# Religious Diversity and the Industrial Revolution

Bas Machielsen

Utrecht University

Amaury De Vicq

University of Groningen

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# Introduction

# Introduction

- Religion is a defining feature of human culture, shaping individual preferences, societal norms, and institutional frameworks for centuries (Becker et al., 2023). Religion can:
  - encourage the accumulation of physical capital by promoting thrift and financial development (Guiso et al., 2006)
  - impact human capital by hindering or stimulating educational systems (Squicciarini, 2020)
  - impact total factor productivity by either fostering or constraining technological change (McCleary et al., 2006)
  - shape political economy, and societal conflict by shaping rituals and legal context (Acemoglu et al., 2012)
- But what about the role of interaction between adherents of different religions?
  - Some studies argue that religious diversity fosters creativity, innovation, and social cohesion (Jha, 2013; Cinnirella and Streb, 2017)
  - Others highlight its potential to hinder cooperation and impede development (Chakravarty et al., 2016; Cosgel et al., 2023; Dhami et al., 2024).
  - But a lack of causal evidence at the society-level.

# This Study

- This study contributes to filling this gap by investigating the nexus between religious diversity and economic growth
  - We use the setting of the Netherlands and economic growth during the Industrial Revolution (~1880-1930)
  - Methodologically, the availability of comprehensive census data and relative ethnic homogeneity of the Dutch population, allows us to isolate the effects of religious diversity more effectively.
- It draws on the religious coping hypothesis to instrument religious diversity by extreme weather to identify the effect of diversity on economic growth.
- Religious diversity particularly salient in light of the growing pluralism in Europe, driven by contemporary migration from regions with diverse religious traditions.
  - But also: other parts of the world.

# This Study [2]

- Using historical weather data, we find places that have been more exposed to extreme winters than others
- Consistent with the *religious coping hypothesis* (Bentzen, 2019), we show that places more exposed to extreme weather in 19th century have remained more homogeneous at the onset of the Dutch Industrial Revolution.
  - Extreme weather events arguably induce exogenous variation in religious diversity.
- We show that these weather shocks are unrelated to any observed heterogeneity among municipalities
  - And argue that they are also unrelated to any unobserved heterogeneity
- We use this variation to explain the differential extent of industrialization and economic performance among municipalities

# Historical Setting

- Our historical setting is the Netherlands in the late 19th century

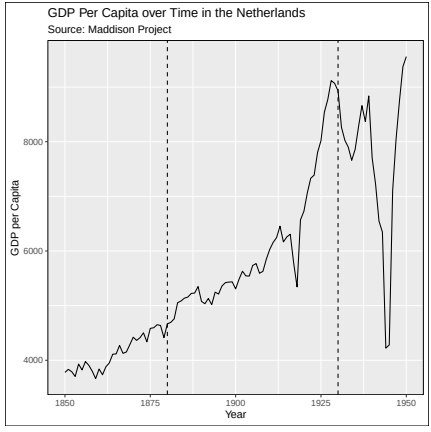



Figure 1: GDP per Capita over Time in the Netherlands

# Historical Setting [2]

- Netherlands was a late industrializer but experienced high GDP per capita growth during the first wave of Industrialization (~1820-1920)
- Ethnically very homogeneous country, however religiously very diverse
  - Mainly but not exclusively due to variations of Protestantism
- Regional variation: the Netherlands had about 1100 municipalities with very different levels of religious diversity
  - Contrary to popular belief: not only "Catholics in the South, Protestants in the North"
- Politics also concentrated along religious divisions
- Also regional variation in Industrialization and development more broadly
  - Not necessarily a "Randstad versus Periphery story"
  - Periphery had many industrial centers

# Empirical Approach

# Endogenous and Independent Variables

- Main Independent Variable:
  - Religious HHI: Based on data from the historical censuses on religious adherence
  - Let $s_{kjt}$ be head count of denomination $k$ in municipality $j$ at time $t$
  - We then calculate a religious HHI index for municipality $j$ at time $t \in \{1809, 1879, 1889, 1899, 1920, 1930\}$ as follows:

$$\text{Religious HHI}_{jt} = \sum_{k=1}^{K} s_{kjt}^2$$

- Main Instrument:
  - Number of Days Extreme Winter (1800-1880)
  - Based on interpolated temperatures for the 19th century

# Outcomes and Specification

- Main Dependent Variables:
  - ***Increase* in Industrial Employment 1889-1930**: Growth in the Share of Total Workforce Working in Industry: From two national professional censuses (*Bedrijfstellingen*). Note: $N \approx 300$
  - **No. of Motorized Vehicles in 1928**: From the *Statistiek der Motorvoertuigen*, first edition.
  - **Total Horsepower in Industrial Sector in 1930**: From the 1930 *Bedrijfstelling*
  - **Share of Population Paying Income Tax in 1933**: From the Provincial Reports (*Provinciale Verslagen*)
- Baseline OLS specification:

$$Y_{ij} = \alpha_j + \delta \text{Religious HHI}_i + \sum_{k=1}^{K} \beta_k \text{Religious Share } k + X'_{ij}\gamma + \epsilon_{ij}$$

- where $Y_{ij}$ is an outcome variable for municipality $i$ in province $j$, and $\alpha_j$ are province dummies.

# Control Variables

- **Initial Development**: We include variables measuring a municipality's starting point so as to compare municipalities with a comparable initial level of development
  - Total Tax Income in 1879
  - Percentage of Workforce Employed in Industry 1889 (Note: $N \approx 300$)
  - Total HP, No. Factories, Employment, No. Steam Engines 1890
  - City Status: From Visser (1985), we find whether a city existed and its population count in $1560, 1400, 1300$, and $1200$.
  - Urban and Market Potential: (Bosker et al., 2013; Curuk and Smulders, 2016)
  - Population in 1879
- **Geographic Controls**:
  - Agricultural (Crop) Suitability and Caloric Suitability (Galor and Ozak, 2016)
  - Distance to River, Distance to Wittenberg (see Zhao, 2023)
  - Area, Elevation, Ruggedness

# Results

# OLS Baseline

- Condition on controls, a negative correlation between municipal religious diversity and % of labor force active in industry.
  - But doesn't imply diverse places being worse off: no fewer motorized vehicles, no lower % of populace paying income tax.

Table 1: Religious Diversity and Economic Development

| | Industry Empl. | | Motorized Vehicles P.C. | | HP P.C. | | % Paying Inc. Tax | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Religious HHI | -0.026 | 0.052* | -0.015*** | -0.012*** | -0.154*** | -0.053 | -0.095*** | -0.047* |
| | (0.029) | (0.029) | (0.004) | (0.004) | (0.051) | (0.041) | (0.030) | (0.028) |
| N | 1076 | 1056 | 1068 | 1048 | 1076 | 1056 | 1064 | 1044 |
| Adj. $R^2$ | 0.18 | 0.32 | 0.16 | 0.21 | 0.24 | 0.28 | 0.26 | 0.35 |
| Extended Controls | No | Yes | No | Yes | No | Yes | No | Yes |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

# Correlations with Religious Shares

- Results robust once conditioned on religious shares
  - Economic effect small: 1 SD increase in Religious Homogeneity $\rightarrow \approx$ 1 percentage point shift to Industrial Workforce

Table 2: Religious Diversity and Economic Development

| | Industry Empl. | | Motorized Vehicles P.C. | | HP P.C. | | % Paying Inc. Tax | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Religious HHI | -0.005 | 0.053* | -0.014*** | -0.012*** | -0.138*** | -0.060 | -0.088*** | -0.058** |
| | (0.030) | (0.029) | (0.004) | (0.004) | (0.047) | (0.044) | (0.030) | (0.027) |
| Protestant Share 1879 | -0.016 | -0.008 | 0.000 | 0.001 | 0.004 | 0.021 | 0.047** | 0.055*** |
| | (0.016) | (0.016) | (0.002) | (0.003) | (0.015) | (0.017) | (0.019) | (0.018) |
| Jewish Share 1879 | 2.080*** | -0.278 | 0.084** | 0.052 | 2.042* | -0.217 | 2.032*** | 0.836** |
| | (0.511) | (0.529) | (0.042) | (0.044) | (1.191) | (1.230) | (0.390) | (0.408) |
| N | 1076 | 1056 | 1068 | 1048 | 1076 | 1056 | 1064 | 1044 |
| Adj. $R^2$ | 0.19 | 0.32 | 0.16 | 0.21 | 0.24 | 0.28 | 0.28 | 0.36 |
| Extended Controls | No | Yes | No | Yes | No | Yes | No | Yes |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

# Correlation with Δ Religious HHI

- Results also robust when considering the *increase* in religious homogeneity through the 19th century

Table 3: Religious Diversity and Economic Development

| | Δ Industry Empl. | | Motorized Vehicles P.C. | | HP P.C. | | % Paying Inc. Tax | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Δ Religious HHI | 0.082* | 0.081* | -0.005 | -0.006 | 0.202 | 0.125 | 0.111* | 0.091 |
| | (0.042) | (0.043) | (0.007) | (0.008) | (0.195) | (0.167) | (0.062) | (0.061) |
| Initial Industry Share | -0.246*** | -0.225*** | 0.012* | 0.013** | 1.362*** | 1.311*** | 0.108* | 0.139*** |
| | (0.060) | (0.059) | (0.007) | (0.006) | (0.492) | (0.473) | (0.062) | (0.045) |
| N | 270 | 270 | 268 | 268 | 270 | 270 | 266 | 266 |
| Adj. $R^2$ | 0.16 | 0.23 | 0.29 | 0.33 | 0.27 | 0.31 | 0.39 | 0.46 |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province FE | No | Yes | No | Yes | No | Yes | No | Yes |

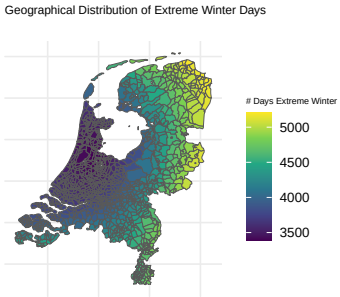
# IV Approach

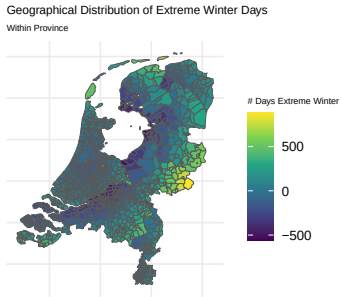
# Extreme Weather

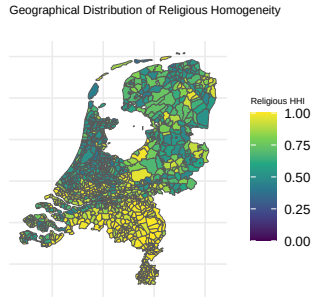
- Our IV approach exploits marginal differences in exposure to the weather (extreme winters) in the 19th century between municipalities in the same province
- Municipalities likely similar *ex ante*
- The *religious coping* hypothesis argues that places with more frequent extreme weather might become more religious (Bentzen, 2019)
  - That in turn leads to a stronger position of the dominant religion
- A direct effect of the weather/climate?
  - By conditioning our estimates on province, and geographical controls, there is likely no direct effect of the climate on industrialization
  - We also employ a placebo test showing that 19th century extreme weather is *not* related to pre-19th century religious diversity
    - Making it unlikely the variable captures some other unobserved heterogeneity between municipalities

# First Stage

- There is a clear visual link between extreme weather and religious diversity



# Placebo Test Ex Ante Diversity

- There is no link between extreme weather and *ex ante* religious diversity
  - Extreme weather in the 19th c. is not correlated with *ex ante* denomination count, nor with religious diversity in the early 19th century (1809 census) conditional on controls

Table 4: Placebo First Stage: Extreme Weather and Pre-19th Century Diversity

| | Denom. Count 1600 | | Denom. Count 1700 | | Denom. Count 1800 | | Rel. HHI 1809 |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Extreme Weather | -0.006 | -0.015 | 0.005 | -0.008 | 0.044* | 0.029 | 0.003 |
| | (0.020) | (0.020) | (0.022) | (0.021) | (0.024) | (0.024) | (0.007) |
| Adj. $R^2$ | 0.139 | 0.355 | 0.140 | 0.478 | 0.187 | 0.491 | 0.459 |
| N | 1116 | 1116 | 1116 | 1116 | 1116 | 1116 | 1020 |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| City Size FE | No | Yes | No | Yes | No | Yes | Yes |

# Placebo Test Migration

- A possible violation of the exclusion restriction could be: extreme weather $\rightarrow$ migration $\rightarrow$ industrialization
  - This does not appear to be the case

Table 5: Extreme Weather and Migration

| | Net Migration 1851-1890 | | Net Migration 1890-1930 | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Extreme Weather | -0.004 | 0.090 | 0.120 | 0.086 |
| | (0.036) | (0.060) | (0.116) | (0.100) |
| N | 1122 | 1110 | 1122 | 1073 |
| Adj. $R^2$ | 0.00 | 0.16 | 0.01 | 0.58 |
| Extended Controls | No | Yes | No | Yes |
| Province FE | Yes | Yes | Yes | Yes |

# IV Results

- The IV results also show a direct link between religious diversity and industrialization
  - A 1 SD increase in religious homogeneity $\rightarrow$ about 6 p.p. *increase* workforce shift to industrial professions

Table 6: Religious Diversity and Economic Development

| | Δ Industry Empl. | | Motorized Vehicles P.C. | | HP P.C. | | % Paying Inc. Tax | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Religious HHI | 0.438** | 0.346* | -0.019 | -0.012 | 0.758 | -0.175 | -0.190 | -0.009 |
| | (0.188) | (0.185) | (0.016) | (0.019) | (0.675) | (0.558) | (0.167) | (0.191) |
| Protestant Share 1879 | -0.145** | -0.115** | 0.014** | 0.008 | -0.301 | -0.019 | 0.165*** | 0.085 |
| | (0.060) | (0.056) | (0.005) | (0.007) | (0.248) | (0.211) | (0.054) | (0.067) |
| Jewish Share 1879 | 0.836 | -0.212 | 0.021 | -0.065 | 3.510 | -0.117 | 1.911*** | -0.122 |
| | (0.538) | (0.613) | (0.067) | (0.071) | (2.390) | (2.299) | (0.657) | (0.734) |
| Initial Industry Share | -0.158** | -0.257*** | 0.010 | 0.006 | 1.606*** | 1.014** | 0.184*** | 0.087* |
| | (0.061) | (0.066) | (0.007) | (0.007) | (0.461) | (0.510) | (0.062) | (0.044) |
| N | 280 | 277 | 278 | 275 | 280 | 277 | 276 | 273 |
| Adj. $R^2$ | -0.17 | 0.06 | 0.14 | 0.33 | 0.23 | 0.36 | 0.28 | 0.47 |
| 1st Stage F Stat | 35.24 | 21.04 | 37.31 | 21.71 | 35.24 | 21.04 | 37.02 | 22.07 |
| Controls | No | Yes | No | Yes | No | Yes | No | Yes |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

# Increase in Homogeneity

- The effect remains robust and similar in size if we use the *increase* in religious homogeneity from 1809 to 1879 (two successive censuses)
  - Strong first stage also supports that (i) first places become more religious and (ii) only then there is an effect on industrialization

Table 7: Religious Diversity and Economic Development

| | Δ Industry Empl. | | Motorized Vehicles P.C. | | HP P.C. | | % Paying Inc. Tax | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Δ Religious HHI | 0.860 | 0.699** | -0.051 | 0.005 | 1.573 | 1.739 | -0.446 | 0.235 |
| | (0.569) | (0.329) | (0.045) | (0.028) | (1.610) | (1.136) | (0.467) | (0.274) |
| Initial Industry Share | -0.326*** | -0.316*** | 0.023*** | 0.013** | 1.274*** | 1.106** | 0.340*** | 0.125** |
| | (0.123) | (0.089) | (0.008) | (0.006) | (0.474) | (0.496) | (0.087) | (0.061) |
| N | 273 | 270 | 271 | 268 | 273 | 270 | 269 | 266 |
| Adj. $R^2$ | -1.08 | -0.54 | -0.11 | 0.32 | 0.19 | 0.18 | -0.01 | 0.44 |
| 1st Stage F Stat | 8.78 | 15.14 | 7.80 | 14.57 | 8.78 | 15.14 | 7.58 | 14.25 |
| Controls | No | Yes | No | Yes | No | Yes | No | Yes |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

# Explaining Cross-Section

- We also explain cross-sectional 1930 Industrial Employment.
  - By using different controls other than 1889 Industrial Employment, retain a sufficiently high sample size.
  - Results similar to small sample results

Table 8: Religious Diversity and Economic Development

| | Industry Empl. | | Motorized Vehicles P.C. | | HP P.C. | | % Paying Inc. Tax | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Religious HHI | 0.891*** | 1.025*** | -0.013 | -0.007 | 0.639* | 0.746* | 0.114 | 0.153 |
| | (0.309) | (0.314) | (0.017) | (0.020) | (0.378) | (0.426) | (0.177) | (0.202) |
| Protestant Share 1879 | -0.086 | -0.109* | 0.000 | 0.000 | -0.057 | -0.063 | 0.031 | 0.033 |
| | (0.056) | (0.061) | (0.003) | (0.004) | (0.063) | (0.069) | (0.025) | (0.030) |
| Jewish Share 1879 | 4.387*** | 1.135 | 0.087 | 0.060 | 4.041*** | 0.954 | 2.550*** | 1.138** |
| | (1.032) | (0.964) | (0.068) | (0.053) | (1.529) | (1.463) | (0.662) | (0.528) |
| N | 1076 | 1056 | 1068 | 1048 | 1076 | 1056 | 1064 | 1044 |
| Adj. $R^2$ | -0.73 | -0.67 | 0.16 | 0.21 | 0.08 | 0.13 | 0.24 | 0.32 |
| 1st Stage F Stat | 47.20 | 41.63 | 49.03 | 43.39 | 47.20 | 41.63 | 49.15 | 44.16 |
| Extended Controls | No | Yes | No | Yes | No | Yes | No | Yes |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

# Conclusion

# Preliminary Conclusion and Next Steps

- Analyses show a robust effect of religious homogeneity on Industrialization
  - But why are religiously homogeneous municipalities more effective at industrializing?
- What mechanism could be responsible for the relationship between religious diversity (homogeneity) and industrialization?
  - Is the change driven by demand (new industrial establishments) or supply (workers learning skills to work in industrial establishments, as in Squicciarini, 2020)?
    - Results on Horsepower suggest demand-driven change
  - Politics
  - Financial Development (as in Kersting et al., 2020)
- Is the change driven by agricultural or service workers taking up industrial professions?
- Which is important: % of Labor Force in Industry vs. Industrial Employment in municipality $i$?