

Education and Military Rivalry*

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Abstract

Motivated by historical evidence on the relation between military threats and expansions of primary education, we assemble a novel panel dataset from the last 150 years in European countries and from the postwar period in a large set of countries. We find empirically that (i) investments in education increase in response to military threats, (ii) democracy has a negative direct effect on education investments, and, (iii) education investments in better democracies respond more to military threats. These empirical results are robust and continue to hold when we instead exploit rivalries in a certain country's immediate neighborhood as an alternative source of variation. To help us interpret these patterns in the data, we develop a theoretical model which is consistent with the three empirical findings. The model has an additional prediction about investments in physical infrastructures, which we also take to the data.

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1 Introduction

What makes countries engage in reforms of mass education? A common view is that such investments are the flipside of democratic transitions. Absent democracy, the elite denies the masses access to education in order to secure its power, while democracy – a wider franchise or open electoral competition – promotes policies for mass education. This explanation might look quite convincing, and seemingly accounts for the history of educational reforms in Europe starting with France. Indeed, Figure 1 (from Lindert, 2004), suggests that public contributions to primary-school education rose sharply in 1880, once France had completed its transition from the Second Empire to the Third Republic, which clearly reflected a move towards greater democracy.

Figure 1 about here

However, another event precipitating the fall of the Second Empire is France’s defeat against Germany in the 1870 Battle of Sedan. In the words of Lindert:

“The resounding defeat by Prussia tipped the scales in favor of the education reformers. Enrollments and expenditures accelerated across the 1870s, with local taxation leading the way. The real victory of universal tax-based education came with Jules Ferry’s Laic Laws of the 1880s, especially the 1881 law abolishing all fees and tuitions charges in public elementary schools.[...]While national politics could not deliver a centralized victory for universal schooling before the military defeat of 1870 [...] after 1881 centralization performed the mopping up role” (Lindert, 2004, p. 112)

Eugene Weber’s work on the modernization of rural France between 1870 and 1914 suggests why military threats may spur centralized investment in mass education (Weber, 1979). A highly disintegrated population that was largely illiterate and spoke a multiplicity of dialects was to be transformed into a unified people sharing the same patriotic values, a spoken and written language, a set of moral principles, and a motivation and ability to defend France in future conflicts¹.

¹As Leon Gambetta would say to the leader of the Breton forces: “I beg you to forget that you are Bretons, and to remember only that you are French”.

In this paper, we study historical panel data on education spending and enrollment – for European countries since the 19th century and a much larger sample in the postwar period – to assess the correlation between military rivalry (or war risk) and enrollment in primary education (or the occurrence of educational reforms). Based on standard OLS regressions, we find that, conditional on country and year fixed effects, primary education is positively and significantly associated with military rivalry or recent involvement in an external war. Moreover, while the estimated coefficient on democracy (gauged by the Polity IV index) comes out negative when we control for military rivalry, the interaction between the two variables is typically positively and significantly associated with education. The coefficient on military rivalry remains stable when we control for the political regime, suggesting that military threats are independently related to mass education.

To address appropriate concerns about endogeneity, we consider rivalries between a country’s bordering countries and third countries as an exogenous source of variation. This rests on the idea is that a country is more likely to perceive military threats when military rivalries are rife in its neighborhood. The reduced-form results, when we regress a country’s primary education on the rivalries among its neighbors, are qualitatively similar to the OLS results. Running the corresponding IV specification, we again find a positive and significant effect of rivalry, a negative direct effect of democracy, and a positive and significant interaction term between the two. The IV estimate of the rivalry effect on primary enrollment is larger than the OLS estimate, suggesting the latter is biased downward. Overall, the empirical results suggest a causal relationship from rivalry to primary enrollment.

Our paper relates to, at least, three strands of research. As for the relationship between public-education investments and democracy, Lott (1999) suggests that non-democracies could invest more than democracies in public education as a means of indoctrination. On the other hand, Glaeser et al. (2007) argue that education and democracy should be positively correlated, as civic participation – needed to support transitions from dictatorship into democracy – is positively related to education. But the evidence for a positive relationship between education and democracy is mixed, at best. Thus, Mulligan, Gil, and Sala-i-Martin (2004) present cross-country evidence indicating that more democratic countries do not have higher levels of social expenditures and, in particular, higher public education spending. More recently, Bursztyn (2014) shows that poor voters in Brazil prefer the government to carry out cash transfers, yielding immediate income increases,

instead of vesting resources into public primary education. Also related to our analysis is Bourguignon and Verdier (2000), who develop a model to explain why the ruling class may sometimes invest in education even though schooling enhances political participation. Analogously, Galor et al (2006) theoretically argue that capital accumulation gradually intensifies the importance of skilled labor in production and therefore generates support in the ruling class for human-capital investment. Galor et al. (2009) maintain that a higher concentration of land ownership typically discourages the development of human capital enhancing institutions, in particular schooling. Based on data for 27 countries and 70 years from 1870, Ansell and Lindvall (2013) find that observed educational reforms reflect the resolution of conflicting interests not only in politics but also in religion. However, no paper in this strand of work looks at the effect of military threats in democracies and autocracies.

A second related literature deals with the impact of wars on economic and political outcomes. On the latter, Ticchi and Vindigni (2009) analyze theoretically a mechanism whereby international conflict may trigger democratic transitions. Their modeling is motivated by a large amount of earlier research in political science and political sociology, such as Giddens (1985), and empirical facts presented by Dolman (2004). Another literature on the economic impact of wars starts with Anderton and Carter (2001), Blomberg and Hess (2006), and Glick and Taylor (2005). More recent research by Martin, Mayer and Thoenig (2008a,b) and by Acemoglu and Yared (2009) evaluates the extent to which wars reduce trade flows. However, this research does not generally investigate the links between wars and investment in education.

A third strand of work deals with state capacity. Hintze (1975) and Tilly (1975), preceding many others, provide historical accounts on the importance of wars for state building. More recently, an economic literature summarized and extended in Besley and Persson (2011) considers theoretically investments in fiscal and legal capacity, and finds positive correlations between past wars and current state capacity in international panel data. Thies (2004), using the same measure as we do, shows that military rivalries raise fiscal capacity in postcolonial developing states. Scheve and Stasavage (2011) investigate the links between wars, democracy, and estate taxation in about 20 countries since 1816 and find that democracy does not systematically influence top rates of estate taxation, whereas wars with mass mobilizations significantly raise these rates. Analogously, we find a correlation between

current educational investments and past wars or military rivalry, while – in parallel to Scheve and Stasavage – the correlation between wars and democracy is more tenuous. In addition, we find that the effect of military rivalry on educational investment is larger in democracies, a finding that may be quite specific to education. In contrast to this literature, we treat state capacity as exogenous, both in the theory part and in our empirical analysis.

We have organized the paper as follows. Section 2 describes two historical examples that speak to the relationship between military rivalry and education reforms. Section 3 introduces our data, descriptive statistics, and empirical specifications. Section 4 presents the econometric results and discusses their robustness to a variety of factual and statistical concerns. Section 5 spells out a theoretical model, which is consistent with three key empirical findings – in addition, the model has an auxiliary prediction, which also finds support in the data. Section 6 concludes.

2 Lessons From History

While each nation’s history has unique elements that cannot be forced into a unified framework, the examples of France and Japan over the 19th century show how military threats or rivalries can spur educational reforms. In each example, we give a background on the historical context and the debate that took place in a volatile international environment, the subsequent process of education reforms, and the outcomes especially with regard to primary enrollment.

2.1 Jules Ferry’s France

Background and Debate In 1870, French public expenditure on education was lagging behind that of Prussia and other European countries. The French education system was mainly private and largely religious. Teaching was done by priests or by anyone who knew how to read, often in improvised classrooms with poor amenities in the backyard of a farm. A large fraction of registered children never attended school. The result was a population with many illiterate or unable to understand the content of a text. In 1863, 7.5 million citizens (about a fifth of the population) spoke only local dialects and no proper French.

Even prior to the Prussian war in 1870, elites knew that French education

had failed to promote national unity. Victor Duruy, appointed Minister of Education in 1863 by Napoleon III, was advocating sweeping educational reforms, better educational facilities, and more of technical education – plans similar to those Jules Ferry would pursue some 20 years later. When Duruy tried to convince the Emperor, he did not manage to gather enough political support especially from a rural population heavily influenced by the Church, so Napoleon III decided to let the project of his minister be defeated by the legislature.

On September 2, 1870, Napoleon III was made prisoner at Sedan, and on February 26, 1871, Germany took control of the French regions of Alsace and Lorraine. This resounding defeat prompted the fall of the Second Empire. After the Sedan battle, the debate about educational reforms would continue. Conservatives and the church saw Sedan as a punishment for France's infidelity to its traditions, while progressives saw it as a reflection of superior Prussian schools and universities. However, the defeat spurred support for the reformers:

“There was nearly universal belief among the French elite that Prussia had triumphed because of the superiority of its celebrated universities: a popular aphorism was that the University of Berlin was the revenge for the defeat at Jena. French praise for German education extended to all levels of the system. Journalists repeated the dicta that the Prussian elementary school teacher was the architect of Sedan and that the modern secondary education of the Realschulen had provided the scientific base for Prussian military efficiency.” (Moody, 1978, p. 87).

Despite the disagreement on the causes of military defeat, a majority agreed that education had played a key role in Prussia's rise to power and that French education had to be reformed, not only to increase literacy, but also to give new generations basic knowledge in arithmetics, history and geography, and to

“teach Frenchmen to be confident of their nation's superiority in law, civilization and republican institutions. It should be consistent with reigning social values, and thereby eliminate disruptive conflicts and promote the unity of the classes. Since France no longer enjoyed religious unity, it must forge a new moral unity

from a unified education that would teach civic morality based on the principles of natural reason” (Moody, 1978, p. 88).

The Reform Process But “the real victory of universal tax-based education came with Jules Ferry’s Laic Laws of the 1880s” (Lindert, 2004). Jules Ferry became Minister of Education in February 1879. He abolished all tuition in public elementary schools in 1881; made enrollment compulsory from age six to thirteen in 1882; made it mandatory for every village with more than twenty children at school age to host a public elementary school in 1883; devoted subsidies to the building and maintenance of schools and to paying teachers in 1885; and established an elementary teaching program, together with monitoring provisions in 1886. These so-called “Laic Laws” still characterize the French educational system today. At the same time, a complementary infrastructure program – the Freycinet plan – was to facilitate access to schools. Millions of francs were spent on road building to match the large amounts spent on schools: 17,320 new schools were built, 5,428 schools were enlarged, 8,381 schools were repaired (Weber, 1979). Enrollment and attendance in primary education steadily increased.

In addition to wider access, the reforms transformed the content of elementary education: new programs emphasized geography, history, and dictation. The new history and geography programs aimed at conveying patriotic values to new generations.² From their very first day at school, children were taught that their first duty was to defend the fatherland. Even gymnastics were meant “to develop in the child the idea of discipline, and prepare him [...] to be a good soldier and a good Frenchman” (Lindert, 2004).

Outcomes Official statistics³ attest that school attendance rose appreciably in the decade after 1882. Primary enrollment rates went up from 1,176 per 10,000 inhabitants in 1870 to 1,430 in 1912. Literacy rates rose from 80% in 1870 to 96% in 1912 (and the initial 80% figure is partly misleading, as most “literate” children did not understand what they read prior to the reforms). Finally, the reforms appear to have increased the sense of patriotism and national unity. Thanks to the Ferry laws,

²As for dictations, they were useful to teach the French language but, beyond that “the exercise was a sort of catechism designed to teach the child that it was his duty to defend the fatherland, to shed his blood or die for the commonwealth, to obey the government, to perform military service, to work, learn, pay taxes and so on” (Lindert, 2004, p. 333).

³As reported in Moody (1978) and Lindert (2004).

“in Ain, Ardennes, Vendee, all children became familiar with references or identities that could thereafter be used by the authorities, the press, and the politicians to appeal to them as a single body” (Lindert, 2004, p. 337),

and in that respect Ferry’s efforts paid off during the subsequent mobilization in 1914.

2.2 Japan in the Meiji Era

Background and Debate From the 17th century, Japan was ruled by military lords (the so-called *shoguns*) of the Tokugawa dynasty. Education was a privilege of the Samurais and centered on tradition and the study of Confucian classics. From the mid 1850s though, Japan came under threats by Western powers. In 1853, US Commodore Matthew Perry presented an ultimatum: open up to trade or suffer the consequences of war. To add credibility to this threat, American warships were sent to Japan and the Trade Convention of Kanagawa was signed on March 31, 1854. Western threats towards Japan in the second half of the 19th century acted as a catalyst for educational reforms:

“In 1872, government leaders were haunted by a crisis of international proportions. [...] European colonial empires had spread into the Far East, threatening the very existence of Japan as a sovereign state. During the years of self-imposed isolation by the Tokugawa regime [...], the country had fallen dangerously behind the West as the industrial revolution got under way. The rise of Western capitalism and international colonialism posed a pervasive threat to Japan, as perceived by the new leaders. They were determined to use any means necessary to transform their country into a modern state in order to preserve the political order and the national sovereignty. Education on the Western model was envisioned as an instrument to achieve that goal.” (Duke, 2009, p. 1).

The Tokugawa implemented various reforms in the early 1860s, but did not go far enough to satisfy the Samurais. Japan fell into civil war and in January 1868, the insurgents prompted Emperor Meiji, who had just taken the throne, to announce an “imperial restoration”.

After this coup d'Etat, a debate emerged about education. Some wanted to preserve the focus on Confucian classics to maintain interpersonal hierarchical relationships and traditional customs, while others favored introducing secular Western science, mathematics and rationalistic thought to modernize the Japanese society. The Western-oriented progressives eventually prevailed over the Eastern-oriented traditionalists. Indeed, "observation of European and American societies convinced leaders such as Kido Koin that mass schooling, like mass conscription, was a fundamental source of the economic and military power of the West. Their initial models were primarily American and French" (Gordon, 2003, p. 67). The newly founded Ministry of Education sent delegates to learn about Western education systems, for instance with the Iwakura mission of 1872-1873.

The Reform Process Thus, the leaders of the Meiji era decided on profound reforms turning to mass education so as to rise up to the challenges posed by the West: "mass compulsory education was a bold initiative, and a risky one for the government" (Gordon, 2003, p. 67). Meiji leaders could have decided to hold back from imparting literacy and potentially subversive "enlightenment" to imperial subjects who were expected to follow orders. But they consciously took this risk, concluding that an ignorant populace would be a greater danger to their projects to build political and economic power. Thus, military threats resulted in a shift in the "equilibrium educational institutions". As Burnett and Wada (2007) argued,

"For the first time in Japanese history education was interpreted as a tool in the push to modernize the nation, a point confirmed by the then Minister of Education Mori Arinori: 'Our country must move from its third class position to second class, and from second class to first: ultimately to the leading position among all countries of the world. The best way of doing this is [by laying] the foundations of elementary education'."

The desire to unify the people after years of civil war and the sense of urgency derived from perceived domestic and foreign threats explains the radical steps taken by the Meiji leaders. They approached education as an instrument to serve the state and were eager to follow what they called the "Prussian notion of education" (Duke, p. 314).

Accordingly, in 1872 a new education system was instituted which declared four years of compulsory elementary education for all children. As explained by Burnett and Wada (2007), “in just a one-year period following the Gakusei of 1872, 12,500 primary schools were established. Within the next five years the number of schools doubled to a figure not surpassed until the 1960s.” The move to mass education was completed by a national training system for teachers. The first teacher’s college was created in Tokyo in July 1872, based on American principles of elementary-school instruction.

Outcomes Initially, reactions to the educational reform were mixed.

“Not everyone was so happy at the obligation to attend school [...] In the 1870s, angry taxpayers reacted to compulsory schooling as they had to the draft: they rioted. Crowds of people destroyed at least two thousand schools, usually by setting them afire. This represented close to one-tenth of the total number of schools. The passive resistance of simply not going to school was even more widespread. Rates of attendance for school-age boys and girls stood at 25 to 50 percent of the eligible population for the first decade of the new system” (Gordon, 2000, p. 68).

One might argue that popular resistance reflected a lack of democracy: peasants neither identified with the emperor, nor with the new ruling class, and therefore disapproved of the new compulsory nationalistic education. Similarly, people at first tried to resist the military reform.

Yet, over time, the educational reforms yielded more and more of a resounding success. Japan overtook most European powers with regard to primary enrollment per school-age child, which rose from 28.1% in 1873 to 98.1% in 1910. From 1865 to 1910, the literacy rate increased from 35% to 75% for men and from 8% to 68% for women. Primary-school enrollment per 10,000 inhabitants rose with blistering speed, from 65 in 1876 to 1,122 in 1905⁴.

Successful education reforms certainly played a role in Japan’s unexpected military victories in the 1895 war against China and the 1905 war against Russia. Overall, the Meiji-era reforms further illustrate the idea that education reform occur as a result of strategic military concerns. The Japanese

⁴See Gordon (2000) and Duke (2009)

example is probably even clearer than the French one, in that military considerations clearly took precedence over humanistic ones. Yet the initial popular resistance may illustrate how a lack of democracy can reduce the effectiveness of educational reforms.

2.3 Summing Up

The historical evidence from France and Japan illustrate how military threats and rivalries may be important for purposeful investments in primary education. Moreover, contrasting the examples of France and Japan suggests that the educational reform triggered by a military threat may also depend on the political regime. In democratic France the reforms met with less resistance than in autocratic Japan, but they eventually had a larger effect on education in Japan. To further explore this issue, we will look for an interactions between democracy and military rivalry in the data.

A positive relationship between military rivalry and primary education enrollment could reflect different objectives of the rulers. These may include desires to (i) generate basic knowledge in mathematics or language, (ii) promote group discipline, or (iii) transmit patriotic values. Our empirical analysis in Section 4 will not be able to directly distinguish between these alternatives.

3 Data and Empirical Specifications

3.1 Sources and Variable Definitions

Education To empirically investigate the determinants of mass education reforms, we use an unbalanced panel with annual data for 137 countries between 1830 and 2001. Our main dependent variable, $Enrollment_{i,t}$, measures primary enrollment per 10,000 inhabitants in country i and year t , in accordance with the UNESCO definition of primary schooling. The underlying data are drawn from the CNTS Data Archive of Banks (2011). In our baseline regressions, we use primary enrollment as a continuous dependent variable. Constructed on a per-capita, rather than per-school-age-child basis, this measure is affected by shifts in demographic structure: for the same prevalence of schooling a young population will have a higher primary enrollment rate per capita than an old population. We therefore control for

population growth in the past 10 years to mitigate such effects. As shown by the descriptive statistics in Table 1, the average primary enrollment rate is 10.5% of the population over our pooled sample, with a large variation across countries and time periods.

To test the robustness of our results, we also analyze the probability of discrete education reforms expanding access to primary education.⁵

War Threats We measure war risk and military threats in two alternative ways. As in the examples of Jules Ferry’s France and Meiji-era Japan, a recent experience of external conflict may raise the perceived likelihood of a new conflict and the salience of military concerns in policy decisions. *War risk* $_{i,t}$ is a binary indicator set equal to one if country i was engaged in an external war in any of the 10 years prior to year t , according to the variable “inter-state war” in the Correlates of War (COW) database. This database also provides information on the outcome (victory or defeat) of past wars and a (crude) estimate of the number of casualties as a percentage of the pre-war population.

We always exclude for each country years during which it is at war from the sample, as an ongoing war – as opposed to a latent rivalry – may severely increase the opportunity cost of public funds. Maybe more importantly, data in times of war are likely to be unreliable.

This measure of war risk is, of course, completely backward-looking and may therefore miss emerging threats without a history of war. Our core measure, *Rivalry* $_{i,t}$, is less subject to this concern. This indicator picks up whether country i has a strategic rival in year t , according to Thompson (2001). Rivalry captures the risk of armed conflict with a country of significant relative size and military strength. It is based on contemporary

⁵Reform is defined in two alternative ways. For the complete sample of countries, a binary *imputed reform* variable is set equal to one in a given year if primary enrollment grew by more than 10% over the previous 5-year period. When analyzing imputed reforms, we collapse the data into five-year averages so as to minimize measurement error. For a reduced sample of 14 European countries (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Sweden, Switzerland, and United Kingdom) over the period 1830 to 1975), a binary *known reform* variable is set equal to one in years when any new law is passed, which extends compulsory education, lowers the cost of education (e.g., abolish school fees for primary education), or increases the number of schools (e.g., makes it compulsory for each municipality to set up at least one primary school). The source for this variable is Flora (1983). There are 52 such reforms in the sample.

perceptions by political decision-makers, gathered from historical sources on foreign policy and diplomacy. Specifically, military rivalries are identified by three criteria: whether two countries regard each other as “(a) competitors⁶; (b) a source of actual or latent threats that pose some possibility of becoming militarized; (c) enemies” (see Appendix A for details).⁷ We also create a measure of the relative strength of rivals, assessing the probability of winning or losing a potential military conflict, by gauging the ratio of their respective armies. To this end, we draw military personnel numbers from the COW National Material Capabilities database.

The summary statistics in Table 1 confirm that Thompson’s rivalry variable captures a wider range of situations than the past-war variable. The two are positively correlated, but less than perfectly so: 16% of the country-year observations in our sample are associated with a war in the previous 10 years, while almost half are associated with one or more strategic rivalries. Among countries engaged in strategic rivalries, a war had materialized in the previous 10 years in 24% of the cases.

Political Regimes For the political regime, we use the institutionalized autocracy and democracy scores (the *polity2* variable) in the Polity IV database. These are themselves combinations of constraints on the executive, openness and competitiveness of executive recruitment, and competitiveness of political participation. The combined score $Democracy_{i,t}$ ranges from -10 to $+10$, where a higher score means that country i at date t is more democratic. About 43% of the country-years in our sample have positive scores.

⁶ “Most states are not viewed as competitors – that is, capable of “playing” in the same league. Relatively weak states are usually capable of interacting competitively only with states in their immediate neighborhood, thereby winnowing the playing field dramatically. Stronger actors may move into the neighborhood in threatening ways but without necessarily being perceived, or without perceiving themselves, as genuine competitors. If an opponent is too strong to be opposed unilaterally, assistance may be sought from a rival of the opponent. Other opponents may be regarded more as nuisances or, more neutrally, as policy problems than as full-fledged competitors or rivals. [...] Actors interpret the intentions of others based on earlier behavior and forecasts about the future behavior of these other actors. The interpretation of these intentions leads to expectations about the likelihood of conflicts escalating to physical attacks. Strategic rivals anticipate some positive probability of an attack from their competitors over issues in contention.” (Thompson, 2001)

⁷To our knowledge, the collection of data and coding of qualitative information conducted by Thompson (2001) is the most rigorous and comprehensive on rivalries to date.

The mean score is -0.37 and the variance is 7.1 , with strong variation both within and between countries: although political regimes often change slowly, about 36% of the total variance in democracy scores is due to the within component. One question in our empirical exercise is whether political change is an important driver of mass education beside external rivalry. Our results are all robust to using lagged democracy score instead of current democracy score (in order to mitigate endogeneity concerns).

Covariates Finally, our regressions include a number of other covariates. Military expenditures and total population are drawn from the COW National Material Capabilities. Measures of government expenditures (per capita) are from the World Development Indicators and CNTS databases. Other covariates used in robustness checks are introduced in context below.

Table 1 about here

3.2 Empirical Specification

Our baseline econometric specification is:

$$\begin{aligned} Enrollment_{i,t} = & \alpha_0 + \alpha_1 Rivalry_{i,t} + \alpha_2 Democracy_{i,t} + \\ & \alpha_3 Rivalry_{i,t} \cdot Democracy_{i,t} + \alpha_4 X_{i,t} + \nu_i + \delta_t + u_{i,t}, \end{aligned} \quad (1)$$

where the variables multiplying α_1 to α_3 were introduced in the previous subsection. Our main parameters of interest are α_1 , which captures the predictive effect on enrollment of war risk faced by country i in year t , and α_3 , which captures the interaction of war risk with the democracy index. As explained above, military threat means at least one strategic rival in year t – or a war in the past 10 years (i.e., between years $t - 10$ and $t - 1$). We also include a set of control variables $X_{i,t}$, country fixed effects ν_i , and year fixed effects δ_t . Hence, the effects we estimate are identified from the variation over time within countries of the right-hand side variables relative to their world average levels. For inference, we report heteroskedasticity-robust standard errors. All results are qualitatively similar, with point estimates of similar magnitude and statistical significance, when we allow for country-specific linear time trends in the error term.⁸

⁸Table W6 in the Online Appendix reports our baseline specifications with country-specific linear time trends. Other tables with country-specific linear time trends are avail-

To test the robustness of our results, we also estimate the probability of a discrete education reform using Logit specifications with the same set of covariates.

Our main prediction is that α_1 should be positive, whereas we are more agnostic about the signs of α_2 and α_3 . Although our tests are primarily based on correlations in the data, we also try to address latent endogeneity issues by considering rivalries in a country's neighborhood as an alternative source of variation. In that case, we look at reduced forms as well as full fledged IV-specifications.

4 Empirical Evidence

4.1 Baseline Results

Table 2 shows the results from our baseline estimation of (1) in the yearly panel, with primary enrollment rates as the dependent variable. All specifications include 10-year population growth, to account for varying shares of school-age children in total population, as well as military expenditure per capita, to control for the possibility that military spending may crowd out education spending. Indeed, we find that high population growth rates are consistently associated with higher primary enrollments, while military spending – holding constant external threats – has a negative coefficient. A natural interpretation of the latter is that limited fiscal capacity restricts the ability to invest in education, if more effort is devoted to building an army.

Table 2 about here

In columns 1 through 3, military threats are measured by the presence of an ongoing military rivalry. Column 1 shows that primary enrollment is positively and significantly associated with military rivalries. The point estimate is sizeable: about one tenth of the standard deviation in primary enrollment. Interestingly, the coefficient on the democracy score is negative and highly significant. At the same level of military threat, autocracies invest more in education than democracies. This finding runs counter to the median voter view of mass-education reforms, which would predict education to be

able from the authors. Due to the small number of countries and the inertia in many variables, we lose statistical significance in most specifications when clustering standard errors by country.

positively related to democracy. The coefficient on military rivalry is stable when we control for the political regime. This appears inconsistent with a view that rivalries only matter insofar as they foster political change and that democratization is really the main force behind expansions of primary enrollment.⁹ In column 2, we add an interaction term to check if the impact of rivalries on educational investments differs by political regime and find that primary enrollment is more positively associated with military threats in democracies than in autocracies. We investigate the democracy results in more detail in Subsection 4.3.

Additional Covariates In column 3, we include two covariates that may affect investments in education. The relative strength of rivals is defined as the army size among any strategic rivals, divided by the size of the country's own military. A higher value of this interaction variable signals a higher risk of losing a potential war. The point estimate suggests that countries with stronger rivals indeed have higher enrollment rates. We also control for total government expenditures per capita. Our main results are unchanged, namely the presence of a strategic rival is associated with higher enrollment in primary education, democracies have less primary education, while the interaction between the democracy indicator and military rivalry is positive. This suggests that war threats may have an independent effect on education investments, aside from any indirect effect that may arise through investments in higher fiscal (state) capacity.

Past Wars vs. Rivalries Columns 4 to 6 of Table 2 present the same set of regressions, except that we replace military rivalry by the occurrence of a war in the past 10 years. Primary enrollment is positively correlated with the occurrence of a war in the past 10 years. Also, consistent with the results

⁹Interestingly, if we regress enrollment on democracy alone, we find a negative correlation once we control for both time and country fixed effects. Murin and Wacziarg (2014) find a positive correlation between democracy and their enrollment variable in regressions that do not include those fixed effects. In our regressions with time and country fixed effects, the correlation between democracy and enrollment captures a *within-country effect relative to world average*. Our fixed-effects estimator purges the effects of the level of democracy and instead captures the potential effect of changes in democracy on educational enrollment. It also eliminates potential sources of positive correlation between democracy and enrollment, for example that arising from the existence of similar worldwide trends in the two variables.

in columns 1 to 3, autocracies invest more in education than democracies. However the interaction term is insignificant in those specifications, as well as the severity of the recent war(s), measured by the number of casualties incurred by the country as a percentage of its pre-war population.

4.2 Plausibility Checks

The motive for investing in mass education in our narrative is that a more educated population is more effective at fighting wars. In this subsection we perform two plausibility checks, which support this narrative. The econometric results are collected in Table 3.

Education as a Means to Win Future Wars A first test is to look at the relationship between education, rivalries and future wars. The first four columns of Table 3 show the results of fixed effects logit regressions. In columns 1 and 2, the dependent variable is a binary indicator for break-out of war in the next 10 years. As expected, being engaged in a rivalry positively predicts future wars. The coefficient on primary schooling is also positive and significant, which provides additional evidence that governments that (rationally) foresee high war risk may increase education investments. Unsurprisingly, military expenditures are higher in the run-up to a war.

Table 3 about here

In columns 3 and 4, the dependent variable is instead an indicator for winning the next war, conditional on a war breaking out in the next 10 years. In column 3, we only include as covariates primary enrollment, democracy and military expenditure per capita. Here, we do find that the probability of winning is positively and significantly associated with current education levels. Perhaps surprisingly, military expenditures are not significantly associated with the probability of victory. To control for asymmetries in military capabilities, column 4 includes the size of the military (per 1,000 inhabitants) also in the country's largest rival. As expected, we find that a larger army positively predicts victory, and a larger army in the rival increases the likelihood of defeat. Importantly, the coefficient on primary enrollment remains identical once we control for the mobilization of the population into the military. Together with the historical evidence in Section 2, these findings support the view that military threats spur investments in mass education in

order to build more effective armies. No other covariate, including military expenditure, enters significantly in the regression for the outcome of future wars.

Military Threats and Military Expenditure As a second check that education investments are indeed driven by military concerns, we rerun our baseline fixed-effects OLS regression but replace education with military expenditure per capita as the dependent variable. As seen in columns 5 and 6 of Table 3, we find the same basic pattern for military spending as we did for primary education: a positive response to strategic rivalries and a higher response in less democratic countries.

4.3 The Political Regime

Our estimates imply that democratic countries invest less in primary education than autocratic countries, absent rivalries or war threats. However, the gap between democracies and autocracies narrows at high war threats.

Possible Channels Political institutions may affect education policy along several channels. As mentioned in the introduction, extending the franchise might foster pro-poor policies, like publicly funded primary schooling. But we find little evidence supporting this hypothesis. A prospective effect in the opposite direction is that democratically elected leaders have higher turnover – and thus shorter expected time horizons – than autocrats, making the former less willing to invest in mass-education policies with mainly long-term benefits. A third channel could conceivably run through the effect of rivalries and wars on regime change: wars may affect education spending mainly because they promote regime change, which in turn affects education policy. However, our findings do not support this third channel, since the direct estimates of military rivalry on education remain unchanged when we control for the democracy score. Instead, our results suggest that war threats or past wars tilt the preferences of ruling elites towards mass education. Even if more schooling may raise the risk of autocratic leaders being ousted, the long gestation lags in education may push this threat too far into the future to affect current policy.

Disaggregating Democracy But our empirical measure of democracy is very broadbrush, making it hard to understand the mechanisms at work. We therefore disaggregate the democracy score into its two main components: constraints on the executive and the openness of executive recruitment. In particular, the effective time horizon of political leaders is best captured by the openness of executive recruitment, while constraints on the executive affect how much of the gains from educational reforms leaders can appropriate. We then run our main specifications, letting these two aspects of democracy enter separately on the right-hand side. To get a stronger signal, we define one dummy variable for each aspect: *High constraints on the executive* ($xconst$ greater than or equal to 4 in the Polity IV database) and *Openness of executive recruitment* ($xopen$ greater than or equal to 3 in the same database).

Table 4 looks at the effect on primary enrollment with military rivalry as the measure of war risk. The estimates in columns 1 and 3 show that executive openness is negatively correlated with the enrollment rate, while executive constraints are not. However, when we introduce interaction terms between rivalry and each specific aspect of democracy in columns 2 and 4, both direct effects are negative and significant, while the interactions with rivalry are both positive and statistically significant. In columns 5 and 6, we run a horse race between the two measures with or without interaction terms. The estimates show that the direct influence of each component of democracy remains, albeit with a larger and more significant interaction term for constraints on the executive.

Table 4 about here

Thus, both aspects of democracy appear to matter. When we take interaction effects into consideration, the direct relationship of both measures with primary schooling rates is negative, but is mitigated or reversed in the presence of rivalries. In particular, the interaction between military threats and high executive constraints is always positive and significant. Although the disaggregated results shed only limited light on the underlying mechanism whereby political regimes influence mass education, they demonstrate the robustness of the negative and significant correlation between the two measures of democracy and primary enrollment.¹⁰

¹⁰This is perhaps surprising in itself: various authors have pointed out that the Polity

4.4 Dealing with Endogeneity

We have found a positive relationship between military rivalry and primary education, as well as a positive relation between primary education and the interaction between rivalry and democracy. Also, we have found suggestive evidence that education helps improve military effectiveness in future conflicts. However, one may argue that our OLS regressions could suffer from reverse causality and/or omitted variables. For instance, a nationalist government that wants to strengthen national identity may simultaneously choose to educate its citizens to foster loyalty to the state, and create rivalries with other states to unite the nation. As another potential source of bias, a country that tries to become more internationally powerful might invest in education to increase its chances of winning future wars and subsequently feel strong enough to engage in rivalry with its neighbors. Thus, more powerful countries¹¹ may have better educated populations and engage in more rivalries, which would bias upwards the coefficient on rivalry in our OLS regressions for education. Conversely, the same OLS coefficient could be downward biased. For instance, a “weak” country may have low levels of education, and other countries might decide to threaten it creating a military rivalry.

Estimating the causal effect of military rivalry on education outcomes is thus difficult because rivalries as well as education outcomes may reflect a country’s purposeful choices and thus reflect its unobserved or unmeasured characteristics. To address this concern, in this subsection we consider another source of variation in military rivalry, namely the rivalries between the neighbors of each country. We first show reduced-form regressions of educational enrollment on this new rivalry variable. We then take the bolder step of using this variable as an instrument for our previous rivalry measure.

Neighboring Rivalry We construct a dummy variable for each country, using information on the rivalries of all its neighboring countries with third

indexes do not display enough time variation to be significantly correlated with outcome variables such as income (e.g. Acemoglu, Johnson, Robinson and Yared, 2008). Yet, we consistently find a negative and significant correlation between Polity indexes and primary schooling rates.

¹¹ “Power” depends on a series of characteristics, from economic development to internal political stability, that we cannot control for in OLS regressions and is therefore a likely source of omitted-variable bias.

countries. More precisely, for country i , *Neighboring rivalry* $_{i,t}$ is equal to 1 if in year t one of its bordering countries j is engaged in a rivalry with at least one other country k which is not contiguous to i . Importantly, we only take into account neighboring countries j and their respective rivals k that *do not* have a rivalry with country i . Hence, *Neighboring rivalry* $_{i,t}$ measures rivalries in the regional environment of country i , between countries that have no rivalries in common with i . This measure of rivalry is much less of a choice variable for country i than the rivalry measure used in the OLS regressions, which mitigates the endogeneity problem. In the data, *Neighboring rivalry* $_{i,t}$ is indeed a good predictor of the original rivalry variable, suggesting that when its regional environment (exogenously) becomes more unstable, country i as well is more likely to be engaged in a rivalry.

When it comes to sample selection, we construct the neighboring rivalry variable for the entire sample, except for countries in Western Europe and the Eastern Bloc during the Cold War.¹² We exclude these regions *a priori* because they were dominated by a series of strategic alliances driven by the United States and the USSR. Therefore, it is implausible to treat regional rivalries as exogenous. Moreover, they have limited predictive powers on individual rivalries. When running the OLS specification on this smaller sample, we find results similar to Table 2, so any differences in results we find are not driven by changes in the sample.

Reduced-form Regressions Panel A of Table 5 reports the results from reduced-form regressions. They have the same specification as our baseline regressions in Table 2, except that we replace *Rivalry* with *Neighboring rivalry* and the interaction between *Rivalry* and *Democracy* by the interaction between *Neighboring rivalry* and *Democracy*. The results are qualitatively similar to the baseline results. In particular, comparing the results in column 2 with those in column 3 of Table 2, the three central coefficients all maintain their signs and continue to be significant at the 1% level. The point estimate is higher for the rivalry variable, but lower (in absolute value) for the democracy and interaction variables.

Table 5, Panel A, about here

¹²Specifically, we exclude the years from 1950 to 1990. The results are robust to small changes in these bounds.

IV regressions In a more demanding specification, we may use *Neighboring rivalry* to instrument for *Rivalry*. This instrument may not be perfect, as a country could influence its bordering states. There is one main concern for the exclusion restriction. If country i is “weak”, countries j and k may be more likely to engage in rivalries, because they know that i will not react – but if i is “strong”, countries j and k may decide to avoid rivalries because they know i could react to stabilize the region. Such behavior would bias our IV estimates downward, i.e., we would underestimate the effect of military threats on schooling. As we shall see, however, our IV yields estimates larger than OLS, thus suggesting that rivalries do indeed have a positive and significant effect on primary enrollment rates.¹³

To run the IV specification, we also need a second instrument for the interaction term between military threats and democracy. As in the reduced-form regressions, we use the interaction of *Neighboring rivalry* with *Democracy*. A valid concern is that the interaction effect between democracy and rivalry is really capturing an interaction effect between rivalry and some other variable. Our basic IV strategy does not address this concern, but in Table W3 in the Web Appendix, we add interaction effects with other variables and show that the results are robust. As before, we treat *Democracy* as exogenous. The results are qualitatively similar when we use lagged *Democracy* instead of *Democracy*.

The standard errors in all our IV regressions are heteroskedasticity-robust. We also report various test statistics (F -test for excluded instruments, Anderson-Rubin test, Cragg-Donald Wald statistic, and Kleibergen-Paap Wald rk F -

¹³Another potential concern with regard to the exogeneity assumption would be an “entanglement effect”. If neighbor j of country i is engaged in rivalries with other countries, country i might be less concerned about war because its neighbor is entangled in potential future wars with other countries. The first-stage regressions suggest that *Neighboring rivalry* does not capture this effect since the instrument is positively correlated with *Rivalry*. One might also be concerned that neighbor rivalries are proxying for neighbor nationalism, which may be correlated with domestic nationalism. One may finally worry that neighboring rivalries reduce trade and thus domestic income. Therefore, the exclusion restriction is not perfect but we cannot think of a better identification strategy to provide additional evidence that rivalries may have a causal effect on education.

As a robustness check, we define a modified instrument: *Contiguous rivalry* $_{i,t}$ as the number of rivalries between bordering countries j and other countries k , weighted by the inverse of the distance between the capitals of countries i and j in year t . As before, we only take into account neighboring countries j and their respective rivals k that do not have a rivalry with country i . This approach yields estimates similar in magnitude to those obtained with *Neighboring rivalry*.

statistic¹⁴).

We run IV (2SLS) regressions with either one instrument and one endogenous regressor (*Rivalry*) or with two instruments and two endogenous regressors (*Rivalry* and *Rivalry·Democracy*). The results are reported in Panels B and C of Table 5. Panel B shows that the first-stage estimates have the expected signs and that the instruments are not weak. Panel C reports the second-stage estimates: the point estimate on *Rivalry* is larger than in the OLS regressions, suggesting that the OLS coefficient was biased downward¹⁵ and the interaction between *Rivalry* and *Democracy* is positive and statistically significant, with roughly the same magnitude as in the OLS regressions. Panel C presents additional test statistics, which reject weak identification. However, if we do include Western Europe and the Eastern Bloc during the Cold War in the sample, the instruments do indeed become weak.¹⁶

Table 5, Panels B and C, about here

Overall, the reduced-form results and the IV results suggest that military threats do indeed have a strong positive effect on primary enrollment.

4.5 Extensions and Robustness

In this section, we describe the results of a series of robustness checks to our baseline results. Tables with the econometric estimates underlying all these checks are available in the Web Appendix.

¹⁴Stock and Yogo (2005) derive the critical values for the Cragg-Donald Wald statistic, which is valid under homoskedasticity. The rule of thumb is to use the same critical values for the Kleibergen-Paap Wald rk F statistic, which is valid under heteroskedasticity. With one instrument, the Stock-Yogo weak ID test critical values at different maximal IV sizes are as follows: 10%: 16.38, 15%: 8.96, 20%: 6.66, With two instruments, they become: 10% : 7.03, 15%: 4.58, 20%: 3.95.

¹⁵A likely explanation for why the IV estimates are bigger than the OLS estimates is classical measurement error of the rivalry measure. Another explanation is heterogeneity in the treatment effect, since the IV coefficient yields an estimate of LATE, which may be larger than ATE.

¹⁶These regressions are reported in the Web Appendix – see Table W1. See Stock and Yogo (2005) on weak instruments and biased IV estimators.

Education Reforms Instead of the continuous enrollment measure, we analyze the effect of military threats on the probability of discrete educational reforms, based on fixed-effect logit estimation – see Table W2 (in the Web Appendix). Consider the effects of strategic rivalry on *Imputed reforms* – i.e., a 10% or higher increase in primary enrollment over a five-year period. Consistent with our predictions, a strategic rivalry raises the probability of a large increase in primary enrollment. However, we find no significant impact of the military strength of rivals. The *Democracy* score still enters negatively, and its interaction with rivalry is positive, although not statistically significant. Finally, neither population growth nor total government expenditure or military expenditure show significant coefficients when democracy is included in the regression.¹⁷

When studying the effect of military threats on *Known reforms*, which broaden access to primary or secondary education, we restrict our attention to the subsample of 14 European countries for which these data are available since 1830. The results are weaker than in the *Imputed reforms* regressions, which is not surprising with such a small number of countries. In particular, we find no effect of democracy and of its interaction with rivalry. But our main findings still hold: a significant positive effect of rivalry (or rival’s military strength) on the probability of observing a reform in primary (or secondary) education, once we control for democracy.

Industrialization and Urbanization Expansion of primary schooling and democratization are salient aspects of development. Another aspect is the transition from a rural to an industrial and urban society. This may lead democracy to be correlated with industrialization and urbanization. If an educated military is more valuable in more industrialized countries, our interaction between rivalry and democracy may pick up this effect. In addition, if industrialization relies on higher human capital, manufacturers may want to lobby for education reform (Galor et al., 2009). To address these concerns, we add measures of industrial development and their interaction with rivalry as covariates to our baseline specification. Specifically, we use the share of industrial activities in GDP (available for 1946-2000), the share

¹⁷We have also checked the sensitivity of our results to the threshold of education expansion used to define imputed reforms. Specifically, we have used thresholds of 5% and 15% expansions in the last five years, instead of 10%. The signs of the coefficients on rivalry and on the democracy score are similar to those obtained with the 10% specification, while the interaction term between rivalries and democracy is still non-significant.

of population living in cities of 50,000 or more inhabitants, and the share of population living in cities of 20,000 or more inhabitants (drawn from Banks, 2011) – see Table W3.

When doing so, our results on democracy are unchanged: the direct coefficient on *Democracy* is negative, its interaction with *Rivalry* is positive, and both are statistically significant. Moreover, as expected, more industrialized and more urbanized countries have higher rates of primary enrollment. Interestingly, we do find that enrollment responds more to military threats in countries with a larger share of industrial activities and a larger share of urban population. For a country with a *Democracy* score of 0, the estimates in Table W3 suggest that the effect of military rivalry on primary education becomes positive around a 20% share of industry, or around a 10% share of population living in cities (with lower thresholds for more democratic countries).

These findings may also shed light on the potential mechanisms behind our main result. Although we cannot test directly the three potential channels – acquisition of basic skills, group discipline, or patriotic values – the positive interaction terms between rivalries and industrialization support the skills channel. Rivalries and wars existed long before the 19th century – when group discipline or patriotism were presumably already valuable in armies – without triggering mass education reforms. But then industrialization has gone together with the development of technologies of modern warfare and more complex war strategies. These may have raised the value of educated soldiers, since an army mastering basic skills is more effective at fighting modern wars. Our results should thus be interpreted as applying primarily to the era of modern warfare.

Additional Covariates and Sample Selection We perform several other robustness tests on our baseline specification – see Table W4. We first include the index of ethnic fractionalization from Alesina et al. (2003), as well as its interaction with rivalry. Ethnic diversity has been shown to affect the amount of social spending and in particular education investment. We find that more fractionalized countries have higher enrollment rates, but the effect of rivalry on primary enrollment decreases with ethnic fractionalization. Yet, our main coefficients remain unaffected.

Then, we include the primary enrollment rate of the rival. Consistent with our intuition, countries increase their enrollment rates more when their

rivals have more educated populations, and therefore presumably more effective armies. Also, we add 10-year lagged enrollment to control for initial conditions. As expected, primary enrollment displays high serial autocorrelation, but our main coefficients of interest are unchanged. We also check that our results do not reflect an entirely European story by excluding Western Europe from the sample. Again, our results are robust to this change, and the coefficients on rivalry actually increase.

Moreover, we account for the possibility that country-specific factors may vary nonlinearly over the sample period, by interacting country fixed effects with dummies for before and after 1950. Our main results on military rivalry, democracy and their interaction do hold up.

Alternative Dependent Variable We have performed other robustness tests as well – see Table W5. One is to compare our baseline results with those obtained with an alternative measure of education, namely education attainment from the Barro-Lee (2010) data set, available at five-year intervals for the postwar period only. We run the specifications in (1), using as the dependent variable the amount of primary education achieved by adults in the 15-19 age span at year $t+5$, starting in 1950. Since education attainment is defined per person of the relevant age group, we do not need to control for population growth in these specifications. We find similar results to those in Table 2 – a (weakly) positive effect of rivalry, a negative effect of democracy, and a positive interaction term. The results are somewhat weaker with the recent occurrence of an external war as the threat variable, but the positive effect of a recent war is significant. As previously mentioned, these results are robust to the inclusion of state-specific linear time trends.

4.6 Summary of Empirical Findings

Taken together, our empirical results provide robust evidence that in the wake of increased strategic rivalry (or in reaction to past wars), countries invest more in mass education. Everything else equal, democracies invest less in primary education than do autocracies. But the interaction between democracy indicators and military rivalry appears to be positive, especially when democracy is measured by constraints on the executive.

5 A Simple Theory

In this section, we lay out a formal model in which public education plays a key role in the efficient operation of the military. The model is constructed so as to be consistent with our main empirical findings and thus helps us interpret them. In addition, the model has an auxiliary prediction, which we also confront with data.

Basic Setup The formal model we develop borrows in spirit from the state-capacity framework of Besley and Persson (2009, 2011), from the voter-participation models by Feddersen and Sandroni (2002) and Coate and Conlin (2004), and from the analysis in Ticchi and Vindigni (2009) of fighting incentives across different political regimes.

Consider a society, where population is normalized to unity and divided into two equally large and homogenous groups (with regard to education) of risk-neutral individuals, $J = I, O$. There are two time periods. Output per capita in each period – equal to total resources and the tax base – is exogenous, constant over time, normalized to $\frac{1}{2}y(e)$, and non-decreasing in the level of public education e with $y(e) = 1 + \beta e$.

All consumption takes place at the end of the second period. One of the groups serves as the incumbent in both periods (thus there is no political turnover). Among political institutions, we focus on the constraints on the executive as the empirical findings are a bit stronger for this aspect of democracy. These constraints are modeled as a share of output δ that the incumbent group, I , must grant to the opposition group, O – thus, a higher value of δ captures stronger constraints (protecting the opposition group from discretionary redistribution).

A war can occur in period 2 with exogenous probability p . For simplicity, if a war is lost all (accumulated) income perishes from the country as a whole – i.e., from both groups.

Education and the Probability of Winning The probability q of winning a war, once it has broken out, depends on individual effort choices by the members of each group in period 2. Specifically, each individual can expend a unit of effort at a utility cost, which is decreasing in the level of education e . We assume a very simple cost function $\frac{x}{e}$, where x is individual-specific

and uniformly distributed on $[0, 1]$ in each group.¹⁸ Any individual in group J follows a behavioral rule to expend his unit of effort if $\frac{x}{e} < \frac{\omega_J}{e}$. Here, ω_J is a rule set by group J members that – if followed by all other members of the group – maximizes the group's aggregate utility (in Feddersen and Sandroni's language, each individual member of group J wants to "do her part" to maximize the group's utility).

The conditional probability of winning the war depends on the shares of individuals in each group that expend effort as:

$$q = \frac{1}{\alpha} \left[\left(\int_0^{\omega_O} dx \right)^\alpha + \left(\int_0^{\omega_I} dx \right)^\alpha \right] = \frac{1}{\alpha} (\omega_O^\alpha + \omega_I^\alpha),$$

where we assume that $\alpha < 1$. This formulation assumes that (aggregate) efforts of the two groups are complements. This could be for geographical reasons: if the two groups inhabit different parts of the country's territory, effort is needed along different parts of the border. Alternatively, the two groups might represent a dominant elite from which officers are drawn and a large non-elite from which common soldiers are drawn: again, effort is needed from both groups. We see this assumption as reflecting an important distinguishing feature of the technology of modern wars – say after after 1820 – compared to those in earlier periods.

The level of public education is chosen by the incumbent group in period 1. It can augment the initial education level, normalized at zero, by investment e in education at cost $C(e) = e^\gamma$, where $\gamma > 1$. We study this choice of education below.

Timing The timing of the model is as follows

1. In period 1, the incumbent makes investment e in future education
2. At the beginning of period 2, a war with a foreign power erupts with probability p .

¹⁸We abstract from the possibility that higher primary education might also give better outside options to people who previously had no education, which in turn would tend to increase – not decrease – military costs. However, this is not a major concern to understand empirical patterns during the period that we study, since the overwhelming majority of countries in our sample enforced military conscription. Useful references on this topic include the CIA World Factbook (<https://www.cia.gov/library/publications/the-world-factbook/>) and the Office of the United Nations High Commissioner for Human Rights (http://www.nationmaster.com/graph/mil_con-military-conscription)

3. If war has erupted, members of each group choose the behavioral rule for effort choice, thus setting ω_I and ω_O . Individual members of each group observe the individual component of their effort cost x and then choose whether to expend one unit of effort at cost $\frac{x}{e}$.
4. An ongoing war is won with probability q .
5. If no war has erupted or a war has been won, the incumbent group consumes a share $1 - \delta$ of output $y(e)$, while the opposition group consumes $\delta y(e)$. After a lost war, the consumption of both groups is zero.

To analyze the model, we proceed by backward induction, starting from the effort choices at stage 3 and going back to the education choice at stage 1. For simplicity, we assume no time discounting.

Equilibrium Efforts Without a behavioral rule for effort choice, individuals would face a severe free-rider problem similar to the problem of voter participation. In our setting, individuals choose to expend effort when their utility cost is low enough. In analogy with the analyses in Feddersen and Sandroni (2002) and Coate and Conlin (2004), we assume that group members choose the behavioral rule that maximizes the expected payoff to the group: i.e., expected consumption minus the group-wide cost of effort.

Thus, group O solves

$$\max_{\omega_I} \left\{ q\delta y(e) - \left(\int_0^{\omega_O} \frac{x}{e} dx \right) \right\} = \left\{ \frac{1}{\alpha} (\omega_O^\alpha + \omega_I^\alpha) \delta y(e) - \frac{1}{e} \frac{\omega_O^2}{2} \right\},$$

taking ω_I as given, while the incumbent group's effort solves

$$\max_{\omega_I} \left\{ \frac{1}{\alpha} (\omega_O^\alpha + \omega_I^\alpha) (1 - \delta) y(e) - \frac{1}{e} \frac{\omega_I^2}{2} \right\}.$$

Simple algebra gives:

$$\omega_O = (\delta y(e) e)^{\frac{1}{2-\alpha}} \quad \text{and} \quad \omega_I = ((1 - \delta) y(e) e)^{\frac{1}{2-\alpha}}.$$

In equilibrium, the conditional probability of winning a war q becomes¹⁹:

$$q^*(e, \delta) = \frac{1}{\alpha} [ey(e)]^{\frac{\alpha}{2-\alpha}} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1 - \delta)^{\frac{\alpha}{2-\alpha}} \right]. \quad (2)$$

¹⁹Note that we are implicitly assuming an interior solution $q^* \in (0, 1)$. This in turn is guaranteed by assuming γ sufficiently large, which in turn implies that the equilibrium e is sufficiently small.

Equilibrium Education Moving back to period 1, the incumbent group chooses education investment e to

$$\max_e [(1-p) + pq^*(e, \delta)][(1-\delta)y(e) - C(e)] ,$$

where the term in the first bracket is the probability that the war is not lost, and the second bracket is the incumbent's share of output less the cost of investment. The corresponding first-order condition is:

$$C'(e) = \gamma e^{\gamma-1} = (1-p)(1-\delta)y'(e) + p(1-\delta) \frac{\partial [q^*(e, \delta)y(e)]}{\partial e} ,$$

where $y'(e) = \beta \geq 0$. Using this and (2), we obtain

$$\begin{aligned} \gamma e^{\gamma-1} &= (1-p)(1-\delta)\beta \\ &+ \frac{p(1-\delta)}{\alpha} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right] \frac{\partial}{\partial e} [e^{\frac{1}{2-\alpha}} y(e)^{\frac{3-\alpha}{2-\alpha}}]. \end{aligned} \quad (3)$$

This equation determines the equilibrium level of education e as a function of the parameters (δ, β, p) . For γ sufficiently large, the equilibrium e is sufficiently small that $q^*(e, \delta)$ lies strictly between 0 and 1, as claimed earlier.

Comparative Statics Performing comparative statics on (3) gives us:

Prediction 1 For δ sufficiently small, $\alpha < 1$, γ large enough (to avoid corners), and $\beta > 0$, equilibrium investment in education e is:

1. increasing in the risk of war, p
2. positively affected by the interaction between democracy δ and the risk of war p
3. decreasing in democracy for $p = 0$ or small.

Thus, $\frac{\partial e}{\partial p} > 0$, $\frac{\partial^2 e}{\partial p \partial \delta} > 0$, and $\frac{\partial e}{\partial \delta} \Big|_{p=0} < 0$.

Proof. Part 1 follows straightforwardly from the fact that

$$\begin{aligned} &\frac{(1-\delta)}{\alpha} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right] \frac{\partial}{\partial e} [e^{\frac{1}{2-\alpha}} y(e)^{\frac{3-\alpha}{2-\alpha}}] \\ &> > (1-\delta)\beta \end{aligned}$$

when δ is sufficiently small and $\alpha < 1$.

Part 2 follows from (3) and from the fact that $\frac{\partial}{\partial e}[e^{\frac{1}{2-\alpha}}y(e)^{\frac{3-\alpha}{2-\alpha}}] > 0$ and that:

$$\text{sign} \left(\frac{\partial^2 e}{\partial p \partial \delta} \right) = \text{sign} \left(\frac{\partial}{\partial \delta} \{(1 - \delta)E(\delta)\} \right) ,$$

where

$$E(\delta) \equiv \left[\delta^{\frac{\alpha}{2-\alpha}} + (1 - \delta)^{\frac{\alpha}{2-\alpha}} \right] .$$

But one can verify that

$$\frac{\partial}{\partial \delta} \{(1 - \delta)E(\delta)\} = -E(\delta) + (1 - \delta) \left(\frac{\alpha}{2 - \alpha} \right) \left(\delta^{\frac{\alpha}{2-\alpha}-1} - (1 - \delta)^{\frac{\alpha}{2-\alpha}-1} \right) ,$$

where the first term on the right-hand side remains bounded when $\delta \rightarrow 0$ whereas the second term becomes arbitrarily large provided $\alpha < 1$.

Finally, Part 3 follows from the fact that the right-hand side of (3) is unambiguously decreasing in δ for $p = 0$ and for $\beta > 0$. ■

Consistency with the Empirical Findings Parts 1-3 of Prediction 1 are obviously consistent with the three main findings reported in Section 4. Intuitively, democracy has a direct negative effect on the motives to invest in education, because stronger constraints on the executive reduce the incumbent's residual claim on the additional output generated by education. For the effect of war threat and the positive interaction between war threat and democracy, the intuition goes as follows. Society's income is (partly) expropriated if a war is lost to a foreign power. The probability of winning a war depends upon both the educational level and fighting efforts by members of the incumbent and opposition groups. In these circumstances, the incumbent group has stronger motives to invest in education if a war becomes more likely. Absent some executive constraints, however, opposition-group members do not benefit a great deal from the economy's resources. Therefore, they have weaker incentives to exert fighting effort than members of the incumbent group – this mechanism is similar to the one in Ticchi and Vindigni (2009). If the efforts by the incumbent and opponent groups are sufficiently complementary ($\alpha < 1$), this incentive gap may lower the prospects of winning a war to such an extent that investments in education respond less to a higher war threat in autocracies than in democracies.²⁰

²⁰Note again that the conclusions change dramatically if $\alpha = 1$. Thus our conclusions rely on the pivotal assumption that war efforts from the opposition group are indispensable: this captures war technology in the 19th century as opposed to the medieval period.

An Auxiliary Prediction The unverifiable and complementary decisions on fighting effort by the two groups drive the model's positive interaction effect between military threats and democracy. In the case of physical investments, their contribution to military success presumably depend less on such unverifiable efforts. By this logic, we can state an auxiliary prediction:

Prediction 2 *Military rivalry might affect other measures of state capacity such as infrastructure, but then the interaction between rivalry and democracy should not be significant.*

Testing Prediction 2 We confront Prediction 2 with data on the length of paved roads from Calderón and Servén (2010), which covers 97 countries over the period 1960-2000. Table 6 shows the results of estimating our main baseline specification with the yearly percentage change in the length of paved roads as the left-hand side variable. While military rivalries still drive this type of investment, we find no effect – neither directly nor through the interaction term – of the political regime on road-building.

Table 6 about here

6 Conclusion

We have argued that military rivalry is an important factor behind countries' decisions to invest in mass primary education. If anything democratization seems to have a negative direct effect on such investments, although primary enrollment appears to respond more to military threats in democracies than in autocracies.

Our approach could profitably be extended in several directions. One would be to look at the effect of military rivalry on other types of public investments, not just primary education (and road expenditure). Some preliminary regressions using Barro-Lee data on secondary-school enrollment suggest a positive correlation between this variable and military rivalry, at least when restricting attention to countries with high per-capita GDP. One could also look at how much current or past military rivalry affects future fiscal capacity following the lead of Tilly (1975) and, more recently, Besley and Persson (2009).

A second extension would be to investigate if other forms of rivalry – for example cross-country competition in product markets, or the importance of

international benchmarking, e.g., as induced by cross-country performance in PISA or Shanghai evaluations – have a similar effect as military rivalry on educational enrollment and other types of public investments.

A third extension could be to look at different types of conflicts. One could look more closely at the correlation between enrollment and past wars, and in particular to distinguish between wars won and lost. Preliminary regressions show a positive correlation between primary enrollment and both a lost war and a won war over the past 10 years, with a stronger correlation if the war was won. This finding goes against the view that past wars might favor future education investments because defeats weaken incumbent elites that might oppose mass education, though it could be linked to the scarcity of public funds if states' financial resources are more depleted after defeats than after victories.

A fourth extension would be to consider not only the size of primary enrollment, but also the governance of primary (and secondary) schools. Recent work by Algan, Cahuc and Shleifer (2013) distinguishes vertical and horizontal school pedagogy, where the former relies heavily upon taking notes from the teacher, whereas the latter involves group interactions among students. One conjecture is that primary-education reforms with their roots in military rivalry are more likely to be associated with vertical systems.

Investigating these and other extensions is left for future research.

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A Data Appendix: Strategic Rivalries

Thompson (2001) lists the following qualitative coding rules to define strategic rivalries and their duration for the period 1816-1999:

1. “Strategic rivals must be independent states, as determined by Gleditsch and Ward’s (1999) inventory of independent states.
2. Beginning and ending dates are keyed as much as possible to the timing of evidence about the onset of explicit threat, competitor, and enemy perceptions on the part of decision-makers. Historical analyses, for instance, often specify that decision-makers were unconcerned about a competitor prior to some year just as they also provide reasonably specific information about the timing of rapprochements and whether they were meaningful ones or simply tactical maneuvers. (...)

As a general rule, the competitor criterion restricts rivalries to their own class within the major-minor power distinction. Major (minor) power rivalries are most likely to involve two major (minor) powers. Definitely, there are exceptions to this rule. Major-minor power rivalries emerge when minor powers become something more than nuisances in the eyes of major power decision-makers. Capability asymmetry may still be quite pronounced but that does not mean that the major power is in a position to, or is inclined toward, the use of its capability advantage. (...)

3. No minimal duration is stipulated in advance (...)
4. Various constituencies within states may have different views about who their state’s main rivals are or should be. Unless they control the government, constituency views are not considered the same as those of the principal decisionmakers. If the principal decision-makers disagree about the identity of rivals, the operational problem then becomes one of assessing where foreign policy-making is most concentrated. (...)
5. If two states were not considered rivals prior to the outbreak of war, they do not become rivals during the war unless their rivalry extends beyond the period of war combat. This rule is designed to avoid complications in assessing the linkages between rivalry and intensive forms of conflict. (...)

6. One needs to be especially skeptical about dating rivalry terminations. Some rivalries experience short-lived and highly publicized rapprochements that turn out to be less meaningful than one might have thought from reading the relevant press accounts at the time. Some rivalries enter long periods of hibernation only to erupt suddenly as if nothing had changed. All of these situations may share the outward appearance of rivalry termination. What needs to be manifested is evidence of some explicit kind of a significant de-escalation in threat perceptions and hostility. (...)
7. The most valuable sources for information pertinent to identifying strategic rivalry are political histories of individual state's foreign policy activities."

B Tables

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Primary enrollment per 10,000	6919	1054.473	528.125	1	3023
Rivalry	6919	0.494	0.500	0	1
Relative army largest rival	6339	1.097	2.765	0	56
Relative army total rivals	6339	1.642	4.299	0	59
War in past 10 years	6919	0.159	0.366	0	1
War casualties	6919	0.055	0.337	0	7.932
Democracy	6919	-0.367	7.120	-10	10
Population growth (10 yrs)	5391	19.312	14.889	-53.650	178.522
Military expenditure (p.c.)	6175	48.257	219.301	0	7398.568
Govt expenditure (p.c.)	6342	162.459	539.483	0.310	8402.080
Income tax	4187	0.684	0.465	0	1
GDP per capita.	4150	1563.041	3543.890	18	38344.930

Note: Unbalanced panel of 137 countries over the period 1830-2001.

Table 2: Primary Enrollment and War Risk

	Primary enrollment per 10,000					
	Strategic Rivalry			War in previous 10 years		
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	54.878*** [20.388]	94.127*** [21.376]	63.369** [25.212]			
Democracy index	-6.871*** [1.277]	-17.632*** [1.603]	-17.976*** [1.695]	-7.276*** [1.266]	-6.929*** [1.328]	-6.261*** [1.345]
Rivalry*Democracy		22.276*** [2.199]	22.434*** [2.355]			
Rel. army of rivals			4.090*** [1.172]			
War in previous 10 years				101.970*** [16.581]	106.019*** [17.222]	63.784*** [17.725]
War in 10 years *Democracy					-2.736 [2.158]	-0.089 [2.117]
War casualties						32.796 [23.831]
Govt expenditure p.c.			-0.250*** [0.029]			-0.273*** [0.027]
Population growth	9.424*** [0.841]	8.814*** [0.823]	8.964*** [0.707]	9.573*** [0.836]	9.543*** [0.837]	8.878*** [0.735]
Military expenditure p.c.	-0.899*** [0.118]	-0.885*** [0.117]	-0.337* [0.188]	-0.916*** [0.115]	-0.921*** [0.113]	-0.121 [0.117]
Observations	4,626	4,626	3,985	4,626	4,626	4,297
R-squared	0.669	0.679	0.721	0.671	0.672	0.700

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. ***p<0.01, ** p<0.05, * p<0.1. In columns (1) to (3) war risk is measured by the existence of one or more strategic rivalries according to the Thompson (2001) classification. In columns (4) to (6) war risk is measured by the occurrence of a war involving the country in the previous 10 years.

Table 3: Education and Probability of Victory

	Probability of war in next 10 years		Probability of winning if war in next 10 years		Military expenditure per capita	
	(1)	(2)	(3)	(4)	(5)	(6)
	Primary enrollment per 10,000	0.001*** [0.000]	0.001*** [0.000]	0.003*** [0.000]	0.004*** [0.001]	
Democracy score	0.012 [0.013]	0.066*** [0.016]	0.054 [0.083]	-0.031 [0.045]	-3.174*** [0.317]	-3.111*** [0.564]
Rivalry	2.422*** [0.181]	2.823*** [0.227]		4.548*** [1.270]	12.057*** [3.391]	19.651*** [6.577]
Rivalry*Democracy						-0.147 [0.984]
Military expenditure p.c.		0.002*** [0.000]	-0.003 [0.002]			
Military size				0.961*** [0.120]		
Military size of rival				-0.0066** [0.003]		
Population growth		-0.038*** [0.009]			-1.214 [1.188]	-1.212 [1.199]
Observations	3,383	2,385	554	455	7,517	7,517
R-squared	0.363	0.397	0.452	0.406	0.395	0.395

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) to (4) are Logit regressions, Columns (5) and (6) are OLS regressions. In columns (1) and (2), the dependent variable is the probability of observing a war involving the country in the next 10 years. In columns (3) and (4), the sample includes only countries which experience a war outbreak in the next 10 years, and the dependent variable is the probability of winning this future war. In columns (5) and (6), the dependent variable is military expenditure per capita.

Table 4: Components of Democracy

	Primary enrollment rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	60.504*** [20.141]	-20.492 [21.620]	52.045** [20.552]	-16.601 [35.095]	53.823*** [20.385]	-65.918* [35.303]
Executive constraints	44.552*** [16.001]	-89.388*** [21.820]			54.146*** [16.052]	-74.782*** [22.007]
Executive constraints*Rivalry		245.543*** [28.146]				233.322*** [28.181]
Executive openness			-68.595*** [19.336]	-113.841*** [27.586]	-77.540*** [19.595]	-93.790*** [27.804]
Executive openness*Rivalry				85.245** [33.742]		54.468 [33.297]
Population growth	9.145*** [0.825]	8.561*** [0.811]	9.254*** [0.834]	9.235*** [0.833]	9.177*** [0.830]	8.605*** [0.817]
Military expenditure p.c.	-0.873*** [0.116]	-0.871*** [0.116]	-0.882*** [0.117]	-0.878*** [0.116]	-0.869*** [0.116]	-0.865*** [0.116]
Observations	4,626	4,626	4,626	4,626	4,626	4,626
R-squared	0.667	0.673	0.667	0.668	0.668	0.675

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. ***p<0.01, ** p<0.05, * p<0.1. "Executive constraints" is equal to 1 if xconst is greater than or equal to 4 in the Polity IV database, and 0 otherwise. "Executive openness" is equal to 1 if xopen is greater than or equal to 3 in the Polity IV database, and 0 otherwise.

Table 5: Rivalries in Neighboring Countries
 Panel A: Reduced-form Regressions

2nd Stage	Primary enrollment rate	
	(1)	(2)
Neighboring rivalry	109.976*** [23.43]	100.629*** [23.28]
Neighboring rivalry*Democracy		8.676*** [2.33]
Democracy	-2.031 [1.352]	-8.748*** [2.317]
Government expenditure (p.c.)	-0.286*** [0.028]	-0.277*** [0.028]
Population growth	7.091*** [0.644]	6.941*** [0.641]
Military expenditure (p.c.)	-0.080 [0.114]	0.074 [0.113]
Observations	3,760	3,760
Country Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Rivalries in Neighboring Countries
Panel B: First-Stage Regressions

1st Stage	Rivalry (1)	Rivalry (2)	Rivalry*Democracy (3)
Neighboring rivalry	0.131*** [0.024]	0.129*** [0.024]	-0.461* [0.249]
Neighboring rivalry*Democracy		0.0028 [0.002]	0.305*** [0.025]
Democracy	-0.002* [0.001]	-0.003* [0.002]	0.276*** [0.024]
Government expenditure (p.c.)	0.000 [0.000]	0.000 [0.000]	-0.000 [0.000]
Population growth	-0.000 [0.000]	-0.000 [0.000]	0.024*** [0.004]
Military expenditure (p.c)	0.0001*** [0.000]	0.0001** [0.000]	0.001 [0.000]
Excluded Instruments	Neighboring rivalry	Neighboring rivalry Neigh. rivalry*Democracy	Neighboring rivalry Neigh. rivalry*Democracy
F-statistic of Excluded Instruments	31.10	17.04	76.26
Observations	3,760	3,760	3,760
Country Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
R-squared	0.838	0.838	0.839

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. For country i , $Neighboring\ rivalry_{i,t}$ is equal to 1 if in year t one of its bordering countries j is engaged in a rivalry with at least one other country k which is not contiguous to i . The sample excludes Western Europe and the Eastern bloc during the Cold War.

Table 5: Rivalries in Neighboring Countries
Panel C: Second Stage Regressions

2nd Stage	Primary enrollment rate	
	(1)	(2)
Rivalry	837.144*** [221.008]	860.127*** [220.624]
Democracy	-0.353 [1.512]	-12.020*** [4.525]
Rivalry*Democracy		22.871*** [8.376]
Government expenditure (p.c.)	-0.302*** [0.028]	-0.292*** [0.028]
Population growth	7.135*** [0.700]	6.460*** [0.736]
Military expenditure (p.c.)	-0.014 [0.127]	-0.035 [0.129]
Endogenous Regressors	Rivalry	Rivalry Rivalry*Democracy
Instruments	Neighboring rivalry	Neighboring rivalry Neighboring rivalry*Democracy
Anderson-Rubin Wald test	23.86	37.60
Cragg-Donald Wald F statistic	62.154	30.190
Kleibergen-Paap Wald rk F statistic	31.100	14.652
Observations	3,760	3,760
Country Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. The sample excludes Western Europe and the Eastern bloc during the Cold War.

Table 6: Road Investments, Rivalry and Democracy

	% change in length of paved roads			
	(1)	(2)	(3)	(4)
Rivalry	1.856** [0.859]	1.801** [0.853]	1.732** [0.862]	1.879** [0.861]
Democracy		0.035 [0.053]	0.059 [0.068]	0.034 [0.071]
Rivalry*Democracy			-0.051 [0.089]	-0.048 [0.090]
Real GDP				4.149* [2.465]
Military expenditure (p.c.)	0.003 [0.002]	0.004** [0.002]	0.004** [0.002]	0.005* [0.003]
Observations	9113	8283	8283	6914
R-squared	0.451	0.442	0.442	0.684

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

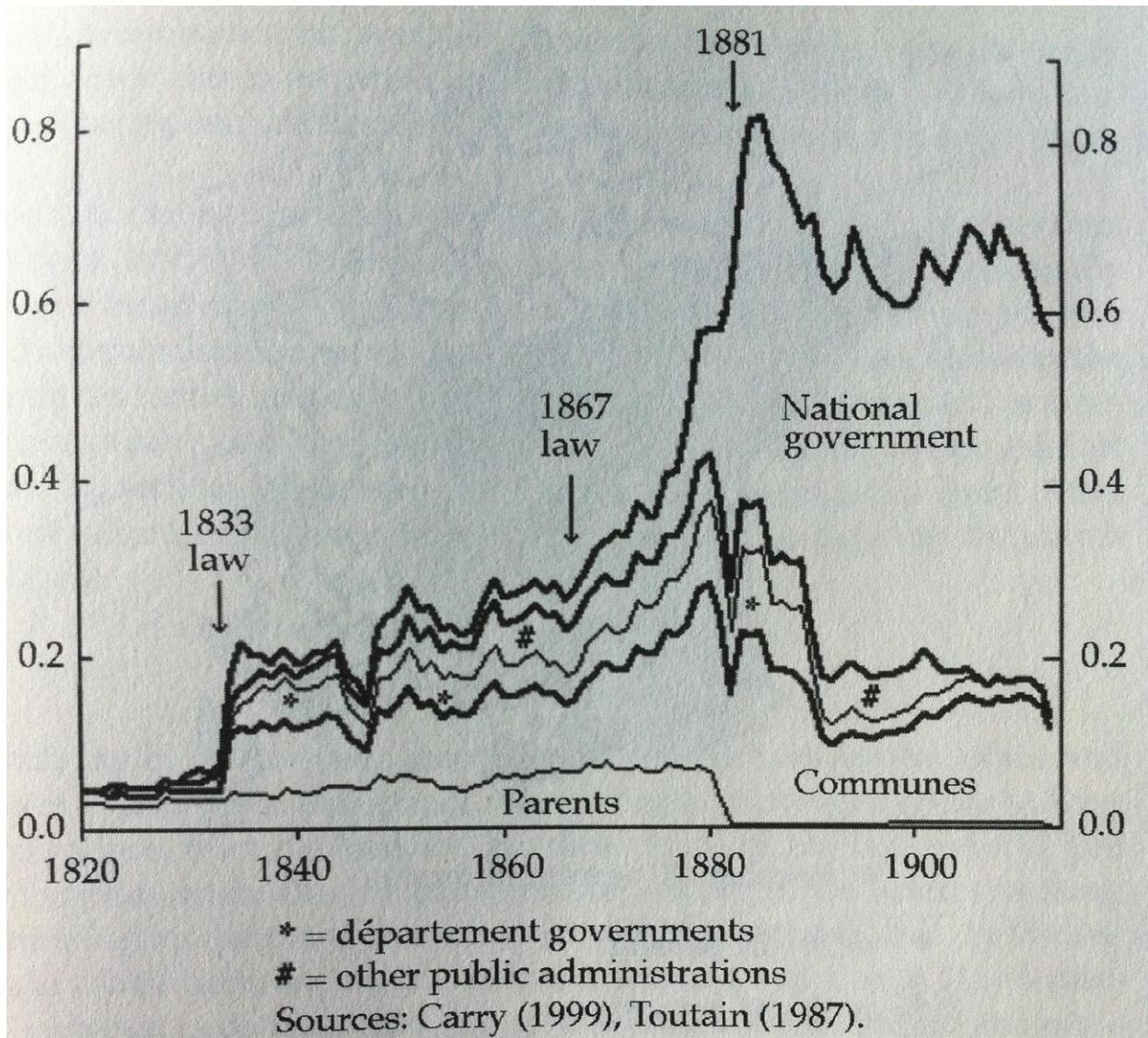


FIGURE 1