

*Preliminary and Incomplete: Please Do Not Distribute or Cite without Authors' Permission*

## **Death and Politics: Proportional Representation and the Mortality Decline**

Christina Gathmann and Steffen Reinhold

First Draft: August 2010

### Abstract:

The spread of proportional system in Continental Europe between 1890 and 1945 marked a major shift in political representation. This paper provides new evidence that this new electoral system also generated substantial health benefits for its population. Using the exemplary case of Switzerland, we show that proportional representation gave left-wing parties, representing the interests of the emerging working class, greater weight in the political process. Consistent with economic theory, proportional representation increased public spending for public health and education as well as social support for the elderly and the Poor. Based on comprehensive archival mortality statistics since 1880, we show that these shifts in public spending were associated with a decline in mortality from infectious diseases, the major killer of the time, by 11.4 percent.

\*Gathmann: University of Mannheim, CESifo, and IZA ([cgathmann@uni-mannheim.de](mailto:cgathmann@uni-mannheim.de)); Reinhold: Mannheim Institute for the Economics of Aging (MEA) ([reinhold@mea.uni-mannheim.de](mailto:reinhold@mea.uni-mannheim.de)). We are grateful to the Swiss Federal Statistical Office, in particular Christoph Junker and Erwin Wüest, for supplying the Swiss deaths by cause statistics and also Toke Aidt for sharing some of the cross-country data. We thank Ina Christ, Christoph Schinke and Christoph Esslinger for superb research assistance and the University of Mannheim for financial support. We alone are responsible for the views in this paper and for all errors.

## 1. Introduction

Between the late nineteenth and early twentieth century, mortality in most of Europe declined dramatically. In Switzerland, for example, crude death rates declined from 21 per 10,000 in 1890 to 11 per 1,000 at the end of World War II in 1945. As a consequence, Swiss life expectancy at birth increased from around 40 years in 1870 to 63 years in 1945. This unprecedented decline in mortality was part of the “epidemiological transition” with reductions in infectious diseases accounting for almost all of the reductions in overall mortality.

Two leading explanations have been proposed for this decline. One explanation attributes the decline to nutritional gains and improved living standards more generally (McKeown, 1976; see also Szreter, 1988). A second set of explanations argues that the mortality decline was the consequence of public health interventions. According to this latter view, the government’s provision of public health facilities, sanitation, clean water and education about health behavior played a key role for the mortality decline (Preston, 1976; Preston and van de Walle, 1978; Woods, 1991).

In this article, we take a step back from the debate about the merit of each explanation. Instead, we explore the role political forces played for the dramatic reductions in mortality. Our starting point is the observation that political representation, i.e. who is allowed to vote and whose interests are represented in the political process, play a crucial role for public policies.<sup>1</sup> Between 1890 and 1945, a major shift in political representation occurred in Europe: parliaments began to be elected based on proportional rule rather than the older plurality rule. Whereas candidates in a plurality system maximize the probability of winning the majority in their local district (winner-takes-all or first-past-the-post system), candidates in a proportional system in contrast maximize the share of votes from the broader population.<sup>2</sup> The available empirical evidence seem to suggest that the spread of proportional representation in Europe increased spending on redistributive programs and public education (Funk and Gathmann, 2010; Milesi-Ferretti et al., 2002; Persson and Tabellini, 2003).<sup>3</sup>

---

<sup>1</sup> Persson and Tabellini (2004) and Besley and Case (2003) provide recent surveys.

<sup>2</sup> Electoral systems may also vary in other, more subtle dimensions. See Taagepera and Shugart (1989) and Cox (1997) for a thorough discussion of real-world electoral systems.

<sup>3</sup> A related literature argues that universal male suffrage increased the provision of public education and redistributive programs (Lindert, 1994; Acemoglu and Robinson, 2005; but see Lizzeri and Persico, 2005 for

The substantive question of this article is then whether the spread of proportional representation contributed to the mortality decline observed in Continental Europe between the late nineteenth and mid-twentieth century. Our empirical focus is hereby on Switzerland for which we obtained comprehensive mortality statistics and observe rich variation in the electoral system for state parliaments over time.

Before we turn to our specific empirical case, we first discuss the mechanism how exactly differences in election rules affect public policies and possibly mortality. Theories of electoral systems suggest at least two important channels. Proportional representation shifts the electoral incentives of all candidates from local constituencies to socio-economic groups (Austen-Smith, 2000; Lizzeri and Persico, 2001; Milesi-Ferretti et al., 2002; Myerson, 1993). Why? Candidates in a plurality system are elected by winning the majority of votes in their local district. To maximize their probability of winning, they favor policies that benefit their local clientele (e.g. pork-barrel projects). Hence, they support the provision of goods that can be targeted geographically like roads or bridges, for example. Candidates elected in a proportional system in contrast, seek to maximize their vote share in one large district, for example. To get support from as many voters as possible, the candidates favor policies that appeal to broad social groups. Hence, they support the provision of general public goods or broad redistributive programs.

The second reason electoral reform affects public policy is because it changes the set of candidates that gets elected (Milesi-Ferretti et al., 2002; Lizzeri and Persico, 2005). Over our time period, the workers' movement became an increasingly important social force in Switzerland and Europe more broadly. Under the old plurality system, they had difficulties to win seats in a district; and even if they did, they never achieved a majority of seats in any canton parliament (e.g. Gruner, 1975). After the adoption of proportional representation however, the political weight of left-wing parties increased substantially in many canton parliaments. To the extent that left-wing candidates represent the interests of the working class, policies in the proportional system should reflect the needs and preferences of this constituency more than under plurality rule.

---

evidence against an increase in redistributive spending). Another set of studies shows that women's suffrage increased spending for public education, health and redistributive programs (Aidt et al., 2006; Lott and Kenny, 1999).

How then would these shifts in political representation affect mortality? There are at least four possible channels: first, politicians, especially if elected by the working class, might support programs to improve the housing conditions in urban areas. Public authorities in Switzerland and elsewhere increasingly tried to contain poor housing and overcrowding because these were known to spread diseases (Burnett, 1991; Koller, 1995; Vögele and Woelk, 2000). Second, redistributive programs more generally could have helped to improve the living conditions of the poor. Since mortality was much higher among the poorer segments of society, this could have an important effect on overall mortality (for example, Spree, 1981). A third, more indirect effect, could have worked through public education. Better access to education and other educative measures, especially for mothers, could have improved food hygiene and hence nutrition (e.g. Woods, 1991). These three channels would predict that the adoption of proportional representation would decrease mortality through better housing conditions, food hygiene and living conditions for the Poor. The fourth channel works however in the opposite direction. Another important factor for reducing mortality in the urban areas was improvements of sanitation and access to clean water –traditionally local public goods (e.g. Evans 1987; Preston and van de Walle, 1978; Vögele, 1998). Since plurality system encourages investments in local public goods, investments in sewage and clean water technology might have actually decreased with the switch to proportional representation.<sup>4</sup> This fourth channel would then predict mortality to actually increase with proportional representation. The effect of proportional representation is therefore a-priori ambiguous and hence, an empirical question. Our empirical analysis mainly focuses on Switzerland over the period from 1880 to 2000. This setting has a number of attractive features. Switzerland's federalist system creates considerable variation in electoral rules at the sub-national level. Some cantons use a proportional, others a plurality system to elect their parliament. Moreover, most cantons switched from a plurality system to a proportional system between 1880 and 2000. Whereas in 1880, all cantons, like all democracies in the world, still had a plurality system in place, 17 cantons switched to proportional representation by the end of World War II. An additional 5 cantons adopted

---

<sup>4</sup> One might argue that these investments are typically made by local governments and hence should be unaffected by electoral reforms at the state level. However, some scattered anecdotal evidence suggests that canton governments in Switzerland did contribute financially to these infrastructure projects.

proportional representation between 1945 and 2000.<sup>5</sup> Using the timing of electoral reforms at the canton level has the additional virtue that it reduces problems of unquantifiable historical and institutional differences between countries since all cantons in Switzerland share a common history and many traditions.

To establish the link between changes in the electoral system, political representation and mortality, we use new archival records from Swiss state ('canton') spanning the period from 1880 to 2000. The Swiss Statistical Office has collected comprehensive deaths by cause statistics that report mortality by age, sex and detailed cause for each canton separately since 1880. For the empirical analysis, we have digitized the paper records and constructed a consistent database of state-level mortality over a 120 years period. We combine the mortality statistics with socio-demographic characteristics from the Population Census, among others, as well as detailed information on each canton's political system which we collected from the cantonal constitutions and relevant electoral laws.

We find that the adoption of proportional representation improved the political representation of left-wing parties. The seat share in canton parliaments of the Social Democratic Party increased by an average of 4.5 percent, though the seat share more than tripled in some cantons. The better representation of workers together with changes in electoral incentives of all representatives in the proportional system had important implications for public spending as well: after the adoption of proportional representation, spending for public health (combining both investments in public sanitation and hospitals), public education and social welfare increased substantially. In contrast, spending on more localized goods like roads decreases, while there seems to be little effect on the overall size of government. We then show that this reorientation of public policy carried substantial health benefits for the population: the death rate from infectious diseases, the major killer of the time, decreased by 11.4 percent. Reductions in mortality were especially pronounced for measles (31 percent), typhoid (21 percent) and infant diarrhea (20 percent). In contrast, we find no effect for other causes of deaths (like cancer or suicide) which should be largely unaffected by the public health and sanitation measures during this time. Finally, evidence based on cross-country data supports

---

<sup>5</sup> Detailed discussions of the Swiss electoral system can be found in Garrone (1991), Giacometti (1941), Kölz (1987), Lutz and Strohmman (1998), Moser (1987) and Poledna (1988).

our argument that the adoption of proportional representation improved general population health in a broader sample of West European and Latin American countries.

The paper is organized as follows. The next section discusses the historical and institutional background in Switzerland, while section 3 introduces the data. In Section 4, we provide (preliminary) evidence that proportional representation was indeed associated with a decline in mortality, especially for infectious diseases. Section 5 shows supporting evidence using infant mortality and crude deaths statistics from Europe and Latin America. Finally, Section 6 concludes.

## **2. Historical Setting and Institutional Background<sup>6</sup>**

### **2.1. Population Fractionalization and Industrialization**

Historically, Switzerland's population has been divided along linguistic lines between the German-, French- and Italian-speaking population and, since the Reformation, along religious lines between Catholics and Protestants. This religious split led to violent clashes, for example, the war in 1847 (*Sonderbundskrieg*) and the cultural conflict (*Kulturkampf*) of the 1870s. While the conflict in 1847 largely took place between Catholic, conservative cantons (Appenzell-Innerrhode, Appenzell-Outerrhode, Uri, Schwyz, Obwalden and Nidwalden) and those with Radical-liberal governments, there were also violent conflicts between the two groups in the cantons of Fribourg, Lucerne, Valais and Zug (Vatter, 2002). The cultural conflict of the 1870s in contrast took place between the Catholic Church and the state involved the educational responsibilities and privileges of the Catholic Church.

In the political arena, the rift was mirrored in the long-lasting struggle between conservative forces supported by the Catholic population and the liberal-radical movement backed by the Protestants. Only in a few cantons was one party able to maintain political dominance over a prolonged period of time. In many other cases, alternating majorities and often temporary coalitions between liberal and conservative groups were the rule rather than the exception. Since the early nineteenth century social changes accompanying industrialization added a new dimension to the existing conflict. As in many European countries, industrialization generated a

---

<sup>6</sup> This section builds on Gruner (1977; 1978), Klöti (1901), Saripolos (1899) and Vatter (2002).

sizeable working class, especially in the urban centers. In its wake, occupation-specific associations emerged in the early decades of the nineteenth century that supported their members in case of illness or work disability ('Hilfsvereine'). For instance, the association of typographers was founded in the cantons of *Aargau* in 1818, *Zurich* in 1819 and *Berne* in 1824. Voluntary associations for the workers more broadly, the so-called 'Grütlivereine', first emerged in Geneva in 1838 and later turned into a national organization in 1843. Among their goals were educational programs and social activities for its members in addition to support in case of illness or disability (Degen, 2009a).

However, it was not until the second half of the nineteenth century that the workers became politically organized: the Social Democratic Party first emerged at the canton level in 1850 and at the national level in 1888. It won its first seat for the federal parliament in 1890 (Degen, 2009b). There are several reasons why the political voice of the workers' movement remained relatively weak until the end of the nineteenth century. The agglomeration of workers in urban centers occurred only comparatively late in Switzerland; in addition, the influx and availability of cheap foreign workers further reduced the political pressure the unions or other political organizations could exert on employers (Gruner, 1975). Furthermore, and in contrast to the workers in other European countries, male workers in Switzerland enjoyed a large number of the political rights: universal male suffrage was introduced in 1848 while the freedom of assembly was written into the federal constitution of 1874. In addition, they could vote in referendums or launch an initiative to affect policies (Gruner, 1975). Therefore, the deprivation of political rights that fueled the workers' movement in neighboring countries like Germany could not act a motor for political reform in Switzerland.

Yet, even as the size of the working class increased following a long period of economic growth after 1880, the political success of the Social Democratic party (and other political organizations of the workers) remained limited: their candidates were rarely able to secure a majority of votes to win a seat in the parliaments under the ruling plurality system; and even if they did, they never achieved a majority of seats until proportional representation was adopted (Gruner, 1977; 1978).

## 2.2 Political Struggle for Proportional Representation

In a climate of unstable majorities between the major parties and political conflicts with the emerging workers' movement, the new system of proportional representation promised to accommodate the diverging political interests and to generate a more stable political environment (see the contemporaneous discussion in Klöti, 1901 and Saripolos, 1899). The prevalence of plurality voting came increasingly under scrutiny as well because ruling parties manipulated voting registers to secure their vulnerable political positions. It was common practice, for example, not to count out-of-canton migrants as part of a canton's population, which lowered the number of representatives that were elected in the rapidly growing urban districts.<sup>7</sup> Here, proportional representation suggested a compromise in the acrimonious battle over the assignment of seats to voting districts.

Before 1890, all cantons in Switzerland had a plurality system in place. Between 1890 and 1992, twenty-three out of the twenty-five cantons switched to proportional representation. The first column of Table 1 shows the year when each canton first elected the legislature under the new rule. In 2000, only two cantons, *Appenzell-Innerrhode* and *Grisons*, still rely exclusively on plurality rule. A few cantons (see column (2) of table 1) use a mixed proportional system, which we code as a proportional system. For example, in 1992, *Uri* has adopted the proportional system in districts with more than two mandates, i.e. about three-quarters (or 47 out of 64) of its voting districts.

In the early adopting cantons, the problems associated with the opposition of two, equally strong parties were an important motor for electoral reform. Here, the workers movement only emerged as an important and independent political force after the adoption of proportional representation. The first adopters of proportional representation however nicely illustrate how increasingly unequal (and perceived as unfair) political representation led to electoral reform. In Ticino (1891), plurality rule and fixed voting districts produced a more and more unequal distribution of seats, which led to violent clashes. The conflict escalated to the point where the

---

<sup>7</sup> Unlike present debates about plurality systems, gerrymandering, i.e. the manipulation of district boundaries by politicians was not an issue in the Swiss cantons at the time. The reason is that voting districts are tied to historical political units, especially communities and county boundaries (*Bezirke* or *Kreise*). Furthermore, number and boundaries of voting districts are typically fixed in the canton constitutions and hence, any changes require approval by the electorate in a referendum (Gruner, 1978).

federal government intervened and mandated proportional representation. In Neuchatel (1895), plurality rule failed to generate a winning candidate even after multiple voting cycles which made policy-making almost impossible.

Industrialization and the rise of left-wing parties played an important role in many cantons adopting between 1900 and 1945, especially in the large, urban centers like Basle City, Zurich or Lucerne. Here, electoral reform was often pushed on the political agenda by a coalition of new left-wing parties and existing minority parties, which hoped to improve their political position. Left-wing parties played less of a role in the few cantons that adopted proportional representation after 1950. Here, proportional representation was typically introduced when cantons abolished their communal meetings ('Landsgemeinden') in favor of more representative forms of government.

### **2.3. Political Consequences**

The adoption of the new electoral rule had immediate consequences for political representation in canton parliaments. Parties that once were the dominant political force in parliament under plurality rule experienced a decline in their seat share. The Radicals in the canton of *Solothurn*, for example, saw their seat share decline from 85 percent under plurality rule to 62 percent when the first parliamentary election was held under proportional rule in 1895.

The decline of a single dominant party was accompanied by the emergence of new political parties. Since proportional rule allowed small(er) parties to win seats in canton parliaments even with only say 10 percent of the popular vote, it was no longer necessary to stick to coalitions between different interest groups. Hence, previously unorganized groups now established their own political party. After electoral reform in the canton of *Basle City* in 1905, for instance, the party of the Catholics was founded shortly after the reform and a liberal party ('mittelständische Bürgerpartei') followed in 1911. New parties also emerged because existing parties split into several factions. After the adoption of a proportional system in Geneva in 1891, for example, the Conservatives split into two parties: the Democrats and the 'Independants'. As the number of parties standing for elections increased, so did the number of parties with seats in the canton parliaments also increased - from on average 3.5 parties under plurality rule

to 4.3 parties under the new proportional system (see Duverger, 1954; Ray, 1967; Lijphart, 1990 for the general mechanism).

An important change was that previously excluded or underrepresented groups now gained access to the legislature in proportion to their popular support. In particular, left-wing parties increased their political weight in many canton parliaments. In the raw data, their share of seats rose from 7.1 percent under the old system to 19.7 percent under proportional system (t-statistic: 17.4). The influence of left-wing parties was strongest in urban centers. In *Basle City*, for example, the left-wing seat share increased from 7 percent to 28 percent after the adoption of proportional representation. Similar developments were observed in other large urban centers like *Zurich* or *Lucerne* but also in some less urban cantons like *Aargau*, *Basle County* or *Zug*.

How exactly proportional rule and its associated changes in political representation affected policies in the Swiss cantons is still an open question.<sup>8</sup> Here, we will rely on some anecdotal evidence from the canton of *Basle City*. It is clear that the rise of left-wing parties as political force brought the question of “social deprivation” (‘soziale Frage’) to the forefront of public policy. Of particular concern were the catastrophic housing conditions of the working class in the urban centers. After adopting proportional representation in 1905, for example, the canton government of *Basle City* passed a housing law (‘Wohnungsgesetzgebung’) that laid down specific criteria for healthy housing conditions and how they should be enforced by the canton’s sanitary department (Koller, 1995). Another area that concerned representatives of the working class in particular was food hygiene. The ‘Grütliverein’ in *Basle City*, for example, demanded already in 1863 that the sanitary department intensified inspections of milk production and distribution – well aware that the lack of food hygiene was a major killer especially for infants and small children. After the shift to proportional representation, leaflets to encourage breast feeding among mothers and with instructions on proper food handling were generated and distributed by the canton’s sanitary department. We now turn to a more systematic investigation how the adoption of proportional representation in the Swiss cantons affected public spending, political representation and mortality.

---

<sup>8</sup> We are currently collecting material from the canton archives to substantiate the link between canton policies and reductions in mortality.

### 3. Data and Empirical Strategy

#### 3.1. Data Description

To assess the consequences of proportional representation for mortality, we assemble a rich new data set for all Swiss cantons between 1880 and 2000.<sup>9</sup> Information on the electoral system and other political institutions comes from a detailed examination of the constitutions of each canton as well as all relevant electoral laws. We complement and cross-check this information with cantonal archives (personal communication) and secondary sources (Lutz and Strohmann, 1998; Klöti, 1901; Schoop, 1987; Société d'histoire et d'archéologie du canton de Neuchâtel, 1989; Wicki, 2006). The institutional measure for the electoral rule in canton parliaments is a binary indicator, which takes a value of one if a canton has a proportional or mixed proportional rule and zero if plurality rule is in place. When a canton switches from plurality rule to proportional representation, the indicator is zero until the first election took place under the new rule. It is one in the year of the first election under proportional representation and all years thereafter.

To investigate how the spread of proportional representation is related to mortality and child survival, state-level mortality data by cause, age and sex is required. We obtained the complete cause of death statistics from the archives of the Swiss Federal Statistical Office ('Bundesamt für Statistik'). Based on the original paper records, we construct a new dataset on deaths by detailed causes, by sex and age for each canton and year between 1880 and 2000.<sup>10</sup> Since the data are very detailed, we aggregate them into age x sex-specific deaths and cause-specific deaths. For our preliminary analysis reported below, we rely on a subset of the available data. This subset covers infant mortality and crude death rates from 1890 to 2000; deaths for 10 causes over the period from 1890 to 1935 and age-specific deaths for 5-year age groups from 1890 to about 1925 for 10 cantons and from 1969-2000 for all cantons. Figure 2 shows the evolution the infant mortality and crude death rates for Switzerland between 1890 and 2000.

---

<sup>9</sup> The data appendix contains a detailed description of the data sources, availability and construction of the main variables.

<sup>10</sup> The construction of a consistent death-by-cause statistics faces the familiar challenge of accounting for the various changes in the classification of diseases over time. Switzerland followed its own (rather detailed) classification until 1930 when it adopted the International Classification of Diseases (ICD). An online appendix describes in detail how we constructed consistent causes by deaths across the national and international classifications used between 1880 and 2000.

The graph demonstrates the dramatic decline in both rates – similar to the evolution reported for other European countries over this period.<sup>11</sup> For example, the infant mortality rates declines from a staggering 153 (per 1,000 births) in 1890 to 83 at the end of World War I in 1919, 42 after World War II in 1945 and less than 5 deaths per 1,000 births in the year 2000.

To investigate how proportional representation affected the size and composition of public spending, we collect detailed public finance statistics for total spending, revenues and public debt which are available annually since 1890.<sup>12</sup> In addition, we collected information on public health, education and social welfare spending. Public health spending combines expenditures for hospitals and investments into hygiene measures. Education spending covers primarily secondary education, which is predominantly publicly provided and under the sole responsibility of the cantons. Welfare spending combines social security payments and social assistance to the poor. Hence, our measure of welfare spending reflects insurance against poverty and provisions for old age. Data on welfare is available since 1890 (for a few cantons) and 1910 (for all cantons), data on education expenditures is available since 1890 and health spending is available since 1930. We complement this with data on road expenditures and subsidies to agriculture. Agricultural subsidies are available since 1890 (for a few cantons) and since 1910 for all cantons; expenditures for roads are available since 1910.

Total spending, health, education and welfare expenditures are measured per capita, while expenditures for roads and agricultural subsidies are expressed per 1,000 inhabitants. All variables are expressed in logs and deflated to 2000 Swiss Francs. Information on the electoral rule is only available in election years while expenditures and revenues are recorded annually. For non-election years, we thus assign the electoral rule used in the last parliamentary election. This annual panel structure allows us to evaluate the effect of the electoral system on government spending in both election and non-election years. To study the relationship between proportional representation and left-wing representation, we use data on the seat

---

<sup>11</sup> The spike in both crude death and infant mortality rates represents the Spanish influenza epidemic of 1918 and 1919 that killed almost 25,000 people (or about 0.6 percent of the total population) in Switzerland.

<sup>12</sup> Note that Switzerland has a strong federalism where canton governments have a lot of fiscal autonomy to provide public goods and to redistribute wealth. For example, a major source of revenue for cantons is the canton income tax (which creates more revenues than the federal income tax), while federal subsidies and other federal transfers account for less than 20 percent of canton revenues. In fact, all political rights and responsibilities remain at the canton level, unless a specific right or responsibility is ceded to the federal government in a national referendum.

share in canton parliaments for the six major parties. We define the parliamentary strength of left-wing parties as the seat share of the Social Democratic Party (including its canton-specific branches). Results using the Social Democratic and Communist Party were very similar and are not reported here. Since the data are not available for all cantons over the whole period, we have an unbalanced panel.<sup>13</sup>

As control variables, we add social, demographic and economic canton characteristics from the decennial Census, e.g. the age structure, population size and the share of urban population defined as people living in cities above 10,000 inhabitants. The state of industrialization is calculated as the percentage of the workforce that is employed in manufacturing and agriculture. We collect further details of the political system to test for confounding effects. In particular, we coded from the canton constitutions whether the canton had adopted women's suffrage and the strength of a canton's direct democracy (whether the canton relies on community meeting, has a mandatory budget referendum or a mandatory law referendum in place and the signature requirement for the voter initiative which is available in all cantons) and the electoral cycle (the number of years between parliamentary elections). Table A1 shows summary statistics of all variables used in the empirical analysis.

### 3.2. Empirical Strategy

Exploiting rich spatial and temporal variation in the timing of electoral reforms between 1890 and today, we employ a simple difference-in-difference approach to estimate changes in public spending, and mortality by age/sex and cause associated with proportional representation. Specifically, we estimate the following general model for canton  $c$  and year  $t$ :

$$\ln(Y_{ct}) = \alpha + \beta * PR_{ct} + \gamma' X_{ct} + \delta_t + \theta_c + \theta_c * year_t + \varepsilon_{ct}, \quad (1)$$

where  $Y_{ct}$  is an outcome of interest like public spending or deaths by age/sex or cause in canton  $c$  and year  $t$  and  $PR_{ct}$  is a binary indicator whether or not a proportional system was in place. Equation (1) also includes canton ( $\theta_c$ ) and year ( $\delta_t$ ) fixed effects; in most

---

<sup>13</sup> Party information is thus far available for the following time periods: *Aargau* (1917-2000), *Berne* (1922-2000), *Basle County* (1908-2000), *Basle City* (1890-2000), *Fribourg* (1916-2000), *Geneva* (1892-2000), *Glarus* (1920-2000), *Grisons* (1919-2000), *Lucerne* (1891-2000), *Neuchatel* (1889-2000), *Nidwalden* (1943-2000), *Obwalden* (1966-2000), *Saint Gallen* (1912), *Schaffhouse* (1892-2000), *Schwyz* (1900-2000), *Thurgau* (1917-2000), *Ticino* (1923-2000), *Uri* (1932-2000), *Vaud* (1933-2000), *Valais* (1921-2000), *Zug* (1890-2000) and *Zurich* (1917-2000).

specifications, we also include basic demographic characteristics like the age structure, population density and degree of urbanization ( $X_{ct}$ ) as well as canton-specific linear time trends ( $\theta_c \cdot \text{year}_t$ ). Our parameter of interest in this simple specification is  $\beta$ .

In this econometric framework, only the timing of adopting proportional representation is assumed to be exogenous. Permanent differences across cantons (between German- and French-speaking cantons, for example) and common factors varying non-linearly over time (such as the two World Wars) are absorbed by canton and year fixed effects respectively. In addition, canton-specific differences that vary linearly over time are all purged from the estimate of  $\beta$ . Only differential trend breaks in public spending and mortality that coincide precisely with the timing of adoption of proportional representation are captured by this parameter. The validity of the identifying assumption is explored in more detail in Section 4.4. Finally, to adjust for serial correlation and other canton-specific random shocks, we cluster standard errors in all specifications at the canton level (Bertrand et al., 2004). Since clustering might underestimate standard errors when the number of clusters is small, we also implement the wild bootstrap - which leaves our qualitative results unchanged (Cameron et al., 2008).

## **4. Evidence from Swiss Cantons**

### **4.1. Public Spending and Left-Wing Representation**

As noted above, politicians elected under proportional representation aim for political support of broad segments of society by adopting their platform to the needs and demands of social groups. In contrast, they will be less sensitive to the demands of geographically concentrated constituencies as candidates elected in a plurality system. Hence, economic theory predicts that we should observe a shift from spending on geographically concentrated projects to spending programs in support of broader groups. Empirically, we test whether the adoption of proportional representation reduces spending on roads but increases spending on public education, social services like social security. How proportional representation affects spending on public hospitals and health infrastructure is theoretically ambiguous: it would increase if it benefits broad social groups in the constituency like access to better hospitals for a broad range of the population. In contrast, public health spending would however decrease if spending is

concentrated in certain districts, for example, providing access to clean water or new sewage canals to certain (urban) constituencies. Given the aggregate nature of the category public health spending at present, it is difficult to assess which of the two forces will dominate.<sup>14</sup> Table 2 reports results of estimating equation (1). Since public spending is expressed in logs per capita, the coefficient on proportional representation can be interpreted as percentage changes. The first specification contains controls for population size, urban population and age structure as well as canton and year dummies. The second specification then adds canton-specific linear trends to control for other, slowly changing omitted characteristics (like improved living standards) over time. Several patterns emerge: first, we do not find evidence that proportional representation increases total revenues or total spending at the canton or local level (see Aidt et al., 2006 and Funk and Gathmann, 2010). Second, road expenditures, which are typically geographically targeted to particular districts, decline after the shift of proportional representation. Finally, expenditures on public education, social services and public health increase substantially with proportional representation – from 15 percent for public health to 25 percent for public education up to 50 percent for social services. The public finance changes toward broad social spending reflect changes in legislative behavior. Part of this effect could be driven by changes in the set of politicians elected into canton parliaments. Adopting the proportional system enabled left-wing parties in Swiss cantons to increase their political presence and hence have stronger influence on policies. Table 3 shows estimates of equation (1) where we now use the seat share of the Social Democratic Party in canton parliaments as dependent variable.<sup>15</sup> The estimates suggest that proportional representation increased the presence of about 4.5 percentage points, which implies an increase by 66 percent.<sup>16</sup> In sum, the evidence suggests that the adoption of a proportional system produced a substantial shift toward public expenditures and increased the presence of

---

<sup>14</sup> Ideally, we would like to investigate the link between proportional representation and public spending at an even more disaggregated level of expenditures. However, data on detailed health interventions are buried in the canton archives and not currently available to us.

<sup>15</sup> Note that we have data on the seat share of various parties available for an unbalanced panel only. In particular, we are still missing the seat shares for the years from 1890 to 1920 for several cantons. While our results above are reported for the Social Democratic Party, estimates including the Communist Party are very similar and not reported here.

<sup>16</sup> The average seat share of the Social Democratic Party under plurality rule is 6.8 percent. Thus,  $0.045/0.068=0.66$ .

left-wing parties. We now turn to the question whether these might have had a positive influence on population health.

#### **4.2. Cause- and Age-Specific Mortality**

Our ultimate goal is to assess whether changes in electoral institutions have real consequences for health. To test this, we first study mortality rates by detailed causes. Our first broad indicator is infant mortality measured as the number of children dying under the age of one as a share of 1,000 births.

In addition, we use death rates (calculated per 1,000 people) for ten important causes of death: typhus, diphtheria, scarlet fever, childbed fever, infant diarrhea, whooping cough, measles, pneumonia, cancer and suicide. At present, we have data over the period from 1880 to 1935 for all cantons available to us. Since this time period covers only 17 (of the 23 observed) transitions from a majority to a proportional system, we need to interpret the results (and in particular, statistical significance) with caution. With this caveat, Table 4 reports estimates of equation (1) where we report only the coefficient on proportional representation. As before, the first specification includes canton and year fixed effects and canton demographic characteristics. The second specification (reported in the final two columns) also adds canton-specific linear trends. Over our short period, we find effects only for measles and infant diarrhea, with reductions of 45% and 10% respectively.

Because the data on cause-specific deaths rates are quite noisy, we also pool across causes to construct aggregate categories of infectious diseases and other diseases.<sup>17</sup> The bottom of the table uses data aggregated by cause, canton and year to regress the log death rate on fixed effects for canton, year and cause as well as cause-specific linear trends. Proportional representation is associated with a reduction in infectious diseases of 11-12 percentage points, while no effect is found for other causes of death. To put these estimates in perspective, the mortality rate from infectious diseases declined from 0.29 in 1890 to 0.3 in 1935, a reduction of 90%. Hence, the shift to proportional representation can account for 13% percent of the total decline in infectious diseases over this period. These effects are quite large.

---

<sup>17</sup> Infectious diseases include diphtheria, diarrhea under age two, childbed fever, measles, scarlet fever, typhus and whooping cough. All other causes include pneumonia, cancer, and suicide.

We next explore the dynamics of proportional representation on infant mortality, infectious disease and other diseases. We estimate variants of equation (1) including dummies for 4-6 years and 1-3 years prior to the adoption of a proportional system as well as dummies for 0-4 years and more than 5 years after adoption (instead of the simple binary indicator for proportional representation used thus far). Table 5 shows again that proportional representation mainly affected infectious diseases and that the effect accumulated over time. We find no effect on infant mortality or other deaths.

An alternative way to look at the effects of the electoral system is to study age-specific mortality. The death by cause statistic reports deaths separately by cause, age and sex for each canton over the whole period. However, the cell numbers are small in most cases. As a first approximation, we study deaths in 5-year age bands aggregated over all causes and sex. The data are currently available from 1880 to 1925 for ten cantons and from 1969 to 2000 for all cantons.<sup>18</sup> Note that due to this data restriction, our estimation relies on only 10 (of the 23) transitions from majority to proportional system. We therefore need to interpret these preliminary estimates with caution. The results of estimating equation (1) for deaths in specific age groups are reported in Table 5. Note that here we use the log of deaths (rather than the death rate) as dependent variable. The reason is that canton-level population counts by age are only available on a year-to-year basis since 1980. Before 1980, population by age is only reported in the eleven decennial censuses between 1880 and 1980. Therefore, we cannot easily calculate death rates because the denominator, the relevant population by specific ages, is only available roughly every 10 years until 1980.<sup>19</sup> Here, we find no consistent relationship between deaths and the spread of proportional representation – presumably because the data are still incomplete and therefore noisy.

---

<sup>18</sup> Over the early period, we have data for *Zurich* (1841-1918), *Berne* (1851-1931), *Solothurn* (1841-1918), *Basle City* (1851-1935), *Appenzell Outerrhode* (1855-1935), *Aargau* (1855-1935), *Thurgau* (1843-1916), *Vaud* (1837-1835), *Neuchatel* (1817-1917) and *Geneva* (1847-1922).

<sup>19</sup> We could employ population projection techniques often used by demographers to estimate the denominators for death rates. However, they essentially use sophisticated interpolation – which can also be achieved by including canton fixed effects and canton-specific time trends.

### 4.3. Preliminary Robustness Analysis

Natural concerns with our empirical strategy are that other political changes or institutional reforms correlated with proportional representation drive the mortality decline or that broader social changes affect both the decision to adopt a proportional system and mortality. Here, we present some, albeit very preliminary robustness tests that fail to substantiate these concerns. First, note that female suffrage, another major reform of voting rights that seems to be related to mortality, was not adopted in any canton before 1959. When it was adopted between 1959 and 1990, mortality rates had already reached low levels. Hence, female suffrage cannot explain our results in the Swiss context. Furthermore, male Swiss citizens enjoyed full voting rights since the federation was created in 1848. The federal constitution of 1848 did not allow cantons to impose wealth or literacy restrictions. Hence, for the period of interest between 1880 and 1945, there are no other major changes in voting rights for men or women that could explain our results.

Second, direct democracy has always played an important role in the cantons as in Switzerland as a whole. Access to the voter initiative might also increase the likelihood of adopting proportional representation since it gives voters to propose electoral reform (which might be opposed by politicians elected under the majority system). Moreover, direct democracy gives citizens more power over individual projects and hence, might increase (or decrease) investments in public health or education. In sum, we could confound the effect of direct democratic institutions for the impact of proportional representation. Table 7 reestimates our baseline controlling for the presence of female suffrage rights and for the three direct democratic institutions available in Swiss cantons: a mandatory law referendum which requires all new laws to be approved by the electorate; a mandatory budget referendum which requires individual projects above a certain monetary threshold to be approved by the electorate; and the initiative that allows citizens to propose new laws or a revision of the constitution. Since the latter is available in almost all cantons, we use the signature requirement to get a policy proposal on the ballot. The results in column (1) show that our estimates are not much affected.

Third, note that Switzerland remained politically neutral during the two World Wars. Hence, we would not expect mortality to decline in 1918 or 1945. And even if there was an indirect effect

through the disruption of transportation networks and trade routes, these aggregate effects are absorbed by year fixed effects in our estimation.

Fourth, cantons adopting proportional representation might have experience faster industrialization and improvements of living standards. Better living standard could then translate into faster declines in mortality. In the second specification in Table 7, we therefore add controls for the employment share in agriculture and manufacturing, overall employment and female labor force participation rate and two income proxies (the number of physicians per 1,000 people and the percent of the population owning a car). Again, our qualitative results are not much affected.

Finally, one might worry that cantons with proportional representation get a larger share of migration. If migrants and their families are often young and relatively healthy, this could also account for our results. We do not have detailed information on migration flows between cantons or from abroad over most of the period. However, the population censuses record every ten years the share of the population that lives in the same canton it was born. For the pooled years of population censuses (1900 to 1990), we regressed this share on a variable indicating the number of years since proportional representation has been adopted as well as decade and canton fixed effects, controls for urban population, population density and employment in agriculture and manufacturing. We find no evidence that cantons that had adopted a proportional system earlier receive a larger number of migrants (not reported).

## **5. Supporting Evidence from Europe and Latin America**

### **5.1. Data Description**

To show that the health benefits associated with proportional representation are not specific to the Swiss setting, we now turn to a broader set of countries from Western Europe and Latin America. Information on the electoral systems in each country is from Flora (1983) for Europe and from Colomer (2004a; 2004b) for Latin America. Data on infant mortality rates and the crude death rates are taken from Mitchell (1998a) for Europe and Mitchell (2008) for Latin America. Additional demographic characteristics are also from these same sources. Some data points for crude death rates and infant mortality looked dubious and were corrected by hand

either through linear interpolation, or, if the decimal point obviously appeared to be misplaced, by correcting the likely typo.<sup>20</sup> Finally, it is important to control for other differences in the political system across countries and within countries over time. We therefore collected the democratic structure of a country from the Polity IV Project (Marshall et al., 2009) and involvement in armed conflicts from the Encyclopedia Britannica (2010).

Overall, we have information on 26 countries for infant mortality and crude death rates covering the period from 1850 to 2005. Data for Europe is available between 1850 and 1980, while data for Latin America is available from 1900 to 2005. Table A2 in the appendix shows the list of European and Latin American countries in our sample; the table also reports the year each country (first) adopted proportional representation (over our sample period). Figure 3 shows the plots of crude death rate per 1,000 people (top panel) and infant mortality rate per 1,000 births (bottom panel) over time, respectively. Overall, there is the familiar decline in crude death rates and infant mortality though there is a lot of variability, especially around periods of involvement in armed conflicts.

## 5.2. Empirical Model

To assess the effect of electoral systems on aggregate mortality, we employ a slightly modified differences-in-differences approach:

$$\ln\left(\frac{Y_{ct}}{1-Y_{ct}}\right) = \alpha + \beta * PR_{ct} + \gamma' X_{ct} + \mu_t + \theta_c + \varepsilon_{ct},$$

(2)

where  $Y_{ct}$  is either the crude death rate or infant mortality,  $PR$  is a dummy taking the value one if the country has a proportional electoral system and zero otherwise.<sup>21</sup> In all specifications we control for year and country fixed effects. In addition, we include as other covariates  $X$  the

---

<sup>20</sup> We corrected crude death rates for the following years and countries: Jamaica 1953, Chile 1988, Uruguay 1988, Italy 1959 and 1974; infant mortality was corrected for Denmark 1900 and Belgium 1903.

<sup>21</sup> Our results remain robust if we use the levels of crude death rates and infant mortality as outcome variables instead of the log of the odds ratios reported here.

demographic composition of the population (the share of male and female population under the age 15 and above the age of 65), the political system (indicators for female suffrage, the Polity IV autocracy, democracy and polity scores, whether an election took place in the current year) and whether the country was involved in an armed conflict with a special dummy for involvement in World War II. Finally, we also control for country-specific trends, either country-specific polynomials or interactions between country and decade dummies.

### 5.3. Empirical Results

We present our basic results for the crude death rates in table 8. The baseline (column (1)) including only country and year fixed effects as well as country-specific linear trends shows that the introduction of proportional representations results in a 2 percent reduction in crude death rates, albeit this reduction is not statistically significant. Including country-specific decade dummies to capture time trends in each country in a flexible fashion, proportional representation reduced crude death rates by 3.8 percent and this is significant at the 10 percent level (column (2)).<sup>22</sup> Adding additional controls for political institutions and war (column (3)) and demographic variables (column (4)) increases the coefficient further: the results now indicate that proportional representation reduces the crude death rate in our sample of European and Latin American countries by 4.6 to 4.9 percent.

On the right hand side of Table 8 we analyze whether proportional representation also had an impact on infant mortality rates. The set of specifications is the same as for crude death rates. Across the different specifications, there is some evidence that proportional representation might be associated with an increase in the infant mortality of about 5 percent. However, this result is driven by the Latin American countries in the twentieth century. For most of the 19<sup>th</sup> century and the early 20<sup>th</sup> century proportional representation resulted in lowered infant mortality – and hence contributed to the substantial mortality decline observed over this period.

---

<sup>22</sup> Based on the Akaike information criterion (AIC), the specification in column (2) and (5) provide the best fit for the data.

In additional robustness checks (not reported), we also include variables measuring the time since introduction of *PR* and leads and lags of the *PR* variable. Furthermore, we check whether the effect of *PR* has stayed constant over time by including an interaction between *PR* and the particular decade. We add a variable indicating the number of years since proportional representation was introduced to our baseline with country-specific decade dummies. The coefficient on time since introduction is positive but not statistically significant from zero indicating that the effect of proportional representation on crude death rates was roughly constant over time. Similarly, adding separate interaction terms between proportional representation and each decade did not yield statistically significant relationships.

Finally, we test whether crude death rates responded prior to the introduction of proportional representation. Such anticipation effects would indicate some omitted third factor or that proportional representation is endogenous with respect to mortality. We do not find evidence that crude death rates or infant mortality rates declined prior to the adoption of proportional representation in our sample of European and Latin American countries. In sum, our results indicate that proportional representation reduced crude death rates, and it seems to have reduced infant mortality rates in the 19<sup>th</sup> century as well.

## References

Aidt, T.S.; Duta, J. and E. Loukoianova. 2006. "Democracy comes to Europe: Franchise extension and fiscal outcomes 1830-1938." *European Economic Review*, 50, 249-83.

Besley, T. and A. Case. 2003. "Political institutions and policy outcomes: Evidence from the United States," *Journal of Economic Literature*, 41, 7-73.

Bickel, W. 1947. *Bevölkerungsgeschichte der Schweiz seit dem Ausgang des Mittelalters*, Zurich: Büchergilde Gutenberg.

Bundesamt für Statistik. 1891-2000. *Statistisches Jahrbuch der Schweiz*. Zurich: Verlag Neue Zürcher Zeitung.

Bundesamt für Statistik. 1880-2000. *Schweizerische Todesursachenstatistik*. Unveröffentlichte Archivtabellen, Bundesamt für Statistik BFS, Sektion Gesundheit GESB, CH-2010 Neuenburg.

Colomer, J. M. 2004a. "Taming the Tiger: Voting Rights and Political Instability in Latin America," *Latin American Politics and Society*, 46, 29-58.

Colomer, J. M. (ed.) 2004b. *Handbook of Electoral Systems Choice*. Basingstoke, UK: Macmillan.

Degen, B. (2009a). „Arbeiterschaft,“ in: *Historisches Lexikon der Schweiz*, edited by Stiftung Historisches Lexikon der Schweiz. Basle: Schwabe. Online publication: November 26, 2009.

Degen, B. (2009a). „Sozialdemokratische Partei,“ in: *Historisches Lexikon der Schweiz*, edited by Stiftung Historisches Lexikon der Schweiz. Basle: Schwabe. Online publication: December 2, 2009.

Degen, B. (2010). „Soziale Frage,“ in: *Historisches Lexikon der Schweiz*, edited by Stiftung Historisches Lexikon der Schweiz. Basle: Schwabe. Online publication: August 27, 2010.

Duverger, M. 1954. *Political parties: Their organization and activity in the modern state*. New York: John Wiley.

Eidgenössische Finanzverwaltung. 1950-2000. *Öffentliche Finanzen der Schweiz*. Statistik der Schweiz. Neuchatel: Eidgenössische Finanzverwaltung.

Encyclopedia Britannica, online version accessed under <http://www.britannica.com/>

Evans, D. 1987. *Death in Hamburg: society and politics in the cholera years: 1830-1910*. Oxford: Clarendon Press.

Flora, P.; Alber, J.; Eichenberg, R.; Kraus, J.K.F.; Pfenning, W. and K. Seeböhm. 1983. *State, Economy and Society 1815–1975*. Frankfurt, Germany: Campus Verlag.

Funk, P. and C. Gathmann. 2010. „How do Electoral Systems affect Fiscal Policy? Evidence from State and Local Governments, 1890-2005.“ CESifo working paper #2958.

Garrone, P. 1991. *L'élection populaire en Suisse. Etude des systèmes électoraux et de leur mise en oeuvre sur le plan fédéral et dans les cantons*. Basel and Frankfurt aM.: Helbing und Lichtenhahn.

Giacometti, Z. 1941. *Das Staatsrecht der schweizerischen Kantone*. Zurich: Polygraphischer Verlag.

Gruner, E. 1968. *Die Arbeiter in der Schweiz im 19. Jahrhundert : soziale Lage, Organisation, Verhältnis zu Arbeitgeber und Staat*. Volume 1, 2a and 2b. Berne: Francke.

Gruner, E. 1975. „Die Arbeiterbewegung in der Schweiz vor der Frage: Reform oder Revolution,“ *Schweizerische Zeitschrift für Geschichte*, 25, 269-281.

Gruner, E. 1977. *Die Parteien in der Schweiz*. Berne: Francke Verlag.

Gruner, E. 1978. *Die Wahlen in den Schweizerischen Nationalrat, 1848-1919*. Volume 2, Berne: Francke Verlag.

Hofferbert, R.I. 1976. *Comparative socio-economic public policy and political data, 1900-60*. Ann Arbor, MI: Inter-university Consortium for Political and Social Research, Study number 34.

Junker, B. 1996. *Geschichte des Kantons Bern seit 1798. Band III: Tradition und Aufbruch, 1881-1995*. Bern: Archiv des Historischen Vereins des Kanton Bern.

Klöti, E. 1901. *Die Proportionalwahl in der Schweiz. Geschichte, Darstellung und Kritik*. Bern: Kommissionsverlag Schmid und Francke.

Koller, B. 1995. *„Gesundes Wohnen“: ein Konstrukt zur Vermittlung bürgerlicher Werte und Verhaltensnormen und seine praktische Umsetzung in der Deutschschweiz 1880 – 1940*. Zurich: Chronos Verlag.

Lijphart, A. 1990. "The political consequences of electoral laws 1945-85." *American Political Science Review*, 84, 481-96.

Lindert, P. 2004. *Growing Public. Social Spending and Economic Growth since the Eighteenth Century*. Cambridge: Cambridge University Press.

Lizzeri, A. and N. Persico. 2001. "The provision of public goods under alternative electoral incentives." *American Economic Review*, 91, 225-45.

Lizzeri, A. and N. Persico. 2005. "A drawback of electoral competition." *Journal of European Economic Association*, 3, 1318-48.

Lutz, G. and D. Strohmann. 1998. *Wahl- und Abstimmungsrecht der Schweizer Kantone*. Berne: Haupt.

Marshall, M. G., Gurr, T. and K. Jagers. 2009. *Polity IV Project: Political Regime Characteristics and Transitions, 1800-2009*. Version p4v2009 [Computer File]. College Park, MD: Center for International Development and Conflict Management (CIDCM), University of Maryland. <http://www.systemicpeace.org/inscr/inscr.htm>

McKeown, T. 1976. *The Modern Rise of Population*. New York: Academic Press.

Milesi-Ferretti, G-M., R. Perotti and M. Rostagno. 2002. "Electoral systems and the composition of public spending." *Quarterly Journal of Economics*, 117, 609-57.

- Mitchell, B.R. 1998. *International Historical Statistics: Europe, 1750–1993*, 4th edition. Basingstoke, UK: Macmillan.
- Mitchell, B.R. 2008. *International Historical Statistics: Americas 1750–2005*, 6th edition. Basingstoke, UK: Macmillan.
- Persson, T. and G. Tabellini. 2003. *Economic effects of constitutions*. Cambridge, MA: MIT Press.
- Persson, T. and G. Tabellini. 2004. "Constitutional rules and economic policy outcomes," *American Economic Review*, 94, 25-46.
- Preston, S.H. and E. van de Walle. 1978. "Urban French Mortality in the Nineteenth Century." *Population Studies* 32:275–97.
- Rae, D. 1967. *The political consequences of electoral laws*. New Haven, CT: Yale University Press.
- Ritzmann-Blickenstorfer, H. 1996. *Historische Statistik der Schweiz*. Zurich: Chronos.
- Saripolos, N. 1899. *La Démocratie et l'élection proportionnelle: Étude historique, juridique et politique*. Paris: Arthur Rousseau.
- Schofield, R; D.S. Reher and A. Bideau. 1991. *The Decline of Mortality in Europe*, Oxford: Clarendon Press.
- Schoop, A. 1987. *Geschichte des Kantons Thurgau*. Volume 1-3, Frauenfeld : Huber.
- Schüpbach, W. 1983. *Die Bevölkerung der Stadt Luzern, 1850-1914*. Stuttgart and Lucerne: Rex-Verlag.
- Schuppli, P. and R. Studer. 2004. "Deflating Swiss prices over the last five centuries." mimeo, University of Oxford and Berne.
- Société d'histoire et d'archéologie du canton de Neuchâtel. 1989. *Histoire du pays de Neuchâtel*. Volume 3, Hauterive: Editions Gilles Attinger.
- Spree, Reinhard. 1981. *Soziale Ungleichheit vor Krankheit und Tod : zur Sozialgeschichte des Gesundheitsbereichs im Deutschen Kaiserreich*. Göttingen : Vandenhoeck und Ruprecht.
- Steiger, J. 1915. *Finanzhaushalt der Schweiz. Band III: Kantone*. Bern: Verlag von Stämpfli & Cie.
- Szreter, S. 1988. "The Importance of Social Intervention in Britain's Mortality Decline c.1850–1914: A Re-interpretation of the Role of Public Health." *Social History of Medicine* 1(1):1–37.
- Vögele, J. 1998. *Urban Mortality Change in England and Germany, 1870-1913*, Liverpool: Liverpool University Press.

Vögele, J. und W. Woelk (eds.) 2000. *Stadt, Krankheit und Tod. Geschichte der städtischen Gesundheitsverhältnisse während der Epidemiologischen Transition (vom 18. bis ins frühe 20. Jahrhundert)*. Berlin: Duncker und Humblot.

Wicki, D. 2006. *Der aargauische Grosse Rat, 1803-2003. Wandel eines Kantonsparlaments - eine Kollektivbiografie*. Baden: Verlag für Kultur und Geschichte.

Woods, R. 1991. "Public Health and Public Hygiene: The Urban Environment in the Late Nineteenth and Early Twentieth Century," in: *Mortality Decline in Europe*, edited by Schofield, Reher and Bideau.

## **Appendix: Data Sources**

This appendix describes the data sources and construction of variables for the 25 Swiss cantons. We drop the canton Jura in our analysis, which was founded only in 1978.

### **Mortality Data:**

The death by cause statistic is a complete count of all deaths reported by the municipal offices and reports of physicians to the federal Statistical Office (Bundesamt für Statistik, 1880-2000). The records report the absolute number of deaths by sex, age and detailed causes for each canton and year since 1880. The statistic does typically not contain the records of Swiss citizens who died abroad. To obtain larger cell sizes, we aggregate the data for each canton and year into deaths by detailed age and sex on the one hand and death rates by detailed causes (for all ages). A brief note on the construction of a consistent classification of causes is warranted. Switzerland followed its own national classification, which was more detailed than the original International Classification of Diseases (ICD), until 1930 when ICD codes were adopted. For 1930, the Statistical Office provides in the original records a walkover from the national classification to the new ICD codes. A more detailed account of the harmonization process for the causes of deaths is available from the authors.

### **Public Spending:**

Canton expenditures and revenues are taken from the annual publication 'Statistisches Jahrbuch der Schweiz' and the Historical Statistics of Switzerland' for 1890 to 1950 and from 'Öffentliche Finanzen der Schweiz' for 1950 to 2000. All expenditure and revenue categories are expressed in logs per capita and deflated to 2000 Swiss Francs using the annual consumer price index reported in Schuppli and Studer (2004). Government expenditures and revenues are interpolated for two years with missing observations (1967 and 1968). Expenditures for public

education are available for the years 1890, 1892, 1893, 1895-1898, 1901-1905, 1909, 1910-1912, 1916, 1920, 1928, 1930, 1934, 1938, 1946 and annually since 1950. The information is taken from 'Statistisches Jahrbuch der Schweiz', 'Historical Statistics of Switzerland', 'Öffentliche Finanzen der Schweiz' and Hofferbert (1976). To measure transfer payments, we use social expenditures which combines social security payments and social assistance to the poor. The data come from 'Finanzhaushalt der Schweiz', 'Historical Statistics of Switzerland' and 'Statistisches Jahrbuch der Schweiz' before 1950, and from 'Öffentliche Finanzen der Schweiz' after 1950. Welfare spending is available since 1890 for two cantons and since 1910 for all cantons (here, we have data for the years 1910-1913, 1930, 1934, 1938, 1942, 1946 and annually since 1950). Expenditures on roads are taken from 'Historical Statistics of Switzerland' and available since 1910 for all cantons (1910, 1925-1927, 1929, 1933, 1936, 1939, 1942, 1944, 1946, 1949, 1952, 1954, 1956, 1958, 1961, 1963-1965, 1967, 1968 and annually since 1970. Missing values, except for gaps spanning more than a decade, are interpolated).

#### Electoral System:

Our measure of electoral system is taken from Lutz and Strohmann (1998), which report the year proportional representation was adopted in each canton. We complement this information with further details on the political system from a detailed study of all canton constitutions in place since 1880 and any relevant electoral laws. Our measure of proportional representation is a binary indicator equal to zero in all years when the parliament is elected according to majority rule. The indicator turns one in the year the parliament is first elected under proportional representation and remains one thereafter.

#### Control variables:

Most of our other control variables are taken from the decennial Census as reported in 'Historical Statistics of Switzerland', Hofferbert (1976) and 'Statistisches Jahrbuch der Schweiz'; the data are available for 1888, 1900, 1910, 1920, 1930, 1941, 1950, 1960, 1970, 1980, 1990 and 2000. The population in each canton is taken from 'Statistisches Jahrbuch der Schweiz' and available annually since 1888. Population density is measured as the log of the number of people (in 1,000) and is taken from the decennial Census. Urban population is measured as the percentage of the population living in cities above 10,000 inhabitants. The data is taken from 'Historical Statistics of Switzerland' and 'Statistisches Jahrbuch der Schweiz' and available for 1890, 1894, 1898, 1903, for each decade between 1910 and 1960 as well as 1962, 1969, 1974, 1979, 1984, 1990 and 2000. The information on the population in different age groups (below 20, between 20 and 64 and above 65), the number of foreigners, percentage born in the same canton and religious affiliation is from the decennial Census. All three variables are expressed as percentage of the total population. Religious affiliation is calculated as the share of the population that is Protestant as opposed to Catholics and other religions. Foreign denotes the

percentage of the population that is not a Swiss citizen in a given canton. We collected several labor market indicators to control for differences in economic activity across cantons. The total number employed and employment in the first (agriculture) and second (manufacturing) sector are from the decennial Census. The distribution across sectors is calculated as percentage of total employment. To control for income differences across cantons, we use car ownership, and the supply of health care. The data on the number of cars per population comes from 'Historical Statistics of Switzerland' and 'Statistisches Jahrbuch der Schweiz'. The variable is zero before the first cars emerged in 1910 and positive thereafter (available for 1914, 1917, 1923, 1929, 1934, 1939, 1945, 1947, 1950, 1954, 1958, 1962, 1966, 1970, 1975, 1978, 1982, 1986, and annually since 1990). Health care supply - calculated as the number of physicians per 1,000 population- is available annually and coded from the 'Historical Statistics of Switzerland' and 'Statistisches Jahrbuch der Schweiz'.

**Table 1: Electoral Systems of Swiss Cantons in 1998**

	Year PR Adopted	Mixed System
<u>Adopted prior to 1919:</u>		
Ticino (TI)	1891	
Geneva (GE)	1892	
Zug (ZG)	1894	X
Neuchatel (NE)	1895	
Solothurn (SO)	1896	
Schwyz (SZ)	1900	X
Basle City (BS)	1905	X
Lucerne (LU)	1911	
St. Gallen (SG)	1912	
Zurich (ZH)	1917	
<u>Adopted 1920-1950:</u>		
Basle County (BL)	1920	
Glarus (GL)	1920	
Thurgau (TG)	1920	
Aargau (AG)	1921	
Fribourg (FR)	1921	
Valais (VS)	1921	
Berne (BE)	1922	
Vaud (VD)	1949/1962	
<u>Adopted 1950-2000:</u>		
Schaffhouse (SH)	1952	X
Nidwalden (NW)	1982	
Obwalden (OW)	1986	
Uri (UR)	1992	X
<u>Not Adopted:</u>		
Appenzell Outerrhode (AR)	N/A	X
Appenzell Innerrhode (AI)	N/A	
Grisons (GR)	N/A	

*Notes:* The table shows the main institutions of each canton's electoral system and its evolution over time. The first column shows the first year the canton parliament was elected under the new proportional rule. *Vaud* had a mixed electoral system between 1949 and 1962 before adopting a pure proportional system in 1962. *Appenzell-Outerrhode* allows its districts to adopt proportional representation since 1997 but only one (Herisau) out of six has chosen to do so. *Appenzell-Innerrhode* and *Grisons* still have a majoritarian system. *Source:* Lutz and Strohmann (1998)

**Table 2: Proportional Representation and Public Spending**

Dependent Variable (in logs)	Estimate [Std. Error]	N R2	Estimate [Std. Error]	N R2
Total Canton Spending	-0.048 [0.066]	2775 0.973	0.068 [0.053]	2775 0.985
Total Canton Revenues	-0.078 [0.074]	2775 0.970	0.061 [0.058]	2775 0.983
Total Local Expenditures	0.004 [0.212]	2631 0.894	0.021 [0.126]	2631 0.955
Share of Local Expenditures	0.759 [4.322]	2631 0.674	0.340 [2.667]	2631 0.859
Public Health Spending	0.423* [0.217]	1775 0.922	0.149 [0.190]	1775 0.967
Public Education Spending	0.098 [0.086]	2775 0.971	0.259*** [0.077]	2775 0.982
Social Security and Welfare Spending	0.297* [0.172]	1775 0.906	0.495** [0.184]	1775 0.943
Welfare Spending (for the Poor)	0.057 [0.206]	2775 0.728	0.324*** [0.102]	2775 0.853
Canton Spending on Roads	-0.333*** [0.104]	1900 0.878	-0.380 [0.263]	1900 0.904

*Notes* : The table reports the coefficient for the dummy variable indicating a proportional system was in place. The dependent variables are real per capita expenditures (in 2000 Swiss Francs) specified in the first column. The first specification reports estimates without canton-specific linear trends, while the second specification includes canton-specific linear trends. Both specifications include year and canton fixed effects as well as controls for the socio-economic structure of a canton (its age structure, population density and the percentage of population living in cities above 10,000 inhabitants). Standard errors in brackets are clustered at the canton level.

**Table 3: Proportional Representation and Left-Wing Parties**

	(1)	(2)
Proportional Representation	0.045** [0.018]	0.046* [0.025]
Observations	1967	1967
R Squared	0.85	0.89
Canton Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Canton Demographics	Yes	Yes
Canton-Specific Linear Trends	No	Yes

*Notes:* The table reports the coefficient for the dummy variable indicating a proportional system was in place. The dependent variable is the percentage of seats held by the Social Democratic party in the canton parliament. The first specification reports estimates without canton-specific linear trends, while the second specification includes canton-specific linear trends. Both specifications include year and canton fixed effects as well as controls for the socio-economic structure of a canton (its age structure, population density and the percentage of population living in cities above 10,000 inhabitants). Standard errors in brackets are clustered at the canton level.

**Table 4: Proportional Representation and Cause-Specific Mortality**

Dependent Variable (in logs)	Estimate [Std. Error]	N R2	Estimate [Std. Error]	N R2
Infant Mortality Rate	0.013 [0.028]	2766 0.957	-0.023 [0.032]	2766 0.965
Typhus Death Rate	-0.211** [0.102]	837 0.736	-0.043 [0.090]	837 0.762
Infant Diarrhea Death Rate	-0.198*** [0.070]	1143 0.901	-0.101* [0.058]	1143 0.921
Diphtheria Death Rate	-0.058 [0.116]	1089 0.705	-0.054 [0.092]	1089 0.736
Measles Death Rate	-0.310** [0.126]	836 0.477	-0.450*** [0.143]	836 0.489
Childbed Fever Death Rate	-0.055 [0.072]	1042 0.452	0.080 [0.064]	1042 0.494
Scarlet Fever Death Rate	-0.031 [0.123]	717 0.623	-0.068 [0.121]	717 0.663
Whooping Cough Death Rate	-0.132 [0.080]	1026 0.527	-0.010 [0.105]	1026 0.541
Suicide Death Rate	-0.019 [0.056]	1110 0.681	-0.032 [0.051]	1110 0.712
Cancer Death Rate	-0.005 [0.031]	1150 0.773	0.013 [0.021]	1150 0.836
Lung Tuberculosis Death Rate	-0.032 [0.037]	1150 0.784	0.004 [0.020]	1150 0.858
Infectious Diseases Death Rate	-0.114** [0.050]	6690 0.691	-0.124** [0.052]	6690 0.711
Other Diseases Death Rate	-0.009 [0.027]	3410 0.875	-0.014 [0.027]	3410 0.899

*Notes* : The table reports the coefficient for the dummy variable indicating a proportional system was in place. The dependent variables are the death rate per 1,000 population shown in the first column. The first specification reports estimates without canton-specific linear trends, while the second specification includes canton-specific linear trends. Both specifications include year and canton fixed effects as well as controls for the socio-economic structure of a canton (its age structure, population density and the percentage of population living in cities above 10,000 inhabitants). Standard errors in brackets are clustered at the canton level.

**Table 5: Dynamic Effects of Proportional Representation**

	4-6 Years before PR	1-3 Years before PR	0-4 Years after PR	5 and more Years after PR	F statistic + p value 4-6 and 1-3 before	F statistic + p value 0-4 and 5pl after
Infant Mortality Rate	0.001 [0.061]	0.006 [0.042]	-0.033 [0.043]	-0.049 [0.047]	0.01 [0.99]	0.57 [0.57]
Infectious Diseases	0.004 [0.061]	-0.069 [0.069]	-0.081 [0.076]	-0.196** [0.084]	1.22 [0.31]	3.33 [0.05]
Other Diseases	-0.025 [0.032]	-0.037 [0.039]	-0.031 [0.042]	-0.027 [0.043]	0.44 [0.65]	0.28 [0.75]

*Notes :* The table reports coefficients for dummy variables relative to the adoption of proportional representation. The dependent variable are specified in the first columns. All specifications include canton and year fixed effects as well as canton-specific linear trends. In addition, the specifications also control for the age structure of the canton, the urban population and population density. Standard errors in brackets are clustered at the canton level.

**Table 6: Proportional Representation and Age-Specific Mortality**

Dependent Variable (in logs)	Estimate [Std. Error]	N R2	Estimate [Std. Error]	N R2
Deaths Age 1 to 4	0.167 [0.109]	1055 0.951	0.029 [0.078]	1055 0.957
Deaths Age 5 to 9	0.511*** [0.156]	683 0.814	-0.083 [0.159]	683 0.828
Deaths Age 10 to 14	0.276 [0.188]	685 0.792	-0.120 [0.072]	685 0.807
Deaths Age 15 to 19	0.202* [0.116]	1126 0.936	0.059 [0.047]	1126 0.945
Deaths Age 20 to 29	0.138 [0.133]	1120 0.964	0.073 [0.055]	1120 0.973
Deaths Age 30 to 39	0.060 [0.140]	1132 0.967	-0.037 [0.036]	1132 0.977
Deaths Age 40 to 49	-0.033 [0.184]	1161 0.966	-0.052 [0.092]	1161 0.982
Deaths Age 50 to 59	0.150 [0.148]	1169 0.973	0.061 [0.072]	1169 0.986
Deaths Age 60 to 69	0.075 [0.136]	1071 0.980	-0.008 [0.044]	1071 0.992
Deaths Age 70 to 79	0.125 [0.120]	923 0.985	0.013 [0.046]	923 0.995
Deaths Age Above 79	0.084 [0.089]	1071 0.986	0.006 [0.067]	1071 0.994

*Notes* : The table reports the coefficient for the dummy variable indicating a proportional system was in place. The dependent variables are total deaths (in logs) in the age group specified in the first column. The first specification reports estimates without canton-specific linear trends, while the second specification includes canton-specific linear trends. Both specifications include year and canton fixed effects as well as controls for the socio-economic structure of a canton (its age structure, population density and the percentage of population living in cities above 10,000 inhabitants). Standard errors in brackets are clustered at the canton level.

**Table 7: Robustness Checks**

Dependent Variable (in logs)	Add Political Institutions	Add Socio- Demographics
Public Health Spending	0.336* [0.193]	0.486** [0.187]
Public Education Spending	0.083 [0.079]	0.145* [0.076]
Social Security and Welfare Spending	0.382*** [0.136]	0.365** [0.142]
Canton Spending on Roads	-0.324** [0.118]	-0.370** [0.171]
Crude Death Rate	-0.014 [0.012]	-0.010 [0.011]
Infant Mortality Rate	-0.049* [0.026]	-0.030 [0.032]
Thyphoid Death Rate	-0.134 [0.094]	-0.206** [0.094]
Infant Diarrhea Death Rate	-0.071 [0.059]	-0.214 [0.148]
Diphtheria Death Rate	-0.038 [0.098]	-0.043 [0.127]
Measles Death Rate	-0.418*** [0.138]	-0.283* [0.142]
Whooping Cough Death Rate	-0.013 [0.105]	-0.108 [0.118]
Infectious Diseases Death Rate	-0.124** [0.053]	-0.123** [0.046]
Other Diseases Death Rate	-0.048* [0.024]	-0.024 [0.025]

*Notes* : The first specification reports a specification without canton-specific linear trends, while specifications include year and canton fixed effects as well as controls for the socio-economic status density and the percentage of population living in cities above 10,000 inhabitants). Standard errors :

**Table 8: Proportional Representation and Mortality in Europe and Latin America**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Crude Death Rate (Log Odds Ratio)				Infant Mortality Rate (Log Odds Ratio)			
Proportional Representation	-0.020 [0.021]	-0.038* [0.019]	-0.049** [0.023]	-0.046** [0.022]	0.050 [0.036]	0.046* [0.026]	0.059 [0.034]	0.059* [0.033]
Observations	2131	2131	1877	1864	2259	2259	2081	2066
AIC	-5119.2	-5811.1	-5283.4	-5253.5	-3260.0	-4308.1	-4166.9	-4144.3
R Squared	0.96	0.97	0.97	0.97	0.98	0.99	0.99	0.99
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Specific Linear Trend	Yes	No	No	No	Yes	No	No	No
Country-Specific Decade Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Country Political System Variables	No	No	Yes	Yes	No	No	No	Yes
Country Demographics	No	No	No	Yes	No	No	Yes	Yes

Notes: The dependent variable is the log odds ratio of the crude death rate,  $\ln[\text{CDR}/(1-\text{CDR})]$  in the first four columns, and the log odds ratio of the infant mortality rate in the final four columns. Robust standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$  and \*\*\*  $p < 0.01$ .

Figure 1: Adoption of Proportional Representation in Swiss Cantons, 1890-2000

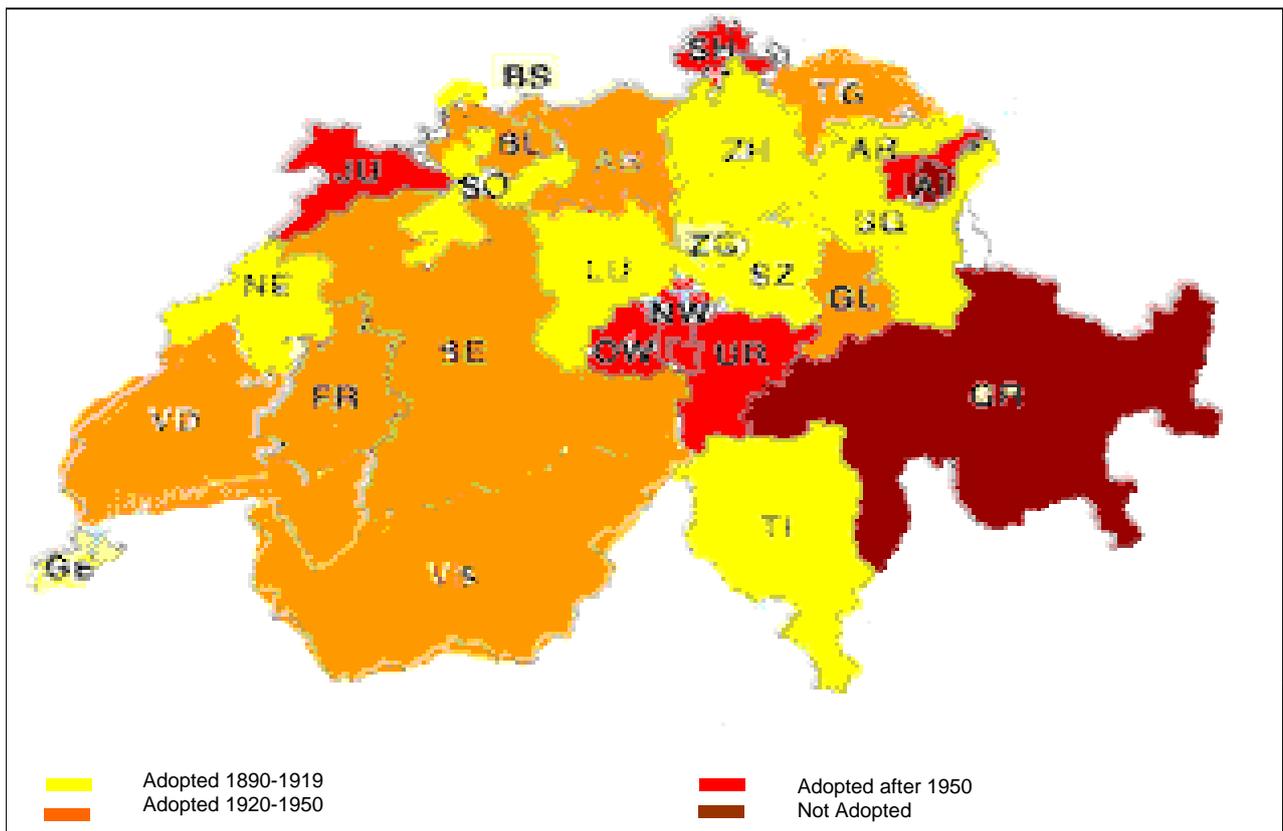


Figure 2: Evolution of Infant Mortality and Crude Death Rate in Switzerland

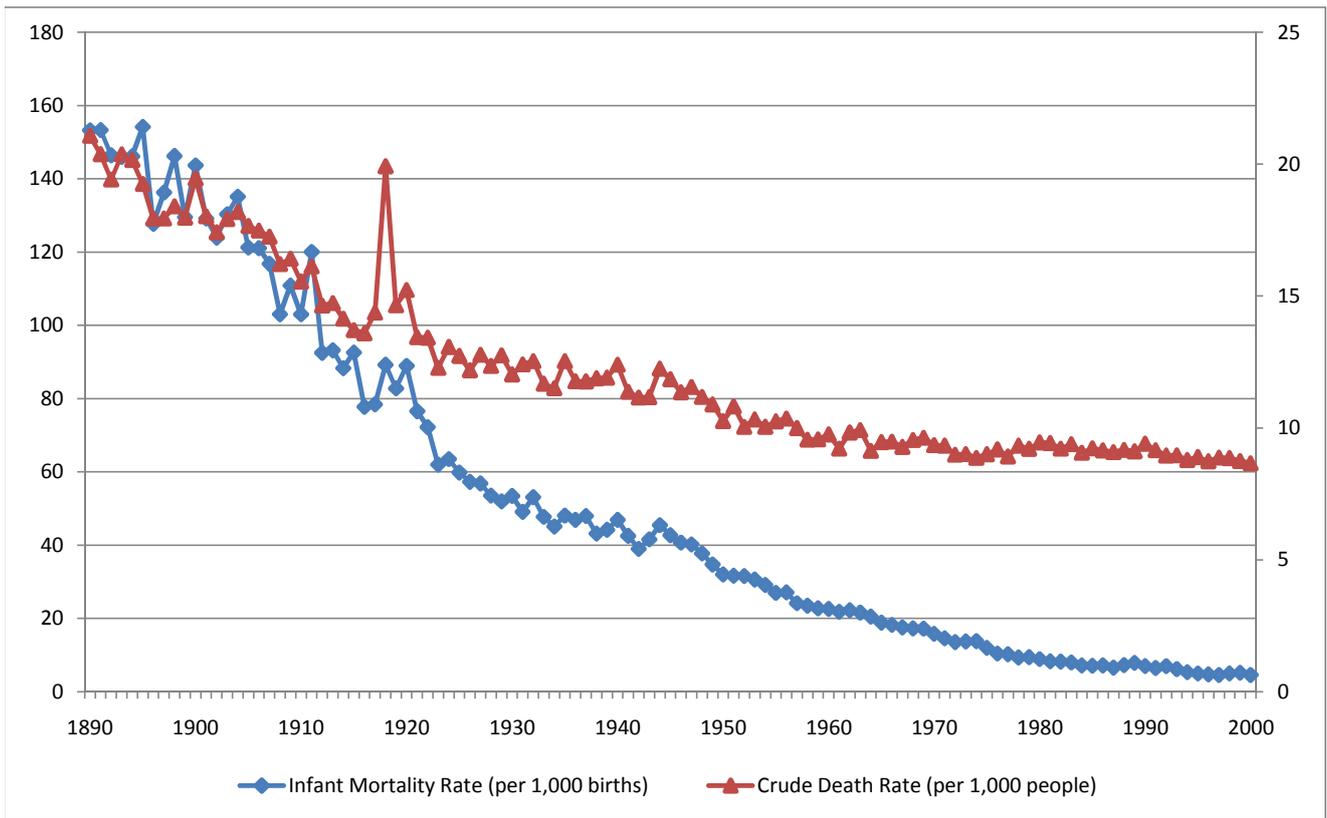
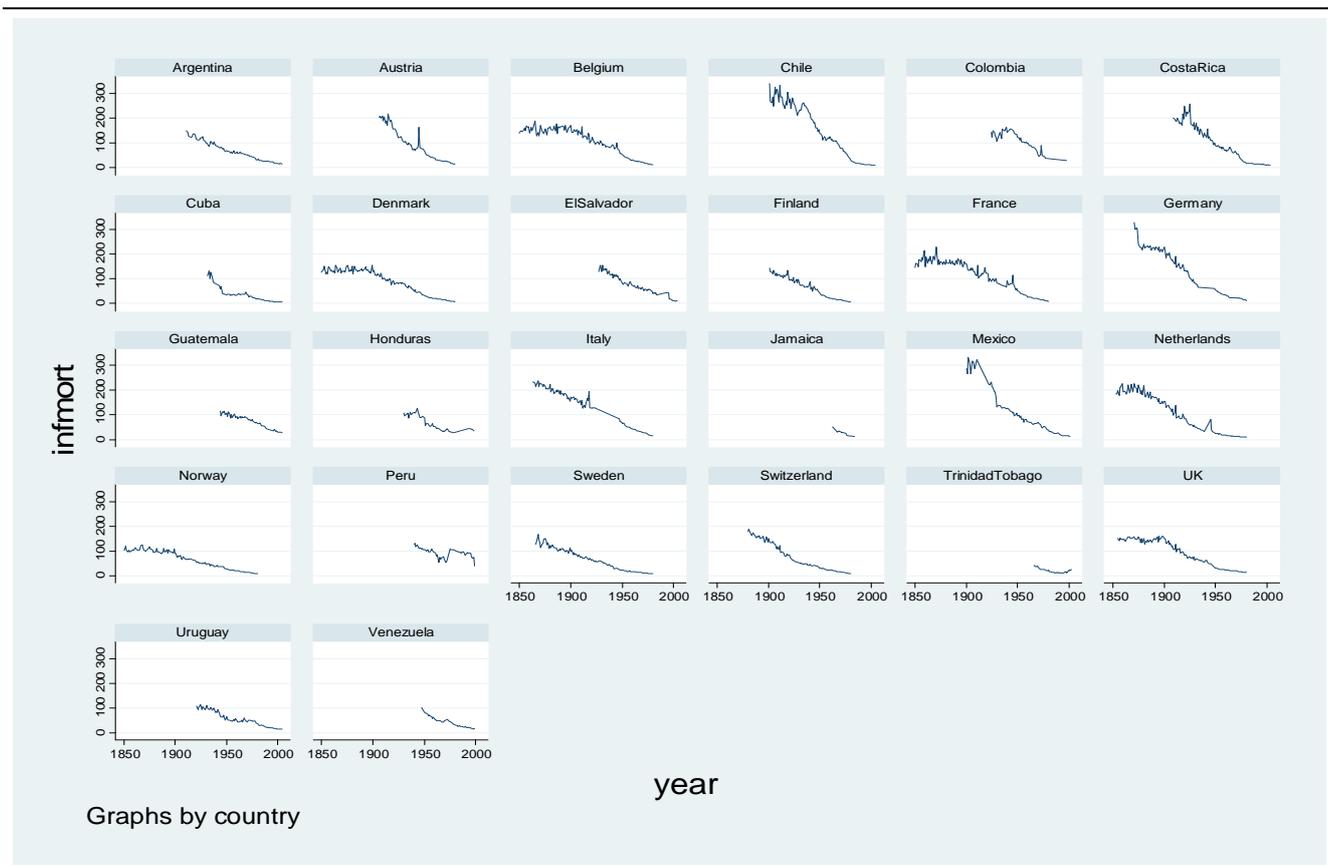
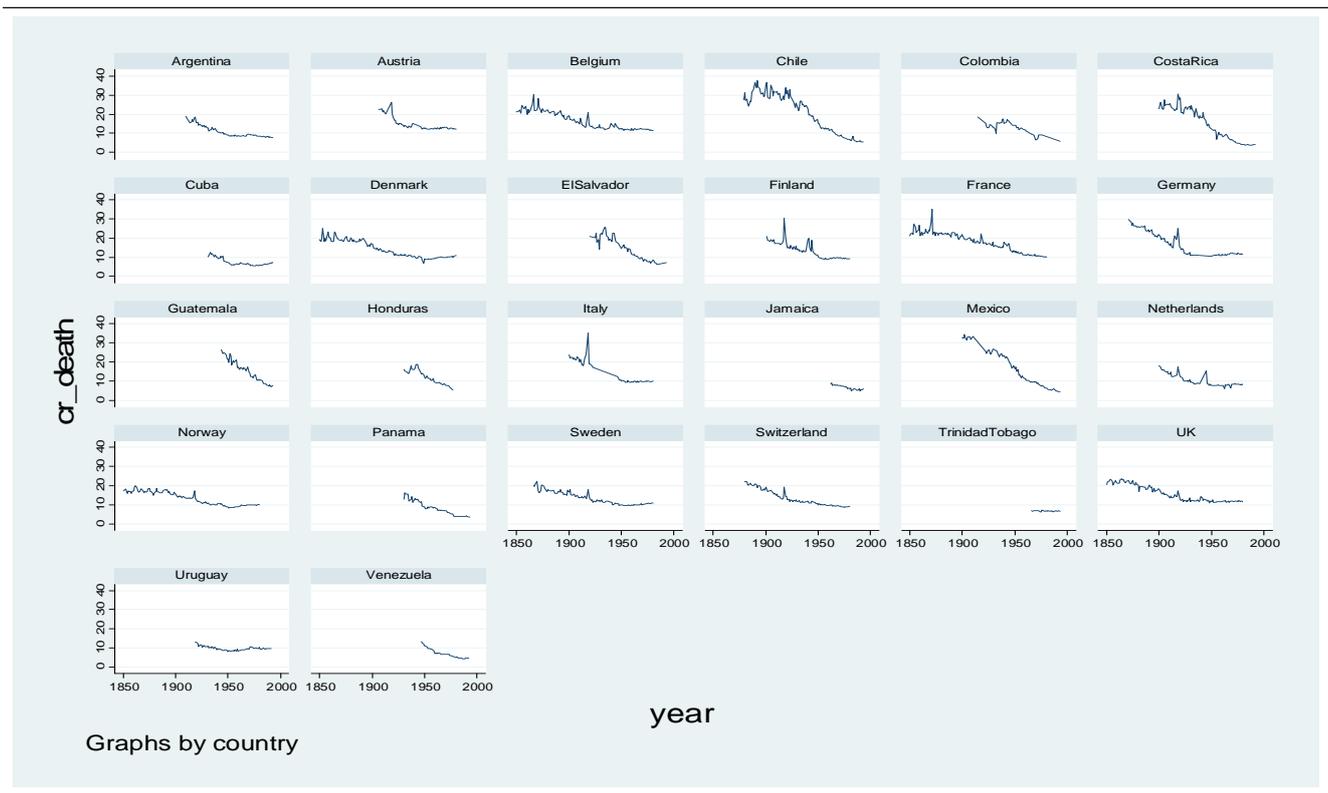


Figure 3: Evolution of Crude Death and Infant Mortality Rates in Europe and Latin America, 1850-2000



**Table A1: Summary Statistics of Swiss Data, 1890-2000**

	Mean	Std. Deviation	Observations
<b><u>Panel A: Deaths by Cause Statistic</u></b>			
Infant Mortality Rate (per 1,000 births)	52.357	48.466	2916
Crude Death Rate (per 1,000 people)	12.285	3.827	2775
Death Rate Typhus	0.046	0.067	1150
Death Rate Infant Diarrhea	0.640	0.570	1150
Death Rate Diphteria	0.184	0.233	1150
Death Rate Measles	0.085	0.141	1150
Death Rate Childbed Fever	0.057	0.042	1150
Death Rate Scarlet Fever	0.029	0.082	1150
Death Rate Whooping Cough	0.120	0.125	1150
Death Rate Suicide	0.196	0.104	1150
Death Rate Cancer	1.350	0.353	1150
Death Rate Lung Tuberculosis	1.469	0.504	1150
<b><u>Panel B: Age-Specific Death Rates</u></b>			
Deaths under Age 1	266.758	486.001	1334
Deaths Age 2 to 4	159.906	162.860	481
Deaths Age 5 to 9	11.105	28.516	716
Deaths Age 10 to 14	8.150	14.846	719
Deaths Age 15 to 19	39.976	56.136	1278
Deaths Age 20 to 29	107.111	148.624	1271
Deaths Age 30 to 39	115.538	151.362	1284
Deaths Age 40 to 49	187.078	269.304	1313
Deaths Age 50 to 59	245.184	250.656	1321
Deaths Age 60 to 69	417.593	411.274	1223
Deaths Age 70 to 79	611.710	639.686	1075
Deaths Age 80 plus	798.590	976.067	1223
<b><u>Panel C: Public Spending and Political Representation</u></b>			
Log Total Spending (per capita)	7.160	1.265	2775
Log Total Revenues (per capita)	7.137	1.267	2775
Log Public Health Spending (per capita)	5.599	1.377	1775
Log Public Education Spending (per capita)	5.247	1.569	2775
Log Social Spending (per capita)	5.597	1.029	1775
Log Welfare Spending (per 1,000)	4.189	0.980	2775
Log Road Spending (per 1,000)	5.586	1.110	1900
Seat Share Social Democratic Party	0.177	0.110	1967
<b><u>Panel D: Demographic Characteristics</u></b>			
Log Population	11.640	1.103	2775
Urban Population (above 10,000)	25.618	25.583	2775
Population Aged 20 to 39 (percent)	29.981	2.550	2775
Population Aged 40 to 64 (percent)	26.788	3.467	2775
Population Aged 65 and above (percent)	9.442	3.559	2775
Car Ownership (percent)	12.267	16.686	2775
Physicians (per 1,000 people)	0.893	0.483	2775
Employment Rate	47.710	4.627	2775
Employment in Agriculture	20.284	13.889	2775
Employment in Manufacturing	43.560	11.344	2775
Share of Protestants	0.409	0.297	2775
Female Labor Force Participation (percent)	40.670	7.656	2525
<b><u>Panel E: Other Political Institutions</u></b>			
Women Suffrage Adopted (1=yes)	0.139	0.228	2775
Mandatory Law Referendum (1=yes)	0.609	0.488	2775
Mandatory Budget Referendum (1=yes)	0.648	0.478	2775
Signature Reuirement Voter Initiative (percent)	4.721	5.318	2773

**Table A2: Proportional Systems in Europe and Latin America, 2000**

	PR in Place in 2000?	Year PR Adopted
Austria	Yes	1919
Belgium	Yes	1899
Denmark	Yes	1920
Finland	Yes	1907
France	Yes	1945
Germany	Yes	1919
Italy	Yes	1919
Netherlands	Yes	1918
Norway	Yes	1921
Sweden	Yes	1909
Switzerland	Yes	1919
United Kingdom	No	N/A
Argentina	Yes	1963
Chile	Yes	1925
Colombia	Yes	1931
Costa Rica	Yes	1896
Cuba	No	1908†
Ecuador	Yes	1950
El Salvador	Yes	1964
Guatemala	Yes	1944†
Honduras	Yes	1981
Jamaica	No	N/A
Mexico	Yes	1970
Nicaragua	Yes	1987†
Panama	Yes	1918†
Peru	Yes	1939
Trinidad and Tobago	No	N/A
Uruguay	Yes	1919†
Venezuela	Yes	1947†

*Notes* : The year of introduction reflect the year the first election took place under the new electoral system. † means that this is also the first year we observe the country in the data.