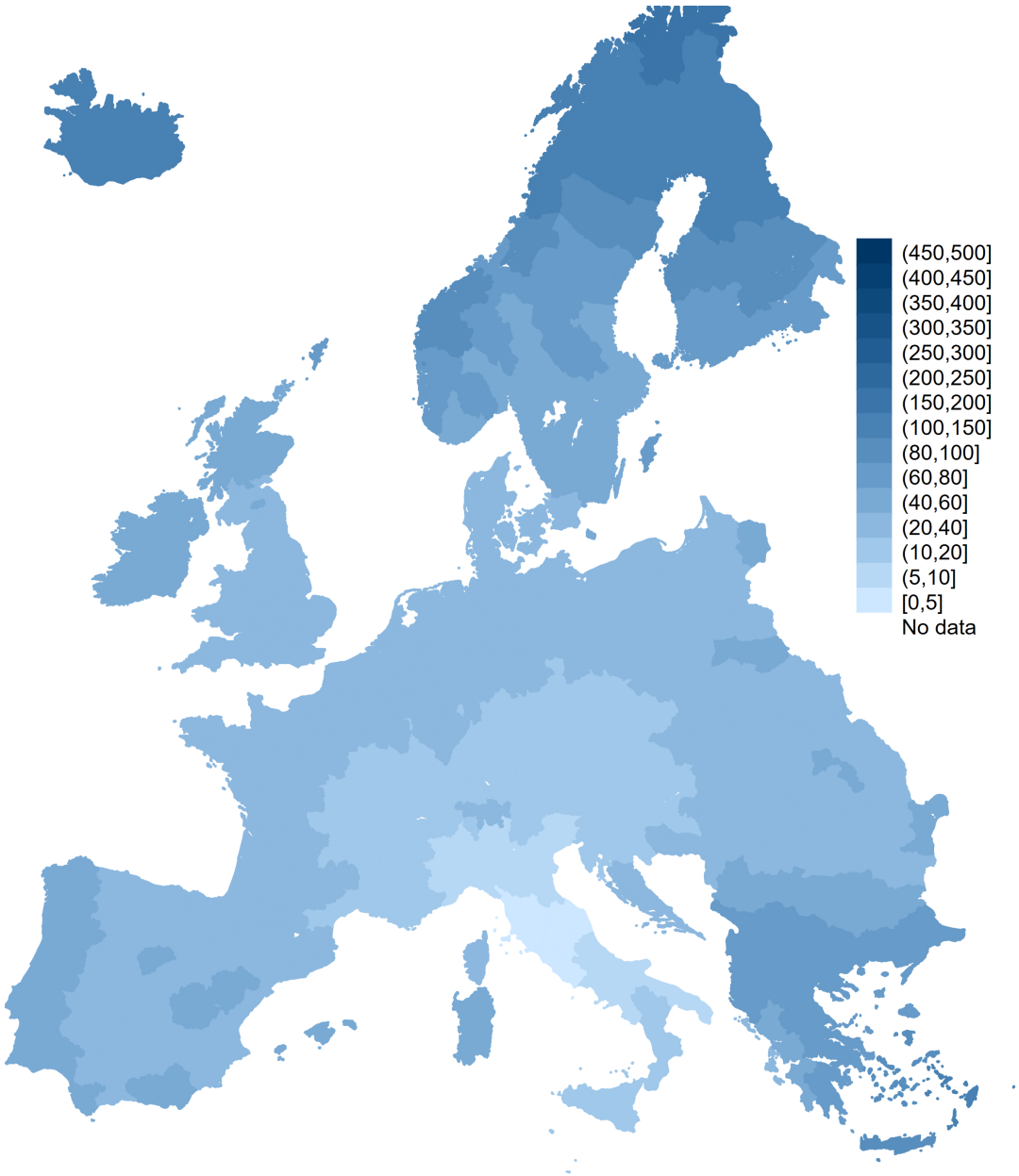
Hours to Rome: 1860



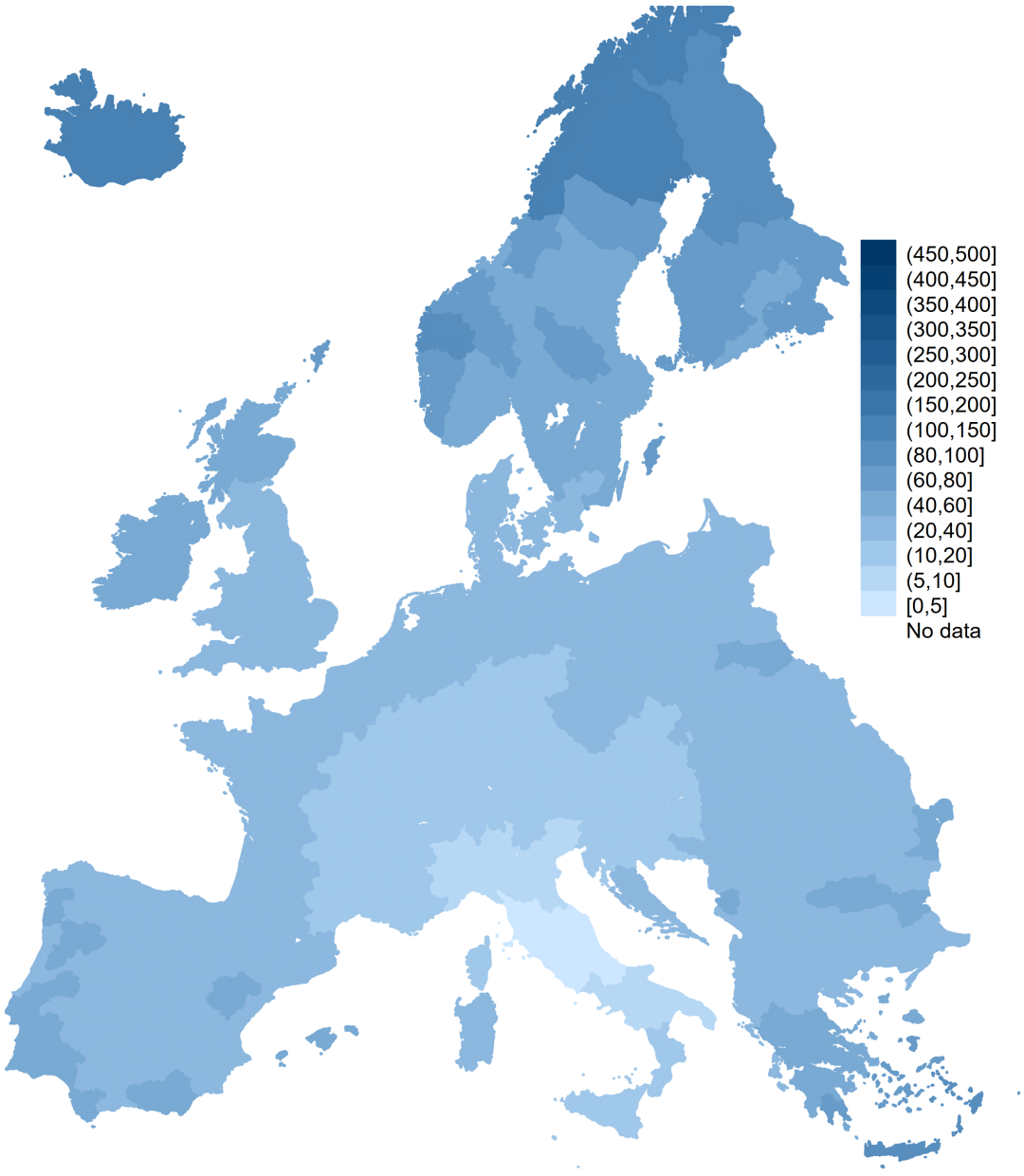
Hours to Rome: 1870



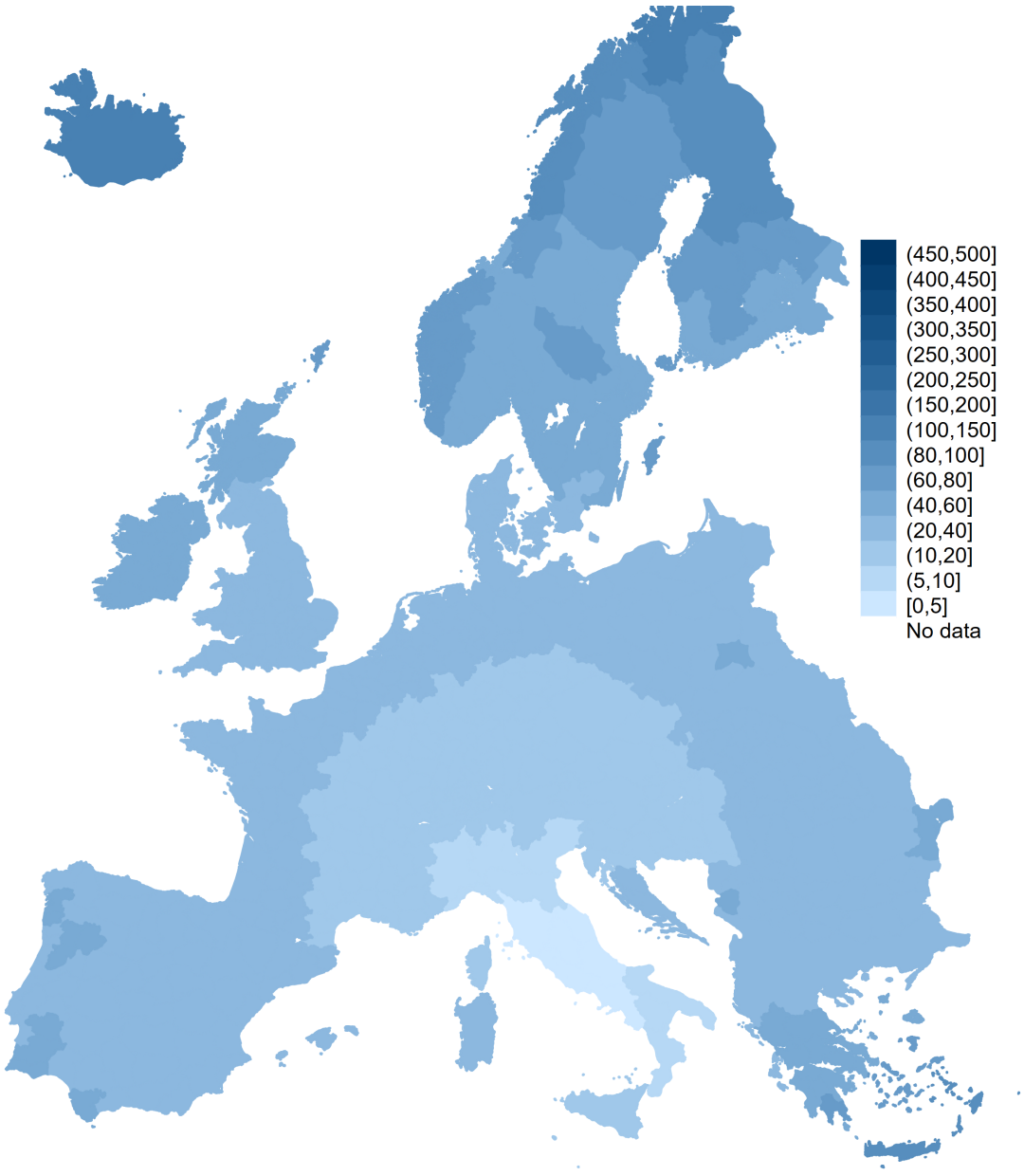
Hours to Rome: 1880



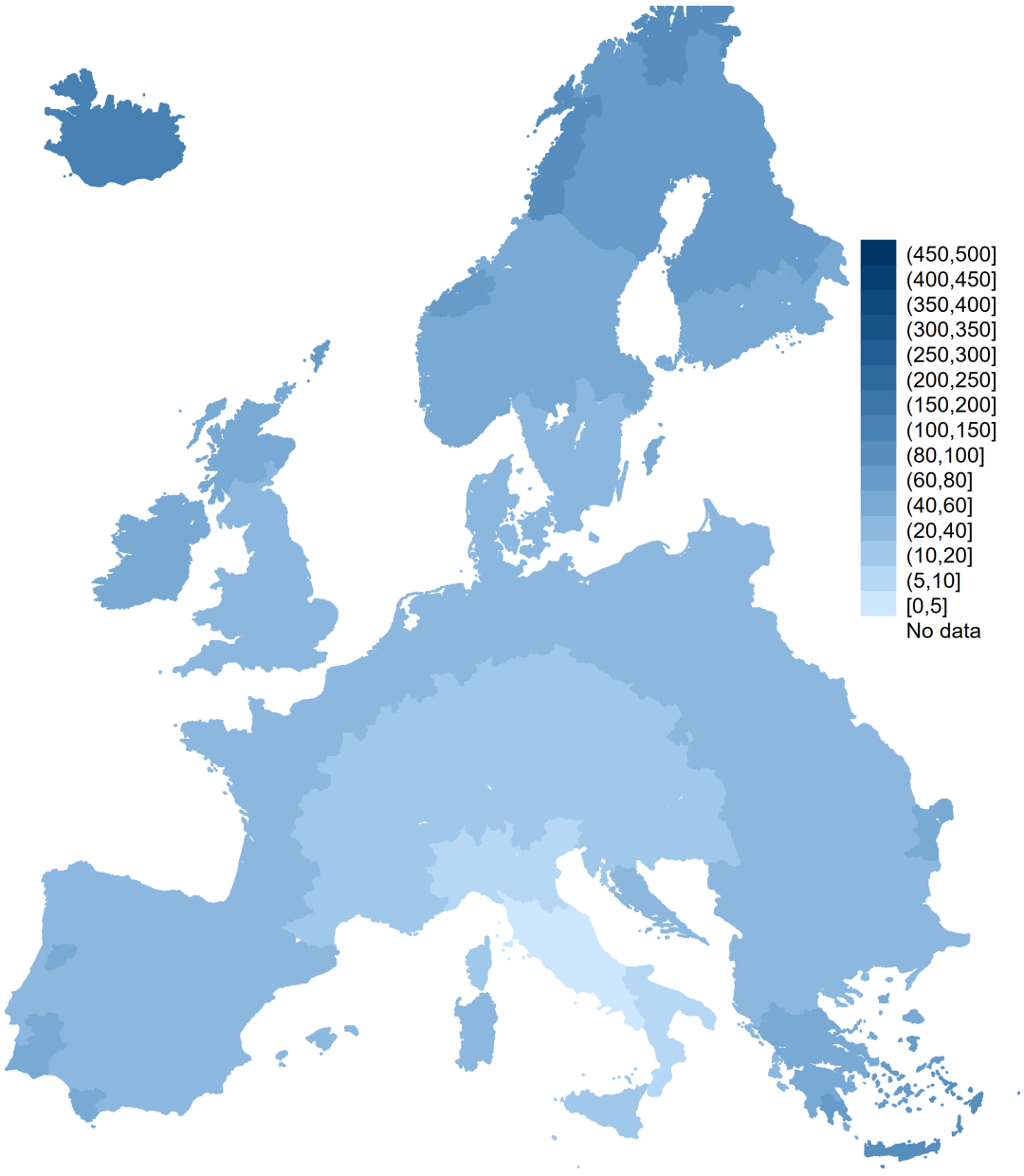
Hours to Rome: 1890



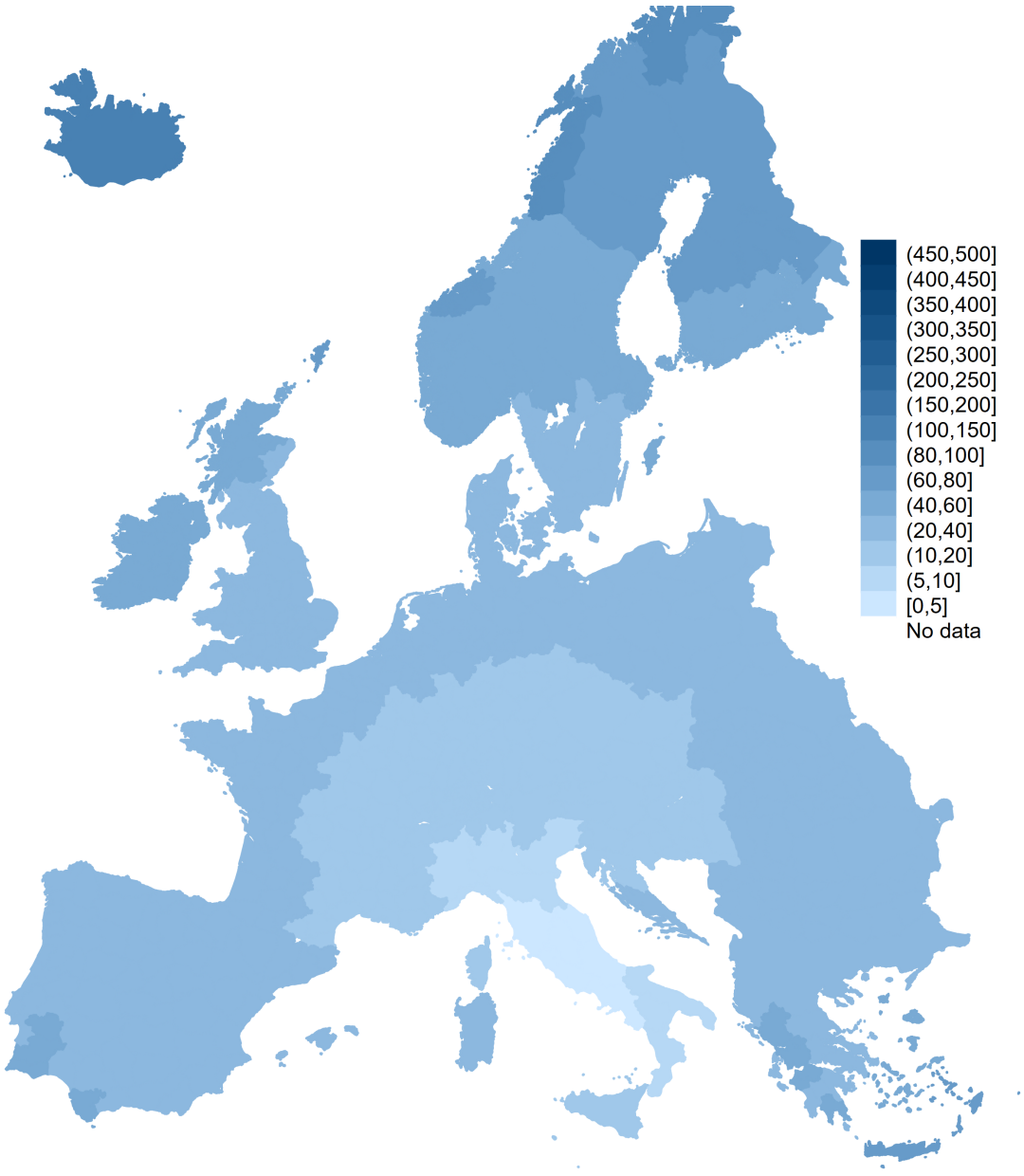
Hours to Rome: 1900



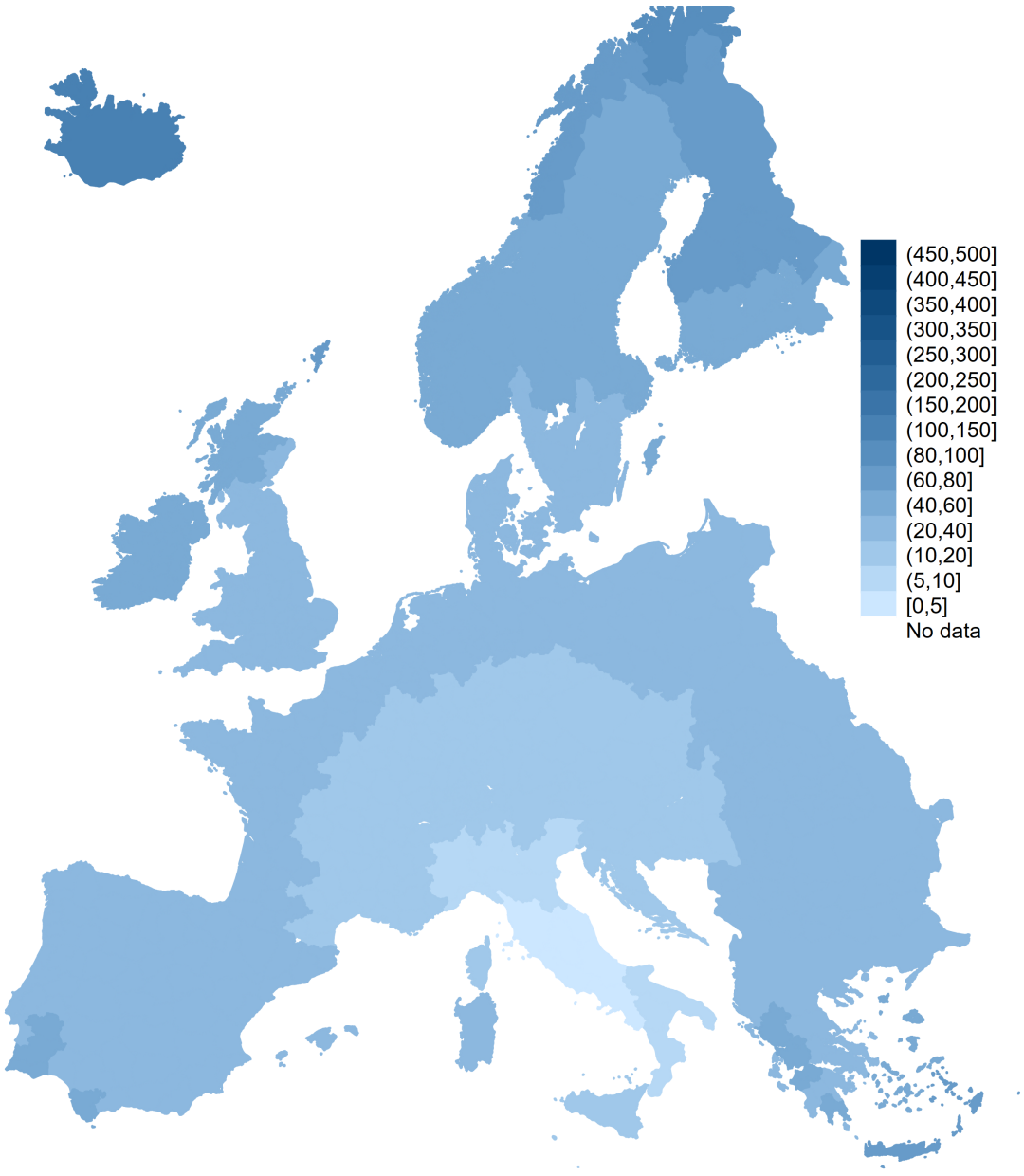
Hours to Rome: 1910



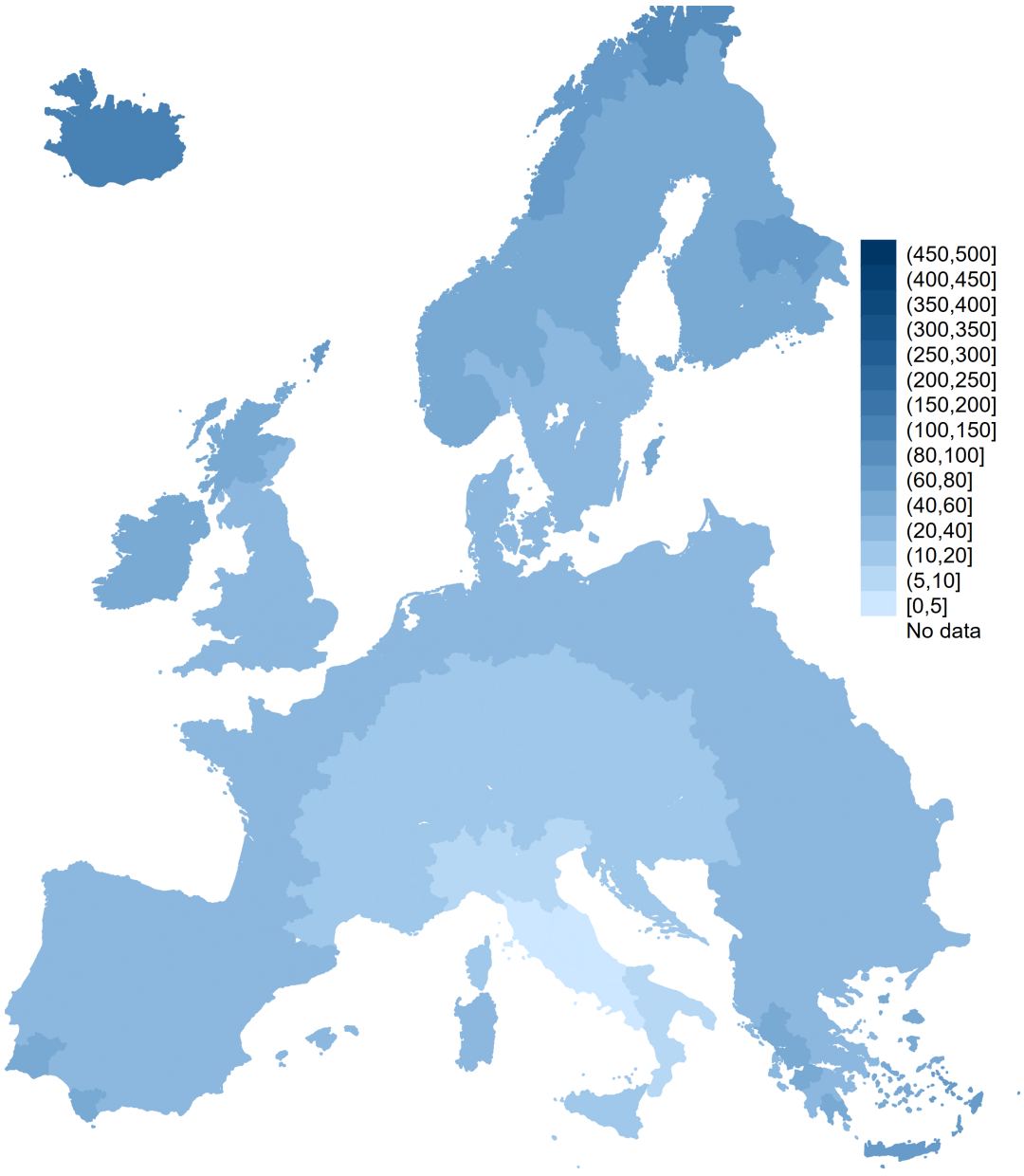
Hours to Rome: 1920



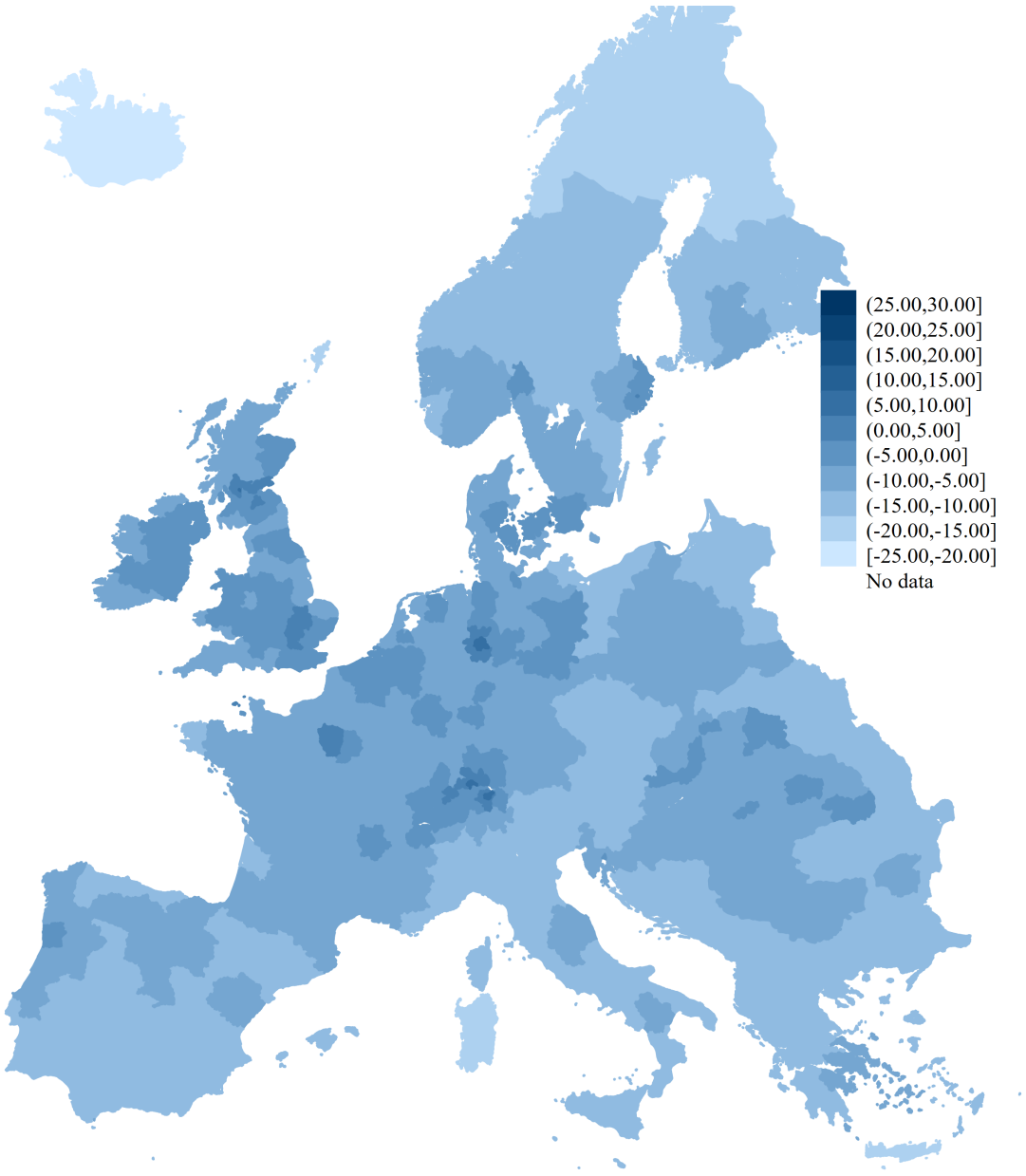
Hours to Rome: 1930



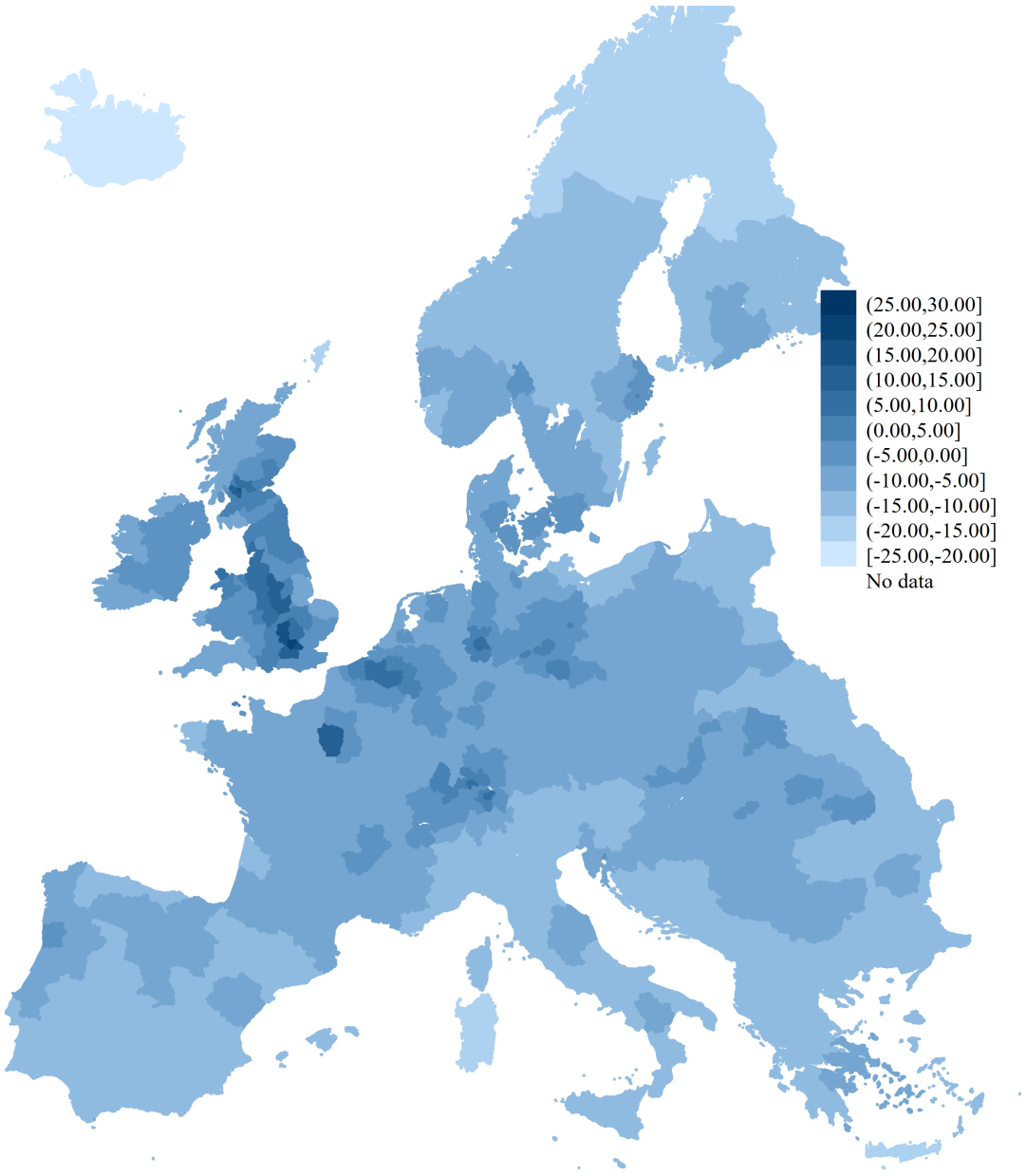
Hours to Rome: 1940



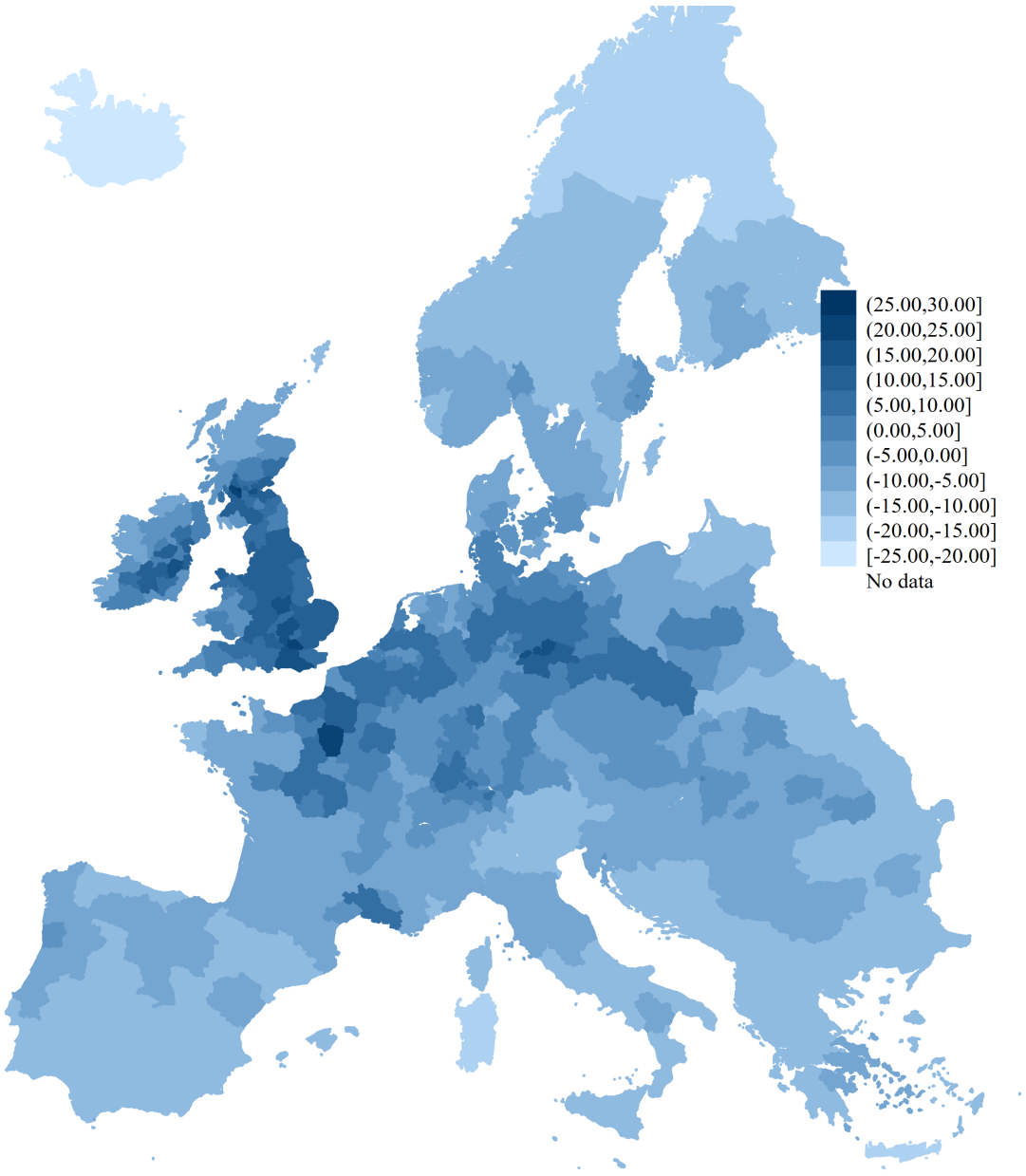
ln Market Access: 1830



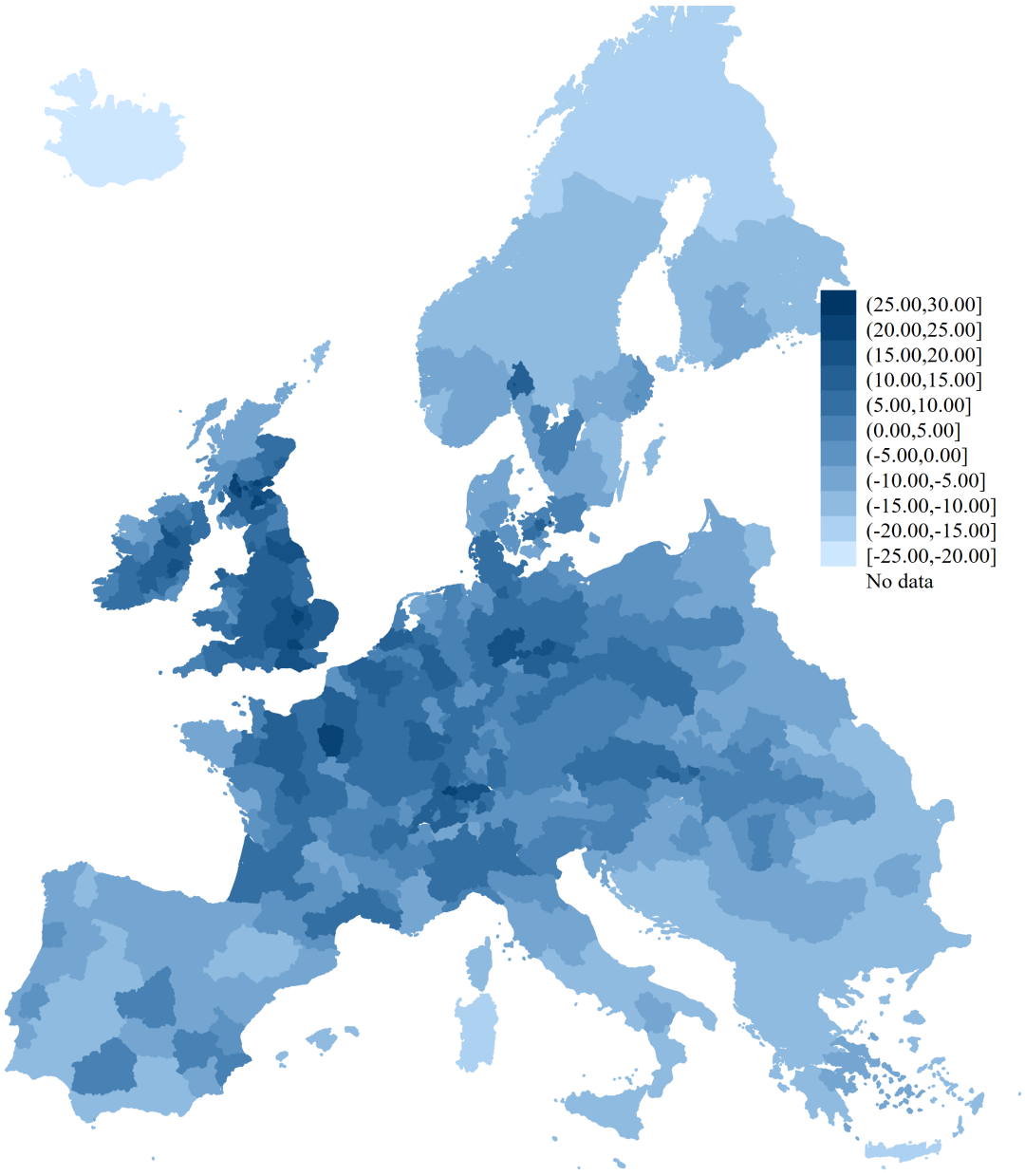
In Market Access: 1840



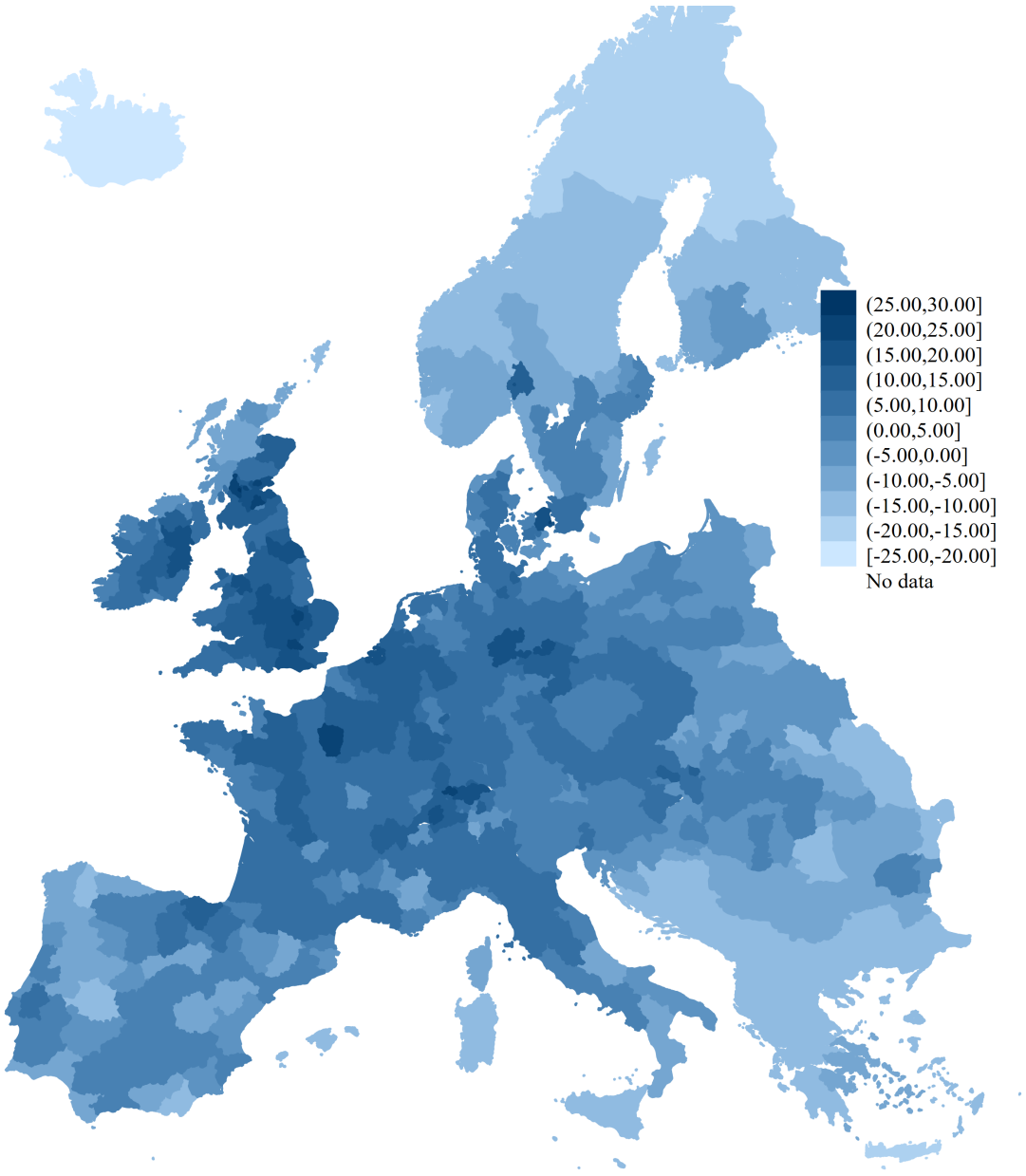
ln Market Access: 1850



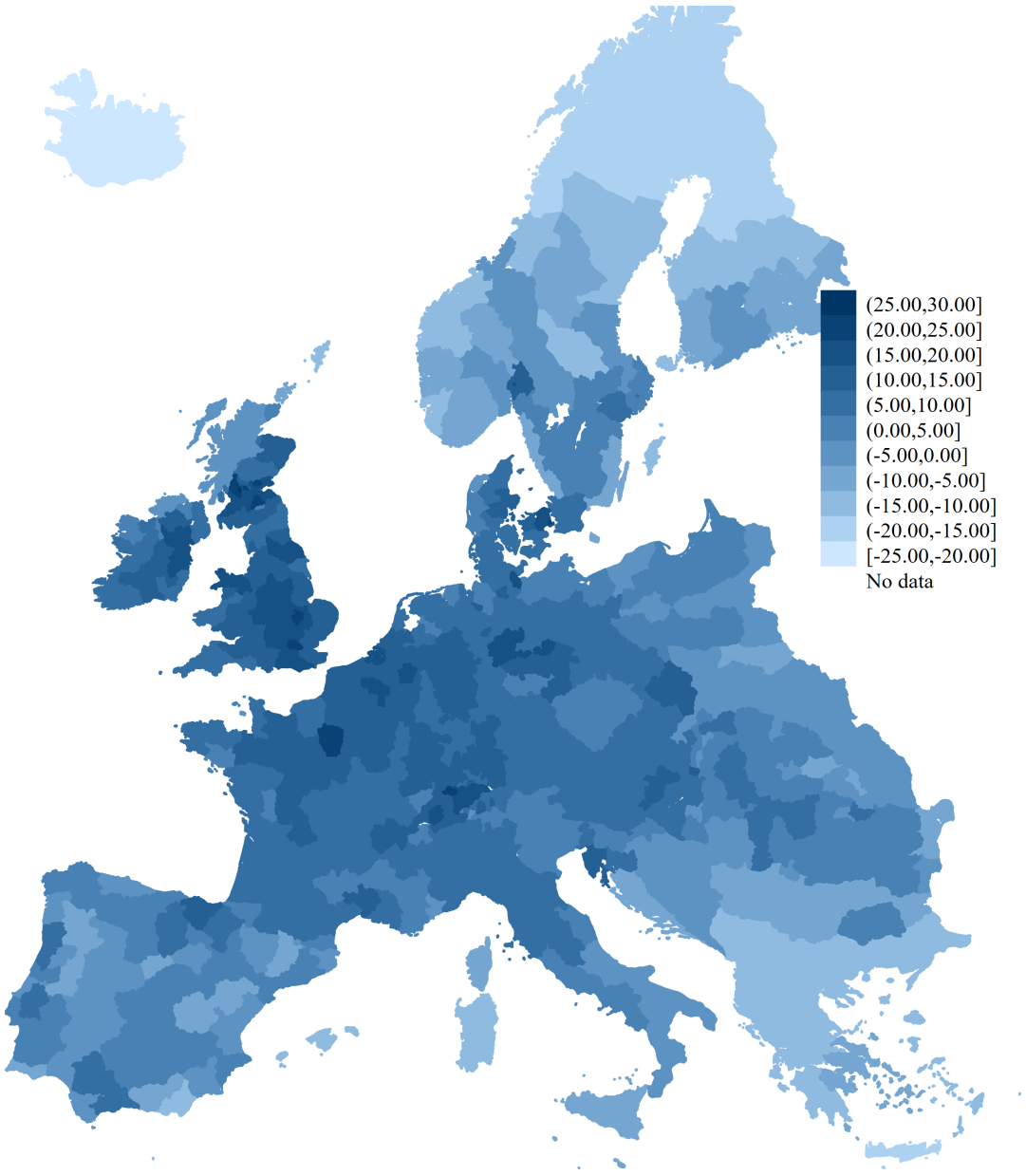
ln Market Access: 1860



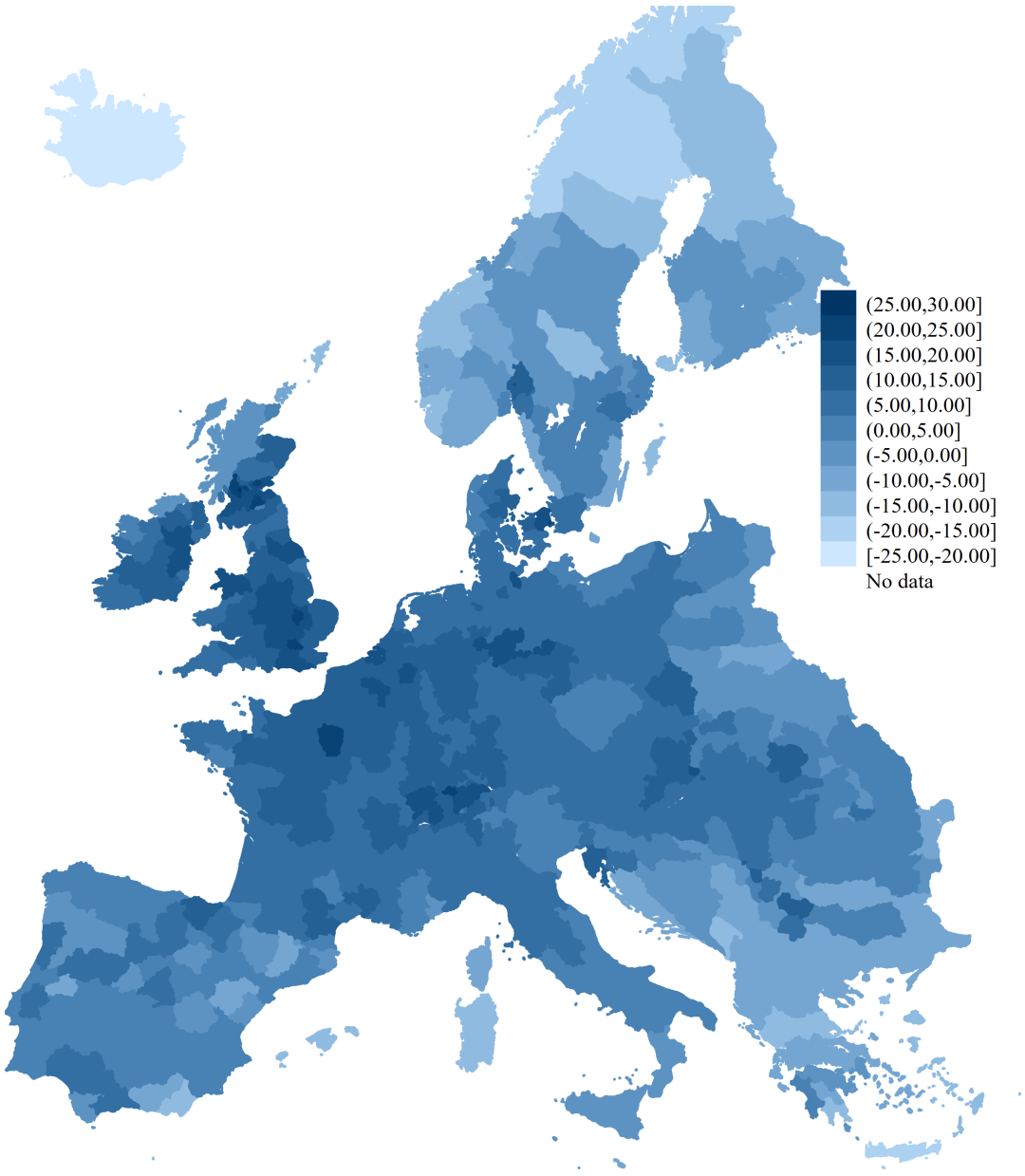
ln Market Access: 1870



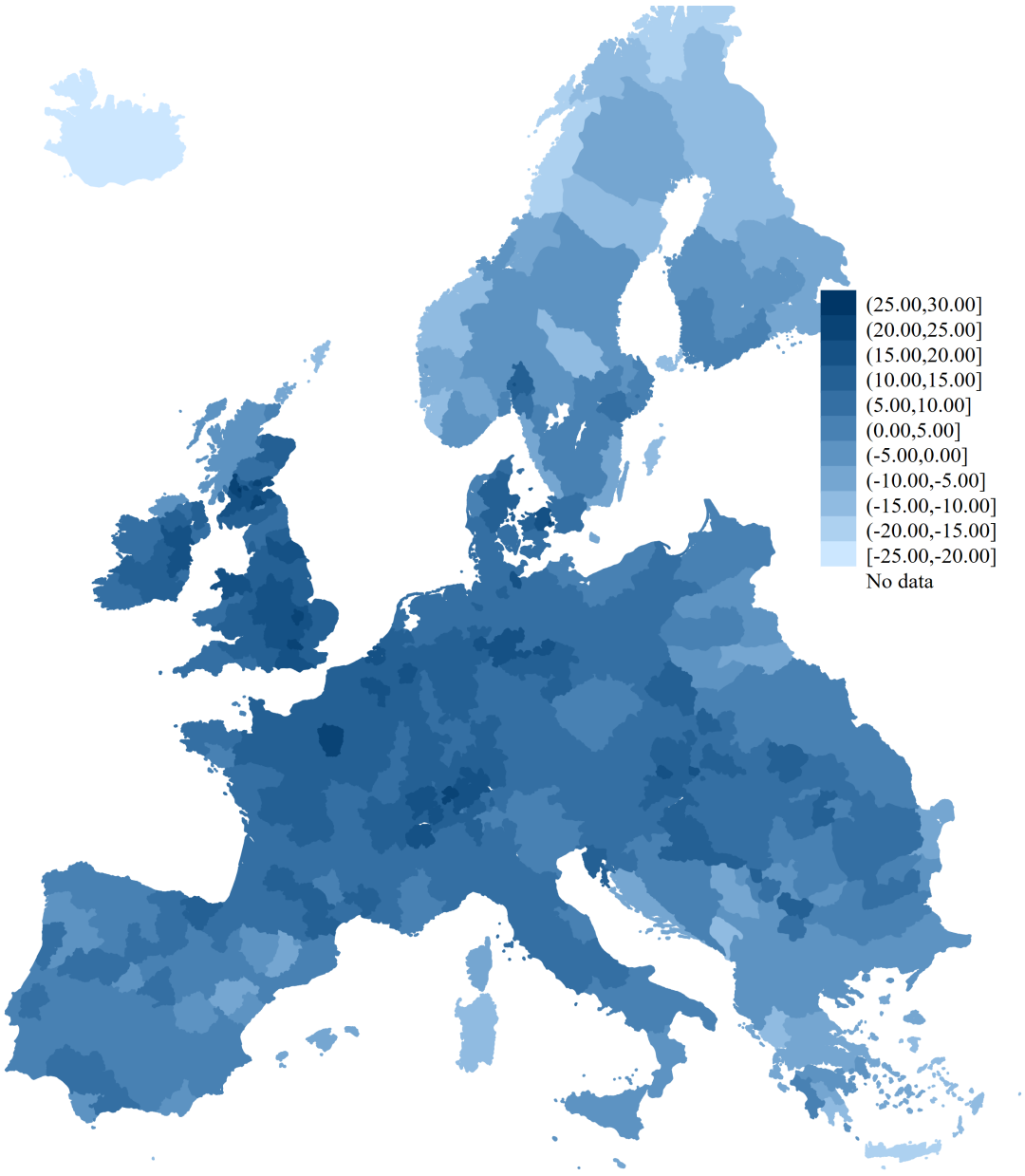
ln Market Access: 1880



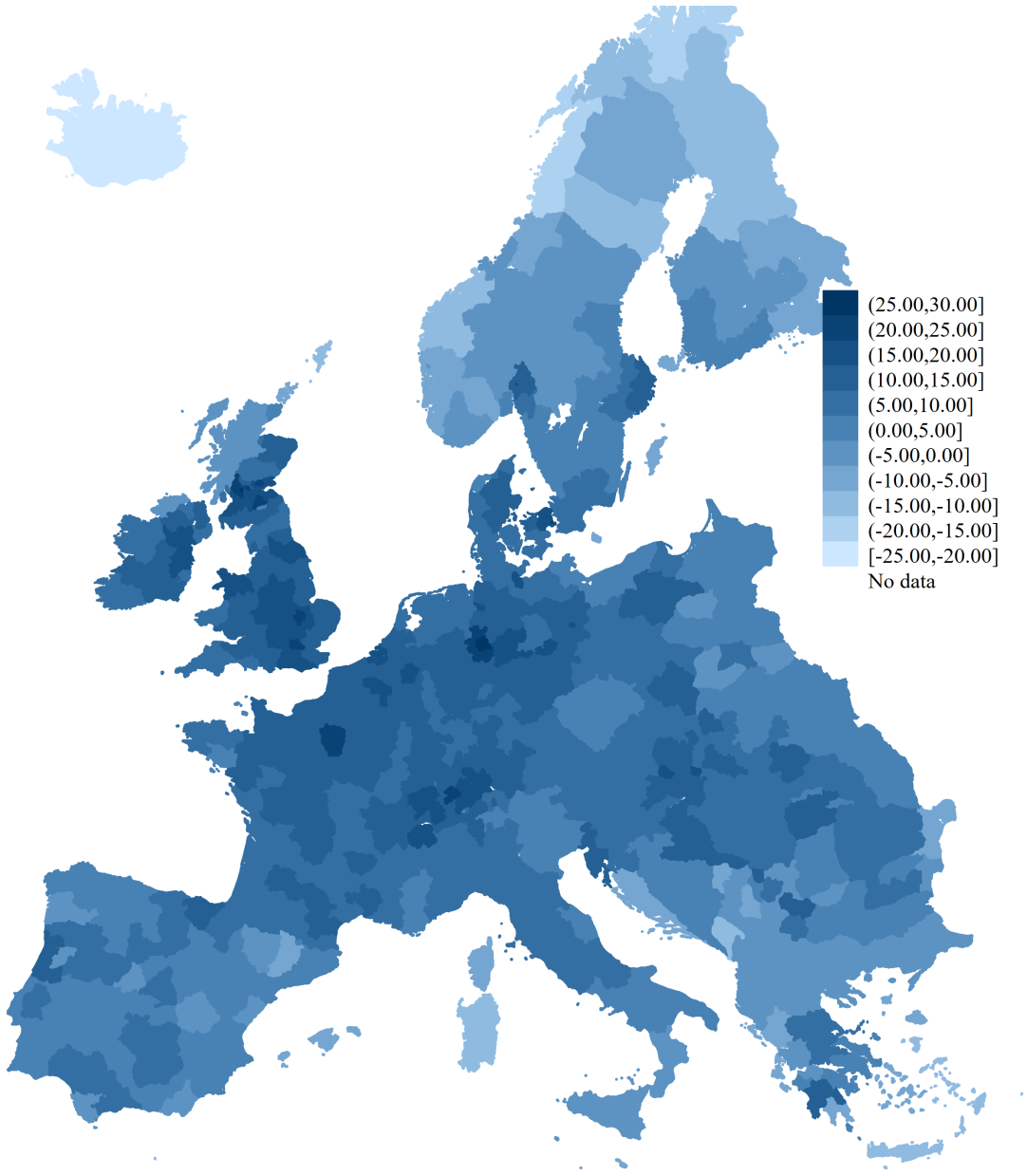
ln Market Access: 1890



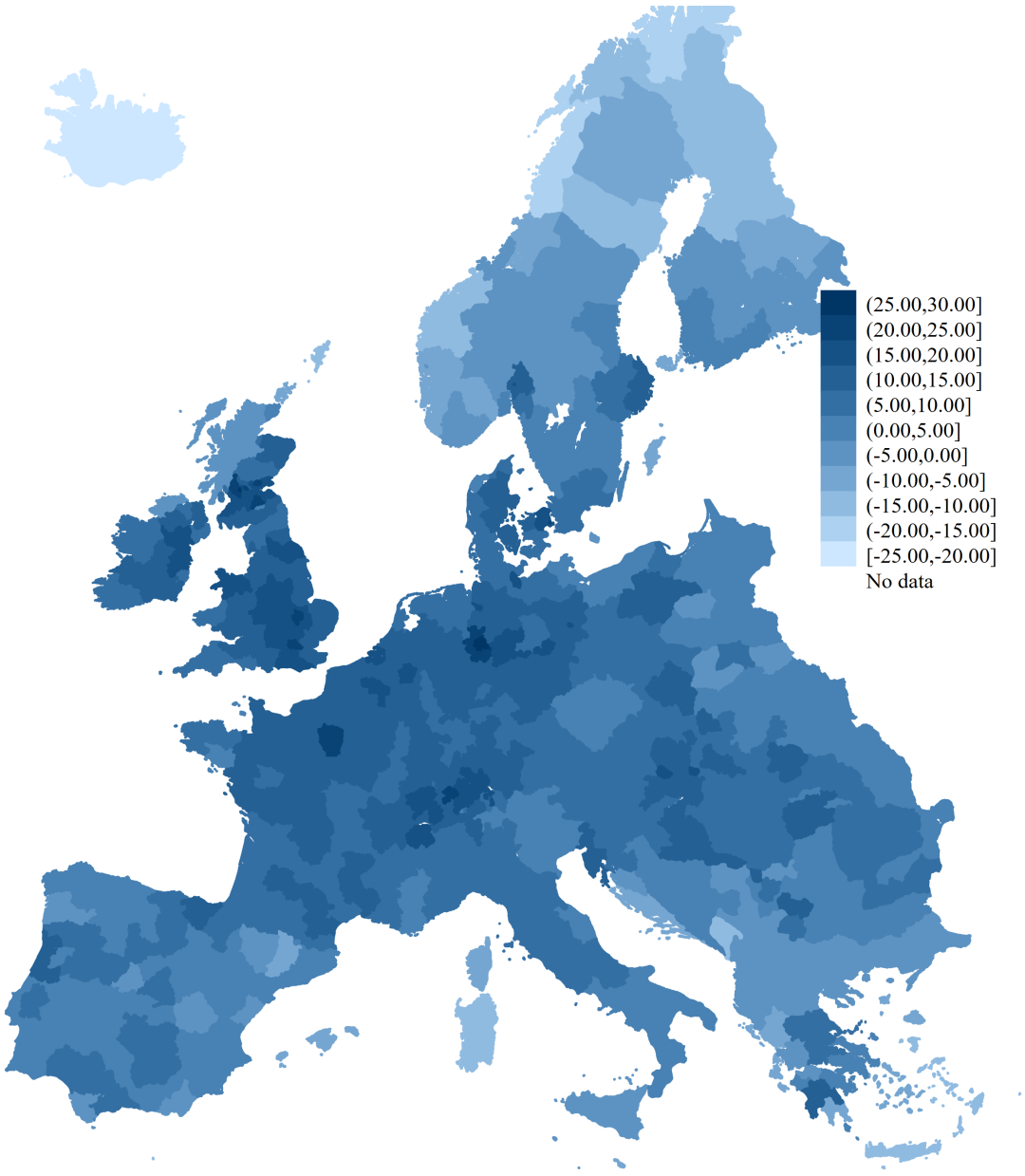
ln Market Access: 1900



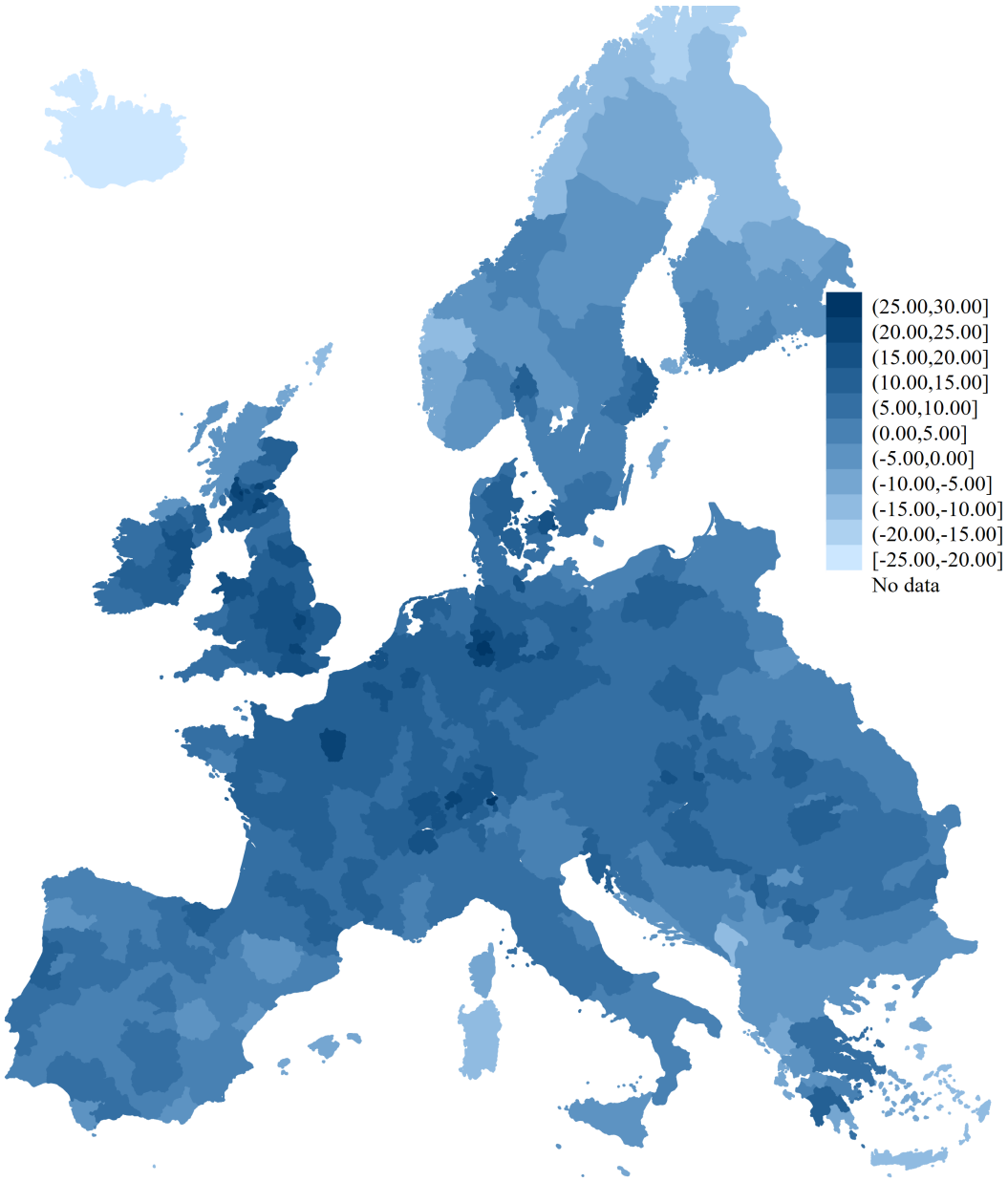
ln Market Access: 1910



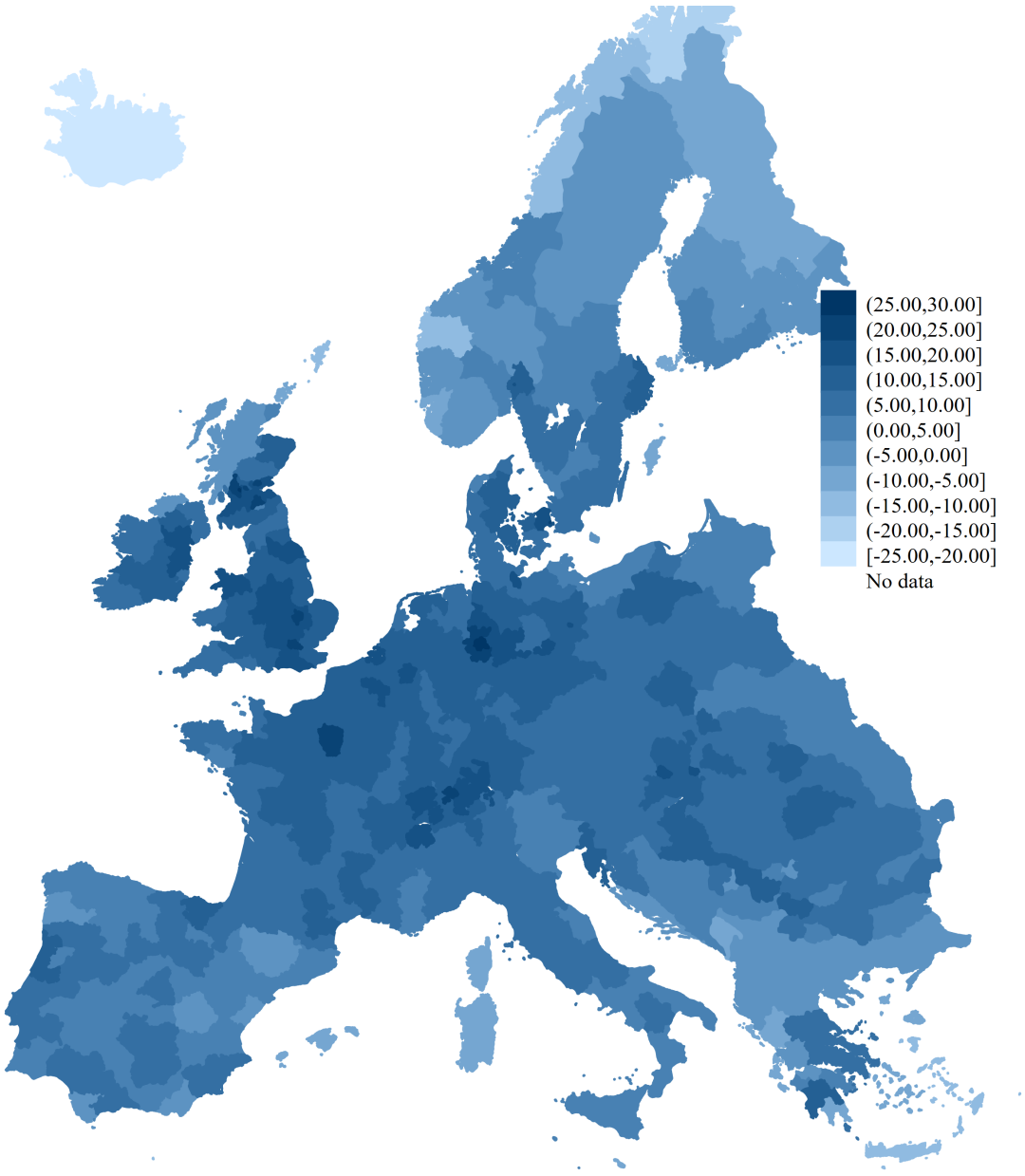
ln Market Access: 1920



ln Market Access: 1930



ln Market Access: 1940



Data: Controls

- Latitude, longitude, and coast distance: computed ourselves.
- River: from Natural Earth Data.
- Altitude: from the World Digital Elevation Model.
- Population density in 1830: from Klein Goldewijk et al. (2013).
- Area: from MPIDR (2013).
- Caloric suitability: from Galor and Özak (2015, 2016).
- Suitability for barley, maize, rye, oats, and wheat: from the FAO-GAEZ project.
- Average precipitation: from WorldClim, originally from the CRU.
- Ruggedness: from Amatulli et al. (2018).
- ... and all are time-invariant and so interacted with the decade fixed effects.
- Maps are in the appendix.

Overview

- Market access predicts greater fertility.
- Magnitude? A one standard deviation increase in market access predicts greater fertility by $\frac{7.91 \times 0.158}{8.93} \approx 0.14$ standard deviations.
- Or: compute counterfactual fertility as:

$$Fertility_{ld} - \hat{\beta}(\ln MA_{ld} - \ln MA_{l,1830})$$

- ... and fertility would have been $\sim 8\%$ lower in 1910.
- Our instrumental variables estimates are $\sim 30\%$ larger than our fixed effects estimates.

Results: Fixed Effects

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.158***	0.125***
	(0.032)	(0.030)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results: Instrumental variables

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.206***	0.180***
	(0.044)	(0.044)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes
KPF	539.7	535.4

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Conceptual Framework

- If children are a normal good, an increase in income would increase fertility (Asrhaf and Galor, 2011; Black et al., 2013).
- Gains to trade, then, can increase fertility if they encourage specialization in goods intensive in unskilled labor (Galor and Mountford, 2008).
- But there are channels through which rising incomes could reduce fertility:
  - Returns to skill and the quality-quantity tradeoff (Becker, 1973; Galor, 2022). Our results should be strongest where literacy and numeracy lagged.
  - Women's work and the opportunity cost of children (Guinnane, 2011). Our results should be strongest where opportunities were more limited for women.

Mechanisms: Evidence

- Results not in blue are in the appendix.
- Proximate mechanisms:
  - Marital and non-marital fertility both rise.
  - Rural marital fertility rises, but we have limited data on outcomes by rural/urban status.
  - Nuptiality rises for women aged 20-24.
- Economic mechanisms:
  - Incomes rise according to real GDP per capita data from Roses and Wolf (2020).
- Heterogeneity:
  - Results are driven by the 1870-1914 period, at the height of the fertility transition.
  - Results are driven by regions that, by 1900, or by 1880, had high incomes, high populations, lower shares of the labor force in agriculture, and higher shares in industry and services in data from Roses and Wolf (2020).
  - Results are larger for countries that lagged in schooling in 1900, or in 1870, and in numeracy in 1880 in the Clio Infra data.
  - Results are larger for countries that lagged in FLFP c. 1900.

Nuptiality rises for women aged 20-24

	(1) Age at Marriage	(2) Age at Marriage	(3) Pct. Married 20-24	(4) Pct. Married 20-24
ln Market Access: (P=1830, θ=8.22)	1.050	-1.069*	0.286***	0.121**
	(0.770)	(0.614)	(0.059)	(0.050)
N	1,188	1,188	1,532	1,532
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Rising Incomes, Rising Populations

	(1) ln RW GDP per capita	(2) ln RW GDP per capita	(3) ln RW Population	(4) ln RW Population
ln Market Access: (P=1830, θ=8.22)	0.018***	0.008**	0.007***	0.005**
	(0.006)	(0.004)	(0.003)	(0.002)
N	1,743	1,743	1,743	1,743
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by GDP in 1900

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.245***	0.205***	0.031	-0.006
	(0.039)	(0.057)	(0.047)	(0.041)
N	1,768	1,768	1,738	1,738
Sample	ln RW GDP per capita Above Median in 1900	ln RW GDP per capita Above Median in 1900	ln RW GDP per capita Below Median in 1900	ln RW GDP per capita Below Median in 1900
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by schooling in 1900

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.014	0.024	0.259***	0.099**
	(0.037)	(0.036)	(0.055)	(0.046)
N	2,027	2,027	2,017	2,017
Sample	Above Median Years of Education in 1900	Above Median Years of Education in 1900	Below Median Years of Education in 1900	Below Median Years of Education in 1900
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by female labor force participation c. 1900

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.033	0.032	0.289***	0.273***
	(0.050)	(0.000)	(0.043)	(0.047)
N	1,623	1,623	1,843	1,843
Sample	Above Median FLFP	Above Median FLFP	Below Median FLFP	Below Median FLFP
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Alternative Mechanisms (1/2)

- Diffusion of norms?
  - Compute "fertility access" as $\sum_{l'} w_{l'd} F_{l'0}$.
  - Here, $w_{l'd} = \frac{\tau_{ll'd}^{-\theta}}{\sum_{l'} \tau_{ll'd}^{-\theta}}$.
  - $F_{l'0}$ is initial fertility of location l', and $w_{l'd}$ are travel cost weights.
  - Diffusion of norms may have played a role, but the evidence is weak, with a standardized β of $\frac{0.287 \times 0.309}{8.93} \approx 0.001$.
- Similarly, "mortality access" (i.e. access to infant mortality) reduces fertility with a standardized $\beta < 0.1$ that is not robust to controls.
- Reshaping the data to a panel of pairs: falling $\tau_{ll'd}$ does not predict fertility convergence.
- What matters – having a railway or being connected to other markets? Results survive controlling for railway density (length per unit area), and railway density has the opposite sign.

Alternative Mechanisms (2/2)

- Sectoral change? Data on employment shares from Roses and Wolf (2020) suggest muted impacts on sectoral shares.
- Urbanization? The result survives controlling for urbanization.
- Human capital? The result survives controlling for country literacy in the Clio Infra data.
- Mortality? Results are driven by countries with greater life expectancy in 1870.
- Political connections? Results survive dropping capitals.

Robustness (1/2)

- Results survive:
  - Tests of the parallel trends assumption.
  - Estimation in long differences – 1870 to 1910, and most other year combinations.
  - Alternative measures of market access.
    - Alternative θ; census data on population from 1850 from Martí Henneberg; contemporary populations; country populations from Federico and Tena-Junguito; city populations from Reba et al. (2016), which are mostly from Chandler; city populations from Bosker et al. (2013), which are mostly from Bairoch.
    - Railway speed of 30 or 120 km per hour.
    - Add border costs. Add roads that predate the railway. Allow steam (i.e. rapid) travel over water.
    - City populations in 1850 from Martí Henneberg.
  - Conley (1999) standard errors.

Robustness (1/2)

- Results survive:
  - Alternative IV cutoff distances.
  - ln Fertility.
  - Discarding Belgium.
  - Discarding periods after 1914.
  - Country trends and country-year fixed effects.
  - Accounting for coal.
  - Discarding the 40% largest units by area – those for which market access and fertility may be most poorly measured.
  - Retaining only locations that appear 9 times. The maximum, 10, is $<$20% of the sample.

Tests of Parallel Trends

	(1) Total Fertility	(2) Total Fertility
F. ln Market Access: (P=1830, θ=8.22)	0.025	-0.007
	(0.041)	(0.039)
ln Market Access: (P=1830, θ=8.22)	0.102***	0.044*
	(0.026)	(0.025)
L. ln Market Access: (P=1830, θ=8.22)	0.143***	0.106***
	(0.027)	(0.027)
N	2,731	2,731
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Long Differences: 1870 to 1910

	(1) Δ Total Fertility	(2) Δ Total Fertility
Δ ln Market Access	0.340***	0.235***
	(0.062)	(0.069)
N	347	347
Controls	No	Yes

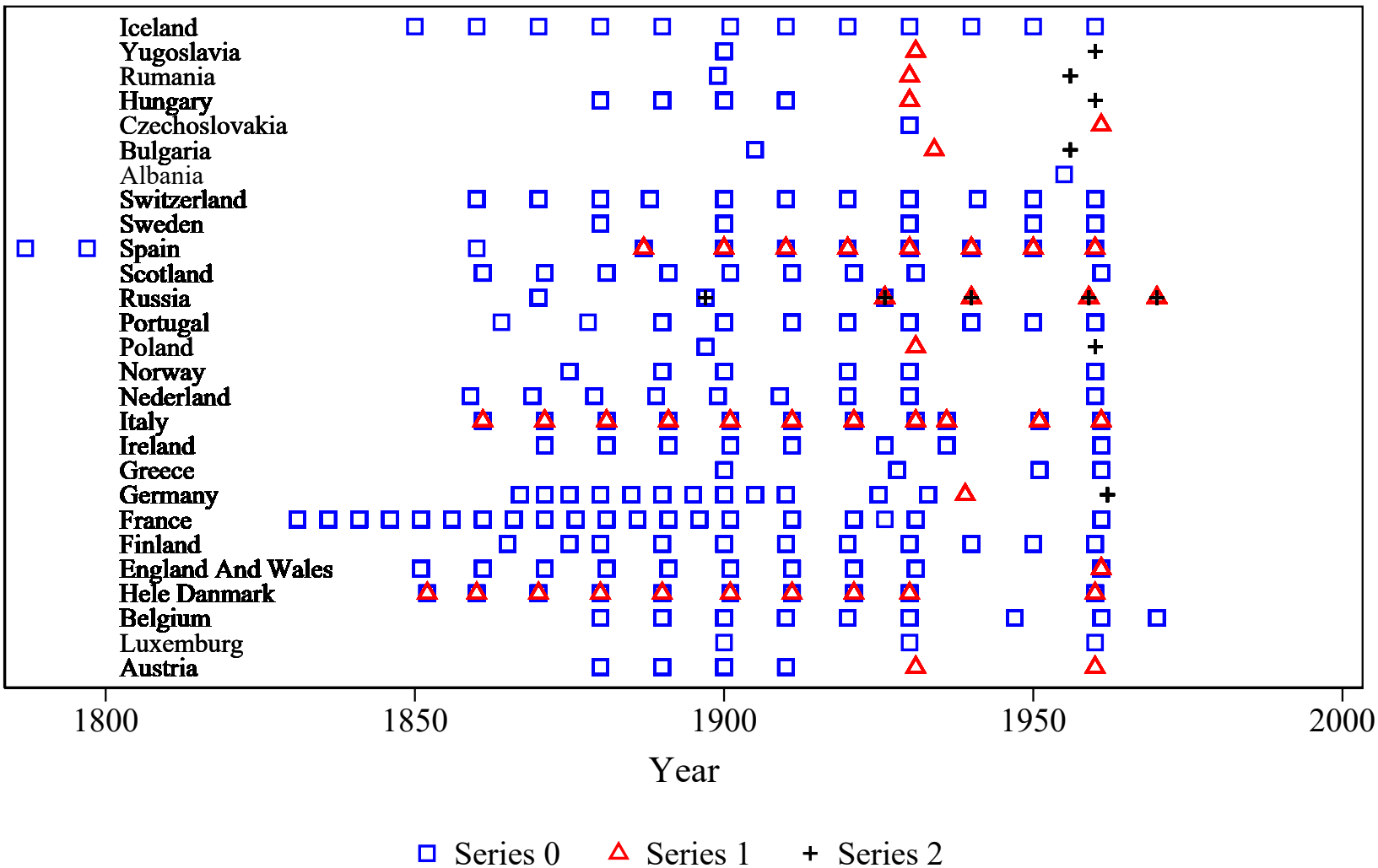
Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Conclusion

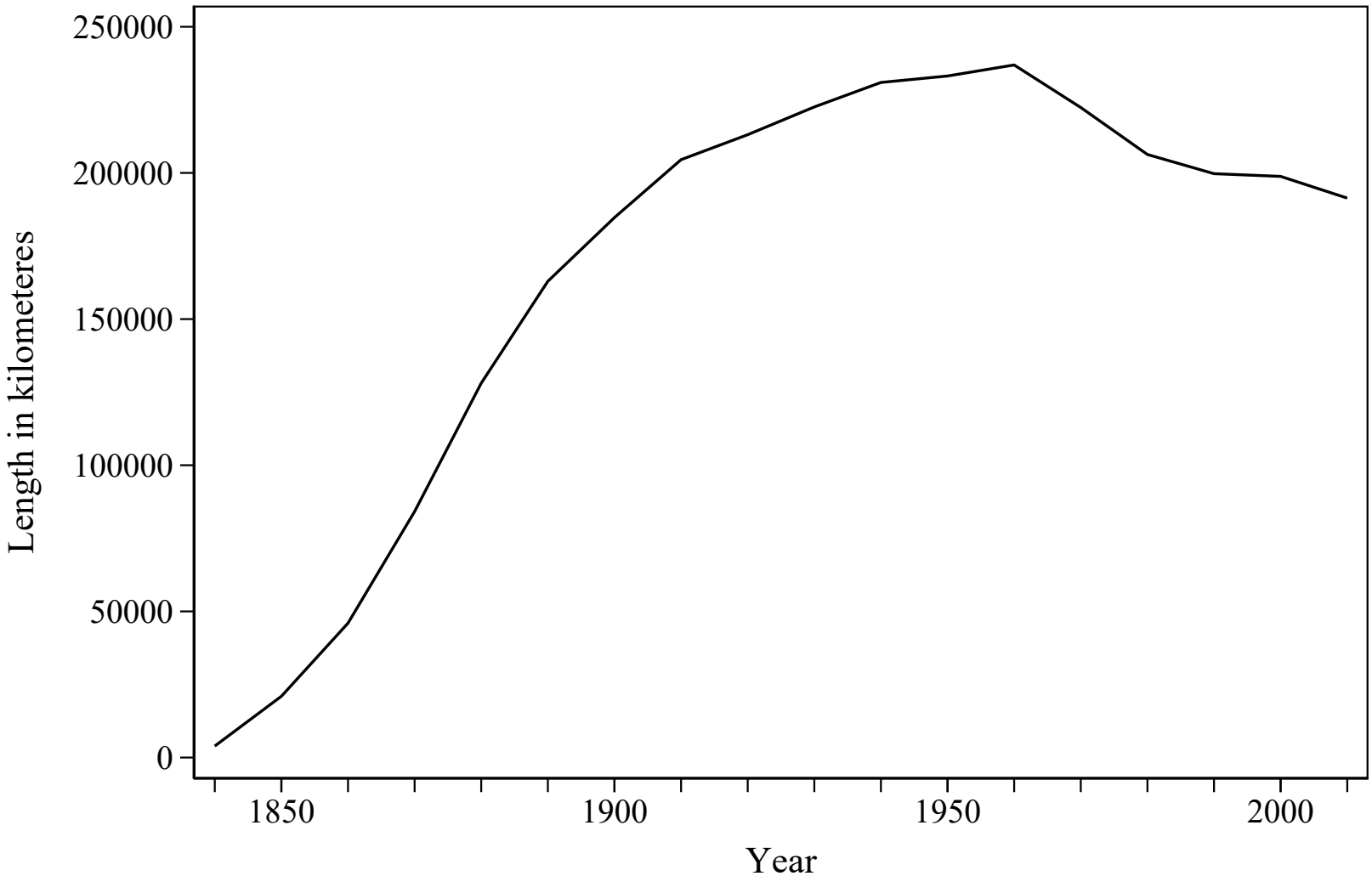
- Market access driven by railways predicts greater fertility in Europe, 1840-1940.
- Probable mechanism? Rising income:
  - Income itself increases with market access.
  - Nuptiality of women aged 20-24 is an intermediate mechanism.
  - The link is strongest in ultimately more developed locations where human capital and FLFP lagged.

8. Further Data Description
9. Further Results
10. Further Evidence: Mechanisms
11. Further Alternative Mechanisms
12. Additional Robustness
13. Maps of Controls

Fertility Data: Availability



Railway length over time



Summary Statistics

	(1) mean	(2) sd	(3) min	(4) max	(5) N
Total Fertility	30.2	8.93	5.90	68.1	4,104
ln Market Access: (P=1830, θ=8.22)	6.98	7.91	-22.1	27.7	4,206
Latitude	49.6	5.75	35.2	70.0	4,206
Longitude	5.14	9.00	-18.6	29.7	4,206
Coast Distance	97.7	134	0	614	4,206
River	0.53	0.50	0	1	4,206
Altitude	318	340	-144	2,186	4,206
Population Density 1830	77.8	179	0.15	2,599	4,206
Area	7,138	12,013	12.3	166,762	4,206
Caloric Suitability	8,000	2,653	0	14,514	4,206
Barley Suitability	7,442	2,230	0	10,604	4,206
Maize Suitability	3,493	3,994	0	14,527	4,206
Rye Suitability	4,567	1,361	0	6,383	4,206
Oat Suitability	2,992	797	0	3,681	4,206
Wheat Suitability	7,286	2,158	0	10,303	4,206
Average Precipitation	73.5	25.2	28.7	231	4,206
Ruggedness	13.7	13.0	0.41	82.0	4,206
Year	1,895	25.1	1,840	1,940	4,206

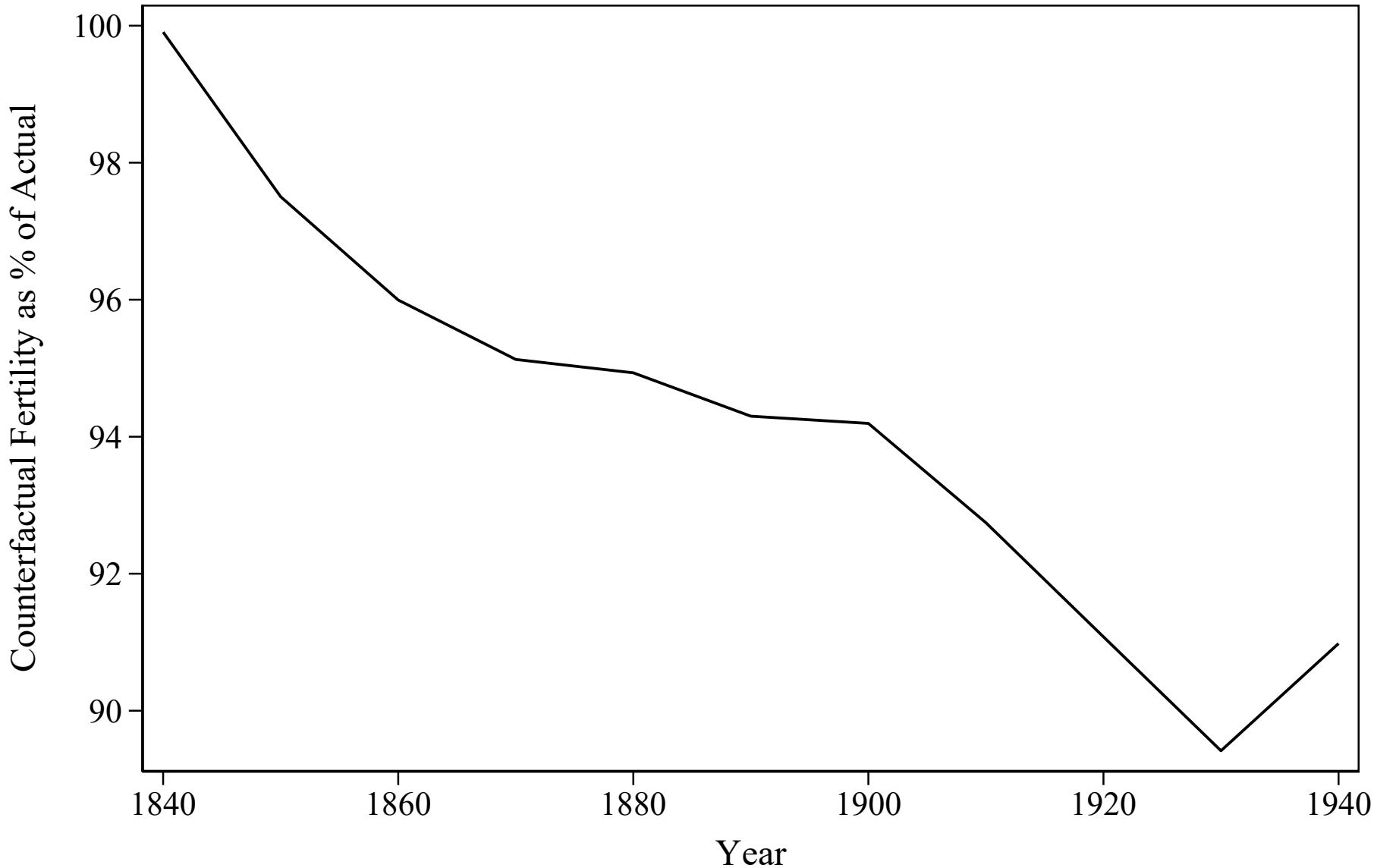
Binned Scatterplot: Net of Fixed Effects

Results: First Stage

	(1) ln Market Access: (P=1830 θ=8.22)	(2) ln Market Access: (P=1830 θ=8.22)
ln Distant Market Access: 500 km	1.225***	1.705***
	(0.053)	(0.074)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Counterfactual Fertility with 1830 Market Access



Marital and non-Marital Fertility

	(1) Marital Fertility	(2) Marital Fertility	(3) Non-Marital Fertility	(4) Non-Marital Fertility
ln Market Access: (P=1830, θ=8.22)	0.268***	0.197***	0.046***	0.033***
	(0.055)	(0.052)	(0.011)	(0.011)
N	4,040	4,040	4,034	4,034
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Urban Fertility (1/2)

	(1) Urban Fertility	(2) Urban Fertility	(3) Urban Marital Fertility	(4) Urban Marital Fertility
ln Market Access: (P=1830, θ=8.22)	0.024	0.027	0.102	0.016
	(0.061)	(0.064)	(0.114)	(0.111)
N	687	687	718	718
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Urban Fertility (2/2)

	(1) Urban Non-Marital Fertility	(2) Urban Non-Marital Fertility	(3) Urban Nuptiality	(4) Urban Nuptiality
ln Market Access: (P=1830, θ=8.22)	-0.044*	0.029	-0.132**	-0.017
	(0.023)	(0.027)	(0.057)	(0.047)
N	687	687	737	737
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Rural Fertility (1/2)

	(1) Rural Fertility	(2) Rural Fertility	(3) Rural Marital Fertility	(4) Rural Marital Fertility
ln Market Access: (P=1830, θ=8.22)	-0.007	-0.002	0.168**	0.022
	(0.046)	(0.049)	(0.075)	(0.075)
N	888	888	936	936
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Rural Fertility (2/2)

	(1) Rural Non-Marital Fertility	(2) Rural Non-Marital Fertility	(3) Rural Nuptiality	(4) Rural Nuptiality
ln Market Access: (P=1830, θ=8.22)	-0.020	-0.024	-0.121**	0.041
	(0.024)	(0.029)	(0.048)	(0.046)
N	888	888	984	984
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Intermediate Outcomes (1/2)

	(1) Nuptiality	(2) Nuptiality	(3) Infant Mortality	(4) Infant Mortality
ln Market Access: (P=1830, θ=8.22)	0.033	0.048*	-0.015	0.059
	(0.027)	(0.026)	(0.039)	(0.039)
N	4,074	4,074	1,606	1,606
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Intermediate Outcomes (2/2)

	(1) Pct. Married by 50	(2) Pct. Married by 50	(3) Pct. Urban	(4) Pct. Urban
ln Market Access: (P=1830, θ=8.22)	0.067**	0.030	-0.022	0.206
	(0.027)	(0.028)	(0.136)	(0.000)
N	2,401	2,401	898	898
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by GDP in 1880

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.293***	0.235***	0.044	0.012
	(0.037)	(0.049)	(0.048)	(0.044)
N	1,666	1,666	1,626	1,626
Sample	GDP in 1880 with imputed Above Median	GDP in 1880 with imputed Above Median	GDP in 1880 with imputed Below Median	GDP in 1880 with imputed Below Median
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by Population in 1900

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.254***	0.161***	0.035	-0.001
	(0.040)	(0.054)	(0.044)	(0.039)
N	1,757	1,757	1,749	1,749
Sample	ln RW Population Above Median in 1900	ln RW Population Above Median in 1900	ln RW Population Below Median in 1900	ln RW Population Below Median in 1900
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by Labor Share in Agriculture in 1900

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	-0.043	0.007	0.219***	0.225***
	(0.047)	(0.039)	(0.049)	(0.054)
N	1,740	1,740	1,766	1,766
Sample	Agriculture Share Above Median in 1900	Agriculture Share Above Median in 1900	Agriculture Share Below Median in 1900	Agriculture Share Below Median in 1900
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by Labor Share in Industry in 1900

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.207***	0.208***	0.021	0.085*
	(0.048)	(0.053)	(0.049)	(0.044)
N	1,748	1,748	1,758	1,758
Sample	Industry Share Above Median in 1900	Industry Share Above Median in 1900	Industry Share Below Median in 1900	Industry Share Below Median in 1900
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by Labor Share in Services in 1900

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.248***	0.261***	-0.013	0.004
	(0.050)	(0.059)	(0.044)	(0.034)
N	1,760	1,760	1,746	1,746
Sample	Services Share Above Median in 1900	Services Share Above Median in 1900	Services Share Below Median in 1900	Services Share Below Median in 1900
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by schooling in 1870

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.121**	0.033	0.223***	0.141***
	(0.048)	(0.046)	(0.035)	(0.038)
N	1,234	1,234	2,810	2,810
Sample	Above Median Years of Education in 1870	Above Median Years of Education in 1870	Below Median Years of Education in 1870	Below Median Years of Education in 1870
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by Numeracy in 1880

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.009	0.030	0.291***	0.177***
	(0.041)	(0.039)	(0.047)	(0.040)
N	1,932	1,932	2,022	2,022
Sample	Above Median Numeracy in 1880	Above Median Numeracy in 1880	Below Median Numeracy in 1880	Below Median Numeracy in 1880
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Results by Numeracy in 1900

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	-0.059	0.009	0.191***	0.138***
	(0.043)	(0.000)	(0.059)	(0.040)
N	1,740	1,740	1,726	1,726
Sample	Above Median Numeracy in 1900	Above Median Numeracy in 1900	Below Median Numeracy in 1900	Below Median Numeracy in 1900
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Fertility Access

	(1) Total Fertility	(2) Total Fertility
ln Weighted Fertility Access (θ=8.22)	0.287	0.666
	(0.640)	(0.437)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Pairwise Results

	(1) AD. Total Fertility	(2) AD. Total Fertility	(3) ln Fertility Difference	(4) ln Fertility Difference
Travel Time	-0.031***		-0.006***	
	(0.005)		(0.001)	
ln Travel Time		-1.359***		-0.238***
		(0.283)		(0.046)
N	901,455	901,455	897,947	897,947
Pair and Year FE	Yes	Yes	Yes	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Mortality Access

	(1) Total Fertility	(2) Total Fertility
ln Weighted Mortality Access (θ=8.22)	-3.529**	-1.865
	(1.396)	(1.332)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

By Life Expectancy in 1870

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.276***	0.272***	0.158***	0.023
	(0.043)	(0.047)	(0.032)	(0.038)
N	1,753	1,753	4,056	2,291
Sample	Above Median Life Expectancy in 1870	Above Median Life Expectancy in 1870	Below Median Life Expectancy in 1870	Below Median Life Expectancy in 1870
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Control for Railway Density

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.153***	0.146***
	(0.031)	(0.030)
Rail Density	-25.722***	-21.105***
	(7.161)	(5.700)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Sectoral Shares

	(1) Agriculture Share	(2) Agriculture Share	(3) Industry Share	(4) Industry Share	(5) Services Share	(6) Services Share
ln Market Access: (P=1830, θ=8.22)	-0.002*	-0.001	0.002	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	1,743	1,743	1,743	1,743	1,743	1,743
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Control for the urbanization rate

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.140***	0.115***
	(0.032)	(0.030)
HYDE Urbanization Rate	-16.080***	-10.595***
	(2.263)	(2.174)
N	4,026	4,026
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses. All specifications also control for urbanization.

Control for Country-Level Education

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.135***	0.105***
	(0.043)	(0.037)
N	3,665	3,665
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Control for Country-Level Numeracy

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.163***	0.105***
	(0.031)	(0.029)
N	3,463	3,463
Fixed Effects	Yes	Yes
Controls	No	Yes

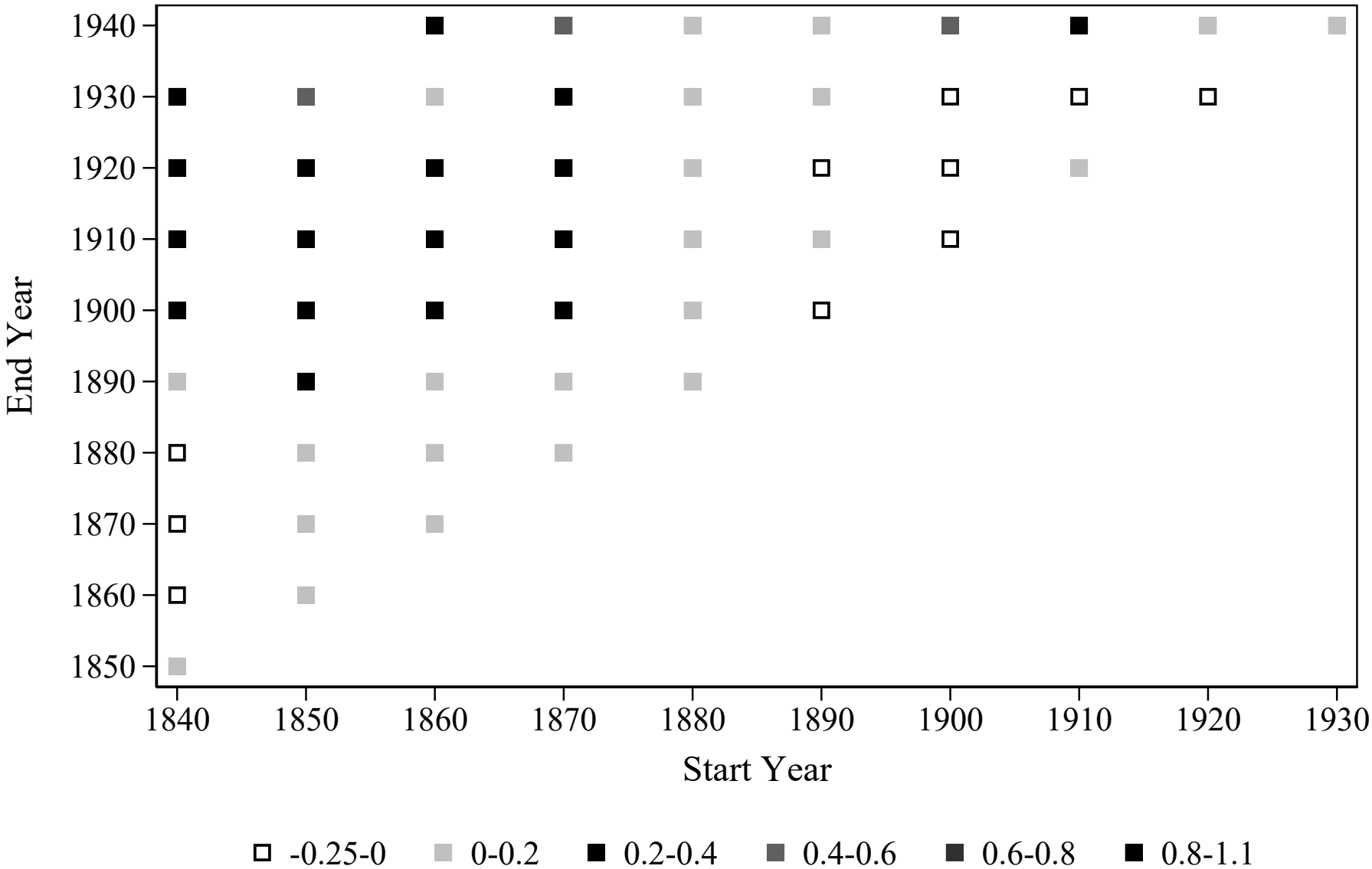
Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Drop Capitals

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.161***	0.121***
	(0.033)	(0.030)
N	3,925	3,925
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Every Long Difference



Long differences IV: 1870 to 1910

	(1) Δ Total Fertility	(2) Δ Total Fertility
Δ ln Market Access	0.562***	0.336***
	(0.104)	(0.110)
N	347	347
Controls	No	Yes
KPF	89.13	141.4

***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Controls are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Robust standard errors in parentheses.

Alternative Market Access (1/6)

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=1)	3.721***	4.395***		
	(0.548)	(0.827)		
ln Market Access: (P=1830, θ=3.60)			0.526***	0.437***
			(0.092)	(0.095)
N	4,056	4,056	4,056	4,056
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Alternative Market Access (2/6)

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=12.86)	0.095***	0.075***		
	(0.019)	(0.018)		
ln Market Access: (P=1850, θ=8.22)			0.157***	0.124***
			(0.032)	(0.030)
N	4,056	4,056	4,056	4,056
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Standardized β by θ

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.111***			
	(0.026)			
ln Market Access: (P=1830, θ=1)		0.272***		
		(0.051)		
ln Market Access: (P=1830, θ=3.60)			0.149***	
			(0.032)	
ln Market Access: (P=1830, θ=12.86)				0.106***
				(0.025)
N	4,056	4,056	4,056	4,056
Fixed Effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Alternative Market Access (3/6)

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=t, θ=8.22)	0.131***	0.103***
	(0.032)	(0.030)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Alternative Market Access (4/6)

	(1) Total Fertility	(2) Total Fertility
ln Market Access (θ=8.22, P=FT 1830)	0.158***	0.125***
	(0.032)	(0.030)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Alternative Market Access (5/6)

	(1) Total Fertility	(2) Total Fertility
ln Market Access (θ=8.22, P=Cities in 1830)	0.173***	0.131***
	(0.032)	(0.031)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Alternative Market Access (6/6)

	(1) Total Fertility	(2) Total Fertility
ln Market Access (θ=8.22, P=Cities in 1800)	0.178***	0.130***
	(0.033)	(0.033)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Market Access with Cities in 1850

	(1) Total Fertility	(2) Total Fertility
ln Market Access (θ=8.22, P=Cities 1850)	0.159***	0.129***
	(0.032)	(0.030)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Rail Speed of 30km per Hour

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22) 30km h	0.211***	0.169***
	(0.045)	(0.041)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Rail Speed of 120km per Hour

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22) 120km h	0.122***	0.093***
	(0.024)	(0.023)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

With Border Costs

	(1) Total Fertility	(2) Total Fertility
ln Market Access with borders (θ=8.22, P=1830)	0.157***	0.124***
	(0.031)	(0.030)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

With Roads

	(1) Total Fertility	(2) Total Fertility
ln Market Access with roads (θ=8.22, P=1830)	0.131***	0.107***
	(0.031)	(0.029)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

With Steam Travel Over Water

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22) with steam	0.156***	0.123***
	(0.032)	(0.030)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

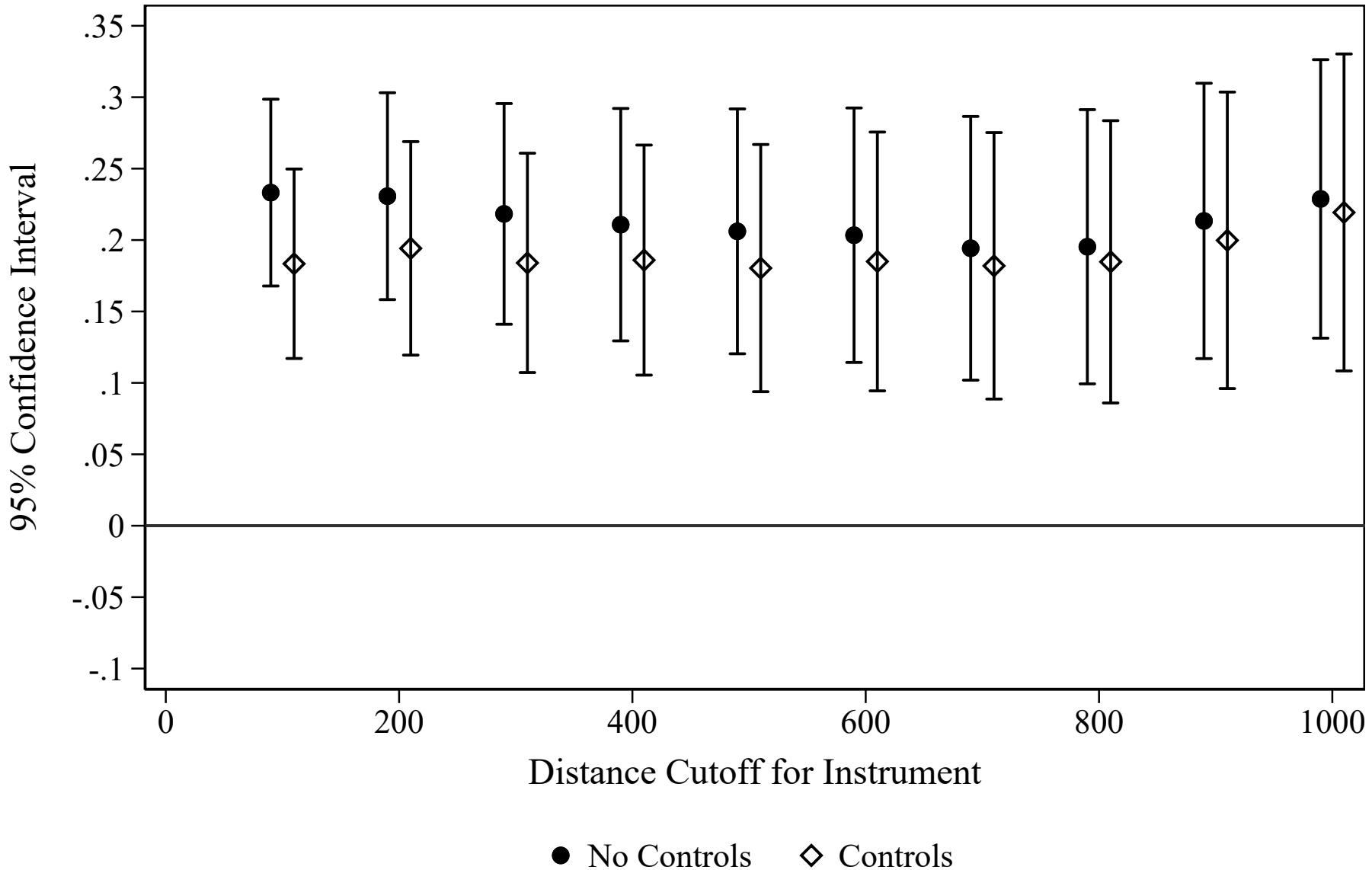
Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Conley Standard Errors

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.158*	0.125***
250 km	(0.086)	(0.043)
500 km	(0.076)	(0.050)
750 km	(0.050)	(0.050)
1000 km	(0.020)	(0.049)
N	4,104	4,104
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Alternative IV Cutoff Distances



ln Fertility

	(1) ln Total Fertility	(2) ln Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.007***	0.005***
	(0.001)	(0.001)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Country Trends

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.055**	0.063**
	(0.027)	(0.026)
N	4,056	4,056
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Country-Year Fixed Effects

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.092***	0.084***
	(0.025)	(0.026)
N	4,044	4,044
Fixed Effects	Yes	Yes
Controls	No	Yes

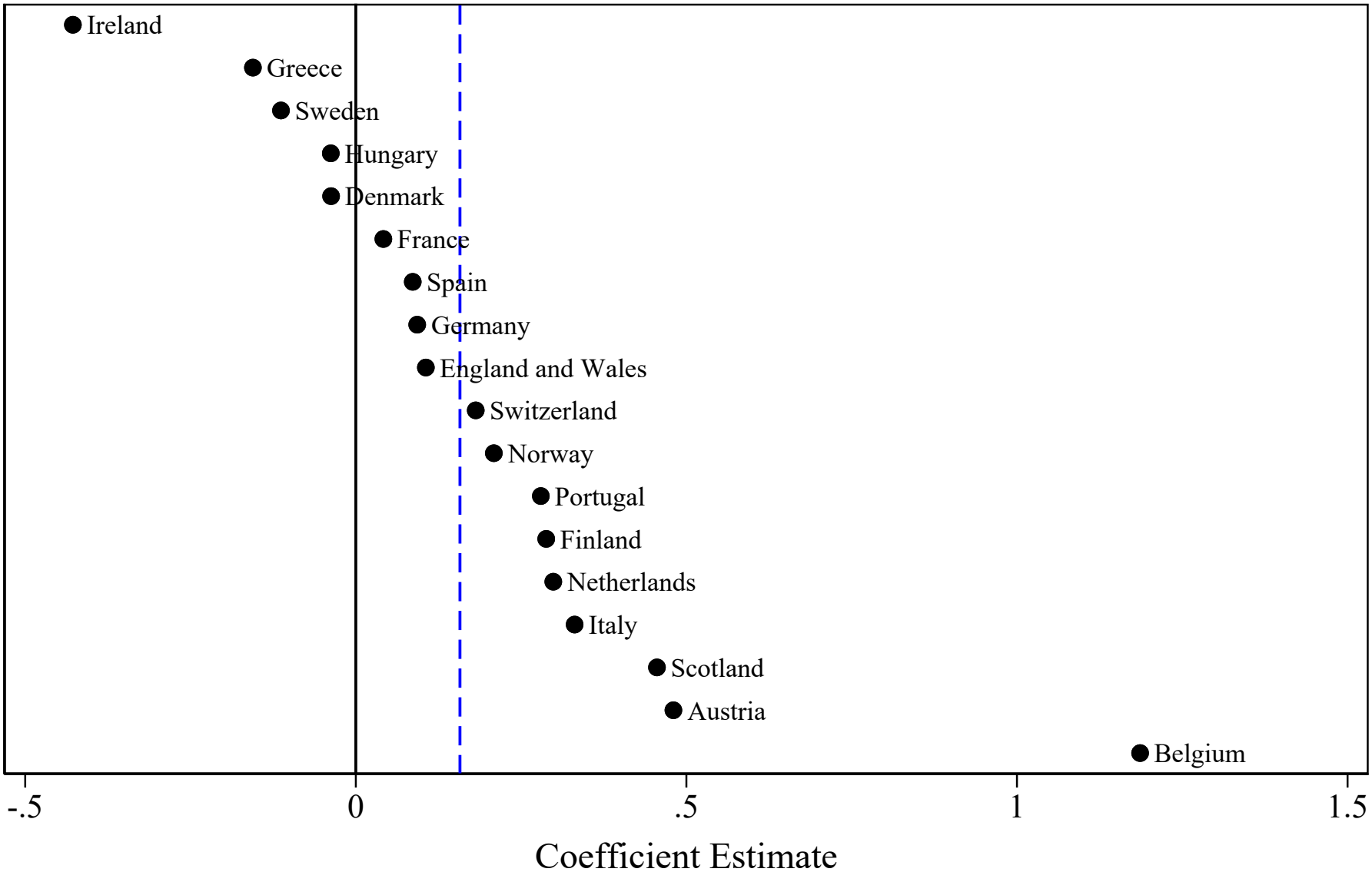
Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Controlling for coal

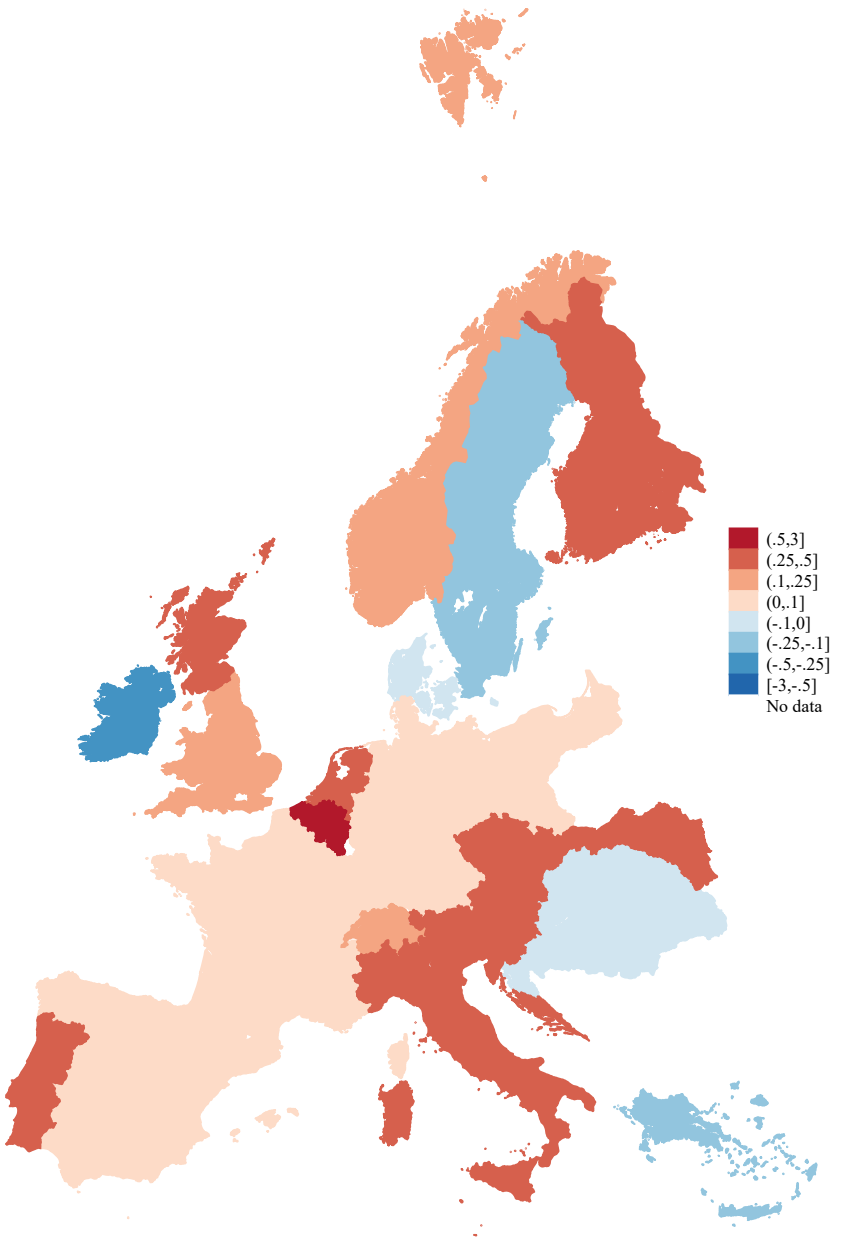
	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.158***	0.124***	0.155***	0.125***
	(0.031)	(0.030)	(0.032)	(0.030)
N	4,056	4,056	4,056	4,056
Coal Control	Coal Share	Coal Share	Carbon Share	Carbon Share
Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Belgium? Results by Country...



Results by Country: Coefficient Estimates



No Belgium

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.159***	0.125***
	(0.032)	(0.030)
N	3,993	3,993
Fixed Effects	Yes	Yes
Controls	No	Yes

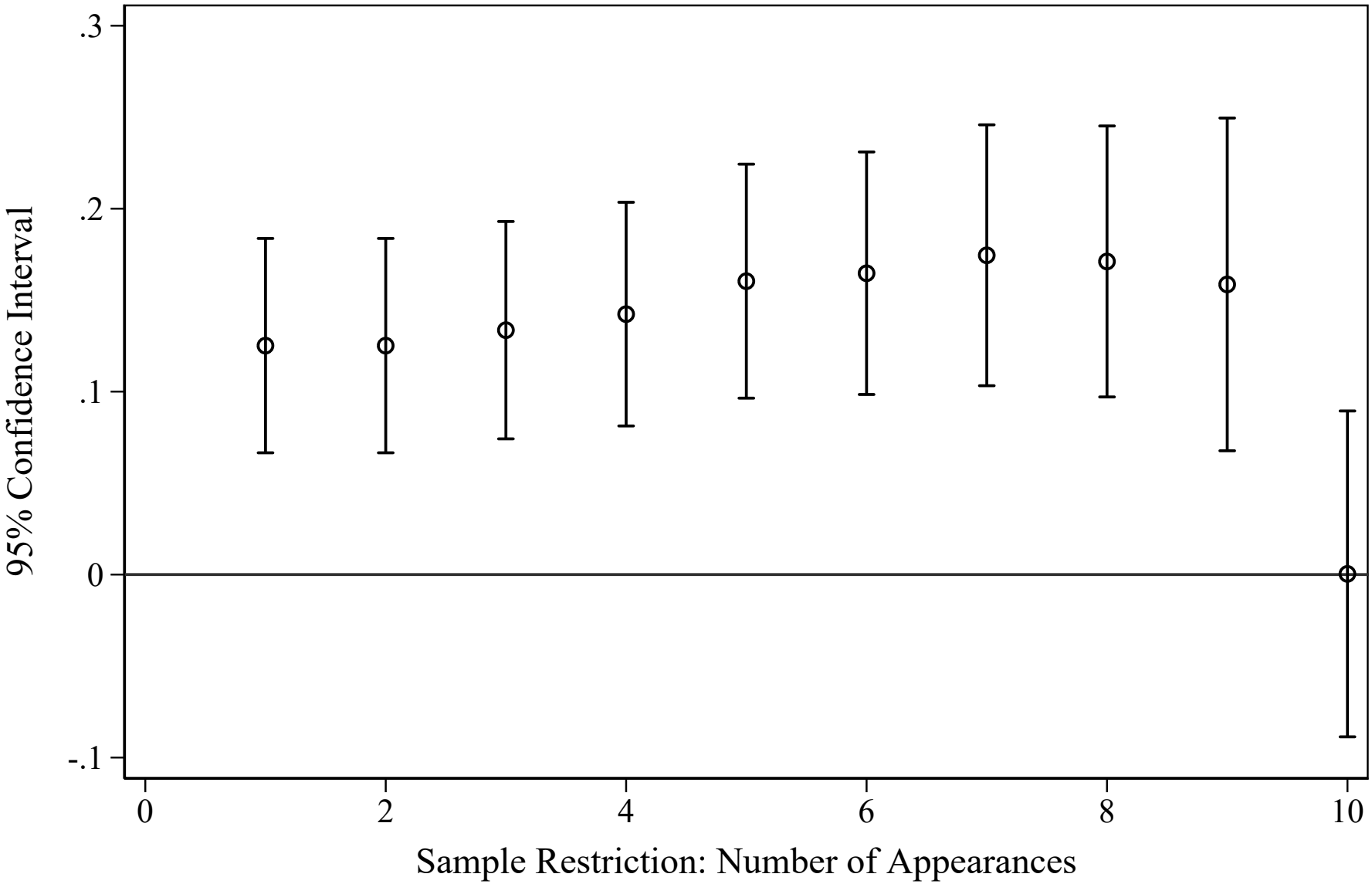
Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Smaller Regions Only

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.231***	0.173***
	(0.038)	(0.041)
N	2,437	2,437
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Restrict Sample by Appearances



Results by Time Period

	(1) Total Fertility	(2) Total Fertility	(3) Total Fertility	(4) Total Fertility	(5) Total Fertility	(6) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.242***	0.102***	-0.089	0.012	-0.039**	0.003
	(0.039)	(0.038)	(0.133)	(0.057)	(0.016)	(0.019)
N	2,447	2,447	1,005	1,005	416	416
Period	1870 to 1910	1870 to 1910	After 1910	After 1910	Before 1870	Before 1870
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Before 1914

	(1) Total Fertility	(2) Total Fertility
ln Market Access: (P=1830, θ=8.22)	0.199***	0.127***
	(0.024)	(0.026)
N	2,996	2,996
Fixed Effects	Yes	Yes
Controls	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant. Fixed effects are for location and decade. Time-invariant controls interacted with decade fixed effects are latitude, longitude, caloric suitability, coast distance, river, altitude, population density in 1830, area, average precipitation, ruggedness, and suitability for barley, maize, rye, oats and wheat. Standard errors clustered by location in parentheses.

Controls: Latitude

Controls: Longitude

Controls: Caloric Suitability

Controls: Wheat Suitability

Controls: Coast Distance

Controls: Average Precipitation

Controls: Ruggedness

Controls: Altitude

Controls: Barley Suitability

Controls: Maize Suitability

Controls: Oat Suitability

Controls: Rye Suitability

Controls: Pop. Density 1830

Controls: River

Controls: Area