Education and Military Rivalry[*]

Philippe Aghion[†] Torsten Persson[‡] and Dorothee Rouzet[§]

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Abstract

Using data from the last 150 years in a small set of countries, and from the postwar period in a large set of countries, we show that large investments in state primary education systems tend to occur when countries face military rivals or threats from their neighbors. By contrast, we find that democratic transitions are negatively associated with education investments, while the presence of democratic political institutions magnifies the positive effect of military rivalries. These empirical results are robust to a number of statistical concerns and continue to hold when we instrument military rivalries with commodity prices or rivalries in a certain country's immediate neighborhood. We also present historical case studies, as well as a simple model, that are consistent with the econometric evidence.

[†]Harvard University and CIFAR
[‡]IIES (Stockholm University) and CIFAR
[§]Harvard University

1 Introduction

What makes countries engage in mass education investments? A common view is that such investments are the flipside of democratic transitions (see e.g., Bourguignon and Verdier, 2000). Absent democracy, the elite chooses to deny mass access to education in order to secure its power, while the introduction of democracy – extending the franchise, increasing electoral competition, or putting tighter constraints on the executive – promotes decisions that favor mass education. This explanation might look quite convincing, and seemingly accounts for the history of education enrollment in Europe starting with France. Indeed, Figure 1 (drawn from Lindert, 2004), suggests that public contributions to primary-school education went up sharply in 1880, once France had completed its transition from the Second Empire to the Third Republic, which clearly reflected a move towards greater democracy.[1]

Figure 1 about here

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

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

One reason why a military defeat may spur centralized investment in mass education is suggested in the work of Eugene Weber on the modernization of rural France between 1870 and 1914 (Weber, 1979). A highly disintegrated

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[1]The complementary view that education favors democracy is analyzed, in particular, by Glaeser et al. (2007).

population, largely illiterate, speaking a multiplicity of dialects, and with no sense of nationhood[2], was to be transformed into a unified people sharing the same patriotic values, a spoken and written language, a set of moral principles, and a motivation and ability to defend France in future conflicts[3].

In this paper, we study historical panel data on education spending and enrollment – for Europe since the 19th century and a larger set of countries in the postwar period – to assess the correlation between military rivalry (or war risk) and primary education enrollment (or the occurrence of educational reforms). First, we perform standard OLS regressions and find that, conditional on country and year fixed effects, mass education is positively and significantly associated with military rivalry, or involvement in an external war in the previous 10 years. Moreover, while the coefficient on democracy (gauged by the Polity IV index) comes out negative when we control for military rivalry, the interaction between the two variables is often positively and significantly associated with mass education. The coefficient on military rivalry remains stable when we control for the political regime, suggesting that military threats have a stable and independent influence on mass education.

To deal with appropriate concerns about endogeneity, we then instrument military rivalry in two different ways. Our first instrument uses data on commodity prices. The idea is that high prices of natural resources or agricultural commodities likely foster rivalries, as states are tempted to compete for control of more valuable resources. Our second instrument uses rivalries with third countries of those countries with which a certain country shares a border. The idea here is to captures when military rivalries are rife in a country's neighborhood. The corresponding IV specifications show a positive and significant effect of rivalry on primary enrollment, a negative direct effect of democracy, and (for the second instrument) a positive and significant interaction term between the two. Overall, our empirical results indicate a causal relationship from rivalry to primary educational enrollment.

Our paper relates to, at least, three literatures. As for the relationship between public education investment and democracy, Lott (1999) suggests that non-democracies could invest more than democracies in public education as a means of indoctrination. On the other hand, Glaeser et al. (2007) argue that education and democracy should be positively correlated, due to

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[2]As a French novelist of that time would put it "In Velay, the word "patrie" signifies nothing and stirs nothing. It exists no more in local speech than in local hearts".

[3]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".

the need for civic participation to raise support for transitions from dictatorship into democracy. But the evidence for a positive relationship between education spending or enrollment and democracy is mixed, at best. In particular, Mulligan, Gil, and Sala-i-Martin (2004) present cross-country evidence indicating that more democratic political institutions do not seem to correlate with higher levels of social expenditures and, in particular, higher public education spending. More recently, Bursztyn (2011) shows that poor voters in Brazil might prefer the government to allocate resources to redistributive policies, yielding immediate income increases (such as cash transfers), instead of allocating resources to public primary education. Also related to our analysis is the work by Bourguignon and Verdier (2000), who develop a model to explain why the ruling class may sometimes decide to invest in education even though schooling enhances political participation. Along similar lines, Galor et al (2006) argue that capital accumulation gradually intensifies the importance of skilled labor in production and therefore generates support among the ruling class for investing more in human capital. Galor et al. (2008) argue that a higher concentration of land ownership typically discourages the development of human capital enhancing institutions, in particular schooling. However, none of these papers looks at the effect of military threats in democracies and autocracies.

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

A third related literature deals with fiscal capacity and state capacity more generally. Hintze (1975) and Tilly (1975), preceding many others, provide historical accounts on the importance of wars for state building. More recently, an economic literature summarized in Besley and Persson (2011) considers theoretically investments in fiscal and legal capacity, and finds robust correlations between past wars and current state capacity in international panel data. Thies (2004), using the same measure of strategic rivalry

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as we do, shows that military rivalry raises fiscal capacity in postcolonial developing states. Scheve and Stasavage (2011) investigate the links between wars, democracy, and estate taxation in about 20 countries since 1816 and find that democracy does not have a systematic influence on top rates of estate taxation, whereas wars with mass mobilizations do significantly raise these rates. Analogously, we find support for a correlation between past wars (and military rivalry more generally) and current educational investments, while (in parallel to Scheve and Stasavage), the correlation between wars and democracy is more tenuous. In addition, we find that the effect of military rivalry on educational investment is larger in democracies, something possibly quite specific to education. Also, in contrast to this literature, we treat state capacity as exogenous, both in the theory part and in our empirical analysis.

We have organized the paper as follows. In Section 2, we describe three historical examples that speak to the relationship between military rivalry and education reforms. We also show that in nearly all countries, for which we have long enough time series, periods with large hikes in primary enrollment are preceded by wars rather than by transitions to democracy. Section 3 presents our data, descriptive statistics, and empirical specification. In Section 4, we describe the econometric results and discuss their robustness to a variety of factual and statistical concerns. In Section 5, we lay out a simple model that rationalizes our main empirical findings. Section 6 concludes.

2   Lessons From History

While each national history has unique elements that cannot be forced into a unified framework, the examples of France, Japan, and Prussia over the 19th century all suggest a relationship between military defeats or rivalry and educational reforms. Prussia led the way in terms of primary enrollment rates in Europe from 1815 until about 1860. In the 1880s, France overtook Prussia as the European enrollment leader. In addition we look at Japan, a leading Asian country at the end of the 19th century, which ended up emulating the Prussian and French models in its own transition to mass education. For each of these examples, we describe the historical context, the debate that emerged due to a volatile international environment, and the subsequent education reforms with a particular focus on primary enrollment.

2.1 Prussia under Stein and Humboldt

Background   As late as 1803, Prussian King Frederick William III would declare:

> "the children of this hardworking Volksklasse should not become lecturers, not chancellery officials, not mathematicians, not religion professors. They should learn to read their catechism, Bible, and hymnal, to write and calculate in accordance to their limited circumstances, to love and fear God and behave accordingly" (Lindert, 2004, p.).

However, after the humiliating defeat to Napoleon I in Jena in 1806, which took the Hohenzollern Monarchy by surprise, the King asked Baron Karl von Stein to head a new ministry devoted to the improvement of Prussian institutions and infrastructures "to make Prussia as vital and as strong as France".

The Reform Process   Stein did not originally pay much attention to education. His primary focus was on the organization and administration of the Prussian state. But he understood the importance of promoting patriotism among the population – he first tried to do so through a city governance reform, in the hope that the participation of the community in its own affairs would create a civic sense. Stein realized that his major reforms, namely the end of villeinage, the reform of the army, and the self-administration of the towns, could be unsuccessful due to the insufficient level of education. He thought that Wilhelm von Humboldt would be capable of bringing about a complete reform of the Prussian education system and called him to Berlin. Thus, on February 28, 1809, von Humboldt became head of the culture and education section at the Ministry of the Interior, although Stein had left office by then. Napoleon had called for his dismissal and the King of Prussia had agreed to that request.

> "From the beginning of the crisis, even prior to the startling defeats of Jena and Auerstadt, two views were competing in government circles about the future direction of Prussia" (Gray, 1986, p. 47)

A "peace party" was organized around von Haugwitz and Lombard, while the "patriots" followed Stein and von Hardenberg. Von Humboldt endorsed the ideals defended by Stein, who had said that

> "the chief idea was to arouse a moral, religious and patriotic spirit in the nation, to instill into it again courage, confidence, readiness for every sacrifice in behalf of independence from foreigners and for the national honor, and to seize the first favorable opportunity to begin the bloody and hazardous struggle" (Ford, 1965, p. 122).

Humboldt sensed that his reforms could play a key role in the survival of Prussia. He had developed his ideas in the July 1809 treatise *Über Die Mit Dem Königsberger Schulwesen Vorzunehmende Reformen* (On reforms to execute with the teaching in Königsberg) and was able to initiate fundamental reforms of curricula, teaching methods, teacher education, and auditing in the school system. His reforms delegated the powers to administer and fund schools to local communities in order to circumvent the surveillance of the French. (They also helped found Berlin University.) However, his perception of insufficient support for his plan to reform educational administration under the current government led Humboldt to present his resignation to the King in the spring of 1810.

After the defeat of Napoleon in 1815 to a coalition of European powers, the immediate external threat to Prussia was removed and the Prussian government stopped endorsing the ideal of reform. Yet, "once the reformed Prussian educational framework was in place, it could not be dislodged by the subsequent waves of conservatism" (Lindert, 2004), because von Humboldt had set up a decentralized education system. In 1876, funds from the Prussian state accounted for only 9% of the budgets of public primary schools, endowments for 3%, fees for 15%, and the remaining 73% came from local taxes. Throughout the 19th century, the provision of local education in German communities kept increasing, and Prussia eventually became the leader in primary enrollment. In this respect, von Humboldt's reforms had lasting consequences. It is also interesting to note that Stein encouraged democratization of towns to gain the support of the population. This may suggest that the probability of successful educational reform is higher in democracies.

The Outcomes   The educational reforms in Prussia had a substantial long-run impact. Of the cohorts born in Prussia before 1801, 16.8% of males were

completely illiterate, as against 2.9% for males born between 1837 and 1841.[4] The literacy rate inched up towards 85% in 1850 and Prussia became the European leader with regard to primary enrollment until the 1880s. The primary school enrollment per 10,000 inhabitants [5] rose from 1,131 in 1815 to 1,592 in 1850.

2.2 Jules Ferry's France

Background   In 1870, French public expenditure on education were lagging behind that of Prussia and other European countries. The French education system was mainly private, largely revolving around churches. Teaching was done by priests or more casually by anyone around (be it the baker, the butcher,..), who knew how to read. Classrooms were often improvised in the backyard of a farm, with poor equipment and amenities. And a large fraction of registered children never attended school. The result was that a large fraction of the population was either illiterate or unable to understand the content of a text. In 1863, 7.5 million citizens (about a fifth of the French population) could not even speak French properly but only local dialects.

Even prior to the war with Prussia in 1870, French elites were aware of the fact that the French education system had failed to promote national unity. Victor Duruy, appointed Minister of Education in 1863 by Napoleon III, was already advocating sweeping educational reforms, the improvement of educational facilities, and the development of technical education. His plans were in many ways similar to those that Jules Ferry would pursue some 20 years later[6]. Duruy tried to gather political support and convince the Emperor that it was in his own interest to implement such a reform. But he did not succeed, partly due to a lack of support from a rural population influenced by the Church.[7]

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[4]Source: Block, Rainer (1995), Der Alphabetisierungsverlauf im Preussen des 19. Jahrhunderts: Quantitative Explorationen aus bildungshistorischer Perspektive , European University Studies (Series XI, Education).

[5]School02 variable from the CNTS data archive (Banks, 2011).

[6]"Duruy's major objective was to make primary education compulsory and tuition free so that each citizen could fulfill his duties under universal suffrage and contribute to the burgeoning economy" (Moody, 1978, p. 72).

[7]"In a letter to the Emperor on 6 February 1866, [Duruy] maintained that his plan would embarrass the Orleanists, the clericals and the republicans, and win millions of families to the Empire, particularly the parents of the million and a half pupils who were now accepted free, but under the stigma of charity" (Moody, p. 72). In fact, Duruy never

The turning point was the French defeat against Prussia in 1870. 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 and helped trigger the subsequent educational reforms by the leaders of the Third Republic.

The Reform Process   After the Sedan defeat, the debate would continue between conservatives forces opposing and progressive forces supporting educational reforms, even though the balance of power had shifted towards the latter. While the conservatives led by the Church would see Sedan as a punishment for France's infidelity to its old (monarchical) traditions, the progressives saw Sedan as a reflection of the superiority of Prussian schools and university system.[8] Overall, even though groups and political parties would still disagree on the causes of military defeat, a majority of them agreed that education in Prussia had played a key role in the rise of this new power, and that education in France had to be reformed, not only to increase literacy, but also to acquaint new generations with basic knowledge in arithmetics, history and geography, and to

"teach Frenchmen to be confident of their nation's superiority in

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managed to reduce the hostility of the rural masses, who looked on farm labor as a natural apprenticeship, and consequently Napoleon decided to let the project of his minister be defeated by the legislature.

[8] "Unexpected defeat, occupation, and sanguinary civil war fixed 1870-71 in the French consciousness as 'the terrible year.' Several national myths were deposed, end of the vision of national glory built during the Second Empire. [...] Frenchmen who had lived through the experience were aware that defeat had exacerbated the social and political divisions of the nation – the Commune provided brutal evidence. But intellectual disagreements were also sharpened as Frenchmen sought for a cause of the disasters that had befallen them. [...] There was a debate about the source of the defeat: the prime culprit was the Empire and all its works. The right viewed Sedan as deserved punishment for infidelity to the traditions of France. Toward the Church there was an initial ambivalence. Most people thought that 'France had neglected intellectual formation, particularly in the sciences [...].' 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 Iena. 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, p. 87).

law, civilization and republican institutions. It should be consistent with reigning social values, and thereby eliminate disruptive conflicts and promote the unity of the classes. Since France no longer enjoyed religious unity, it must forge a new moral unity from a unified education that would teach civic morality based on the principles of natural reason" (Moody, 1978, p. 88).

Jules Ferry was appointed the new Minister of Education in February 1879. In 1881, he abolished all tuitions fees in public elementary schools; in 1882, he made school enrollment compulsory from age six to thirteen; in 1883, it became compulsory for every village with more than twenty children at school age to host a public elementary school; in 1885, subsidies were devoted to the building and maintenance of schools and to paying teachers; and in 1886, an elementary teaching program was established, together with monitoring provisions. These are the so-called "Laic Laws", which still characterize the French educational system today. At the same time, a whole infrastructure program – the Freycinet plan – was initiated to facilitate children's access to schools. Millions of francs were spent on building roads to match the large amounts spent on schools: 17,320 new schools had to be built, 5,428 schools were enlarged, 8,381 schools were repaired.[9] As a result, enrollment as well as attendance in primary education steadily increased.

The reforms not only generalized the access to schooling, but also transformed the content of elementary education: new programs emphasized geography, history, and dictation. The new teaching programs in history and geography aimed at conveying patriotic values to new generations. As for dictations, they were useful to teach people 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).

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

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[9] Source: Weber, E (1979), Peasants into Frenchmen : The Modernization of Rural France, 1870-1914 , Chatto & Windus.

in the child the idea of discipline, and prepare him [. . .] to be a good soldier and a good Frenchman."

The Outcomes Official statistics attest that school attendance rose appreciably in the decade after 1882. Primary enrollment rates went up from 1,176 per 10,000 inhabitants in 1870 to 1,430 in 1912. Literacy rates rose from 80% in 1870 to 96% in 1912 (and the initial 80% figure is partly misleading, as most supposedly literate children did not understand the content of 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), and in that respect Ferry's efforts paid off during the subsequent mobilization in 1914.

2.3   Japan in the Meiji Era

Background   From the 17th century, Japan was ruled by military lords (the so-called *shoguns*) of the Tokugawa dynasty. Under the Tokugawa, education was a privilege of the Samurais and centered on tradition and the study of Confucian classics. However, starting in the mid 1850s, Japan came under threats by Western powers. In 1853, Commodore Matthew Perry from the US arrived in Japan with an ultimatum to the authorities: agree to trade or suffer the consequences of war. To add credibility to this threat, American warships were sent to Japan in 1854. Subsequently, the Trade Convention of Kanagawa was signed on 31 March, 1854. The threats posed to Japan by Western powers in the second half of the 19th century acted as a catalyst for educational reforms. As put by Duke:

> "In 1872, government leaders were haunted by a crisis of international proportions. Powerful western nations were expanding trading posts throughout the world. 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 from the early 1600s, the country had fallen dangerously behind the West as the industrial revolution got under way. The rise of western capitalism and interna-

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tional colonialism posed a pervasive threat to Japan, as perceived by the new leaders. They were determined to use any means necessary to transform their country into a modern state in order to preserve the political order and the national sovereignty. Education on the Western model was envisioned as an instrument to achieve that goal." (Duke, 2009, p. 1).

The Tokugawa implemented various reforms at the beginning of the 1860s, but did not go far enough to satisfy the Samurais. As a result, Japan fell into civil war. In early January 1868, the insurgents prompted the Emperor Meiji, who had just taken the throne, to announce an "imperial restoration," which in fact was nothing less than a coup d'Etat.

The Reform Process   The education debate featured the opposition between those who wanted to preserve the focus on Confucian classics and maintain interpersonal hierarchical relationships, and those who wanted to introduce secular Western science with more mathematical thinking to catch up with Western technology. This debate fed a broader political crisis, culminating with the civil war. Following the imperial restoration", Western-oriented progressives eventually prevailed over Eastern-oriented traditionalists. The newly founded Ministry of Education sent delegates to the West to learn about their education system, for instance with the Iwakura mission of 1872-1873.

To rise up to the challenges posed by the West, in 1872, a new education system was instituted which declared four years of compulsory elementary education for all children. As explained by Burnett and Wada (2007),

> "in just a one-year period following the Gakusei of 1872, 12,500 primary schools were established. Within the next five years the number of schools doubled to a figure not surpassed until the 1960s."

The move to mass education was completed by a national training system for teachers. The first teacher's college was created in Tokyo in July 1872, based on American principles of elementary-school instruction.

The Outcomes   Initially, reactions to the educational reform were mixed.

"Not everyone was so happy at the obligation to attend school and the opportunity to graduate. The elementary schools were to be financed by a 10 percent local surcharge to the national property tax. 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 be 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 to the educational reforms reflected a lack of democracy in the Japanese system – the peasants did not identify with the emperor, nor with the new ruling class, and therefore disapproved of the nationalistic education that was now compulsory. Similarly, people at first tried to resist the military reform.

Yet, over time, the Japanese educational reforms appeared more and more a resounding success. Japan overtook most European powers with regard to primary enrollment per school-age child, which rose from 28.1% in 1873 to 98.1% in 1910. From 1865 to 1910, the literacy rate increased from 35% to 75% for men and from 8% to 68% for women. The primary-school enrollment per 10,000 inhabitants rose with blistering speed, from 65 in 1876 to 1,122 in 1905.

The success of education reforms certainly played a role in the unexpected military victories by Japan in the 1895 war against China and the 1905 war against Russia. Overall, Japan's educational reforms during the Meiji era further illustrate the idea that education reform occur as a result of strategic military concerns. The Japanese example is probably even clearer than the French one, in that the military considerations clearly took precedence over humanist ones. The popular resistance to the reforms may reflect the fact that a lack of democracy reduces the effectiveness of the educational reform.

2.4   Taking Stock

Figure 2 summarizes our historical overview of educational reforms in Prussia, France and Japan. In all three cases, military defeats and/or perceived

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military threats appear to have prompted an otherwise reluctant ruling class to invest in mass primary education.

Figure 2 about here

Let us also take a less detailed bird's-eye view on historical evidence from the large sample (of 137 countries) that we use for econometric estimation in the next section. We restrict attention to 53 countries within that sample for which more than forty years of primary enrollment data are available. For each of these countries, we first identify the twenty-year period, during which primary enrollment rose the most sharply – we call this the "educational reform period"[10]). We then look at the preceding twenty years to see whether a war or a democratic transition took place during that period. We use the *polity2* index from the Polity IV database[11] and define a democratic transition as occurring when the *polity2* variable moves from the "anocracy" to the "democracy" range, i.e., when crossing the score of 6 (at a scale from -10 to 10) from below. We identify external wars from the Correlates of War dataset[12] and military rivalry data are drawn from Thompson (2001). These two datasets are described in more details in the next section.

Table 1 summarizes our findings. The first column indicates the educational-reform period, the second whether or not a war occurred during the preceding twenty years, while the third indicates whether a democratic transition occurred in the preceding twenty years.

Table 1 about here

The table shows clearly that in most countries of the sample a war precedes the educational reform, while a democratic transition rarely occurs in the pre-reform period. Among the 53 countries in this table, it is only in two countries where a democratic transition occurs before the rise in education. Most often, the democratic transition instead takes place *after* the educational reform period[13].

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[10]The educational reform period in Table 1 is defined as the period during which the change in primary enrollment rate was the greatest *in percentage terms,* not in absolute value.

[11]See the dataset http://www.systemicpeace.org/polity/polity4.htm.

[12]http://www.correlatesofwar.org/

[13]See Appendix B for details about the dates of wars and democratization, as well as the availability of data on primary enrollment per country.

However, in several countries in this sample the sharpest increase in primary enrollment took place after the first or the second World War, and the degree of involvement in either of those wars varied a great deal across countries. More generally, the table by no means shows any causal evidence. Also, our identification of the "educational reform" is very crude and may miss important changes in the education system. For example, in the case of France as well as Germany, the greatest increase in primary enrollment does not coincide with the reform periods pinpointed in the historical case studies above[14]. Yet, this crude measure of educational reform hints at the possibility that wars, and more generally military threats, play a more important a role than democratic transitions in promoting broad access to education.

Subsections 2.1-2.3 presented case-study evidence about wars or military threats leading to educational reforms for Prussia, France and Japan. Subsection 2.4 presented cruder but broader historical evidence suggesting that wars or military rivalry are likely drivers of educational reform, while democracy may not be. In the next section, we turn to a more systematic empirical analysis of the relationship between primary enrollment, military wars or rivalry, and democracy.

3   Data and Specifications

3.1   Sources and Variable Definitions

Education   To investigate the determinants of mass education reforms empirically, we use an unbalanced panel with annual data for 137 countries between 1830 and 2001. Our main dependent variable, *enrollment*, measures primary enrollment per capita. It is defined according to the UNESCO criteria and expressed per 10,000 inhabitants. The underlying data are drawn from the CNTS Data Archive of Banks (2011). In a first set of regressions, we use primary enrollment as a continuous dependent variable. Since it is constructed as enrollment per capita, rather than enrollment per school-age child, this measure is affected by shifts in the demographic structure of the population. We therefore control for population growth in the previous 10 years to mitigate this concern.

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[14]In France, measured literacy rates were already high prior by 1870. Yet the Jules Ferry reforms of the 1880s raised the average educational level of the French population to a considerable extent compared to what it was before 1880.

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We also analyze the probability of education reforms, where 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 the previous 5-year period. When we perform the analysis of imputed reforms, we collapse the data into five-year averages so as to minimize measurement error. For a reduced sample of 14 European countries (over the period 1830 to 1975), a binary *known reform* variable is set equal to one in years when new education reforms were adopted. The latter entail any new law which extends compulsory education, lowers the cost of education (e.g., abolish school fees, provide for free primary education), or increases the number of schools (e.g., by making it compulsory for each municipality to set up at least one primary school). The source for this variable is Flora (1983).

War Threats   We measure war risk and vulnerability to military threats in two alternative ways. Recent experience of external war is likely to raise the perceived likelihood of a new conflict and the salience of military concerns in policy decisions. Hence, our first variable *war risk* is a binary indicator set equal to one if the country was engaged in an interstate war in the previous 10 years, 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) measure of the number of casualties as a percentage of the pre-war population.

This measure of war risk is, of course, completely backward-looking and may therefore miss emerging threats without a history of war. Our second measure, *military rivalry*, is less subject to this concern. Here, we define a dummy variable for whether a country has a strategic rival in a given year according to Thompson (2001). Thompson's measure captures the risk of armed conflict with a country of significant relative size and military strength. It is based on contemporary perceptions by political decision-makers, gathered through the investigation of historical sources on foreign policy and diplomacy. Specifically, military rivalries are identified by three criteria: whether two countries regard each other as "(a) competitors[15]; (b)

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[15] "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

a source of actual or latent threats that pose some possibility of becoming militarized; (c) enemies" (see Appendix for details). 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 army sizes. To this end, we draw military personnel numbers from the COW National Material Capabilities database.

Political Regimes The political regime is constructed from the institutionalized autocracy and democracy scores in the Polity IV database (*polity2* variable), which are themselves combinations of constraints on the executive, the openness and competitiveness of executive recruitment, and the 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.

Covariates Finally, our regressions include several control variables. Military expenditure and total population are drawn from the COW National Material Capabilities. Fiscal capacity is proxied by a dummy variable equal to one whenever the country has a (permanent) income-tax system in a particular year. Information on the date of introduction of an income tax is available for 76 countries and comes from Besley and Persson (2011). We use data for GDP per capita, converted to US dollars, from Penn World Tables 7.0 and CNTS, as well as measures of government expenditures per capita from the WDI and CNTS databases.

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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. [...] Threatening enemies who are also adjudged to be competitors in some sense, as opposed to irritants or simply problems, are branded as rivals. This categorization is very much a social-psychological process. 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)

3.2 Specifications

Our baseline regression equation is expressed as:

$$enrollment_{i,t} = \alpha_0 + \alpha_1 war\ risk_{i,t} + \alpha_2 democracy_{i,t} + \tag{1}$$
$$\alpha_3 war\ risk_{i,t} \cdot democracy_{i,t} + \alpha_4 X_{i,t} + \nu_i + \delta_t + u_{i,t} \ ,$$

where $enrollment_{i,t}$ refers to the primary enrollment rate in country i and year t. Our main coefficient of interest is α_1, which captures the effect of the war risk faced by country i in year t. As explained above, this military threat is measured either by having had a war some time in the past 10 years (i.e., between years $t - 10$ and $t - 1$) or by having at least one strategic rival in year t as defined above. We also include $democracy_{i,t}$, the democracy index in country i at time t, and an interaction term between war risk and democracy, as well as a set of control variables $X_{i,t}$. Finally, and importantly, the specification entails country fixed effects ν_i, and year fixed effects δ_t. Hence, the effects we estimate are identified from the variation over time within countries of the right-hand side variables relative to their world average levels..

We also estimate the probability of a discrete education reform according to the following Probit specification:

$$\Pr(reform_{i,t}) = \beta_0 + \beta_1 war\ risk_{i,t} + \beta_2 democracy_{i,t} + \tag{2}$$
$$\beta_3 war\ risk_{i,t} \cdot democracy_{i,t} + \beta_4 X_{i,t} + \eta_i + \mu_t + v_{i,t} \ ,$$

where the $reform$ variable is either *imputed reforms* (for the entire sample of countries) or *known reforms* (for the historical European sample).

Our main prediction is that the coefficients which capture the effect of war risk on education policy should be positive. We exclude countries at war from the sample, as an ongoing war (as opposed to a latent rivalry) may severely increase the opportunity cost of public funds. Maybe more importantly, data in times of war may also be unreliable. The expected coefficient on democracy is not clear a priori. On the one hand, the median voter in a democracy may be poorer than in an autocracy and thus more favorable to mass education. On the other hand, a rent-seeking policymaker in an autocracy may be more likely to appropriate the future benefits of higher income due to education investments, and therefore more inclined to incur the cost of educational reforms than a democratic government.

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3.3 Descriptive Statistics

Descriptive statistics for the annual data underlying the specifications with continuous primary enrollment (as in (1)) as the left-hand side variables are shown in Table 2. These data are averaged over 5-year periods for the specifications with imputed reforms (as in (2)) as the left-hand side variable. As the table shows, 16% of the country-years in our sample have a war in the previous 10 years, around 50% are associated with one or more strategic rivalries, and 4% involve war with another state. Of the country-years in the sample, about 42% have positive values of the democracy score, with a mean score of -0.37. We see a large variance in the severity of war threats either in terms of the number of casualties in past wars, or in terms of the relative size of the military in the largest rival (or the sum of rivals) vs. the country itself.

Table 2 about here

4 Empirical results

4.1 Primary Enrollment Rates

Baseline Results   Table 3 shows the results from our baseline estimation of (1) on the yearly panel, with primary enrollment rates as the dependent variable and war risk measured by the presence of an ongoing military rivalry. All specifications include 10-year population growth, to account for varying shares of school-age children in total population, as well as military expenditure per capita, to control for the possibility that military spending may crowd out education spending. Indeed, we find that high population growth rates are consistently associated with higher primary enrollment per capita, while military spending – holding constant the level of external threats – has a negative coefficient. A natural interpretation of the latter is that fiscal capacity is limited, so that more effort towards building an army restricts the ability of the government to invest in mass education.

Column 1 shows that the correlation between rivalry and primary enrollment is positive and significant. In column 2, we add the democracy score. Interestingly, when faced with the same level of military threats, autocracies invest more in education than democracies. This finding runs counter to the median voter view of mass education reforms, which would predict better

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education outcomes in more democratic countries. Also, the coefficient on military rivalry remains stable as we control for the political regime, which appears inconsistent with the view that democratization *per se* would be the main underlying force behind increases in primary enrollment across countries. In column 3, we add an interaction term to check if the impact of rivalries on educational investments differs by political regime. We find that primary enrollment responds more positively to military threats in democracies than in autocracies. We discuss the democracy results in Subsection 4.3 below.

Covariates In columns 4 and 5, we include the relative strength of rivals, defined as the military size of the largest rival (column 4) or of the sum of rivals (column 5), in both cases divided by the size of the country's own military. The point estimates suggest that countries with stronger rivals (i.e., with a higher risk of losing a potential war) have higher enrollment rates, magnifying the effect of war threats for countries more likely to lose war if a war were to occur. However, this magnification effect is not statistically significant. Finally, in column 6, we control for total government expenditures per capita. Our main results are unchanged, namely the presence of a strategic rival is associated with higher enrollment in primary education, democracies have less primary education, while the interaction between the democracy indicator and military rivalry is positive. In addition, the relative strength of rivals is now significantly associated with higher enrollment rates.

<div align="center">**Table 3 about here**</div>

Past Wars Instead of Rivalries Table 4 presents the same set of regressions, except that we replace military rivalry by the occurrence of a war in the past 10 years, distinguishing also between won and lost wars. Our main finding is that primary enrollment responds positively and significantly to a war in the past 10 years. Systematically, this effect appears stronger if the war was won than if it was lost. This finding goes against the view that past wars might favor future education investments because defeats weaken incumbent elites that might oppose mass education. A higher number of casualties, gauging the intensity of the recent war, tends to magnify the impact of recent wars on education, but the coefficient is only significant for wars won. Consistent with our previous set of results, we find that everything else equal, autocracies invest more in education than democracies. However, the

interaction between democracy and past wars now appears to be negative (in the case of lost wars).

Table 4 about here

4.2 Education Reforms

Next, we consider the effect of war risk on the probability of an educational reform, based on the probit regression in (2). Table 5 looks at the effects of military risk or rivalry on imputed reforms (i.e., a 10% or higher increase in primary enrollment over a five-year period). Consistent with our predictions, we find that 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 index still enters negatively, and its interaction with rivalry is positive although not significant, consistent with the previous tables. Finally, neither population growth, nor total government expenditure, nor military expenditure, show significant coefficients when democracy is included in the regression.

Table 5 about here

In Table 6, we study the effect of military threats on known reforms which broaden access to primary or secondary education. We restrict our attention to the subsample of 14 European countries for which these data are available since 1830. The results are weaker than in the previous regressions, which is not surprising with such a small number of countries. In particular, we find no effect of democracy and 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.

Table 6 about here

4.3 The Political Regime

Our estimates are striking in that they imply that democratic countries invest less in primary education and pursue less education reforms than autocratic countries, absent rivalries or war threats. However, the gap between democracies and autocracies narrows when war risk is high.

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The nature of the political system may affect education policy along several channels. As mentioned already in the introduction, extending the franchise might foster policies in the interest of the poor, which may include publicly funded primary schooling. But we find little evidence supporting this hypothesis.[16] A prospective mechanism leading in the opposite direction is that democratically elected leaders have higher turnover – and therefore supposedly shorter time horizons – than autocrats, which may make the former less willing to invest in mass-education policies with mainly long-term benefits. A third channel could conceivably run through the effect of rivalries and wars on regime change: wars might affect education spending mainly because they promote regime change, which in turn affects education policy. However, our findings do not support this idea, since the direct estimates of military rivalry on education remains unchanged when we hold constant the political regime. Instead, our results suggest that war threats or past wars tilt the preferences of the elite towards mass education, even in autocratic regimes where more schooling might imply a higher risk of the leader being ousted.

While the positive interaction effect is an intriguing finding which remains to be understood, our results thus suggest that military competition between states has played a more important role for the emergence of mass education than has democratization. (Section 5 below gives an attempt of a theoretical rationalization.)

Disaggregating Democracy But maybe the concept of democracy is too broadbrush to help us understand the mechanisms at work. To make further progress, we try to disentangle the effects of two main components of the democracy score: constraints on the executive and the openness of executive recruitment. In Table 7, we thus run our main specifications, letting each of these two aspects of democracy enter separately on the right hand side. Specifically, we use *constraints on the executive* (*xconst*) in the Polity IV database, which takes values between 1 and 7, and *openness of executive recruitment* (*xropen*) in the same database, which takes values between 1 and 4.

Panel A 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

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[16]As mentioned earlier, Bursztyn (2011) questions the impact of democratization on education spending based on the Brazilian example.

executive openness is negatively correlated with the enrollment rate, while executive constraints are not. However, when we introduce interaction terms between rivalry and one particular aspect of democracy in Columns 2 and 4, both direct effects are negative and significant. The interactions with rivalry are both positive and statistically significant. In Columns 5 and 6, we perform a horse race between the two measures of democracy, with or without our interaction terms. The estimates show that the direct influence of each component of democracy remains, albeit with a larger interaction term for executive openness.

Panel B considers the same specifications as Panel A, but with the probability of an imputed reform replacing primary enrollment as the dependent variable. In columns 1 and 3, constraints on the executive as well as openness of recruitment are negatively and significantly correlated with education reforms. When looking at interactions between rivalry and these two measures of democracy in columns 2 and 4, however, none of the interactions comes out significant.

Overall, both measures of democracy appear to have a negative and significant direct effect, regardless of how we measure mass education. Results for the interaction effects are somewhat less clear. Taken together, the disaggregated results do not shed all that much light on the underlying mechanism whereby political regimes influence mass education.

<div align="center">**Table 7 about here**</div>

4.4 Instrumental Variables Estimation

We have established a positive relationship between military rivalry and primary education outcomes, as well as a positive interaction between rivalry and democracy. Still, there might be concerns regarding the direction of causality. More educated countries may be more prone to have rivalries for other reasons than the hypothesized effect of primary education on their military efficiency. To disentangle the direction of causality, we use an instrumental-variables approach with two different instruments, both of which rely on the regional context in which rivalries are embedded.

Commodity-Price Approach Our first IV-approach relies on data for commodity prices. Positive shocks to the price of natural resources or agricultural commodities likely foster rivalries, as states will compete for control

of more valuable resources. We do not use shocks affecting a country's own commodity prices, which may affect education through other channels than the emergence of rivalries, e.g., through their effect on the fiscal balance. Instead, our instrument is constructed exclusively from shocks to neighboring countries, which are the most likely potential rivals. The total commodity price shock variable, available for 155 countries over the period 1960-2000, comes from Aghion et al. (2010). It is a composite measure calculated from yearly changes in the prices of 42 commodity categories, weighted by their average shares in the country's total exports in 1985-1987. For each country i, we define our instrument $shock\_contig_{i.t}$ as the fraction of its bordering countries that experienced a positive commodity price shock of more than one standard deviation in year t. We include $shock\_contig$ and up to three lags of this variable as instruments in the first stage. In the second stage, we control for the country's own commodity price shock (again, set equal to 1 if the shock is above one standard deviation in a given year). This is to rule out that the exclusion restriction is violated because of correlated commodity prices, due to similar crop choices (soil qualities) and mineral availability among neighboring countries.

The main results of the IV estimation are shown in Table 8. The first stage is a Probit regression for the likelihood of observing a strategic rivalry. We see from these regressions that current or recent positive commodity price shocks in neighboring countries do raise the probability of engaging in a strategic rivalry. (We have tested for more lags, results not reported, and found only non-significant coefficients after year 3.) In the second stage, we confirm a positive effect of rivalry on primary education and a negative effect of the democracy score. In columns 1 and 2, we run the regression without fixed effects. We find that rivalry has a positive and significant effect on primary enrollment rates. Surprisingly, the coefficient on the *democracy* (*polity2*) score turns out positive. However, when we include country and year fixed effects in columns 3 and 4, the same regressions yield a negative coefficient on democracy, indicating that the positive correlation was due to time-invariant country characteristics. The coefficients on military rivalry remain positive, significant and larger than their OLS counterparts. These IV results lend support to our claim that causality runs from military threats to education policies rather than from education levels to the aggressiveness of foreign policy.

Table 8 about here

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Rivalries Approach Our second IV-approach relies more directly on the strategic rivalries data. It captures the exogenous component, from the perspective of a given country, of the competition between its neighbors. Specifically, this instrument *rivalry_contig* is constructed, for each country i, from rivalries of a neighboring state j with other countries k. For country i, *rivalry_contig$_{i,t}$* is defined as the number of rivalries between bordering states j and other countries $k \neq i$, weighted by the inverse of the distance between the countries i and j, in year t. In this calculation, we restrict attention to neighbors j which are not too small or too large relative to country i to be credible rivals, using the criterion that neighbors must have at least 30% of the population of country i and vice versa. Hence, *rivalry_contig* measures how prone the immediate regional environment of country i is to military rivalries. We also use the interaction of *rivalry_contig* and the *democracy (polity2)* score to instrument for the interaction term between military threats and *democracy*.

Table 9, panel A shows the estimates of the first-stage regressions. They show that *rivalry_contig* has predictive power for the probability that a country is engaged in a strategic rivalry, and its interaction with the democracy score is positively and significantly associated with the interaction of rivalry and *democracy*. The F-tests confirm that our instruments are not weak. Panel B of the table displays the second-stage estimates. In columns 1 and 2, the first stage is a probit regression for the probability of rivalry. In columns 3 to 5, the first stage is a OLS regressions of rivalry and its interaction with *democracy* on our instruments and controls. The IV regressions show again a positive and significant effect of rivalry on primary enrollment rates, as well as a negative direct coefficient on democracy and a positive and significant interaction term.

These regressions exclude Western European countries, because our instrument does not capture adequately the historical determinants of rivalry in Western Europe. Most European countries in our sample were involved in treaties or alliances throughout the period considered. This makes it hard to believe that country i would not directly interact with third parties k that a neighboring country j face as rivals – such direct interaction between i and k would violate the exclusion restriction. It may also be that states involved in other rivalries did not raise the external threat perception of bordering countries, if they were bound together by alliances. Indeed, the simple correlation between the instrument and rivalry is positive and significant in all other regions, but negative in Western Europe suggesting that rivalries in

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this area are of a different nature.[17].

<div align="center">**Tables 9 about here**</div>

4.5   Robustness Checks

In this section, we run a series of robustness checks to test the validity of our baseline results.

Industrialization and Urbanization   First, democracy may be correlated with the level of industrialization and urbanization. If an educated military is more valuable in more industrialized countries, where the army requires more skills, we may be concerned that our interaction term between rivalry and democracy is picking up this effect. In Table 10, we add as control variables several measures of industrial development and their interaction with rivalry: the share of industrial activities in GDP (available for 1946-2000), the share of population living in cities of 50,000 or more inhabitants, and the share of population living in cities of 20,000 or more inhabitants (drawn from Banks, 2011).

Most importantly, our results on democracy are unchanged: its direct coefficient is negative, its interaction with rivalry is positive, and both are significant. Moreover, as expected, more industrialized and more urbanized countries have higher rates of primary enrollment. Interestingly, we do find that enrollment responds more to military threats in countries with a larger share of industrial activities and a larger share of urban population. For a country which has a score of 0 on the *polity2* scale, the point estimates suggest that the effect of military rivalry on primary education becomes positive around a 20% share of industry in value added, or around a 10% share of population living in cities of at least 50,000 people. In short, rivalry is positively associated with primary enrollment except for the least urbanized and least industrialized countries.

<div align="center">**Table 10 about here**</div>

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[17]As it turns out, including Western European countries into this regression leads to coefficients on rivalry that are about ten times higher than those in Table 9, Panel B.

Other Covariates and Sample Selection   We perform several other robustness tests on our baseline specification in Table 11. In column 1, we include the index of ethnic fractionalization from Alesina et al. (2003), as well as its interaction with rivalry. Ethnic diversity has been shown to affect the amount of social spending and in particular education investment. We find that more fractionalized countries have higher enrollment rates, but the effect of rivalry on primary enrollment decreases with ethnic fractionalization. Yet, our main coefficients remain unaffected. In column 2, we include the primary enrollment rate of the rival. Consistent with our intuition, the results show that countries increase their enrollment rates more when their rivals have more educated populations, and therefore presumably more effective armies. In column 3, we add 10-year lagged enrollment to control for initial conditions. As expected, primary enrollment displays high serial autocorrelation, but our main coefficients of interest are unchanged. In column 4, we check that our results do not reflect an entirely European story by excluding Western Europe from the sample. Again, our results are robust to this change, and the coefficients on rivalry actually increase. In column 5, we account for the possibility that country-specific factors may vary over the sample period, by interacting country fixed effects with dummies for before and after 1950. Finally in column 6, we add continent-specific time trends to the regression. Each time we find that primary enrollment rates are higher, all things equal, in countries engaged in a military rivalry, and that the effect of a rivalry is stronger in more democratic countries.

Table 11 about here

Alternative Measure of Education   We also compare our baseline results with those obtained with an alternative measure of primary schooling, namely education attainment from the Barro-Lee (2010) data set, available at five-year intervals for the postwar period only. We run the specifications of (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. Table 12 presents the results. 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 3 – a (weakly) positive effect of rivalry, a negative effect of democracy, and a positive interaction term. The results are somewhat weaker with the recent occurrence of

an external war as the threat variable, but the positive effect of a recent war is significant.

Table 12 about here

Military Expenditures   As a check that education investments are indeed driven by military concerns, we also run our baseline regression replacing education with military expenditure per capita as the left-hand side variable. As we can see in Table 13, we find the same pattern for military spending as we did for primary education enrollment: military spending responds positively to strategic rivalries and it is higher in less democratic countries.

Table 13 about here

Education as a Means to Win Future Wars   The motive for investing in mass education in our narrative above, as well as our theory below, is that a more educated population is more effective at fighting wars. If we regress the probability of winning the next war, conditional on a war outbreak in the next 10 years, we do find that it is positively and significantly associated with current primary enrollment. The regressions are shown in Table 14. Together with the historical evidence outlined in Section 2, these findings support the view that military threats spur investments in mass education in order to build more effective armies. We also find that primary education has some predictive power on the probability of observing a war in the near future.

Table 14 about here

Other Robustness Tests[18]   We have performed other robustness tests as well. One is to consider yet another measure of external threats, based on future conflicts. If countries correctly anticipate war risks, the incidence of future wars should proxy for military threats *ex ante*. This proxy is more vulnerable to endogeneity concerns than our rivalry or past war data, as the willingness to engage in wars can be influenced by past education levels. Despite this word of caution, it provides a useful check to our main hypothesis.

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[18]To save space, we do not show the corresponding regression results. These are available upon request.

We run (1), but measure war risk by a binary variable that takes a value of one if and only if a war breaks out in the following 10 years. Our results are the same in the basic specification, namely: future wars enter positively in the enrollment regression, democracy enters negatively, and the interaction term is positive.

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 five years, instead of 10%. The signs of the coefficients on rivalry and on the democracy score are similar to those obtained with our baseline specification, although the interaction term between rivalries and democracy is no longer significant.

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

5   A Simple Theory

How can we understand the empirical results summarized at the end of the previous section? This is certainly not obvious, but in this section we propose a simple theoretical model that may help rationalize our main findings. In line with the historical discussion and the focus of our empirical work, the model highlights the prospective role of public education in the efficient operation of the military.

Basic Setup   The formal model we develop borrows in spirit from the state-capacity framework of Besley and Persson (2009, 2011), from the voter participation frameworks by Feddersen and Sandroni (2002) and Coate and Conlin (2004), and from the analysis by Ticchi and Vindigni (2009) of fighting incentives across different political regimes. Consider a society, where the population is normalized to unity and divided into two equally large and homogenous groups (with regard to education) of risk-neutral individuals, $J = I, O$. There are two time periods. Output per capita in each period –

equal to total resources and the tax base – is exogenous and constant over time and normalized to $\frac{1}{2}$. All consumption takes place at the end of the second period.

One of the groups serves as the incumbent in both periods (thus there is no political turnover). Among political institutions, we focus on the constraints on the executive. These are modeled as a share of output δ that the incumbent group, I, must grant to the opposition group, O – thus a higher value of δ captures more democratic institutions in the sense of higher checks and balances (protecting opposition groups from discretionary redistribution). A war can occur in period 2 with exogenous probability p. For simplicity, all (accumulated) income perishes from the country as a whole – i.e., to both groups – if a war is lost.

The conditional 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 an individual specific utility cost that is decreasing in the level of education e. We assume a very simple cost function $\frac{x}{e}$, where variable x is individual-specific and uniformly distributed on $[0, 1]$ in each group. Any individual in group J will follow a behavioral rule to expend his unit of effort if $\frac{x}{e} < \frac{\omega_J}{e}$, where ω_J is the rule set by group J members, which if followed by all other members of the group, maximizes the group's aggregate utility (in Feddersen and Sandroni's language, each individual member of group J wants to "do her part" to maximize the group's utility).

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

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

where we assume that $\alpha < 1$. This formulation assumes that (aggregate) efforts of the two groups are complementary. This could be for geographical reasons: if the two groups inhabit different parts of the country's territory, effort is needed along different parts of the border. Another possibility is that the groups represent an dominant elite from which officers are drawn and a large non-elite from which common soldiers are drawn: again, effort is needed from both groups.

Thus, education in this basic model only serves to cut the cost of each individual's perceived fighting effort, but it is straightforward to let output depend on the level of education (see further below). The level of education

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

Timing   The timing of the model is as follows

1. In period 1, the incumbent makes investment e in future education

2. At the beginning of period 2, a war with a foreign power erupts with probability p.

3. If war has erupted, members of each group choose the behavioral rule for effort choice, thus setting ω_I and ω_O. Individual members of each group observe the individual component of their effort cost x and then choose whether to expend one unit of effort at cost $\frac{x}{e}$.

4. If a war has erupted, it is won with probability q.

5. If no war has erupted or a war has been won, the incumbent group consumes $1 - \delta$, while the opposition group consumes δ.

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

Thus, group O solves

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

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

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

Simple algebra gives us:

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

In equilibrium, the conditional probability of winning a war q becomes[19]:

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

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

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

The first-order condition becomes:

$$C'(e) = p(1-\delta) \frac{\partial q^*(e, \delta)}{\partial e} , \tag{3}$$

or

$$\gamma e^{\gamma-1} = \frac{p(1-\delta)}{2-\alpha} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right] e^{\frac{2(\alpha-1)}{2-\alpha}} ,$$

which implies equilibrium educational investment

$$e = \left\{ \frac{p(1-\delta)}{\gamma(2-\alpha)} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right] \right\}^{\frac{2-\alpha}{(\gamma-1)(2-\alpha)+2(1-\alpha)}} . \tag{4}$$

Equation (4) immediately implies that for γ sufficiently large the expression $q^*(e, \delta) = \frac{1}{\alpha} e^{\frac{\alpha}{2-\alpha}} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right]$ strictly lies between 0 and 1, as claimed earlier.

Comparative Statics One can now show:

Proposition 1 *For δ small enough and γ large enough that we do not run into corners, equilibrium investment in education e, is increasing in the risk of war, p, and positively affected by the interaction between democracy δ and the risk of war p, namely: $\frac{\partial e}{\partial p} > 0$ and $\frac{\partial^2 e}{\partial p \partial \delta} > 0$.*

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[19]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.

Proof. Part 1 follows straightforwardly from (4); Part 2 follows from the fact that:

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

where

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

But one can verify that

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

where the first term in the RHS of the above equation remains bounded when $\delta \to 0$ whereas the second term becomes arbitrarily large. This establishes the Proposition. ∎

Intuitively, these results of our model capture a relatively simple idea. 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 democracy in the form of some checks and balances, however, opposition-group members do not benefit a great deal from the economy's resources. Therefore, they have weaker incentives to exert fighting effort than members of the incumbent group – this mechanism is similar to the one in Ticchi and Vindigni (2009). If the efforts by the incumbent and opponent groups are sufficiently complementary ($\alpha < 1$), this incentive gap may lower the prospects of winning a war to such an extent that investments in education respond less to a higher war threat in autocracies than in democracies.

As it stands, the above model does not predict different signs for the direct effect of democracy on education $\frac{\partial e}{\partial \delta}$ and the interaction effect $\frac{\partial^2 e}{\partial p \partial \delta}$. However, once we allow output y to also depend positively on education, then the direct effect of democracy can become negative. For example, suppose that $y = y(e) = 1 + \beta e$, with β small. For small enough β, it is still the case (by continuity) that for sufficiently low δ : $\frac{\partial e}{\partial p} > 0$ and $\frac{\partial^2 e}{\partial p \partial \delta} > 0$. But in addition, we also obtain $\frac{\partial e}{\partial \delta} < 0$. To see the latter, note that in the extended model, the first-order condition for e becomes

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

33

where $y'(e) = \beta > 0$.

In the absence of military rivalry, i.e., for $p = 0$, we can write equilibrium educational investment as

$$e = \left[\frac{(1-\delta)\beta}{\gamma} \right]^{\frac{1}{\gamma - 1}} .$$

Clearly, education is now decreasing in democracy parameter δ. By continuity, the results remains true for p sufficiently small.

Intuitively, democracy has a direct negative effect on the motives to invest in education, simply because stronger checks and balances reduce the incumbent's residual claim on the additional output generated by education.

An Auxiliary Prediction   The unverifiable and complementary decisions on fighting effort by the two groups are the drivers of the model's positive interaction effect between military threats and democracy. But for other types of physical investments, their contribution to military success presumably depend less on such efforts. Following this logic, military rivalry might affect other measures of state capacity such as infrastructure, but the interaction between rivalry and democracy should be less significant. We confront this auxiliary prediction of the model with data on the length of paved roads from Calderón and Servén (2010), which covers 97 countries over the period 1960-2000. Table 15 shows the results of estimating our main specification with the yearly percentage change in the length of paved roads as the left-hand side variable. While military rivalries still drive this type of investment, we find no effect – neither directly nor through the interaction term – of the political regime on road-building.

Table 15 about here

6   Conclusion

We have argued that military rivalry is an important factor behind countries' decisions to invest in mass primary education. Democratization does not seem to play an important role, even though primary enrollment appears to respond more to threats in democracies than in autocracies. Moreover, a more severe war, as measured by a higher number of casualties, tends to

magnify the impact of recent wars on education, whereas the impact of military rivalry on primary education is larger in more industrialized countries and in those facing stronger and more educated rivals.

Our approach could be extended in several directions. A first would be to investigate if economic rivalry – e.g., measured by trade competition – has a similar effect on education policies as military rivalry. A second direction would be to endogenize fiscal capacity and in particular look at how much current or past military rivalry affects future fiscal capacity. Yet, another would be to consider not only the size of primary enrollment, but also the governance of primary (and secondary) schools. Recent work by Algan, Cahuc and Shleifer (2011) 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. Our conjecture is that primary-education reforms primarily driven by past military rivalry, should put vertical systems in place, which may prevail still today. This and other extensions are left for future research.

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A   Data Appendix: Strategic Rivalries

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

1. "Strategic rivals must be independent states, as determined by Gleditsch and Ward's (1999) inventory of independent states.

2. Beginning and ending dates are keyed as much as possible to the timing of evidence about the onset of explicit threat, competitor, and enemy perceptions on the part of decision-makers. Historical analyses, for instance, often specify that decision-makers were unconcerned about a competitor prior to some year just as they also provide reasonably specific information about the timing of rapprochements and whether they were meaningful ones or simply tactical maneuvers. (...)

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

3. No minimal duration is stipulated in advance (...)

4. Various constituencies within states may have different views about who their state's main rivals are or should be. Unless they control the government, constituency views are not considered the same as those of the principal decisionmakers. If the principal decision-makers disagree about the identity of rivals, the operational problem then becomes one of assessing where foreign policy-making is most concentrated. (...)

5. If two states were not considered rivals prior to the outbreak of war, they do not become rivals during the war unless their rivalry extends beyond the period of war combat. This rule is designed to avoid complications in assessing the linkages between rivalry and intensive forms of conflict. (...)

6. One needs to be especially skeptical about dating rivalry terminations. Some rivalries experience short-lived and highly publicized rapprochements that turn out to be less meaningful than one might have thought from reading the relevant press accounts at the time. Some rivalries enter long periods of hibernation only to erupt suddenly as if nothing had changed. All of these situations may share the outward appearance of rivalry termination. What needs to be manifested is evidence of some explicit kind of a significant de-escalation in threat perceptions and hostility. (...)

7. The most valuable sources for information pertinent to identifying strategic rivalry are political histories of individual state's foreign policy activities."

B Data Appendix: Primary Enrollment, Wars and Democratization

This Appendix presents the data underlying Table 1. For each of the 53 countries for which we have more than 40 years of education data, we list (i) the 20-year period with the highest observed increase in primary enrollment rates; (ii) the date, if any, in which the country became a democracy as measured by crossing the threshold of 6 in the *polity2* scale; (iii) the wars in which the country was engaged in the 20 years prior to the observed surge in primary education.

Country	Availability of data on primary enrollment rate	Education reform period (20-year period with greatest increase in primary enrollment)	Date of democractic transition (*)	Rivalries and wars starting in a 20-year period before education reform (**)
Afghanistan	1946-1998	1946-1966	Always < 6	Second Afghan Anti-Reform War of 1928-1937 (intra-state) Strategic rivalry with Iran, 1816-1929 Strategic rivalry with Pakistan, 1947–1979 Second World War of 1939-1945
Albania	1919-1998	1934-1954	2002	Strategic rivalry with Greece, 1913-1987 First World War of 1914-1918
Argentina	1882-1998	1889-1919	1983	Lopez War of 1864-1870 Fourth Argentina War of 1870-1871 (intra state) Fifth Argentina War of 1874 (intra state) Argentine Indians War of 1879-1880 (intra state)
Belgium	1860-1980	1889-1919	1853	None
Bolivia	1882-1981	1882-1902	1982	War of the Pacific of 1879-1883 Bolivia-Criollos War of 1870-1871 (intra state war)
Brazil	1868-1981	1946-1966	1985	Second World War of 1939-1945
Bulgaria	1889-1985	1889-1909	1990	Bosnia and Bulgaria Revolt of 1875-1876 (intra state war) Serbian-Bulgarian War of 1885 Strategic rivalry with Greece 1878-1953 Strategic rivalry with Romania 1878-1945 Strategic rivalry with Turkey 1878-1950 Strategic rivalry with Yugoslavia 1878-1954
Canada	1865-1980	1946-1966	1888	Second World War of 1939-1945
Chile	1882-1980	1893-1913	1965	War of the Pacific of 1879-1883
China	1919-1998	1938-1958	Always < 6	Manchurian War of 1929 Intra-Guomindang War of 1929-1930 (intra state war) Second Sino-Japanese War of 1931- Third Sino-Japanese War of 1937-1941
Columbia	1886-1980	1893-1913	1867	None
Costa Rica	1882-1980	1946-1966	1875	Second World War of 1939-1945
Cuba	1902-1980	1954-1974	Always < 6	Second World War of 1939-1945
Czechoslovakia	1919-1992	1943-1963	> 6 in 1918	No data
Denmark	1882-1980	1882-1902	1911	Second Schleswig-Holstein War of 1864
Dominican Republic	1865-1980	1900-1920	1978	None in dataset
Ecuador	1886-1980	1946-1966	1979	Second World War of 1939-1945
Finland	1919-1980	1919-1939	> 6 in 1918	Kinship Wars from 1918-1920
France	1815-1981	1827-1847	1876	Franco-Spanish War of 1823
Germany	1867-1939	1867-1887	1919	Second Schleswig-Holstein War of 1864
Greece	1860-1980	1913-1933	1864	Greco-Turkish War of 1897 First Balkan War of 1912-1913
Guatemala	1882-1980	1947-1967	1996	Second World War of 1939-1945
Haiti	1905-1981	1907-1927	1990	Strategic Rivalry with the United States 1891–1915
Honduras	1882-1980	1946-1966	1982	Second World War of 1939-1945
Hungary	1919-1980	1926-1946	1990	First World War of 1914-1918 Hungarian Adversaries War of 1919
Iran	1889-1980	1889-1909	Always < 6	None

(*) The democratic transition is identified as the first year in which the PolityIV index reached 6.
   (when the PolityIV index is greater than 6 at the beginning of the PolityIV sample, the cell indicates: >6 in *beginning date of sample*)

(**) Wars are identified from the Correlates of War database; strategic rivalries are identified from Thompson (2001).

Country	Availability of data on primary enrollment rate	Education reform period (20-year period with greatest increase in primary enrollment)	Date of democractic transition (*)	Rivalries and wars starting in a 20-year period before education reform (**)
Ireland	1922-1980	1946-1966	Above 6 in 1922	Second World War of 1939-1945
Italy	1882-1980	1889-1919	1947	First Italian-Ethiopian War of 1887
Japan	1867-1998	1867-1887	1952	Convention of Kanagawa of 1854 (with US) Anglo-Japanese Friendship Treaty of 1854 Treaty of Shimoda of 1855 (with Russia) United-States Japan Treat of Amity and Commerce of 1858 Treaty of Amity and Commerce between France and Japan of 1858
Liberia	1887-1980	1946-1966	2006	Second World War of 1939-1945
Luxemburg	1886-1981	1926-1946	No data	First World War of 1914-1918
Mexico	1882-1980	1919-1939	1997	Third Mexican War of 1910-1914 First World War of 1914-1918
Mongolia	1926-1980	1930-1950	1992	Conquest of Mongolia of 1920-1921
Netherlands	1857-1980	1899-1919	1917	First Dutch-Achinese War of 1873-1878
New Zealand	1907-1980	1946-1966	Above 6 in 1907	Second World War of 1939-1945
Nicaragua	1902-1980	1939-1959	1990	No data
Norway	1830-1981	1960-1980	1898	Second World War of 1939-1945 Enduring rivalry with Russia 1956–1987
Panama	1903-1980	1906-1926	1989	Panama seceded from Colombia with the backing of the United States in 1903
Paraguay	1882-1980	1882-1902	1992	Lopez War of 1864-1870
Peru	1886-1980	1930-1950	1980	First World War of 1914-1918
Poland	1919-1980	1946-1966	Above 6 in 1918	Second World War of 1939-1945
Portugal	1854-1980	1854-1874	1911	No data
Romania	1882-1980	1893-1913	1996	None
Spain	1859-1980	1919-1939	1900	Second Spanish-Moroccan War of 1909-1910 First World War of 1914-1918
Sweden	1882-1980	1939-1959	1914	None
Switzerland	1880-1982	1939-1959	Above 10 in 1880	No
Thailand	1887-1980	1919-1939	1992	First World War of 1914-1918
Turkey	1886-1980	1886-1906	1960	Second Russo-Turkish War of 1877-1878
United Kingdom	1860-1980	1860-1880	1880	Second British-Burmese War of 1852 Crimean War of 1853-1856 Anglo-Persian War of 1856-1857 Indian Mutiny of 1857-1859
United States	1825-1982	1860-1880	1809	Mexican-American War of 1846-1847
Uruguay	1882-1980	1946-1966	1952	Second World War of 1939-1945
Venezuela	1886-1980	1919-1939	1958	First World War of 1914-1939
Yugoslavia	1919-1980	1930-1950	2000	First World War of 1914-1939

(*) The democratic transition is identified as the first year in which the PolityIV index reached 6.
  (when the PolityIV index is greater than 6 at the beginning of the PolityIV sample, the cell indicates: >6 in *beginning date of sample*)

(**) Wars are identified from the Correlates of War database; strategic rivalries are identified from Thompson (2001).

**Table 1: Education Surge, Democratization and War:
Historical Episodes**

Country	Greatest increase in primary enrollment	Democratization in preceding 20 years?	War in preceding 20 years?
Afghanistan	1946-1966	No	Yes
Albania	1934-1954	No	Yes
Argentina	1889-1919	No	Yes
Belgium	1889-1919	No	No
Bolivia	1882-1902	No	Yes
Brazil	1946-1966	No	Yes
Bulgaria	1889-1909	No	Yes
Canada	1946-1966	No	Yes
Chile	1893-1913	No	Yes
China	1938-1958	No	Yes
Columbia	1893-1913	No	No
Costa Rica	1946-1966	No	Yes
Cuba	1954-1974	No	Yes
Czechoslovakia	1943-1963	No	No data
Denmark	1882-1902	No	Yes
Dominican Republic	1900-1920	No	No data
Ecuador	1946-1966	No	Yes
Finland	1919-1939	Yes	Yes
France	1827-1847	No	Yes
Germany	1867-1887	No	Yes
Greece	1913-1933	No	Yes
Guatemala	1947-1967	No	Yes
Haiti	1907-1927	No	Yes
Honduras	1946-1966	No	Yes
Hungary	1926-1946	No	Yes
Iran	1889-1909	No	No
Ireland	1946-1966	No	Yes
Italy	1889-1919	No	Yes
Japan	1867-1887	No	Yes
Liberia	1946-1966	No	Yes
Luxembourg	1926-1946	No data	Yes

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Country	Greatest increase in primary enrollment	Democratization in preceding 20 years?	War in preceding 20 years?
Mexico	1919-1939	No	Yes
Mongolia	1930-1950	No	Yes
Netherlands	1899-1919	No	Yes
New Zealand	1946-1966	No	Yes
Nicaragua	1939-1959	No	No data
Norway	1960-1980	No	Yes
Panama	1906-1926	No	Yes
Paraguay	1882-1902	No	Yes
Peru	1930-1950	No	Yes
Poland	1946-1966	No	Yes
Portugal	1854-1874	No	No data
Romania	1893-1913	No	No
Spain	1919-1939	Yes	Yes
Sweden	1939-1959	No	No
Switzerland	1939-1959	No	No
Thailand	1919-1939	No	Yes
Turkey	1886-1906	No	Yes
United Kingdom	1860-1880	No	Yes
United States	1860-1880	No	Yes
Uruguay	1946-1966	No	Yes
Venezuela	1919-1939	No	Yes
Yugoslavia	1930-1950	No	Yes

Table 2: Summary Statistics (yearly data)

Variable	Obs	Mean	Std. Dev.	Min	Max
Enrollment per 10,000	6939	1052.99	528.29	1	3023
Rivalry	6939	0.496	0.500	0	1
Rel. army largest rival	6359	1.106	2.777	0	56
Rel. army total rivals	6359	1.653	4.303	0	59
War in previous 10 years	6939	0.159	0.366	0	1
Lost war casualties	6939	0.033	0.281	0	7.932
Won war casualties	6939	0.028	0.214	0	3.922
Polity2	6939	-0.369	7.116	-10	10
Population growth (10 yrs)	5401	19.31	14.89	-53.65	178.52
Military expenditure p.c.	6194	48.11	218.98	0	7398.57
Govt expenditure p.c.	6362	161.97	538.71	031	8402.08
Income tax	4207	0.681	0.466	0	1
GDP p.c.	4150	1563.04	3543.89	18	38344.9

Table 3: Primary Enrollment and Military Rivalry

| | | Rate of primary enrollment | | | | |
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	55.843***	54.922***	94.242***	78.431***	77.437***	63.460***
	[17.537]	[17.820]	[17.891]	[19.905]	[19.798]	[20.274]
Polity2		-6.877***	-17.644***	-18.952***	-18.979***	-17.986***
		[1.152]	[1.474]	[1.484]	[1.482]	[1.499]
Rivalry*Polity2			22.261***	23.331***	23.390***	22.420***
			[1.943]	[2.064]	[2.065]	[2.076]
Rel. army largest rival				2.521		
				[2.672]		
Rel. army total rivals					2.157	4.108***
					[1.518]	[1.544]
Govt expenditure p.c.						-0.250***
						[0.014]
Population growth.	9.033***	9.423***	8.811***	9.807***	9.808***	8.962***
	[0.473]	[0.489]	[0.485]	[0.545]	[0.545]	[0.544]
Military expenditure p.c.	-0.885***	-0.898***	-0.885***	-1.150***	-1.148***	-0.337***
	[0.049]	[0.050]	[0.049]	[0.061]	[0.061]	[0.080]
Observations	4849	4636	4636	4285	4285	3995
R-squared	0.675	0.670	0.679	0.697	0.698	0.722

All specifications include country and time fixed effects and standard errors clustered by country.

Standard errors in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4: Primary Enrollment and Recent Wars

	Rate of primary enrollment					
	(1)	(2)	(3)	(4)	(5)	(6)
War in	92.726***	101.734***	105.710***			
previous 10 years	[15.173]	[15.627]	[15.915]			
Won war in				123.198***	105.674***	89.445***
previous 10 years				[20.713]	[21.603]	[20.997]
Lost war in				71.446***	60.262***	26.721
previous 10 years				[20.142]	[21.232]	[21.548]
Polity2		-7.262***	-6.915***	-6.897***	-7.254***	-6.119***
		[1.148]	[1.177]	[1.178]	[1.149]	[1.147]
War in 10 years			-2.716			
*Polity2			[2.065]			
Won war*Polity2					2.051	
					[2.343]	
Lost war*Polity2					-7.495***	
					[2.181]	
Won war casualties					65.060**	73.110***
					[27.147]	[27.568]
Lost war casualties					2.141	-6.476
					[26.933]	[28.124]
Govt. exp. p.c.						-0.275***
						[0.013]
Population growth.	9.191***	9.575***	9.545***	9.475***	9.597***	8.828***
	[0.472]	[0.487]	[0.487]	[0.490]	[0.487]	[0.487]
Military expenditure p.c.	-0.900***	-0.916***	-0.921***	-0.911***	-0.909***	-0.107
	[0.049]	[0.050]	[0.050]	[0.050]	[0.050]	[0.067]
Observations	4849	4636	4636	4636	4636	4307
R-squared	0.677	0.672	0.672	0.673	0.673	0.702

All specifications include country and time fixed effects and standard errors clustered by country.

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Imputed Education Reforms and Military Rivalry

	Probit for "imputed reforms"					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	0.271**	0.177	0.190*	0.347**	0.379***	0.374**
	[0.119]	[0.113]	[0.113]	[0.145]	[0.145]	[0.148]
Polity2		-0.055***	-0.059***	-0.062***	-0.061***	-0.065***
		[0.007]	[0.010]	[0.010]	[0.010]	[0.011]
Rivalry*Polity2			0.009	0.013	0.013	0.019
			[0.014]	[0.017]	[0.017]	[0.017]
Rel. army largest rival				0.007		
				[0.029]		
Rel. army total rivals					-0.005	-0.000
					[0.019]	[0.019]
Govt expenditure p.c.						0.000
						[0.000]
Population growth.	0.009***	0.004	0.004	0.003	0.003	0.002
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Military expenditure p.c.	-0.001**	-0.001**	-0.001**	-0.001	-0.001	-0.001
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1390	1299	1299	1163	1163	1099

All specifications include time fixed effects and standard errors clustered by country.

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Known Education Reforms and Military Rivalry

			Probit for "known reforms"			
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	0.233***	0.235**	0.283*	-0.036	-0.111	-0.021
	[0.085]	[0.092]	[0.144]	[0.234]	[0.237]	[0.213]
Polity2		0.005	0.000	-0.002	-0.000	-0.000
		[0.013]	[0.013]	[0.023]	[0.023]	[0.022]
Rivalry*Polity2				0.033	0.040	0.028
				[0.034]	[0.034]	[0.026]
Rel. army largest rival				0.107***		
				[0.024]		
Rel. army total rivals					0.074***	0.095***
					[0.016]	[0.018]
Govt expenditure p.c.			0.000			0.000
			[0.001]			[0.001]
Population growth	-0.001	-0.000	-0.009	0.006	0.009	0.009
	[0.009]	[0.009]	[0.016]	[0.008]	[0.008]	[0.013]
Military expenditure p.c.	0.000	0.000	0.000	0.001	0.001	0.001
Observations	881	880	826	852	852	798

S.E. clustered by country. Standard errors in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 7: Components of Democracy

Panel A

	Primary enrollment rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	62.892***	-67.565**	71.757***	-181.294***	67.273***	-307.087***
	[18.252]	[28.332]	[20.721]	[63.734]	[20.736]	[65.719]
Exec. constraints	2.782	-17.572***			14.630***	-12.974**
	[3.658]	[4.977]			[4.373]	[5.664]
Exec. const.*Rivalry		36.400***				48.978***
		[6.064]				[6.678]
Exec. openness			-41.348***	-80.415***	-48.924***	-73.776***
			[10.071]	[13.697]	[10.309]	[13.800]
Exec. open.*Rivalry				71.590***		50.794***
				[17.056]		[17.115]
Population growth	9.653***	9.246***	9.741***	9.615***	9.543***	9.023***
	[0.503]	[0.505]	[0.537]	[0.536]	[0.539]	[0.538]
Military expenditure p.c.	-0.847***	-0.843***	-0.835***	-0.822***	-0.817***	-0.800***
	[0.051]	[0.050]	[0.051]	[0.051]	[0.052]	[0.051]
Observations	4481	4481	3995	3995	3995	3995
R-squared	0.671	0.674	0.673	0.674	0.674	0.680

All specifications include country and time fixed effects and standard errors clustered by country.

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Panel B

	Probability of "imputed reforms"					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	0.257**	0.257**	0.316**	0.322**	0.317**	0.322**
	[0.122]	[0.122]	[0.130]	[0.130]	[0.131]	[0.131]
Exec. constraints	-0.006*	-0.007			-0.001	-0.000
	[0.003]	[0.005]			[0.008]	[0.010]
Exec. const.*Rivalry		0.003				0.000
		[0.007]				[0.015]
Exec. openness			-0.006**	-0.007*	-0.004	-0.007
			[0.003]	[0.004]	[0.006]	[0.008]
Exec.open*Rivalry				0.004		0.003
				[0.005]		[0.012]
Population growth	0.009***	0.008***	0.008***	0.008***	0.008***	0.008***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Military expenditure p.c.	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1303	1303	1198	1198	1198	1198

All specifications include time fixed effects and standard errors clustered by country.

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 8: IV – Commodity-Price Approach

	Primary enrollment rate			
	(1)	(2)	(3)	(4)
Rivalry	799.292*	671.247***	292.107	290.874**
	[434.690]	[207.962]	[209.645]	[132.882]
Polity2	6.879***	6.453***	-8.434***	-6.692***
	[1.426]	[1.557]	[1.258]	[1.340]
Military expenditure p.c.	-0.023	-0.064*	-0.134***	-0.124***
	[0.035]	[0.038]	[0.025]	[0.028]
Own country shock	2.846	-9.588	53.349***	
	[41.559]	[38.961]	[18.769]	
Year fixed effects	no	no	yes	yes
Country fixed effects	no	no	yes	yes
First stage: rivalry				
shock_contig	0.364***	0.261**	0.364***	0.261**
	[0.114]	[0.125]	[0.114]	[0.125]
L.shock_contig		0.291**		0.291**
		[0.126]		[0.126]
L2.shock_contig		0.392***		0.392***
		[0.129]		[0.129]
L3.shock_contig		0.297**		0.297**
		[0.144]		[0.144]
Observations	2402	2087	2402	2087

All specifications include country and time FE and SE clustered by country.

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 9: IV – Regional-Rivalry Approach

Panel A: First stage

	Rivalry Probit (1)	Rivalry Probit (2)	Rivalry OLS (3)	Rivalry OLS (4)	Rivalry*polity2 OLS (5)
Rivalry_contig	15.815***	16.024***	13.514***	13.493***	-30.028*
	[2.654]	[2.700]	[1.737]	[1.733]	[15.927]
Polity2		0.007**	-0.001	0.001	0.487***
		[0.003]	[0.001]	[0.001]	[0.012]
Rivalry_contig*polity2				-0.564***	17.403***
				[0.163]	[1.496]
Observations	3455	3379	3379	3379	3379
R-squared			0.772	0.773	0.825
F statistic			1450.28	1401.31	900.28

Other coefficients not reported. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Panel B: Second stage

			Primary enrollment rate		
	(1)	(2)	(3)	(4)	(5)
Rivalry	331.629	277.712	242.998	325.646*	492.938***
	[266.452]	[271.384]	[147.834]	[167.145]	[187.981]
Polity2		-0.508	-0.448	-20.727**	-20.454**
		[1.189]	[1.376]	[8.985]	[8.247]
Rivalry*Polity2				36.408**	37.543***
				[15.819]	[14.482]
Gov't expenditure p.c.					-0.399***
					[0.049]
Population growth	7.570***	7.809***	7.688***	6.829***	5.607***
	[0.441]	[0.452]	[0.725]	[0.833]	[0.769]
Military expenditure p.c.	-0.579***	-0.574***	-0.585***	-0.605***	0.230*
	[0.048]	[0.048]	[0.106]	[0.109]	[0.138]
Endogenous variables	rivalry	rivalry	rivalry	rivalry, rivalry*polity2	rivalry, rivalry*polity2
First stage	Probit	Probit	OLS	OLS	OLS
Observations	3455	3379	3379	3379	3164

All specifications include country and time FE and standard errors clustered by country.

Standard errors in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Western Europe excluded.

Table 10: Robustness: Industrialization and Urbanization

	Primary enrollment rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	60.902***	-148.555***	150.333***	-154.856***	118.140***	-254.160***
	[17.728]	[32.812]	[15.924]	[24.782]	[16.255]	[26.133]
Polity2	-8.452***	-9.117***	-19.069***	-10.909***	-20.662***	-11.825***
	[1.472]	[1.462]	[1.359]	[1.423]	[1.377]	[1.423]
Rivalry*polity2	5.621***	5.973***	21.357***	11.197***	23.297***	12.327***
	[1.779]	[1.765]	[1.734]	[1.810]	[1.750]	[1.803]
Industry/GDP	7.092***	2.886***				
	[0.758]	[0.935]				
Riv.*industry/GDP		7.128***				
		[0.943]				
% Urban (50,000)			8.687***	-0.976		
			[0.832]	[1.016]		
Riv.*% urban (50,000)				14.523***		
				[0.918]		
% Urban (20,000)					5.699***	-1.792**
					[0.700]	[0.797]
Riv.*% urban (20,000)						12.788***
						[0.716]
Observations	3551	3551	5341	5341	5134	5134
R-squared	0.785	0.789	0.712	0.725	0.715	0.732

All specifications include country and time fixed effects and standard errors clustered by country.

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 11: Robustness: Specification and Sample Selection

| | Primary enrollment rate | | | | | |
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	235.331***	162.249	102.291***	185.977***	7.798	120.891***
	[50.843]	[146.363]	[14.971]	[22.597]	[22.872]	[16.390]
Polity2	-6.038***	-89.206***	-5.397***	-8.944***	-8.505***	-2.500**
	[1.836]	[27.911]	[1.187]	[1.753]	[1.272]	[1.245]
Rivalry*polity2	2.733	92.965***	5.597***	14.514***	6.204***	7.671***
	[2.318]	[27.914]	[1.595]	[2.323]	[1.763]	[1.737]
Rel. army rivals		8.685***	-0.707	10.823***	2.664**	1.101
		[1.313]	[1.144]	[1.446]	[1.246]	[1.261]
Ethnic frac.	1,497.845***					
	[332.801]					
Ethnic frac*rivalry	-313.186***					
	[88.696]					
Prim. enrollment rivals		0.185***				
		[0.020]				
L10.primenr			0.803***			
			[0.015]			
Population growth	3.689***	8.957***	3.612***	7.650***	2.880***	5.720***
	[0.566]	[0.655]	[0.454]	[0.513]	[0.474]	[0.445]
Military expenditure p.c.	-0.330***	-0.532***	-0.193***	-0.634***	-0.372***	-0.217***
	[0.042]	[0.067]	[0.051]	[0.065]	[0.048]	[0.053]
Observations	2692	1952	3927	3099	4285	4175
R-squared	0.778	0.838	0.838	0.813	0.842	0.816

All specifications include country and time fixed effects and standard errors clustered by country.

Standard errors in brackets. ***p<0.01,**p<0.05,*p<0.1.. (4) excludes Western Europe.

In (5) country FE are interacted with before/after 1950 dummies. (6) includes continent-specific time trends.

Table 12: Barro-Lee Education Attainment Data

Percentage of primary schooling attained 5 years later by adults 15-19 years old					
	(1)	(2)	(3)	(4)	(5)
Rivalry	3.049*	3.334	3.243		
	[1.844]	[2.595]	[2.571]		
Polity2	-0.365**	-0.345**	-0.346**	-0.196	-0.198
	[0.146]	[0.153]	[0.153]	[0.123]	[0.122]
Rivalry*Polity2	0.452**	0.892***	0.893***		
	[0.206]	[0.257]	[0.257]		
Rel. army largest rival		-0.151			
		[0.641]			
Rel. army total rivals			-0.095		
			[0.558]		
War in previous 10 years				7.032***	
				[2.090]	
War in 10 years*Polity2				-0.164	
				[0.257]	
Won war in previous 10 years					5.247*
					[2.882]
Lost war in previous 10 years					9.188***
					[2.619]
Won war in 10 years*Polity2					0.241
					[0.349]
Lost war in 10 years*Polity2					-0.338
					[0.315]
Military expenditure p.c.	0.006	-0.001	-0.001	0.005	0.005
	[0.004]	[0.005]	[0.005]	[0.004]	[0.004]
Govt expenditure p.c.	-0.002**	-0.001*	-0.001*	-0.001**	-0.001**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Observations	1114	952	952	1114	1114
R-squared	0.112	0.098	0.098	0.116	0.122

All specifications include country and time FE and standard errors clustered by country.
Standard errors in brackets. ***p<0.01,**p<0.05,*p<0.1.

Table 13: Military Expenditure and Rivalry

	Military expenditure per capita				
	(1)	(2)	(3)	(4)	(5)
Rivalry	34.084***	30.979***	31.256***	32.491***	32.841*
	[10.049]	[10.678]	[10.792]	[5.925]	[17.328]
Polity2		-4.206***	-4.291***	-2.984***	-9.043***
		[0.706]	[0.852]	[0.394]	[1.307]
Rivalry*Polity2			0.204	-1.337**	5.498***
			[1.149]	[0.624]	[1.819]
Rel. army largest rival				0.402	
				[0.823]	
Share of industry in GDP					-5.406***
					[0.685]
Population growth.	-1.218***	-1.279***	-1.281***	1.358***	-2.293***
	[0.241]	[0.257]	[0.257]	[0.129]	[0.455]
Observations	9113	8283	8283	6914	5273
R-squared	0.451	0.442	0.442	0.684	0.403

All specifications include country and time FE and standard errors clustered by country.

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 14: Education and Probability of Victory

	Probability of war in next 10 years		Probability of winning if war in next 10 years	
	(1)	(2)	(3)	(4)
Primary enrollment per 10,000	0.001***	0.001***	0.004***	0.009***
	[0.000]	[0.000]	[0.001]	[0.002]
Democracy score	0.004	0.007	0.001	-0.016
	[0.007]	[0.007]	[0.051]	[0.070]
Military expenditure p.c.		0.001***		0.003
		[0.000]		[0.003]
Rivalry		1.499***		-12.780
		[0.125]		[290.386]
Observations	4117	3453	320	280

All specifications include country and time FE and standard errors clustered by country.

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 15: Road Investments, Rivalry and Democracy

	% change in length of paved roads			
	(1)	(2)	(3)	(4)
Rivalry	1.856**	1.801**	1.732**	1.879**
	[0.859]	[0.853]	[0.862]	[0.861]
Polity2		0.035	0.059	0.034
		[0.053]	[0.068]	[0.071]
Rivalry*Polity2			-0.051	-0.048
			[0.089]	[0.090]
Real GDP				4.149*
				[2.465]
Military expenditure p.c.	0.003	0.004**	0.004**	0.005*
	[0.002]	[0.002]	[0.002]	[0.003]
Observations	9113	8283	8283	6914
R-squared	0.451	0.442	0.442	0.684

All specifications include country and time FE and SE clustered by country.

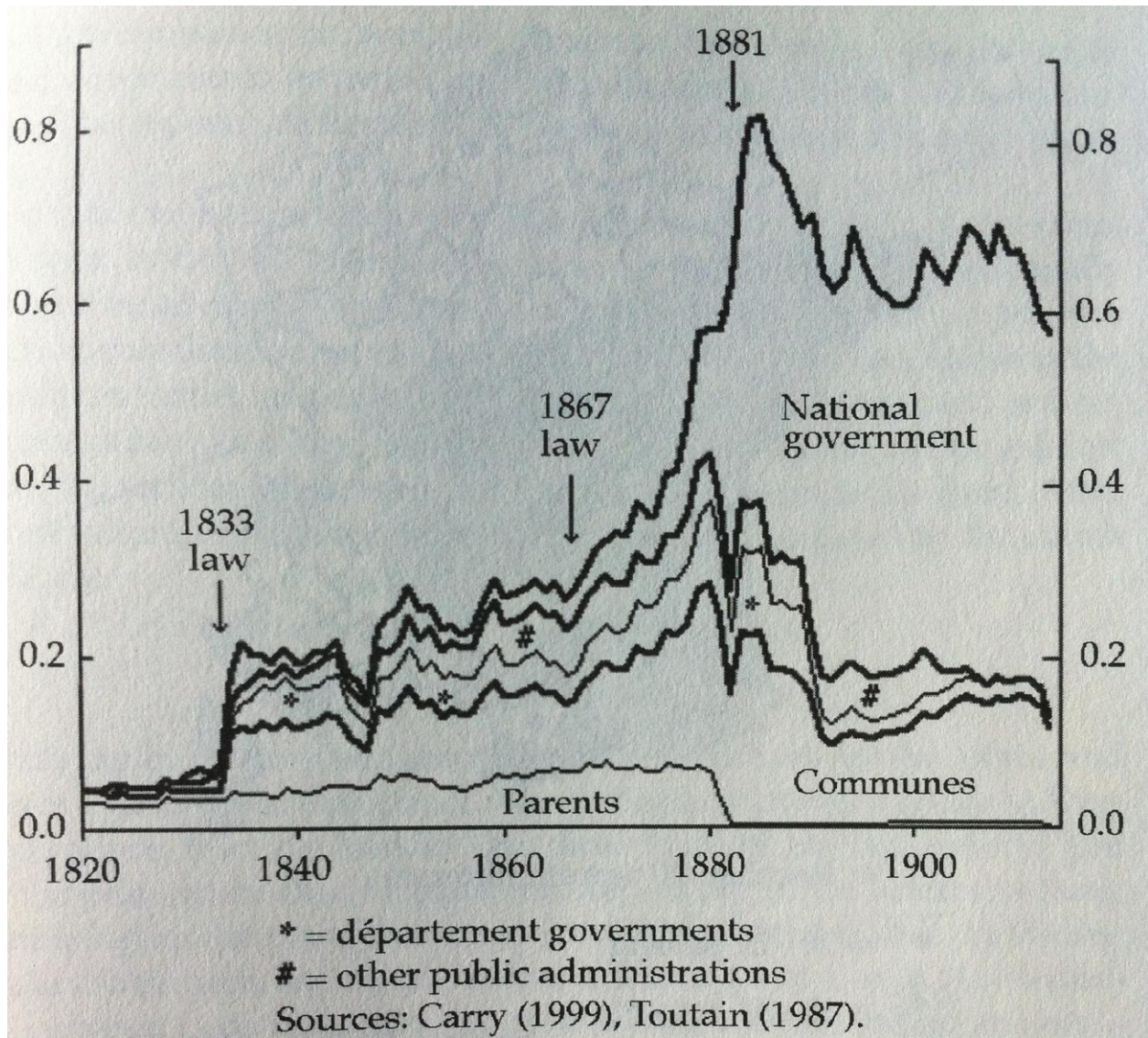Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

1881

1867
law

National
government

1833
law

#

*

*

#

*

Parents

Communes

1820   1840   1860   1880   1900

* = département governments
\# = other public administrations
Sources: Carry (1999), Toutain (1987).

FIGURE 1

Country	Period	External Threat	New Policies	Key Figures	Outcome
Prussia	1810s	Defeat of Iena in 1806	1. Reforms of curricula, teaching methods and teacher education 2. Delegating power to local communities regarding administration and funding of schools 3. Foundation of Berlin University	Wilhelm von Humboldt Baron vom Stein	1. Failure in the short run due to the opposition of the French 2. Substantial impact in the long run: - 16.8% of males born in Prussia before 1801 were completely illiterate, as against 2.9% for males born between 1837 and 1841 [9] - starting in the 1810s, literacy rates gradually increased and reached 85% in 1850 [3] - Prussia became the leader for primary enrollment until the 1880s [4] - schools remained funded primarily by local taxes throughout the XIXth century [4] 3. Primary school enrollment per 10,000 people: 1131 in 1815 vs. 1592 in 1850 [5] **
France	1880s	Franco-Prussian War of 1870	1. Abolition of all fees and tuition charges in public elementary schools 2. Education is made compulsory until age 13 3. Religious education in public school is forbidden 4. 17,320 new schools are built, 5,428 enlarged, 8,381 repaired [1] 5. The new curriculum promotes patriotism	Jules Ferry	1. France overtook Prussia as the leader for primary enrollment in the 1880s [4] 2. Literacy rates quickly increased from 80% in 1870 to 96% in 1912 [6] 3. Increased sense of patriotism and unity [1] 4. Primary school enrollment per 10,000 people: 1176 in 1870 vs. 1430 in 1912 [5] **
Japan	1870s	Risk of colonization by Western powers	1. Introduction of modern science in the curriculum 2. Elementary education is made compulsory 3. 25,000 new schools are built [2]	Mori Arinori Yamagata Aritomo	1. Strong popular resistance in early stages 2. Resounding success in a few decades: - Japan overtook most European powers in terms of primary enrollment, which rose from 28.1% in 1873 to 98.1% in 1910 [7] - from 1865 to 1910, the literacy rate increased from 35% to 75% for men and from 8% to 68% for women [7] - traditionalists and progressives agreed on the curriculum planned by the 1890 Imperial Rescript [8] 3. Primary school enrollment per 10,000 people: 65 in 1876 vs. 1122 in 1905 [5] **

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** Note that, in the long run, primary school enrollment per capita depends on the primary school enrollment rate of new generations but also on the evolution of the demographic structure of the country.

FIGURE 2