

EDUCATION AND MILITARY RIVALRY

Philippe Aghion

College de France, London School of Economics, and CIFAR

Xavier Jaravel

London School of Economics

Torsten Persson

IIES (Stockholm University) and CIFAR

Dorothee Rouzet

OECD

Abstract

What makes countries engage in reforms of mass education? Motivated by historical evidence on the relation between military threats and expansions of primary education, we assemble a panel dataset from the last 150 years in European countries and from the postwar period in a large set of countries. We uncover three stylized facts: (i) investments in education are associated with military threats, (ii) democratic institutions are negatively correlated with education investments, and (iii) education investments respond more strongly to military threats in democracies. These patterns continue to hold when we exploit rivalries in a country's neighborhood as an alternative source of variation. We develop a theoretical model that rationalizes the three empirical findings. The model has an additional prediction about investments in physical infrastructures, which finds support in the data. (JEL: N30, N40, I20, H56)

1. Introduction

Why do countries engage in reforms of mass education? In a common view, such investments are the flipside of democratic transitions: autocracies deny the masses educational access to secure the power of the ruling elite, whereas democracies—with a wider franchise or open electoral competition—promote mass education. At

The editor in charge of this paper was Nicola Gennaioli.

Acknowledgments: We are grateful to Daron Acemoglu, Roland Benabou, Tim Besley, Nick Bloom, Oded Galor, Claudia Goldin, Oliver Hart, Elhanan Helpman, Bengt Holmstrom, Kalina Manova, Nathan Nunn, Francesco Trebbi, Hans-Joachim Voth, Fabrizio Zilibotti, and particularly to Joel Moky and the editor and referees of this journal, for their precious help and suggestions. We also thank seminar participants at Harvard, Brown, Stanford GSB, IIES, Toulouse School of Economics, the College de France, and a Canadian Institute for Advanced Research (CIFAR) program meeting for useful comments. Financial support from the ERC and the Torsten and Ragnar Söderberg Foundation is gratefully acknowledged.

E-mail: paghion@fas.harvard.edu (Aghion); x.jaravel@lse.ac.uk (Jaravel); Torsten.Persson@iies.su.se (Persson); dorothee.rouzet@oecd.org (Rouzet)

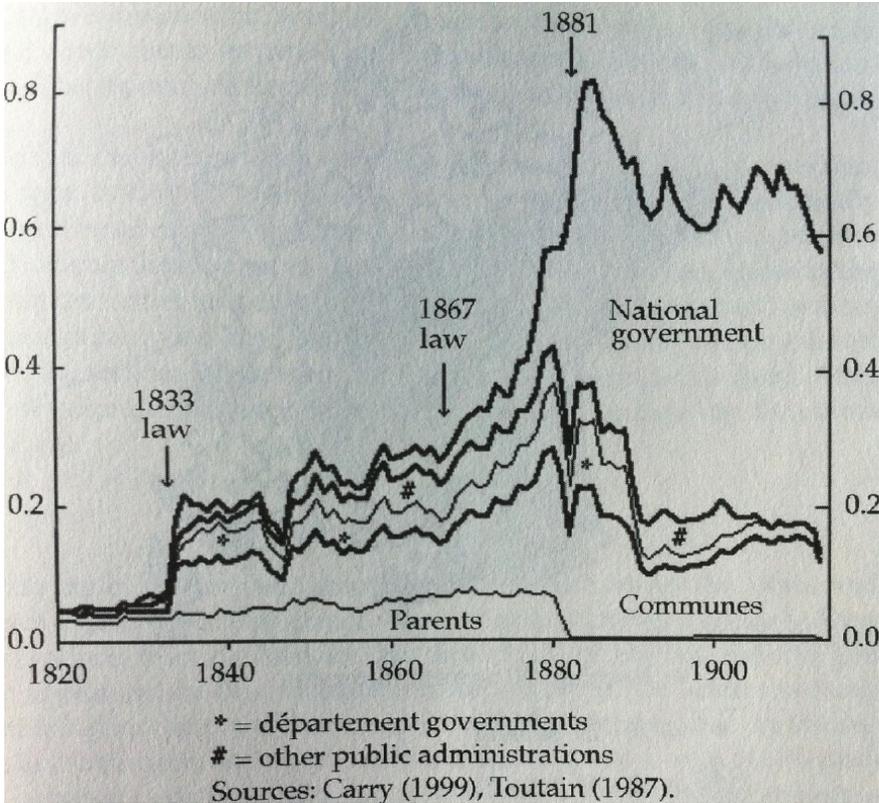


FIGURE 1. Contributions to primary school education in France over time (reproduced from Lindert 2004).

a first glance, this explanation may seem to account for the history of educational reforms in Europe. In France, for example, Figure 1 (from Lindert 2004) suggests that public contributions to primary-school education rose sharply in 1880 once the Second Empire had given way to the Third Republic, clearly a move toward greater democracy.

However, another dramatic event precipitated the fall of the Second Empire, namely France's defeat against Germany in the 1870 Battle of Sedan. In Lindert's words:

"The resounding defeat by Prussia tipped the scales in favor of the education reformers. Enrollments and expenditures accelerated across the 1870s [...]. 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 and largely illiterate population that spoke a multiplicity of dialects was to be transformed into a unified people with common patriotic values, a spoken and written language, a set of moral principles, and a motivation and ability to defend France in future conflicts.¹

This paper studies historical panel data on education spending and enrollment—for European countries since the 19th century, and a much larger sample in the second half of the 20th century—to assess the correlation between military threats and primary education. Standard panel regressions with country and year fixed effects yield three stylized facts. First, primary-education enrollments are positively and significantly associated with military rivalry or recent involvement in an external war. Second, the correlation between democracy (gauged by the Polity IV index) and education investments is negative when we control for military rivalry. Third, the interaction between democracy and military rivalry is typically positively and significantly associated with education. We note that these results are no longer statistically significant when we cluster standard errors by country over the entire panel, an issue that we examine in detail in Section 4.²

Similar empirical patterns hold when considering rivalries between a country's bordering neighbors and third countries as an alternative source of variation (a country is more likely to perceive military threats when military rivalries are rife in its neighborhood). In particular, regressing a country's primary education on the rivalries among its neighbors yields qualitatively similar results to those with direct rivalries as the independent variable. Our main contribution is to unveil these new stylized facts.

The second contribution of the paper is to develop a simple model of state investment in education, which rationalizes our findings on how educational investments relate to military rivalry, democracy, and the interaction between war threat and democracy. In this model, the probability of winning a prospective war depends upon on the educational level and on the fighting efforts by members of an incumbent as well as an opposition group. Then, the incumbent group has stronger motives to invest in education when war becomes more likely. Absent democracy, however, opposition-group members have weaker incentives to fight than incumbent-group members, as the former cannot claim much of the economic returns from winning the war. If the efforts by the incumbent and opponent groups are sufficiently complementary, this incentive gap may lower the gains from winning a war in autocracy so much that education responds less to war threats than in a democracy.³

1. As 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".

2. The first stylized fact, on the positive correlation between military rivalry and primary enrollment, is robust to clustering over long subperiods.

3. In particular, the model helps understand what is specific to educational investments: namely, that the interaction between rivalry and democracy significantly affects educational investment as opposed to other measures of state capacity such as infrastructure. The contrast between educational investment and infrastructure is shown in Table 7.

Our paper speaks to, at least, three strands of research. On education and democracy, Lott (1999) suggests that nondemocracies could invest more than democracies in public education as a means of indoctrination. But Glaeser et al. (2007) argue that education and democracy should be positively correlated, as civic participation—needed for democratization—is positively related to education. But the empirical evidence on the relation between education and democracy is mixed. Thus, the cross-country evidence of Mulligan et al. (2004) suggests that more democratic countries do not have higher public-education spending.

More recently, Murtin and Wacziarg (2014) find that education fosters democratization, but no relationship from the political regime to education attainment. Bursztyn (2016) shows that poor voters in Brazil prefer immediate income from cash transfers to higher public primary education. Bourguignon and Verdier (2000) develop a model where a ruling class sometimes invests in education although schooling enhances political participation. Galor and Moav (2006) and Galor et al. (2009) theoretically argue that capital accumulation makes skilled labor more important in production and therefore generates ruling-class support for human-capital investments, whereas more concentrated land ownership typically discourages such investments. In data for 27 countries and 70 years from 1870, Ansell and Lindvall (2013) find that observed educational reforms reflect 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 literature asks how wars might shape political or economic outcomes. Motivated by earlier research in political science and sociology, such as Giddens (1985) and Dolman (2004), Ticchi and Vindigni (2008) theoretically show how international conflict may trigger democratic transitions. Research on the economic impact of wars starts with Anderton and Carter (2001), Blomberg and Hess (2006), and Glick and Taylor (2010). More recent work by Martin et al. (2008a,b) and Acemoglu and Yared (2010), evaluates whether wars reduce trade. However, this research does not generally investigate the links between wars and investment in education.

In a third strand of work on state capacity, Hintze (1975) and Tilly (1975) argue that historically wars were important for state building. Besley and Persson (2011) summarize more recent work that considers theoretically investments in fiscal and legal capacity, and find positive correlations between past wars and current state capacity in international panel data. Thies (2004) uses the same measure as we do to show that military rivalries raise fiscal capacity in postcolonial developing states. Scheve and Stasavage (2012) study wars, democracy, and estate taxation in about 20 countries since 1816 and find that democracies do not systematically influence top rates of estate taxation, whereas wars with mass mobilizations do. Analogously, we find a correlation between educational reforms and past wars or military rivalry, while the correlation between wars and democracy is more tenuous. In addition, we find that military rivalries affect educational investments more in democracies. In contrast to this literature, we treat state capacity as exogenous, both in the theory part and in our empirical analysis.

More recently, Alesina and Reich (2015) ask how policies of nation-building, including education, can help homogenize the population. They point at a soft channel, facilitating communication among citizens with different local languages and cultures, and a coercive channel, prohibiting local cultures. Alesina and Reich argue that democracies and nondemocracies differ in both how much they invest in homogenization and how much they use the coercive channel. But they do not link policies of nation building to military threats or their interplay with democracy.

Finally, to explain state-building in Europe after 1500, Gennaioli and Voth (2015) develop a model that links the centralization of tax collection to the importance of money for winning a war. Money became more important after 1500 with the introduction of gunpowder (calling for stronger fortifications) and standing armies with firearms. Although we also emphasize the relationship between military rivalry and state investments, our emphasis is on the relationship between education investments and the interaction between military rivalry and democracy.

Our paper is organized as follows. Section 2 describes three historical examples of the relation between military rivalry and education reforms. Section 3 introduces our panel data, descriptive statistics, and empirical specifications. Section 4 presents econometric results and discusses their robustness to a variety of factual and statistical concerns. Section 5 spells out a theoretical model consistent with our three empirical findings—an auxiliary prediction of the model also finds support in the data. Section 6 concludes.

2. Lessons from History

The historical examples of France, Japan, and China over the 19th century illustrate how military threats can spur educational reforms. Moreover, Japan and especially China illustrate how military threats may dominate democracy in the reform process. A comparison between France and China suggests that the effect of military threat on education may be enhanced by democracy. In each example, we give a background on the historical context and debate in a volatile international environment, on the subsequent process of education reforms, and on outcomes especially for primary enrollment.

2.1. Jules Ferry's France

Background and Debate. In 1870, public expenditures on education in France were lagging behind those in Prussia and other European countries. In its mainly private and largely religious schools, teaching was done by a priest or anyone who knew how to read, often in an improvised poor-amenity classroom in a farm backyard. A large fraction of registered children never attended school, which resulted in a population where many were unable to understand the content of a simple text. In 1863, about a fifth of this population (7.5 million citizens) spoke only local dialects.

Even prior to the Prussian war, elites knew that French education had failed to promote national unity. Appointed Minister of Education in 1863 by Napoleon III, Victor Duruy 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. But as he did not manage to gather enough political support especially from a rural population heavily influenced by the Church, the emperor let his minister's proposal 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. Conservatives and the church saw Sedan as a punishment for France's infidelity to its traditions, whereas progressives saw it as a reflection of superior Prussian schools and universities. 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 French education had to be reformed, not only to increase literacy, but also to give new generations basic knowledge in arithmetic, 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 promote the unity of the classes. Since France no longer enjoyed religious unity, it must forge a new moral unity from a unified education” (Moody 1978, p. 88).

The Reform Process. Jules Ferry became Minister of Education in February 1879. His reforms—the so-called “Laic Laws”, which still characterize French education—came in rapid sequence: in 1881, all tuition fees in public elementary schools were abolished; the next year, enrollment became compulsory from age six to thirteen; in 1883, it became mandatory for every village with more than twenty children at school age to host a public elementary school; 2 years later subsidies were introduced to the building and maintenance of schools and to paying teachers; and in 1886, an elementary teaching program was introduced, together with monitoring provisions. At the same time, a complementary program—the Freycinet plan—was to facilitate school access. 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 programs aimed at conveying patriotic values to new generations.⁴ 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 statistics⁵ attest that school attendance rose substantively in the decade after 1882. Primary enrollment rates went up from 12% of the population in 1870 to over 14% in 1912. Literacy rates rose from 80% in 1870 to 96% in 1912 (the initial 80% figure is overstated, 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,

“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).

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 had been ruled by military lords (*shoguns*) of the Tokugawa dynasty. Education was a privilege of the Samurais and centered on tradition and the study of Confucian classics. In the mid-1850s, 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. Continued western threats toward 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

4. As 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).

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

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 the new Emperor Meiji to announce an “imperial restoration”.

This coup d’Etat was followed by a debate about education, where some wanted to preserve the focus on Confucian classics to maintain hierarchical relations and traditional customs, whereas others wanted to introduce Western science and rationalistic thought to modernize the Japanese society. The Western-oriented progressives eventually prevailed. 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. Meiji era leaders thus decided on profound education reforms 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 concluded that an ignorant populace would be a greater danger to their project to build political and economic power. 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 urgent 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 2009, p. 314).

In 1872, a new system introduced 4 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.

Over time, however, the reforms became a resounding success. Japan overtook most European powers with regard to primary enrollment, 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.⁶

The educational 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 further illustrates how education reform occur as a result of strategic military concerns. The Japanese 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 or delay the effectiveness of educational reforms.

2.3. *China and the Hundred Days’ Reform*

Background and Debate. 19th century China offers another illustration how a military threat can prompt educational reforms. But it also shows the fragility of such reforms in the absence of democracy, and the complementary roles of military rivalry and democracy in fostering educational enrollment. Throughout the 19th century, China debated how to reform its education system (notably its civil-service examination) and incorporate modern science into traditional curriculums. The hope was that this would give China the power to stand up to Western colonizers. This debate culminated during the Hundred Days’ Reform, although it was eventually abandoned.

In the first half of the 19th century, the geopolitical situation of China was similar to that of Japan. The Middle Kingdom was forced to open itself to Western powers. The Opium wars of 1839–1842 and 1856–1860 and the destruction of the old Summer Palace by British and French troops in 1860 attest to the delicate situation of China. Several Chinese officials advocated adopting Western military technology and armament, and consequently an educational shift from the study of Confucian classics to modern science. But such a reform would threaten the established order—for centuries, the civil service examination had been based on the teachings of Confucius, ensuring a ruling elite with a conservative world view. The elites knew that reforming

6. See Gordon (2000) and Duke (2009).

education might result in “losing the soul of China” with ensuing changes of the existing social hierarchy.

Two Steps of Reform. The Chinese elite pushed only gradually for educational reform. First, it argued that Western military technology could be mastered by establishing shipyards and arsenals and by hiring foreign advisers. The Arsenal schools established in the 1860s by the Qing government provided applied training in Western science and engineering and produced Chinese-language translations of important books in the natural and applied sciences (see Cantoni and Yuchtman 2013). These reforms were part of the “self-strengthening movement”, which held that China would learn from, catch up with, and finally surpass the foreigners.

This belief was challenged by the unexpected defeat to Japan in 1895. It seemed that China needed more than “self-strengthening” and the young Guangxu Emperor ordered a series of reforms to bring about sweeping social and institutional changes—a famous episode of Chinese history known as the Hundred Days’ Reform. His advisers Kang Yuwai and Liang Qichao recommended a second stage of educational reforms, with the creation of a “national-school system” that would grant degrees and replace the Imperial examination system. Consequently, the Imperial University, also known as Peking (Beida) University, was founded in 1898. With a curriculum geared toward the sciences, this university was bound to have large repercussions on the whole education system: “This was not merely to be a university located in the capital, but the Imperial university, the new creator of intellectual standards and norms, the ultimate and official authority that trumped all education experiments at the local level” (Karl and Zarrow 2002, p. 110).⁷

Partial Undoing of Reforms. A coup d’Etat was staged by conservative opponents led by Empress Dowager Cixi in September 1898. The radical reformers were executed or forced into exile and the Empress overturned the ambitious reforms, with one significant exception. Peking University survived the coup, although with a modified curriculum: the pluralistic approach was limited, imperial edicts would be studied more, Empress Dowager’s and Emperor Guangxu’s birthdays would be observed, and so forth. In short, the advisers of the Empress designed “an institutional practice in which ritual observance of political loyalty played a central role” and “the Qing dynasty rose ever more prominently into the sacred space they had formerly dominated” (Karl and Zarrow 2002, p. 117). Although the Guangxu reforms were overturned, they still served as a basis for new reforms a few years later, including the 1905 suppression of the Imperial examination system.

7. There was no doubt that “Liang Qichao’s reform for the Imperial University proved terribly threatening to the conservative powers that be, who were unwilling to countenance the idea that the Chinese intellectual tradition, and by extension the source of their own power, was anything but sacred in nature” (Karl and Zarrow 2002, p. 113).

2.4. *Summing Up*

The historical evidence from France, Japan and China illustrate how military concerns may drive purposeful reforms in primary education. Moreover, contrasting the examples of France with that of Japan and (especially) China, suggests that the reforms 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 and China, even if they eventually had a larger effect on Japanese education. To further explore this issue, we look for interactions between democracy and military rivalry in the data.

A positive relationship between military rivalry and primary enrollments could reflect different objectives of rulers, including 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. A positive effect of military rivalry on primary enrollment may also reflect the evolution of military technology. Rivalries and wars had existed a long time without inducing mass education reforms, but in the 19th century industrialization brought modern-warfare technologies and more complex war strategies that raised the value of educated soldiers. Our empirical analysis will indeed show that the positive correlation between military rivalry and education enrollment applies only to countries beyond a minimum-threshold level of industrialization.

3. Data and Empirical Specifications

3.1. *Sources and Variable Definitions*

Education. To empirically investigate mass-education reforms, we use an unbalanced panel with annual data for 166 countries between 1830 and 2010. Our main dependent variable, $Enrollment_{i,t}$, measures primary enrollment per 10,000 inhabitants in country i and year t , following the standard UNESCO convention. The data are drawn from the CNTS Data Archive of Banks (2011). Our baseline regressions 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. To mitigate such effects, we control for population growth in the past 10 years. As shown 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 education reforms that discretely expand access to primary education.⁸

8. Reform 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

TABLE 1. Summary statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Primary enrollment per 10,000	7125	1048.971	534.812	1	3168
Rivalry	4995	0.713	0.453	0	1
War in past 10 years	7258	0.147	0.354	0	1
At war	6738	0.047	0.211	0	1
Democracy	7222	-0.377	7.111	-10	10
Openness of executive	6973	3.235	1.388	0	4
Constraints on executive	6973	3.906	2.385	1	7
Population growth (10 years)	4972	19.381	15.216	-60.424	207.327
Military expenditure (p.c.) (1)	7258	0.114	0.350	0	5.314
Military expenditure (p.c.) (2)	7258	41.652	203.051	0	7398.568
Military expenditure / GDP	4245	4.232	5.864	0	140.782
Military exp. / Government exp.	4895	22.744	24.147	0	409.671
Urbanization (100,000)	7219	14.278	13.779	0	100
Urbanization (50,000)	6559	18.040	16.474	0	384.7
Urbanization (20,000)	6314	24.852	18.500	0	122.6
Industry share of GDP	3880	26.657	14.213	0	85
Ethnic fractionalization	6907	39.741	25.306	0	93.017

Notes: Unbalanced panel of 137 countries over the period 1830–2001. Military expenditures per capita measured (1) in pounds before 1914 (set to zero after 1914), (2) in dollars after 1914 (set to zero before 1914).

War Threats. We measure war risk and military threats in two alternative ways. As in Jules Ferry's France and Meji-era Japan, a recent external conflict may raise the perceived likelihood of a new conflict and the salience of military concerns in policy decisions. *Recent war* $_{i,t}$ is a binary indicator set equal to one if country i had 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 a country from the sample in years of war, since an ongoing war—as opposed to a latent rivalry—may severely increase the opportunity cost of public funds. Moreover, data in times of war are likely to be unreliable.

This backward-looking measure of war risk will miss emerging threats without a history of militarized conflict. 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) and Colaresi et al. (2010). Rivalry captures the risk of

the previous 5-year period. When analyzing imputed reforms, we collapse the data into 5-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 1830–1975), 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.

armed conflict with a country of significant relative size and military strength, based on contemporary 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) competitors;⁹ (b) a source of actual or latent threats that pose some possibility of becoming militarized; (c) enemies” (see the Appendix for details).¹⁰ 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 Recent war variable. The two are positively correlated, but less than perfectly so: 15% of country-year observations in our sample are associated with a war in the previous 10 years, whereas over 70% are associated with one or more strategic rivalries. The sample for strategic rivalries is smaller, however, as it only includes countries experiencing a rivalry at some point in their history since 1830—our estimation therefore draws on within-country variation over time in rivalries and enrollment. In the strategic-rivalries sample, a war had materialized in the previous 10 years in 23% of all country-years.

Political Regimes. For political regimes, 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. 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.

Covariates. Finally, our regressions include a number of other covariates. Two of these are military expenditures and total population, drawn from the COW National

9. “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).

10. To our knowledge, the collection of data and coding of qualitative information conducted by Thompson (2001) and Colaresi et al. (2010) is the most rigorous and comprehensive on rivalries to date.

Material Capabilities with additional data from the World Development Indicators (for the post-1960 period) and CNTS. As there is a break in the series in 1914, we include pre- and post-1914 military expenditures separately. Urbanization rates are drawn from the same sources and measure the share of population living in cities of over 100,000 inhabitants in our baseline regressions. We test the robustness of our results to thresholds of 50,000 and 20,000 inhabitants. Measures of GDP and government expenditures (per capita) are from the World Development Indicators and CNTS databases. Other covariates used in robustness checks are introduced in context in what follows.

3.2. Empirical Specifications

Our preferred econometric specification, used to unveil our stylized facts, is as follows:

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

where the variables multiplying α_1 to α_3 were introduced in the previous section. 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 previously, war risk means either at least one strategic rival in year t —or a war in the past 10 years (i.e., between years $t - 10$ and $t - 1$). Our expectation is that α_1 should be positive, whereas we are more agnostic about the signs of α_2 and α_3 .

We include a set of control variables $X_{i,t}$, country fixed effects v_i , and year fixed effects δ_t . Hence, the associations we estimate are identified from time variation within countries of the right-hand side variables relative to their world average levels. Our baseline regressions results report heteroskedasticity-robust standard errors.

After presenting the results from our preferred specification, we implement a series of robustness tests, considering alternative inference methods, dependent variables, controls, and samples. In particular, our three stylized facts on the relationship between education, military rivalry, and democracy are no longer statistically significant when we cluster standard errors by country over the full length of the panel, an issue that we investigate in detail in Section 4.5.

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, military expenditure per capita to control for education being crowded out

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	160.321*** (21.755)	180.098*** (23.313)	101.704*** (24.567)			
Democracy	-2.876* (1.477)	-13.076*** (2.284)	-7.776*** (2.484)	-7.523*** (1.300)	-7.861*** (1.336)	-4.881*** (1.463)
Rivalry × Democracy		15.616*** (2.500)	1.961 (2.407)			
Rel. army of rivals			2.083** (0.950)			
War in previous 10 years				75.808*** (16.900)	73.778*** (17.328)	98.977*** (16.145)
War in 10 years ×Democracy					2.313 (2.024)	-3.295* (1.814)
War casualties						0.204* (0.114)
Urbanization	12.446*** (1.322)	11.902*** (1.279)	10.923*** (1.480)	16.554*** (1.102)	16.628*** (1.107)	11.672*** (1.045)
Population growth	8.160*** (1.143)	8.118*** (1.116)	4.604*** (0.921)	6.775*** (0.808)	6.789*** (0.802)	4.768*** (0.719)
Military expenditure p.c. before 1914	189.300*** (66.703)	178.482*** (64.325)	209.813*** (65.444)	218.766*** (63.822)	218.344*** (63.671)	225.617*** (44.397)
Military expenditure p.c. after 1914	-0.739*** (0.126)	-0.726*** (0.125)	-0.317*** (0.093)	-0.891*** (0.129)	-0.886*** (0.129)	-0.389*** (0.080)
Govt expenditure/GDP			-0.116 (0.392)			0.416 (0.352)
Observations	3140	3140	1830	4364	4364	2948
R-squared	0.762	0.767	0.856	0.738	0.738	0.824

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

by military spending, and urbanization rates to net out the impact of modernization in general and higher concentration of schools in cities. Indeed, we find that high population growth rates and high urbanization rates are consistently associated with higher primary enrollments, whereas military spending—holding constant external threats—has a positive coefficient before 1914 but a negative coefficient afterward. An interpretation of this pattern could be that military and education spending were separate facets of state-building in the earlier period, whereas beyond a certain level limited fiscal capacity restricts the education investments if more effort is devoted to building an army.

In columns (1) through (3), military threats are gauged by ongoing military rivalries. Column (1) shows that primary enrollment is positively and significantly associated with military rivalries. The point estimate is sizeable: almost a third of the standard deviation in primary enrollment. Interestingly, the coefficient on the democracy score

is negative and 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 positively related to democracy. The coefficient on military rivalry is stable when we control for the political regime. This appears to contradict the idea that rivalries only matter insofar as they foster political change so democratization expands primary enrollment.¹¹ In column (2), our baseline specification, we add an interaction term and find that primary enrollment is more positively associated with military threats in democracies than in autocracies. The coefficient implies that being engaged in a strategic rivalry is associated with additional primary enrollment of 0.9% (of the population) in an autocracy with a Polity score of -6 (the 33rd percentile of the distribution), but of 2.3% in a democracy with a Polity score of 3 (the 67th percentile). We further investigate the democracy results in Section 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 of 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 in a reduced sample that does not cover the earlier period. Our main results are unchanged, namely the presence of a strategic rival is associated with higher enrollment in primary education, and democracies have less primary education. 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 versus Rivalries. Columns (4)–(6) of Table 2 present the same set of regressions, except that we replace military rivalry by war in the past 10 years. Primary enrollment is positively correlated with a past war. Also, consistent with the results in columns (1)–(3), autocracies invest more in education than democracies. However the interaction term is insignificant or only marginally significant 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. Two plausibility checks support this narrative according to the results in Table 3.

11. This is consistent with Murtin and Wacziarg (2014) who find no causal relationship from democracy to primary schooling when they control for the level of development with GDP per capita and average education of the population. Murtin and Wacziarg however find a link from education to democratization. Although our model is agnostic about this direction of causality, it is not inconsistent with it.

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 /GDP / Govt exp.	
	(1)	(2)	(3)	(4)	(5)	(6)
Primary enrollment per 100	0.011*** (0.002)	0.014*** (0.002)	0.044*** (0.006)	0.046*** (0.007)		
Democracy	-0.002 (0.001)	0.001 (0.001)	-0.015*** (0.004)	-0.017*** (0.004)	-0.168*** (0.036)	-0.179 (0.161)
Rivalry	0.146*** (0.015)	0.177*** (0.020)		0.012 (0.056)	0.573* (0.317)	8.021*** (1.654)
Rivalry × Democracy					0.115*** (0.038)	0.297* (0.173)
Urbanization		-0.001 (0.001)	-0.006* (0.003)	-0.006 (0.004)	0.014 (0.019)	-0.129* (0.076)
Population growth		-0.001** (0.001)			0.053*** (0.019)	0.011 (0.043)
Military expenditure p.c. before 1914		-0.053** (0.026)	-0.492*** (0.090)	-0.502*** (0.091)		
Military expenditure p.c. after 1914		0.000 (0.000)	-0.001*** (0.000)	-0.001** (0.000)		
Military size/Population				-3.702 (3.005)		
At war					1.470** (0.577)	6.885 (4.260)
Observations	4489	3140	817	715	2028	2321
R-squared	0.353	0.391	0.813	0.804	0.599	0.452

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. 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 that experience a war outbreak in the next 10 years, and the dependent variable is the probability of winning this future war. Primary enrollment is defined per 100 inhabitants (instead of per 10,000 inhabitants) for this table only. In columns (5) and (6), the dependent variable is military expenditure as a share of GDP and of total government expenditure, respectively. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Education as a Means to Win Future Wars. Our first check concerns the relations between education, rivalries and future wars. The first four columns of Table 3 show the results of fixed-effects, linear probability regressions. In columns (1) and (2), the dependent variable is a binary indicator for breakout 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 raise education investments. Surprisingly, military expenditures are not higher in the run-up to a war once we control for rivalry.

Next, our dependent variable is an indicator for *winning* the next war, conditional on 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. 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 to that in column (3). 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 as a ratio of either GDP or total government expenditure 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 correlation with strategic rivalries, which is higher in democratic countries.

4.3. *The Political Regime*

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

Possible Channels. Political institutions may affect education along several channels. Extending the franchise might foster pro-poor policies, including publicly funded primary schooling, but we find little evidence supporting this hypothesis. Second, democratically elected leaders have higher turnover—and thus shorter expected time horizons—than autocrats, which may make the former less willing to invest in mass-education policies with mainly long-term benefits. Third, there may be an indirect effect: 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 toward mass education. Even if more schooling would raise the risk of autocratic leaders being ousted, the long gestation lags in education may push this threat so far into the future that it does not affect their current behavior.

Disaggregating Democracy. 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,

TABLE 4. Components of democracy.

	Primary enrollment rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	145.728*** (21.904)	205.438*** (37.383)	165.214*** (21.386)	108.479*** (22.227)	140.131*** (21.634)	183.359*** (38.172)
Executive constraints			87.237*** (16.564)	-23.216 (34.460)	126.861*** (17.111)	3.555 (33.172)
Executive constraints × Rivalry				142.098*** (36.851)		168.506*** (34.870)
Executive openness	-82.047*** (18.112)	-26.524 (34.175)			-121.455*** (18.042)	-20.229 (32.994)
Executive openness × Rivalry		-78.943** (38.054)				-146.360*** (37.742)
Urbanization	12.369*** (1.297)	12.627*** (1.290)	11.453*** (1.340)	11.224*** (1.309)	11.366*** (1.310)	11.510*** (1.258)
Population growth	7.869*** (1.127)	7.825*** (1.130)	7.862*** (1.098)	7.896*** (1.081)	7.582*** (1.112)	7.524*** (1.095)
Military expenditure p.c. before 1914	186.510*** (65.551)	186.028*** (65.432)	184.584*** (66.858)	180.076*** (66.352)	177.710*** (64.623)	170.962*** (63.727)
Military expenditure p.c. after 1914	-0.740*** (0.126)	-0.748*** (0.127)	-0.718*** (0.126)	-0.707*** (0.124)	-0.716*** (0.125)	-0.715*** (0.125)
Observations	3145	3145	3145	3145	3145	3145
R-squared	0.764	0.765	0.765	0.766	0.769	0.772

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. “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 *xropen* is greater than or equal to 3 in the Polity IV database, and 0 otherwise. ** $p < 0.05$; *** $p < 0.01$.

whereas 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 on a scale of 1–7, indicating at least substantial limitations on executive authority) and *Openness of executive recruitment* (*xropen* greater than or equal to 3 in the same database on a scale of 0–4, corresponding to the designation of the executive leader through competitive elections).

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, whereas 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 insignificant, whereas the interaction with rivalry is positive for executive constraints and negative for executive openness. 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 and the interaction terms remain similar, albeit with a larger interaction term for openness of executive recruitment.

Thus, both aspects of democracy appear to matter in opposite directions.¹² When we take interaction effects into consideration, the direct relationship of both measures with primary schooling rates is not statistically significant, present military threats, the relationship between high executive constraints, and primary schooling is consistently positive. Conversely, high openness of the executive recruitment, which gives executive leaders a lower stake in long-term investments, are associated with lower enrollment in the presence of rivalries. Overall the former effect dominates. The disaggregated results therefore shed some light on the underlying mechanism whereby political regimes influence mass education: the critical institutions appear to lie in better accountability mechanisms with more extensive powers of the legislative branch. These findings will guide our theoretical framework in Section 5.

4.4. *Education and Neighboring Rivalries*

We have documented that primary education is positively related to military rivalry and to the interaction between rivalry and democracy. Moreover, we have found suggestive evidence that education helps improve military effectiveness in future conflicts. We caution against a causal interpretation of these stylized facts: our OLS regressions could suffer from reverse causality or omitted variable bias. For instance, a nationalist government may simultaneously choose to educate its citizens to foster loyalty to the state, and create rivalries with other states to unite the nation. Or 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 rival its neighbors. Thus, more powerful countries¹³ may have better educated populations and engage in more rivalries, which would bias upward the coefficient on rivalry in our OLS regressions for education. Conversely, the same 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.

Although we cannot credibly estimate the causal effect of military rivalry on education investments, we present some additional evidence supporting the stylized facts unveiled in Section 4.1. Specifically, we consider another source of variation in military rivalry, namely 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 original rivalry measure, without claiming that the exclusion restriction is satisfied.

12. This is perhaps surprising in itself: various authors have pointed out that the Polity indexes do not display enough time variation to be significantly correlated with outcome variables such as income (e.g., Acemoglu et al. 2008).

13. “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.

Measuring Neighboring Rivalry. We construct a dummy variable for each country, using information on the rivalries of all its neighboring countries with third countries. For country i , $Neighboring\ rivalry_{i,t}$ is thus 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 not contiguous to i . Importantly, we only consider neighbors j and rivals k that *do not* have a rivalry with i . Hence, $Neighboring\ rivalry_{i,t}$ measures rivalries in the regional environment of country i , between countries that themselves have no rivalries with i . This measure of rivalry is much less of a choice variable for country i than the rivalry measure used in our OLS regressions. 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 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.¹⁴ We exclude these regions *a priori* because they were dominated by a series of strategic alliances driven by the United States and the USSR. Moreover, they have limited predictive powers on individual rivalries. When running the baseline 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* both in the direct term and in the interaction term with *Democracy*. The results are qualitatively similar to the baseline results. In particular, comparing the results in column (2) of Panel A in Table 5 with those in column (2) 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 similar for the democracy and interaction variables.

IV-Regressions. In a more demanding specification, we use *Neighboring rivalry* to instrument for *Rivalry*. This instrument is imperfect, as a country could influence its bordering states, but we view the results of the IV-specification as a useful (descriptive) addition to the other stylized facts documented in this paper.

To run the IV, 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 B.4 of the Online Appendix, we add interaction effects with other variables and show that the results are robust. The results are qualitatively similar when we use lagged *Democracy* instead of *Democracy*.

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

TABLE 5. Rivalries in neighboring countries.

<i>Panel A: Reduced-form regressions</i>			
	Primary enrollment rate		
	(1)	(2)	
Neighboring rivalry	283.702*** (17.688)	251.776*** (19.419)	
Democracy	-7.560*** (1.226)	-17.659*** (2.088)	
Neighboring rivalry × Democracy		14.239*** (2.210)	
Urbanization	15.857*** (1.101)	15.250*** (1.091)	
Population growth	6.230*** (0.793)	6.115*** (0.758)	
Military expenditure p.c. before 1914	210.618*** (61.586)	211.708*** (61.698)	
Military expenditure p.c. before 1914	-0.837*** (0.133)	-0.807*** (0.130)	
Observations	4237	4237	
R-squared	0.749	0.753	
<i>Panel B: First stage regressions</i>			
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	3760	3760	3760
Country fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
R-squared	0.838	0.838	0.839

TABLE 5. Continued.

<i>Panel C: Second stage regressions</i>		
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	3760	3760
Country fixed effects	Yes	Yes
Time fixed effects	Yes	Yes

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. In Panel B, 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 that is not contiguous to i . The sample excludes Western Europe and the Eastern bloc during the Cold War. In Panel C, the sample excludes Western Europe and the Eastern bloc during the Cold War. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

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 $rk F$ -statistic¹⁵).

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

15. Stock 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.

Rivalry is larger than in the OLS regressions¹⁶ 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.¹⁷

Overall, the reduced-form and IV results are in line with the previously reported stylized facts. We repeat, however, that the IV results should be interpreted with caution. Military threats in nearby countries may not be fully exogenous to a country due to spillovers. For instance, we document in Table B.2 of the Online Appendix that primary enrollment in a reference country is a statistically significant predictor of future values of military threat in surrounding countries. Our results may therefore reflect a broader regional pattern, where periods of warfare coincided with periods of nation-building and education investments.

4.5. Extensions and Robustness

In this section, we describe the results of a series of robustness checks to our baseline specifications.

Clustering. In the presence of serial correlation, clustered standard errors are necessary to avoid biased standard errors (see, e.g., Bertrand et al. 2004). Table 6 checks the robustness of our main results to clustering standard errors by country. Let us first examine the robustness of our first and main stylized fact, the positive relationship between primary enrollment and rivalry. Columns (1) and (2) show that, in the absence of controls besides country and time fixed effects, the positive correlation between primary enrollment and rivalry is robust to clustering standard errors by country. The regression coefficient is still significant at the 5% level in column (2), although the standard errors are substantially higher than in column (1). But columns (3) and (4) show that once our baseline additional controls are introduced, statistical significance is lost with clustered standard errors.¹⁸

However, given the large set of controls and fixed effects included in our specifications, full clustering by country is a demanding specification. As an alternative, in columns (5)–(8) we consider standard errors clustered at the country level over shorter time horizons, namely 10, 20, 30, and 40 years, as opposed to the full length of the panel. These specifications account for any pattern of serial correlation at the country level within the specified horizon. Statistical significance is retained for all these specifications, although the standard errors grow with the horizon of clustering.

16. A likely explanation for why the IV estimates are bigger than the OLS estimates is classical measurement error of the rivalry measure.

17. These regressions are reported in Table B.1 of the Online Appendix. See Stock and Yogo (2005) on weak instruments and biased IV estimators.

18. Column (3) of Table 6 replicates our preferred specification, also reported in column (1) of Table 2.

TABLE 6. Clustering with/without controls.

	Primary enrollment rate							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	No clustering with no control	Clustering with no control	No clustering with controls	Clustering with controls	10-year clustering with controls	20-year clustering with controls	30-year clustering with controls	40-year clustering with controls
Rivalry	182.840*** (19.027)	182.840** (87.137)	160.321*** (21.755)	160.321 (115.027)	160.321** (55.475)	160.321** (64.955)	160.321** (76.812)	160.321* (84.115)
Population growth			8.160*** (1.143)	8.160*** (2.818)	8.160** (1.861)	8.160** (2.311)	8.160*** (2.360)	8.160*** (2.596)
Democracy			-2.876* (1.477)	-2.876 (5.874)	-2.876 (3.131)	-2.876 (3.666)	-2.876 (3.875)	-2.876 (4.155)
Military expenditure (p.c) before 1913			189.300*** (66.703)	189.300* (113.124)	189.300** (92.825)	189.300** (91.094)	189.300* (97.258)	189.300** (94.053)
Military expenditure (p.c) after 1914			-0.739*** (0.126)	-0.739** (0.369)	-0.739*** (0.215)	-0.739*** (0.283)	-0.739** (0.321)	-0.739** (0.352)
Urbanization			12.446*** (1.322)	12.446** (5.722)	12.446*** (3.176)	12.446*** (3.693)	12.446*** (4.333)	12.446*** (4.366)
Constant	853.976*** (47.320)	853.976*** (112.487)	459.385 (299.502)	459.385 (515.698)	459.385 (420.568)	459.385 (412.732)	459.385 (446.748)	459.385 (428.400)
Observations	4497	4497	3140	3140	3140	3140	3140	3140
R-squared	0.683	0.683	0.762	0.762	0.762	0.762	0.762	0.758

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

Given that our education variable is interpolated over 10-year periods, it is important to check that the results hold up to clustering over at least a 10-year horizon.

Education is serially correlated at longer horizons, however, and a limitation of the paper is that statistical significance of our first and main stylized fact is lost when clustering by country over horizons of more than 40 years. Moreover, columns (3)–(8) of Table 6 show that statistical significance for our second stylized fact—the negative direct relationship between democracy and primary enrollment—is lost when we cluster standard errors by country over any horizon. Likewise, unreported results show that our third stylized fact, on the interaction between military threat and democracy, is no longer statistically significant when clustering over any horizon. Collecting more data, covering more countries and more years, is therefore an important task for future research, to help raise statistical precision and improve robustness.

Education Reforms. Instead of the continuous enrollment measure, we analyze the effect of military threats on the probability of discrete educational reforms—see Table B.3 (Online Appendix). Consider the effects of strategic rivalry on *Imputed reforms*—defined as a 10% or higher hike 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.¹⁹

We also study the effect of military threats on *Known reforms*. Here, we consider broadened access to primary or secondary education, but 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. Democratization and expansion of primary schooling are both 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

19. We 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 5 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, whereas the interaction term between rivalries and democracy is still nonsignificant.

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), and variations of the urbanization measure with the share of population living in cities of 50,000 or more inhabitants, as well as the share of population living in cities of 20,000 or more inhabitants—see Table B.4 of the Online Appendix.

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 except over the reduced time period for which the industry share of GDP is available. Moreover, as expected, more industrialized and more urbanized countries have higher rates of primary enrollment when only the direct effect is included. 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 column (6) of Table B.4 of the Online Appendix suggest that the effect of military rivalry on primary education becomes positive around a 15% share of population living in towns and cities (with lower thresholds for more democratic countries). For instance, primary enrollment would be predicted to be higher by 0.8% of the population where 25% of the population lives in cities (at the mean) and by 2.5% of the population where the urbanization rate reaches 43% (the mean plus one standard deviation); again with higher values 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 industrialization brought along the development of modern-warfare technologies 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 B.5 of the Online Appendix. 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 lower enrollment rates, and the effect of rivalry on primary enrollment also decreases with ethnic fractionalization. Yet, our main coefficients remain unaffected.

Further, we include the primary enrollment rate of the rival. Consistent with our intuition, countries raise their enrollment rates more when their rivals have more

educated populations, and therefore presumably more effective armies.²⁰ Also, we add 10-year lagged enrollment to control for initial conditions. As expected, primary enrollment displays high serial autocorrelation, but our main coefficient of interest on rivalry is 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, and the coefficients on rivalry actually increase.

Finally, 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 result on military rivalry does hold up.

Alternative Dependent Variable. We have performed other robustness tests as well—see Table B.6 of the Online Appendix. One is to compare our baseline results with those obtained with an alternative measure of education, namely education attainment from the Barro-Lee (2013) data set, available at 5-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 statistically significant.

4.6. Summary of Findings

Taken together, our empirical results provide a robust set of stylized facts, which is new to the best of our knowledge. 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 where public education plays a key role in the efficient operation of the military. The model is construed 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.

20. Interestingly, the direct coefficient on rivalry turns negative when we control for the education of rivals, which suggests that facing weaker, less skilled potential enemies actually acts as a disincentive to invest in one's own primary education. However the overall effect of rivalry (for a rival of equal military size) turns positive at a fairly low level of the rival's enrollment, of around 750 per 10,000.

Basic Setup. Our formal model borrows from the state-capacity framework of Besley and Persson (2009, 2011), from the vote R -participation models of Feddersen and Sandroni (2006) and Coate and Conlin (2004), and from the analysis of fighting incentives across different political regimes of Ticchi and Vindigni (2008).

Consider a society with a population of risk-neutral individuals normalized to unity and divided into two equally large and homogenous groups (with regard to education), $J = I, O$. 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 $1/2y(e)$ and nondecreasing in the level of public education e with $y(e) = 1 + \beta e$.

All consumption occurs at the end of period 2. One group is the incumbent in both periods (no political turnover). Among political institutions, we focus on executive constraints, 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 —a higher value of δ means stronger constraints (more protection from discretionary redistributive taxation).

A war may occur in period 2 with exogenous probability p . For simplicity, a lost war makes all (accumulated) income perish from the country—that is, 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 x/e , where x is individual-specific and uniformly distributed on $[0, 1]$ in each group.²¹ Any individual in group J follows a behavioral rule to expend his unit of effort if $x/e < \omega_J/e$. 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 the language of Feddersen and Sandroni (2006), each 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 reflect geography: if the groups inhabit different parts of the territory, effort is needed along different parts of the border. Alternatively, the two groups might represent a dominant elite supplying officers a

21. We 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).

large nonelite from supplying common soldiers: again, effort is needed from both groups. We see the complementarity as an important distinguishing feature of modern wars—say after 1820.

Public education is chosen by the incumbent group in period 1. It can augment initial education, normalized at zero, by investment e in education at cost $C(e) = e^\gamma$, where $\gamma > 1$.

Timing. The timing of the model is as follows:

- (1) In period 1, the incumbent invests e in future education.
- (2) At the beginning of period 2, a war with a foreign power erupts with probability p .
- (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 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 $y(e)$, whereas 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 turnout. In our setting, individuals choose to expend effort when their utility cost is low enough. Drawing on Feddersen and Sandroni (2006) and Coate and Conlin (2004), we assume that group members choose the behavioral rule that maximizes expected group payoff, that is, 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, whereas 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 becomes²²

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

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 investment cost. 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

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

This equation determines equilibrium education e as a function of parameters (δ, β, p) . For γ sufficiently large, 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 the following.

PREDICTION 1. For δ sufficiently small, γ (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, $\partial e / \partial p > 0$, $\partial^2 e / \partial p \partial \delta > 0$, and $\partial e / \partial \delta|_{p=0} < 0$.

Proof. Part 1 follows straightforwardly from the fact that

$$\frac{(1-\delta)}{\alpha} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right] \frac{\partial}{\partial e} \left[e^{\frac{1}{2-\alpha}} y(e)^{\frac{3-\alpha}{2-\alpha}} \right] \gg (1-\delta)\beta$$

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

Part 2 follows from (3) and from the fact that

$$\frac{\partial}{\partial e} \left[e^{\frac{1}{2-\alpha}} y(e)^{\frac{3-\alpha}{2-\alpha}} \right] > 0 \quad \text{and that} \quad \text{sign} \left(\frac{\partial^2 e}{\partial p \partial \delta} \right) = \text{sign} \left(\frac{\partial}{\partial \delta} \{ (1-\delta)E(\delta) \} \right),$$

22. Note 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.

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

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 $\beta > 0$. \square

Consistency with the Empirical Findings. Parts 1–3 of Prediction 1 are 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.²³ 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 fight than incumbent-group members—this is similar to the result in Ticchi and Vindigni (2008). If 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.²⁴

An Auxiliary Prediction. Of course, the model in this section offers only a proposed interpretation of our empirical results. 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, however,

23. A potentially counteracting effect, pointed out by a referee, is that more democracy already in period 1 should constrain the incumbent to align herself more with the median voter's incentives to invest in education. This in turn might result in more educational investment. We are ignoring this effect by assuming that educational investment is decided by an incumbent in period 1, no matter the constraint on the executive at that date: in our model democracy affects surplus sharing but not who decides about education. However, our regressions suggest that, if any, such counteracting effect of democracy would be dominated. Moreover, we think that our model captures the reality of most representative democracies where, once elected, politicians still enjoy a large degree of discretion over public investment policy.

24. Note 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.

TABLE 7. Road investments, rivalry, and democracy.

	% change in length of paved roads			
	(1)	(2)	(3)	(4)
Rivalry	2.400** (0.968)	2.503** (0.989)	2.477*** (0.948)	2.522*** (0.932)
Democracy		0.048 (0.052)	0.063 (0.101)	0.040 (0.103)
Rivalry × Democracy			-0.023 (0.110)	-0.008 (0.110)
Urbanization	-0.161*** (0.053)	-0.169*** (0.054)	-0.168*** (0.054)	-0.194*** (0.055)
Military expenditure (p.c.)	0.003 (0.002)	0.003* (0.002)	0.003* (0.002)	0.004*** (0.002)
Real GDP				1.376* (0.826)
Road length per square km				-0.004*** (0.001)
Observations	2566	2542	2542	2542
R-squared	0.122	0.125	0.125	0.127

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

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 7 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. Although 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.

6. Conclusion

This paper has uncovered three new stylized facts. First, investments in mass primary education are positively correlated with military rivalries. Second, if anything, democratization seems to be negatively associated with such investments. Third,

primary enrollment appears to respond more to military threats in democracies than in autocracies.

Our approach could profitably be extended in several directions. One important extension would be to try and raise the precision of our statistical estimates, which are not robust to country clustering over the entire sample for our current data. Collecting more data, covering more countries and more years, to improve robustness is thus an urgent task for future work.

A second extension would be to look at the association of military rivalry and other types of public investments, not just primary education (and road expenditure). 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 third extension would be to investigate if other forms of rivalry—for example, cross-country competition in product markets, or the importance of international benchmarking, for example, 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 fourth 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 lost wars as well as won wars over the past 10 years, with a stronger correlation with won wars. This finding rejects the view that past wars might favor future education investments because they weaken incumbent elites that might oppose mass education, but could be linked to scarce public funds if state financial resources are more depleted after defeats than victories.

A fifth 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 et al. (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 associated with vertical systems.

Investigating these and other extensions is left for future research.

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 decision makers. 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."

Colaresi et al. (2010) further refine the data to distinguish between three types of rivalries: spatial, where rivals contest the exclusive control of a territory; positional, where rivals contest relative shares of influence over activities and prestige within a system or subsystem; and ideological, where rivals contest the relative virtues of different belief systems relating to political, economic or religious activities.

References

- Acemoglu, Daron, Simon Johnson, James A. Robinson, and Pierre Yared (2008). "Income and Democracy." *American Economic Review*, 98(3), 808–842.
- Acemoglu, Daron and Pierre Yared (2010). "Political Limits to Globalization." *American Economic Review*, 100(2), 83–88.
- Alesina, Alberto, Arnaud Devleeschauwer, William Easterly, Sergio Kurlat, and Romain Wacziarg (2003). "Fractionalization." *Journal of Economic Growth*, 8, 155–194.
- Alesina, Alberto and Bryony Reich (2015). "Nation Building." NBER Working Paper No. 18839. National Bureau of Economic Research, Cambridge, MA.
- Algan, Yann, Pierre Cahuc, and Andrei Shleifer (2013). "Teaching Practices and Social Capital." *American Economic Journal: Applied Economics*, 5, 189–210.
- Anderton, Charles H. and John R. Carter (2001). "The Impact of War on Trade: An Interrupted Times-Series Study." *Journal of Peace Research*, 38, 445–457.
- Ansell, Ben and Johannes Lindvall (2013). "The Political Origins of Primary Education Systems: Ideology, Institutions, and Interdenominational Conflict in an Era of Nation-Building." *American Political Science Review*, 107, 505–522.
- Banks, Arthur S. (2011). *Cross-National Time-Series Data Archive*. Databanks International, Jerusalem, Israel.
- Barro, Robert J. and Jong Wha Lee (2013). "A New Data Set of Educational Attainment in the World, 1950–2010." *Journal of Development Economics*, 104, 184–198.
- Bertrand, Marianne, Esther Dufló, and Sendhil Mullainathan (2004). "How Much Should We Trust Differences-in-Differences Estimates." *Quarterly Journal of Economics*, 119, 249–275.
- Besley, Timothy and Torsten Persson (2009). "The Origins of State Capacity: Property Rights, Taxation, and Politics." *American Economic Review*, 99(4), 1218–1244.
- Besley, Timothy and Torsten Persson (2011). *Pillars of Prosperity: The Political Economics of Development Clusters*. Princeton University Press.
- Blomberg, S. Brock and Gregory D. Hess (2006). "How Much Does Violence Tax Trade?" *Review of Economics and Statistics*, 88, 599–612.
- Bourguignon, Francois and Thierry Verdier (2000). "Oligarchy, Democracy, Inequality and Growth." *Journal of Development Economics*, 62, 285–313.
- Burnett, Bruce and Masato Wada (2007). "The Ebb and Flow of Japanese Educational Reform." Australian Association for Research in Education.
- Bursztyjn, Leonardo (2016). "Poverty and the Political Economy of Public Education Spending: Evidence from Brazil." *Journal of the European Economic Association*, 14, 1101–1128.
- Calderón, Cesar and Luis Servén (2010). "Infrastructure in Latin America." World Bank Policy Research WP Series 5317.
- Cantoni, Davide and Noam Yuchtman (2013). "The Political Economy of Educational Content and Development: Lessons from History." *Journal of Development Economics*, 104, 233–244.
- Coate, Stephen and Michael Conlin (2004). "A Group Rule Utilitarian Approach to Voter Turnout: Theory and Evidence." *American Economic Review*, 94(5), 1476–1504.
- Colaresi, Michael P., Karen Rasler, and William R. Thompson (2010). *Strategic Rivalries in World Politics: Position, Space and Conflict Escalation*. Cambridge University Press.
- Dolman, Everett C. (2004). *The Warrior State*. Palgrave-McMillan, Basingstoke, United Kingdom.
- Duke, Benjamin C. (2009). *The History of Modern Japanese Education: Constructing the National School System (1872–1890)*. Rutgers University Press, New Brunswick, NJ.
- Feddersen, Timothy and Alvaro Sandroni (2006). "A Theory of Participation in Elections." *American Economic Review*, 96(4), 1271–1282.
- Flora, Peter (1983). *State, Economy, and Society in Western Europe, 1815–1975*. St. James Press, Chicago.
- Galor, Oded and Omer Moav (2006). "Das Human Kapital: A Theory of the Demise of the Class Structure." *Review of Economic Studies*, 73, 85–117.

- Galor, Oded, Omer Moav, and Dietrich Vollrath (2009). "Inequality in Land Ownership, the Emergence of Human Capital Promoting Institutions and the Great Divergence." *Review of Economic Studies*, 76, 143–179.
- Gennaioli, Nicola and Hans-Joachim Voth (2015). "State Capacity and Military Conflict." *Review of Economic Studies*, 82, 1409–1448.
- Giddens, Anthony (1985). *The Nation State and Violence*. University of California Press.
- Glaeser, Edward, Giacomo Ponzetto, and Andrei Shleifer (2007). "Why Does Democracy Need Education?" *Journal of Economic Growth*, 12, 77–99.
- Glick, Reuven and Alan M. Taylor (2010). "Collateral Damage: Trade Disruption and The Economic Impact of War." *Review of Economics and Statistics*, 92, 102–127.
- Gordon, Andrew (2003). *A Modern History of Japan*. Oxford University Press.
- Gordon, Andrew (2000). *Japan's March Toward Militarism*. Wesleyan Edu.
- Hintze, Otto (1975). "Military Organization and the Organization of the State." In *The Historical Essays of Otto Hintze*, edited by Felix Gilbert. Oxford University Press.
- Karl, Rebecca E. and Peter G. Zarrow (2002). *Rethinking the 1898 Reform Period*. Harvard University Press, Cambridge, MA.
- Lindert, Peter (2004). *Growing Public: Social Spending and Economic Growth since the Eighteenth Century*. Cambridge University Press.
- Lott, John R. (1999). "Public Schooling, Indoctrination, and Totalitarianism." *Journal of Political Economy*, 107, S127–S157.
- Martin, Philippe, Thierry Mayer, and Mathias Thoenig (2008a). "Civil Wars and International Trade." *Journal of the European Economic Association*, 6, 541–550.
- Martin, Philippe, Thierry Mayer, and Mathias Thoenig (2008b). "Make Trade Not War?" *Review of Economic Studies*, 75, 865–900.
- Moody, Joseph N. (1978). *French Education Since Napoleon*. Syracuse University Press, Syracuse, NY.
- Mulligan, Casey B., Ricard Gil, and Xavier Sala-i-Martin (2004). "Do Democracies have Different Public Policies than Nondemocracies?" *Journal of Economic Perspectives*, 18(1), 51–74.
- Murtin, Fabrice and Romain Wacziarg (2014). "The Democratic Transition." *Journal of Economic Growth*, 19, 141–181.
- Scheve, Kenneth and David Stasavage (2012). "Democracy, War, and Wealth: Lessons from Two Centuries of Inheritance Taxation." *American Political Science Review*, 106, 81–102.
- Stock, James H. and Motohiro Yogo (2005). "Testing for Weak Instruments in Linear IV Regression." In *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, edited by Donald W. K. Andrews and James H. Stock. Cambridge University Press.
- Thies, Cameron G. (2004). "State Building, Interstate and Intrastate Rivalry: A Study of Post-Colonial Developing Country Extractive Efforts, 1975–2000." *International Studies Quarterly*, 48, 53–72.
- Thompson, William R. (2001). "Identifying Rivals and Rivalries in World Politics." *International Studies Quarterly*, 45, 557–586.
- Ticchi, Davide and Andrea Vindigni (2008). "War and Endogenous Democracy." IZA Working Paper 3397.
- Tilly, Charles (1975). "Reflection on the History of the European State-Making." In *The Formation of National States in Western Europe*, edited by Charles Tilly. Princeton University Press.
- UNESCO: International Bureau of Education (2000). "Prospects." *Quarterly Review of Comparative Education*, 23, 613–623.
- Weber, Eugen (1979). *Peasants into Frenchmen: The Modernization of Rural France 1870–1914*. Chatto & Windus, London.

Supplementary Data

Supplementary data are available at [JEEA](#) online.