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Education and Military Rivalry[*]

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Abstract

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

1 Introduction

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

Figure 1 about here

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

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

Eugene Weber's work on the modernization of rural France between 1870 and 1914 suggests why military threats may spur centralized investment in mass education (Weber, 1979). A highly disintegrated population that was largely illiterate and spoke a multiplicity of dialects was to be transformed into a unified people sharing the same patriotic values, a spoken and written language, a set of moral principles, and a motivation and ability to defend France in future conflicts[1].

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

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

Similar empirical patterns hold when considering rivalries between a country's bordering countries and third countries as an alternative source of variation. A country is more likely to perceive military threats when military rivalries are rife in its neighborhood. Regressing a country's primary education on the rivalries among its neighbors yields results qualitatively similar to our preferred specifications, which use direct rivalries as the independent variable.

To rationalize our main findings we develop a simple model of state investment in education by the ruling group of a country which faces military threat and needs to educate and mobilize the whole population in order to improve its chances of winning the war. The model explains both, the positive effect of military rivalry on educational investment (the probability of winning the war is increasing in the domestic level of education) and the positive interaction between war threat and democracy. The intuition for the latter can be explained as follows. Winning the war yields a return to the domestic country, a larger fraction of which accrues to the opposition group the higher the level of democracy. Now, suppose that the probability of winning a war depends upon both the educational level and fighting efforts by members of the incumbent and opposition groups. In those circumstances, the incumbent group has stronger motives to invest in education if a war becomes more likely. Absent democracy, 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. If the efforts by the incumbent and opponent groups are sufficiently complementary, 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.[2]

Our paper relates to, at least, three strands of research. As for the relationship between public-education investments and democracy, Lott (1999) suggests that non-democracies could invest more than democracies in public education as a means of indoctrination. On the other hand, Glaeser et al. (2007) argue that education and democracy should be positively correlated, as civic participation – needed to support transitions from dictatorship into democracy – is positively related to education. But the evidence for a positive relationship between education and democracy is mixed, at best. Thus, Mulligan, Gil, and Sala-i-Martin (2004) present cross-country evidence indicating that more democratic countries do not have higher levels of social expenditures and, in particular, higher public education spending. More recently, Murin and Wacziarg (2014) find that education fosters democratization, but they do not find any evidence for a relationship running from the political regime to education attainment. Bursztyn (2014) shows that poor voters in Brazil prefer the government to carry out cash transfers, yielding immediate income increases, instead of vesting resources into public primary education. Also related to our analysis is Bourguignon and Verdier (2000), who develop a model to explain why the ruling class may sometimes invest in education even though schooling enhances political participation. Analogously, Galor et al. (2006) theoretically argue that capital accumulation gradually intensifies the importance of skilled labor in production and therefore generates support in the ruling class for human-capital investment. Galor et al. (2009) maintain that a higher concentration of land ownership typically discourages the development of human capital enhancing institutions, in particular schooling. Based on data for 27 countries and 70 years from 1870, Ansell and Lindvall (2013) find that observed educational reforms reflect the resolution of conflicting interests not only in politics but also in religion. However, no paper in this strand of work looks at the effect of military threats in democracies and autocracies.

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

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

A third strand of work deals with state capacity. Hintze (1975) and Tilly (1975), preceding many others, provide historical accounts on the importance of wars for state building. More recently, an economic literature summarized and extended in Besley and Persson (2011) considers theoretically investments in fiscal and legal capacity, and finds positive correlations between past wars and current state capacity in international panel data. Thies (2004), using the same measure as we do, shows that military rivalries raise fiscal capacity in postcolonial developing states. Scheve and Stasavage (2011) investigate the links between wars, democracy, and estate taxation in about 20 countries since 1816 and find that democracy does not systematically influence top rates of estate taxation, whereas wars with mass mobilizations significantly raise these rates. Analogously, we find a correlation between current educational investments and past wars or military rivalry, while – in parallel to Scheve and Stasavage – the correlation between wars and democracy is more tenuous. In addition, we find that the effect of military rivalry on educational investment is larger in democracies, a finding that may be quite specific to education. In contrast to this literature, we treat state capacity as exogenous, both in the theory part and in our empirical analysis. More recently, Alesina and Reich (2015) look at how policies of nation-building, in particular education, can help homogenize a country's population. They point at two channels whereby education and other nation-building policies can achieve that goal: a soft channel, by facilitating communication among citizens with different local languages and cultures, and a coercive channel, by prohibiting local cultures. Then, they argue that democracies and non-democracies differ with respect to both, how much to invest in homogenization and also the extent to which the coercive channel should be used.

But they do not link policies of nation building to military threat, and to its interplay with democracy. Finally, to explain the acceleration in state-building in Europe after 1500, Gennaioli and Voth (2016) develop a model of the relationship between the importance of money for winning a war and the degree of centralization in tax collection. That the importance of money in wars rose sharply after 1500, is explained by the authors as the combined effect of the introduction of gunpowder (which called for stronger fortifications) and the development of standing armies with firearms. While we also emphasize the relationship between military rivalry and state investments, our emphasis is on the relationship between education investments and the interaction between military rivalry and democracy.

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

2 Lessons From History

While each nation's history has unique elements that cannot be forced into a unified framework, the examples of France, Japan, and China over the 19th century show how military threats or rivalries can spur educational reforms. Moreover, Japan and especially China illustrate the view that military threat more than democracy per se is the driving force behind school enrollment, although the comparison between France and China will also suggest that the effect of military threat on educational enrollment is enhanced by democracy. In each example, we give background on the historical context and the debate that took place in a volatile international environment, the subsequent process of education reforms, and the outcomes especially with regard to primary enrollment.

2.1 Jules Ferry's France

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

Even prior to the Prussian war in 1870, elites knew that French education had failed to promote national unity. Victor Duruy, appointed Minister of Education in 1863 by Napoleon III, was advocating sweeping educational reforms, better educational facilities, and more of technical education – plans similar to those Jules Ferry would pursue some 20 years later. When Duruy tried to convince the Emperor, he did not manage to gather enough political support especially from a rural population heavily influenced by the Church, so Napoleon III decided to let the project of his minister be defeated by the legislature.

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

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

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

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

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

In addition to wider access, the reforms transformed the content of elementary education: new programs emphasized geography, history, and dictation. The new history and geography programs aimed at conveying patriotic values to new generations.[3] From their very first day at school, children were taught that their first duty was to defend the fatherland. Even gymnastics

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

were meant "to develop in the child the idea of discipline, and prepare him [...] to be a good soldier and a good Frenchman" (Lindert, 2004).

Outcomes   Official statistics[4] attest that school attendance rose substantively in the decade after 1882. Primary enrollment rates went up from 12% of the population in 1870 to over 14% in 1912. Literacy rates rose from 80% in 1870 to 96% in 1912 (and the initial 80% figure is partly misleading, as most "literate" children did not understand what they read prior to the reforms). Finally, the reforms appear to have increased the sense of patriotism and national unity. Thanks to the Ferry laws,

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

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

2.2   Japan in the Meiji Era

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

> "In 1872, government leaders were haunted by a crisis of international proportions. [...] European colonial empires had spread into the Far East, threatening the very existence of Japan as a sovereign state. During the years of self-imposed isolation by the Tokugawa regime [...], the country had fallen dangerously behind

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[4]As reported in Moody (1978) and Lindert (2004).

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

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

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

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

"For the first time in Japanese history education was interpreted as a tool in the push to modernize the nation, a point confirmed

by the then Minister of Education Mori Arinori: 'Our country must move from its third class position to second class, and from second class to first: ultimately to the leading position among all countries of the world. The best way of doing this is [by laying] the foundations of elementary education'."

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

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

Outcomes   Initially, reactions to the educational reform were mixed.

> "Not everyone was so happy at the obligation to attend school [...] In the 1870s, angry taxpayers reacted to compulsory schooling as they had to the draft: they rioted. Crowds of people destroyed at least two thousand schools, usually 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 reflected a lack of democracy: peasants neither identified with the emperor, nor with the new ruling class, and therefore disapproved of the new compulsory nationalistic education. Similarly, people at first tried to resist the military reform.

Yet, over time, the educational reforms yielded more and more of a resounding success. Japan overtook most European powers with regard to

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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. [5].

Successful education reforms certainly played a role in Japan's unexpected military victories in the 1895 war against China and the 1905 war against Russia. Overall, the Meiji-era reforms further illustrate the idea that education reform occur as a result of strategic military concerns. The Japanese example is probably even clearer than the French one, in that military considerations clearly took precedence over humanistic ones. Yet the initial popular resistance may illustrate how a lack of democracy can reduce or delay the effectiveness of educational reforms.

2.3   China and the Hundred Days' reform

Background and Debate   19th century China offers yet one more illustration of the role that military threat can play in prompting educational reforms. But it also shows the fragility of such reforms in the absence of democracy, thereby illustrating the complementary roles of military rivalry and democracy in fostering educational enrollment. Throughout that century, there was a debate in China as to how to reform the education system (and notably the civil service examination) in order to incorporate the study of modern science into traditional curriculums. The hope was that reforming education would give China the power to stand up to Western colonizers. This debate culminated during the Hundred Days' Reform, although that education reform was eventually abandoned.

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

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[5]See Gordon (2000) and Duke (2009)

knew that reforming education might result in "losing the soul of China" or "giving up being Chinese," and, perhaps even more importantly, would probably imply great changes to the social hierarchy.

The reforms in two steps   Thus, during the second part of the 19th century, if the Chinese elite pushed for educational reform, it did so gradually. First, the view was that Western military technology could be mastered by establishing shipyards and arsenals and by hiring foreign advisers. Arsenal schools, first established in the 1860s by the Quing government, provided applied training in Western science and engineering and produced Chinese-language translations of important books in the natural and applied sciences (see Cantoni and Yutchman, 2011). These reforms were part of the so called "self-strengthening movement" and relied on the conviction that China would learn from foreigners, and thereby catch up with them and finally surpass them.

    This belief was challenged by the unexpected defeat to Japan in 1895. It seemed that China needed more than "self-strengthening" and the young Guangxu Emperor ordered a series of reforms to bring about sweeping social and institutional changes – a famous episode of Chinese history known as the Hundred Days' Reform. His advisers, notably Kang Yuwai and Liang Qichao, recommended to move to a second stage of educational reforms, with the creation of a "national school system" that would grant students degrees and would replace the Imperial examination system. Consequently, the Imperial University, also known as Beijing University, was founded in 1898. The creation of this university, with a curriculum geared towards the sciences, was bound to have large repercussions on the whole Chine education system: "This was not merely to be a university located in the capital, but the Imperial university, the new creator of intellectual standards and norms, the ultimate and official authority that trumped all education experiments at the local level" (Karl and Zarrow, 2002, page 110).[6]

The partial undoing of the reforms   A coup d'Etat was to be staged by conservative opponents led by Empress Dowager Cixi in Septem-

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

ber 1898. The radical reformers were executed or forced into exile and the Empress Dowager overturned the ambitious reforms promulgated by the Guangxu Emperor, with one significant exception. The Imperial University survived the coup, although the curriculum was modified: the pluralistic approach to knowledge was limited, imperial edicts would be studied more often, the Empress Dowager's birthday and Emperor Guangxu's birthday would be observed, etc. In short, the advisers of the Empress Dowager designed "an institutional practice in which ritual observance of political loyalty played a central role" and "the Qing dynasty rose ever more prominently into the sacred space they had formerly dominated." (Karl and Zarrow, page 117). Although Guangxu's reforms were overturned by the Empress Dowager, they served as a basis for other reforms which occurred a few years later, notably with the suppression of the Imperial examination system in 1905.

2.4   Summing Up

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

A positive relationship between military rivalry and primary education enrollment could reflect different objectives of the rulers. These may include desires to (i) generate basic knowledge in mathematics or language, (ii) promote group discipline, or (iii) transmit patriotic values. Our empirical analysis in Section 4 will not be able to directly distinguish between these alternatives. The positive effect of military rivalry on primary education enrollment may also reflect the evolution of military technology over time: rivalries and wars existed long before the 19th century without inducing mass education reforms. But then industrialization has gone together with the development of technologies of modern warfare and more complex war strategies, which in turn raised the value of educated soldiers. Our empirical analysis will indeed show that the positive correlation between military rivalry and education enrollment applies to countries that have reached a

minimum threshold level of industrialization.

3 Data and Empirical Specifications

3.1 Sources and Variable Definitions

Education To empirically investigate the determinants of mass education reforms, we use an unbalanced panel with annual data for 166 countries between 1830 and 2010. Our main dependent variable, $Enrollment_{i,t}$, measures primary enrollment per 10,000 inhabitants in country i and year t, in accordance with the UNESCO definition of primary schooling. The underlying data are drawn from the CNTS Data Archive of Banks (2011). In our baseline regressions, we use primary enrollment as a continuous dependent variable. Constructed on a per-capita, rather than per-school-age-child basis, this measure is affected by shifts in demographic structure: for the same prevalence of schooling a young population will have a higher primary enrollment rate per capita than an old population. We therefore control for population growth in the past 10 years to mitigate such effects. As shown by the descriptive statistics in Table 1, the average primary enrollment rate is 10.5% of the population over our pooled sample, with a large variation across countries and time periods.

To test the robustness of our results, we also analyze the probability of discrete education reforms expanding access to primary education.[7]

War Threats We measure war risk and military threats in two alternative ways. As in the examples of Jules Ferry's France and Meji-era Japan, a

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

recent experience of external conflict may raise the perceived likelihood of a new conflict and the salience of military concerns in policy decisions. *Recent war$_{i,t}$* is a binary indicator set equal to one if country i was engaged in an external war in any of the 10 years prior to year t, according to the variable "inter-state war" in the Correlates of War (COW) database. This database also provides information on the outcome (victory or defeat) of past wars and a (crude) estimate of the number of casualties as a percentage of the pre-war population.

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

This measure of war risk is, of course, completely backward-looking and may therefore miss emerging threats without a history of militarized conflict. Our core measure, *Rivalry$_{i,t}$*, is less subject to this concern. This indicator picks up whether country i has a strategic rival in year t, according to Thompson (2001) and Colaresi et al. (2010). Rivalry captures the risk of armed conflict with a country of significant relative size and military strength. It is based on contemporary perceptions by political decision-makers, gathered from historical sources on foreign policy and diplomacy. Specifically, military rivalries are identified by three criteria: whether two countries regard each other as "(a) competitors[8]; (b) a source of actual or latent threats that pose some possibility of becoming militarized; (c) enemies" (see Appendix A for details).[9] We also create a measure of the relative strength of rivals, assessing

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

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

the probability of winning or losing a potential military conflict, by gauging the ratio of their respective armies. To this end, we draw military personnel numbers from the COW National Material Capabilities database.

The summary statistics in Table 1 confirm that Thompson's rivalry variable captures a wider range of situations that the past-war variable. The two are positively correlated, but less than perfectly so: 15% of the country-year observations in our sample are associated with a war in the previous 10 years, while over 70% are associated with one or more strategic rivalries. It should be noted that the sample for strategic rivalries is smaller as it only includes countries experiencing a rivalry at some point in their history since 1830; the estimation therefore draws on the within-country variation over time in rivalries and enrollment. Among countries engaged in strategic rivalries, a war had materialized in the previous 10 years in 23% of the cases.

Political Regimes   For the political regime, we use the institutionalized autocracy and democracy scores (the *polity2* variable) in the Polity IV database. These are themselves combinations of constraints on the executive, openness and competitiveness of executive recruitment, and competitiveness of political participation. The combined score $Democracy_{i,t}$ ranges from -10 to $+10$, where a higher score means that country i at date t is more democratic. About 43% of the country-years in our sample have positive scores. The mean score is -0.37 and the variance is 7.1, with strong variation both within and between countries: although political regimes often change slowly, about 36% of the total variance in democracy scores is due to the within component. One question in our empirical exercise is whether political change is an important driver of mass education beside external rivalry.

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

Other covariates used in robustness checks are introduced in context below.

Table 1 about here

3.2 Empirical Specifications

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

$$
\begin{aligned}
Enrollment_{i,t} \;=\; & \alpha_0 + \alpha_1 WarRisk_{i,t} + \alpha_2 Democracy_{i,t} + \hspace{2cm} (1) \\
& \alpha_3 WarRisk_{i,t} \cdot Democracy_{i,t} + \alpha_4 X_{i,t} + \nu_i + \delta_t + u_{i,t} \;,
\end{aligned}
$$

where the variables multiplying α_1 to α_3 were introduced in the previous subsection. Our main parameters of interest are α_1, which captures the predictive effect on enrollment of war risk faced by country i in year t, and α_3, which captures the interaction of war risk with the democracy index. As explained above, military threat means at least one strategic rival in year t – or a war in the past 10 years (i.e., between years $t - 10$ and $t - 1$). Our main prediction is that α_1 should be positive, whereas we are more agnostic about the signs of α_2 and α_3.

We include a set of control variables $X_{i,t}$, country fixed effects 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. Heteroskedasticity-robust standard errors are reported.

After presenting the results from our preferred specification, we implement a series of robustness tests, considering alternative inference methods, dependent variables, controls, and samples. We note that our results are not robust to clustering over the whole period, which we investigate in detail in Subsection 4.5.

4 Empirical Evidence

4.1 Baseline Results

Table 2 shows the results from our baseline estimation of (1) in the yearly panel, with primary enrollment rates as the dependent variable. All specifications include 10-year population growth, to account for varying shares

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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. We also control for urbanization rates in order to net out the impact of modernization in general and the higher concentration of schools in cities. Indeed, we find that high population growth rates and high urbanization rates are consistently associated with higher primary enrollments, while military spending – holding constant external threats – has a positive coefficient before 1914 but a negative coefficient afterwards. An interpretation of this pattern could be that military spending and education spending were two facets of state-building in the earlier period, while once a certain level of expansion of the state has been reached, limited fiscal capacity restricts the ability to invest in education if more effort is devoted to building an army.

Table 2 about here

In columns 1 through 3, military threats are measured by the presence of an ongoing military rivalry. Column 1 shows that primary enrollment is positively and significantly associated with military rivalries. The point estimate is sizeable: almost a third of the standard deviation in primary enrollment. Interestingly, the coefficient on the democracy score is negative and significant. At the same level of military threat, autocracies invest more in education than democracies. This finding runs counter to the median voter view of mass-education reforms, which would predict education to be positively related to democracy. The coefficient on military rivalry is stable when we control for the political regime. It appears to go against a view that rivalries only matter insofar as they foster political change and that democratization is really the main force behind expansions of primary enrollment.[10] In column 2, which is our baseline specification, we add an interaction term to check if the impact of rivalries on educational investments differs by political regime and find that primary enrollment is more positively associated with military threats in democracies than in autocracies. The coefficient implies that being engaged in a strategic rivalry is associated with additional primary

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

enrollment of 0.9% of the population in an autocracy with a Polity score of -6 (at the 33rd percentile of the distribution) and of 2.3% in a democracy with a Polity score of 3 (67th percentile). We investigate the democracy results in more detail in Subsection 4.3.

Additional Covariates   In column 3, we include two covariates that may affect investments in education. The relative strength of rivals is defined as the army size among any strategic rivals, divided by the size of the country's own military. A higher value of this interaction variable signals a higher risk of losing a potential war. The point estimate suggests that countries with stronger rivals indeed have higher enrollment rates. We also control for total government expenditures per capita on a reduced sample which does not cover the earlier period. Our main results are unchanged, namely the presence of a strategic rival is associated with higher enrollment in primary education, and democracies have less primary education. This suggests that war threats may have an independent effect on education investments, aside from any indirect effect that may arise through investments in higher fiscal (state) capacity.

Past Wars vs. Rivalries   Columns 4 to 6 of Table 2 present the same set of regressions, except that we replace military rivalry by the occurrence of a war in the past 10 years. Primary enrollment is positively correlated with the occurrence of a war in the past 10 years. Also, consistent with the results in columns 1 to 3, autocracies invest more in education than democracies. However the interaction term is insignificant or only marginally significant in those specifications, as well as the severity of the recent war(s), measured by the number of casualties incurred by the country as a percentage of its pre-war population.

4.2   Plausibility Checks

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

Education as a Means to Win Future Wars   A first test is to look at the relationship between education, rivalries and future wars. The first four columns of Table 3 show the results of fixed effects linear probability regressions. In columns 1 and 2, the dependent variable is a binary indicator for breakout of war in the next 10 years. As expected, being engaged in a rivalry positively predicts future wars. The coefficient on primary schooling is also positive and significant, which provides additional evidence that governments that (rationally) foresee high war risk may increase education investments. Surprisingly, military expenditures are not found to be higher in the run-up to a war once we control for rivalry.

<div align="center">

Table 3 about here

</div>

In columns 3 and 4, the dependent variable is instead an indicator for winning the next war, conditional on a war breaking out in the next 10 years. In column 3, we only include as covariates primary enrollment, democracy and military expenditure per capita. Here, we do find that the probability of winning is positively and significantly associated with current education levels. Perhaps surprisingly, military expenditures are not significantly associated with the probability of victory. To control for asymmetries in military capabilities, column 4 includes the size of the military (per 1,000 inhabitants) also in the country's largest rival. As expected, we find that a larger army positively predicts victory, and a larger army in the rival increases the likelihood of defeat. Importantly, the coefficient on primary enrollment remains identical once we control for the mobilization of the population into the military. Together with the historical evidence in Section 2, these findings support the view that military threats spur investments in mass education in order to build more effective armies. No other covariate, including military expenditure, enters significantly in the regression for the outcome of future wars.

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

4.3   The Political Regime

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

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

Disaggregating Democracy   But our empirical measure of democracy is very broadbrush, making it hard to understand the mechanisms at work. We therefore disaggregate the democracy score into its two main components: constraints on the executive and the openness of executive recruitment. In particular, the effective time horizon of political leaders is best captured by the openness of executive recruitment, while constraints on the executive affect how much of the gains from educational reforms leaders can appropriate. We then run our main specifications, letting these two aspects of democracy enter separately on the right-hand side. To get a stronger signal, we define one dummy variable for each aspect: *High constraints on the executive* (*xconst* greater than or equal to 4 in the Polity IV database on a scale of 1 to 7, indicating at least substantial limitations on executive authority) and *Openness of executive recruitment* (*xropen* greater than or equal to 3 in the same database on a scale of 0 to 4, corresponding to the designation of the

executive leader through competitive elections).

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

<div align="center">**Table 4 about here**</div>

Thus, both aspects of democracy appear to matter in opposite directions.[11] When we take interaction effects into consideration, the direct relationship of both measures with primary schooling rates is not statistically significant, but in the presence of military threats, the relationship between high executive constraints, and primary schooling is consistently positive. Conversely, high openness of the executive recruitment, which gives executive leaders a lower stake in long-term investments, are associated with lower enrollment in the presence of rivalries. Overall the former effect dominates. The disaggregated results therefore shed some light on the underlying mechanism whereby political regimes influence mass education: the critical institutions appear to lie in better accountability mechanisms and more extensive power of the legislative branch. These findings will guide our theoretical framework below.

4.4 Education and Neighboring Rivalries

We have documented a positive relationship between military rivalry and primary education, as well as a positive relationship between primary education and the interaction between rivalry and democracy. Moreover, we have found

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

suggestive evidence that education helps improve military effectiveness in future conflicts. We caution against a causal interpretation of these stylized facts: our OLS regressions could suffer from reverse causality or omitted variable bias. For instance, a nationalist government that wants to strengthen national identity may simultaneously choose to educate its citizens to foster loyalty to the state, and create rivalries with other states to unite the nation. As another potential source of bias, a country that tries to become more internationally powerful might invest in education to increase its chances of winning future wars and subsequently feel strong enough to engage in rivalry with its neighbors. Thus, more powerful countries[12] may have better educated populations and engage in more rivalries, which would bias upwards the coefficient on rivalry in our OLS regressions for education. Conversely, the same OLS coefficient could be downward biased. For instance, a "weak" country may have low levels of education, and other countries might decide to threaten it, creating a military rivalry.

Although we cannot conclusively estimate the causal effect of military rivalry on education investments, in this subsection we present additional evidence supporting the robustness of the stylized facts unveiled in Subsection 4.1. Specifically, we consider another source of variation in military rivalry, namely the rivalries between the neighbors of each country. We first show reduced-form regressions of educational enrollment on this new rivalry variable. We then take the bolder step of using this variable as an instrument for our previous rivalry measure, but we note that the exclusion restriction is likely to be violated.

Measuring Neighboring Rivalry We construct a dummy variable for each country, using information on the rivalries of all its neighboring countries with third countries. More precisely, for country i, *Neighboring rivalry$_{i,t}$* is equal to 1 if in year t one of its bordering countries j is engaged in a rivalry with at least one other country k which is not contiguous to i. Importantly, we only take into account neighboring countries j and their respective rivals k that *do not* have a rivalry with country i. Hence, *Neighboring rivalry$_{i,t}$* measures rivalries in the regional environment of country i, between countries that have no rivalries in common with i. This measure of rivalry is much less

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

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of a choice variable for country i than the rivalry measure used in the OLS regressions. In the data, *Neighboring rivalry$_{i,t}$* is indeed a good predictor of the original rivalry variable, suggesting that when its regional environment (exogenously) becomes more unstable, country i as well is more likely to be engaged in a rivalry.

When it comes to sample selection, we construct the neighboring rivalry variable for the entire sample, except for countries in Western Europe and the Eastern Bloc during the Cold War.[13] We exclude these regions *a priori* because they were dominated by a series of strategic alliances driven by the United States and the USSR. Moreover, they have limited predictive powers on individual rivalries. When running the baseline specification on this smaller sample, we find results similar to Table 2, so any differences in results we find are not driven by changes in the sample.

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

<div align="center">

Table 5, Panel A, about here

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

To run the IV specification, we also need a second instrument for the interaction term between military threats and democracy. As in the reduced-form regressions, we use the interaction of *Neighboring rivalry* with *Democracy.*

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

A valid concern is that the interaction effect between democracy and rivalry is really capturing an interaction effect between rivalry and some other variable. Our basic IV strategy does not address this concern, but in Table W4 in the Web Appendix, we add interaction effects with other variables and show that the results are robust. The results are qualitatively similar when we use lagged *Democracy* instead of *Democracy*.

The standard errors in all our IV regressions are heteroskedasticity-robust. We also report various test statistics (F-test for excluded instruments, Anderson-Rubin test, Cragg-Donald Wald statistic, and Kleibergen-Paap Wald *rk F*-statistic[14]).

We run IV (2SLS) regressions with either one instrument and one endogenous regressor (*Rivalry*) or with two instruments and two endogenous regressors (*Rivalry* and *Rivalry·Democracy*). The results are reported in Panels B and C of Table 5. Panel B shows that the first-stage estimates have the expected signs and that the instruments are not weak. Panel C reports the second-stage estimates: the point estimate on *Rivalry* is larger than in the OLS regressions[15] and the interaction between *Rivalry* and *Democracy* is positive and statistically significant, with roughly the same magnitude as in the OLS regressions. Panel C presents additional test statistics, which reject weak identification. However, if we do include Western Europe and the Eastern Bloc during the Cold War in the sample, the instruments do indeed become weak.[16]

Table 5, Panels B and C, about here

Overall, the reduced-form results and the IV results are in line with the previously-documented stylized facts. We note that the IV results should be interpreted with caution, because the exclusion restriction is likely to be violated. Military threats in nearby countries may not be fully exogenous

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

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

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

to the country under examination, as there are spillovers. For instance, we document in Table W2 that primary enrollment in the reference country is a statistically-signficant predictor of future values of military threat in the surrounding countries. Our results may therefore be part of a broader regional pattern, where periods of warfare coincided with nation-building and education investments.

4.5 Extensions and Robustness

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

Table 6, about here

Clustering   Table 6 investigates the robustness of our results to clustering standard errors by country. In the presence of serial correlation, clustered standard errors are necessary to avoid biased standard errors (see e.g. Duflo et al. (2004)). Columns (1) and (2) show that, in the absence of controls besides country and time fixed effects, the positive correlation between primary enrollment and rivalry is robust to clustering standard errors by country. The regression coefficient is still significant at the 5% level in column (2), although standard errors increased substantially compared with column (1). However, Columns (3) and (4) show that once our baseline additional controls are introduced, statistical significance is lost with clustered standard errors.[17] Given the large set of controls and fi xed effects included in our specifications , full clustering by country is a demanding specification. As an alternative, in Columns (5) to (8) we consider standard errors clustered at the level of countries over various time horizons, namely over 10, 20, 30, and 40 years, as opposed to clustering by country over the full length of the panel. These specifications account for any pattern of serial correlation at the country level within the specified horizon. Statistical significant is retained for all of these specifications, although standard errors increase as the horizon of clustering gets larger. Given that our education variable is interpolated over 10-years periods, it was important to check that clustering by country over a 10-year horizon leaves the results unaffected. Education is autocorrelated

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[17]Column (3) of Table 6 replicates our preferred specification, also reported in Column (1) of Table 2.

at longer horizons, however, and a limitation of this paper is that statistical significance is lost when clustering by country over horizons of more than 40 years. Collecting more data, covering more countries and for more years, is an important agenda for future work, to help increase statistical precision and improve robustness.

Education Reforms   Instead of the continuous enrollment measure, we analyze the effect of military threats on the probability of discrete educational reforms – see Table W3 (in the Web Appendix). Consider the effects of strategic rivalry on *Imputed reforms* – i.e., a 10% or higher increase in primary enrollment over a five-year period. Consistent with our predictions, a strategic rivalry raises the probability of a large increase in primary enrollment. However, we find no significant impact of the military strength of rivals. The *Democracy* score still enters negatively, and its interaction with rivalry is positive, although not statistically significant. Finally, neither population growth nor total government expenditure or military expenditure show significant coefficients when democracy is included in the regression.[18]

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

Industrialization and Urbanization   Expansion of primary schooling and democratization are salient aspects of development. Another aspect is the transition from a rural to an industrial and urban society. This may lead democracy to be correlated with industrialization and urbanization. If an educated military is more valuable in more industrialized countries, our

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[18]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 the 10% specification, while the interaction term between rivalries and democracy is still non-significant.

interaction between rivalry and democracy may pick up this effect. In addition, if industrialization relies on higher human capital, manufacturers may want to lobby for education reform (Galor et al., 2009). To address these concerns, we add measures of industrial development and their interaction with rivalry as covariates to our baseline specification. Specifically, we use the share of industrial activities in GDP (available for 1946-2000), and variations of the urbanization measure with 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 – see Table W4.

When doing so, our results on democracy are unchanged: the direct coefficient on *Democracy* is negative, its interaction with *Rivalry* is positive, and both are statistically significant except over the reduced time period for which the industry share of GDP is available. Moreover, as expected, more industrialized and more urbanized countries have higher rates of primary enrollment when only the direct effect is included. Interestingly, we do find that enrollment responds more to military threats in countries with a larger share of industrial activities and a larger share of urban population. For a country with a *Democracy* score of 0, the estimates in column 6 of Table W4 suggest that the effect of military rivalry on primary education becomes positive around a 15% share of population living in towns and cities (with lower thresholds for more democratic countries). For instance, primary enrollment would be predicted to be higher by 0.8% of the population where 25% of the population lives in cities (at the mean) and by 2.5% of the population where the urbanization rate reaches 43% (the mean plus one standard deviation); again with higher values for more democratic countries.

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

Additional Covariates and Sample Selection   We perform several other robustness tests on our baseline specification – see Table W5. We first include the index of ethnic fractionalization from Alesina et al. (2003), as well as its interaction with rivalry. Ethnic diversity has been shown to affect the amount of social spending and in particular education investment. We find that more fractionalized countries have lower enrollment rates, and the effect of rivalry on primary enrollment also decreases with ethnic fractionalization. Yet, our main coefficients remain unaffected.

Then, we include the primary enrollment rate of the rival. Consistent with our intuition, countries increase their enrollment rates more when their rivals have more educated populations, and therefore presumably more effective armies.[19] Also, we add 10-year lagged enrollment to control for initial conditions. As expected, primary enrollment displays high serial autocorrelation, but our main coefficient of interest on rivalry is unchanged. We also check that our results do not reflect an entirely European story by excluding Western Europe from the sample. Again, our results are robust to this change, and the coefficients on rivalry actually increase.

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

Alternative Dependent Variable   We have performed other robustness tests as well – see Table W6. One is to compare our baseline results with those obtained with an alternative measure of education, namely education attainment from the Barro-Lee (2010) data set, available at five-year intervals for the postwar period only. We run the specifications in (1), using as the dependent variable the amount of primary education achieved by adults in the 15-19 age span at year $t+5$, starting in 1950. Since education attainment is defined per person of the relevant age group, we do not need to control for population growth in these specifications. We find similar results to those in Table 2 – a (weakly) positive effect of rivalry, a negative effect of democracy, and a positive interaction term. The results are somewhat weaker with the

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

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

4.6 Summary of Empirical Findings

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

5   A Simple Theory

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

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

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

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

value of δ captures stronger constraints (protecting the opposition group from discretionary redistribution).

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

Education and the Probability of Winning   The probability q of winning a war, once it has broken out, depends on individual effort choices by the members of each group in period 2. Specifically, each individual can expend a unit of effort at a utility cost, which is decreasing in the level of education e. We assume a very simple cost function $\frac{x}{e}$, where x is individual-specific and uniformly distributed on $[0, 1]$ in each group.[20] Any individual in group J follows a behavioral rule to expend his unit of effort if $\frac{x}{e} < \frac{\omega_J}{e}$. Here, ω_J is a rule set by group J members that – if followed by all other members of the group – maximizes the group's aggregate utility (in Feddersen and Sandroni's language, each individual member of group J wants to "do her part" to maximize the group's utility).

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

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

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

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

distinguishing feature of the technology of modern wars – say after after 1820 – compared to those in earlier periods.

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

Timing   The timing of the model is as follows

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

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

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

4. An ongoing war is won with probability q.

5. If no war has erupted or a war has been won, the incumbent group consumes a share $1 - \delta$ of output $y(e)$, while the opposition group consumes $\delta y(e)$. After a lost war, the consumption of both groups is zero.

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

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

Thus, group O solves

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

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

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

Simple algebra gives:

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

In equilibrium, the conditional probability of winning a war q becomes[21]:

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

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

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

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

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

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

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

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

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[21]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.

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

Prediction 1 *For δ sufficiently small, $\alpha < 1$, γ large enough (to avoid corners), and $\beta > 0$, equilibrium investment in education e is:*
1. *increasing in the risk of war, p*
2. *positively affected by the interaction between democracy δ and the risk of war p*
3. *decreasing in democracy for $p = 0$ or small.*
Thus, $\frac{\partial e}{\partial p} > 0$, $\frac{\partial^2 e}{\partial p \partial \delta} > 0$, and $\frac{\partial e}{\partial \delta}_{|p=0} < 0$.

Proof. Part 1 follows straightforwardly from the fact that

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

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

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

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

where

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

But one can verify that

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

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

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

Consistency with the Empirical Findings Parts 1-3 of Prediction 1 are obviously consistent with the three main findings reported in Section 4. Intuitively, democracy has a direct negative effect on the motives to invest

in education, because stronger constraints on the executive reduce the incumbent's residual claim on the additional output generated by education.[22] For the effect of war threat and the positive interaction between war threat and democracy, the intuition goes as follows. Society's income is (partly) expropriated if a war is lost to a foreign power. The probability of winning a war depends upon both the educational level and fighting efforts by members of the incumbent and opposition groups. In these circumstances, the incumbent group has stronger motives to invest in education if a war becomes more likely. Absent some executive constraints, however, opposition-group members do not benefit a great deal from the economy's resources. Therefore, they have weaker incentives to exert fighting effort than members of the incumbent group – this mechanism is similar to the one in Ticchi and Vindigni (2009). If the efforts by the incumbent and opponent groups are sufficiently complementary ($\alpha < 1$), this incentive gap may lower the prospects of winning a war to such an extent that investments in education respond less to a higher war threat in autocracies than in democracies.[23]

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

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

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

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

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

Table 7 about here

6   Conclusion

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

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

A second extension would be to investigate if other forms of rivalry – for example cross-country competition in product markets, or the importance of international benchmarking, e.g., as induced by cross-country performance in PISA or Shanghai evaluations – have a similar effect as military rivalry on educational enrollment and other types of public investments.

A third extension could be to look at different types of conflicts. One could look more closely at the correlation between enrollment and past wars, and in particular to distinguish between wars won and lost. Preliminary regressions show a positive correlation between primary enrollment and both a lost war and a won war over the past 10 years, with a stronger correlation if the war was won. This finding goes against the view that past wars might

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favor future education investments because defeats weaken incumbent elites that might oppose mass education, though it could be linked to the scarcity of public funds if states' financial resources are more depleted after defeats than after victories.

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

Investigating these and other extensions is left for future research.

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A   Data Appendix: Strategic Rivalries

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

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

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

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

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

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

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

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

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

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

B Tables

Table 1: Summary Statistics (updated)

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

Note: Unbalanced panel of 137 countries over the period 1830-2001. Military expenditure per capita (1) before 1914 in British pounds, set to zero after 1914; (2) after 1914 in US dollars, set to zero before 1914.

Table 2: Primary Enrollment and War Risk (updated)

	Primary enrollment per 10,000					
	Strategic Rivalry			War in previous 10 years		
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	160.321***	180.098***	101.704***			
	(21.755)	(23.313)	(24.567)			
Democracy	-2.876*	-13.076***	-7.776***	-7.523***	-7.861***	-4.881***
	(1.477)	(2.284)	(2.484)	(1.300)	(1.336)	(1.463)
Rivalry*Democracy		15.616***	1.961			
		(2.500)	(2.407)			
Rel. army of rivals			2.083**			
			(0.950)			
War in				75.808***	73.778***	98.977***
previous 10 years				(16.900)	(17.328)	(16.145)
War in 10 years					2.313	-3.295*
*Democracy					(2.024)	(1.814)
War casualties						0.204*
						(0.114)
Urbanization	12.446***	11.902***	10.923***	16.554***	16.628***	11.672***
	(1.322)	(1.279)	(1.480)	(1.102)	(1.107)	(1.045)
Population growth	8.160***	8.118***	4.604***	6.775***	6.789***	4.768***
	(1.143)	(1.116)	(0.921)	(0.808)	(0.802)	(0.719)
Military expenditure p.c.	189.300***	178.482***	209.813***	218.766***	218.344***	225.617***
before 1914	(66.703)	(64.325)	(65.444)	(63.822)	(63.671)	(44.397)
Military expenditure p.c.	-0.739***	-0.726***	-0.317***	-0.891***	-0.886***	-0.389***
after 1914	(0.126)	(0.125)	(0.093)	(0.129)	(0.129)	(0.080)
Govt expenditure / GDP			-0.116			0.416
			(0.392)			(0.352)
Observations	3140	3140	1830	4364	4364	2948
R-squared	0.762	0.767	0.856	0.738	0.738	0.824

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

Table 3: Education and Probability of Victory (updated)

	Probability of war in next 10 years		Probability of winning if war in next 10 years		Military expenditure	
					/ GDP	/ Gov't exp.
	(1)	(2)	(3)	(4)	(5)	(6)
Primary enrollment per 100	0.011***	0.014***	0.044***	0.046***		
	(0.002)	(0.002)	(0.006)	(0.007)		
Democracy	-0.002	0.001	-0.015***	-0.017***	-0.168***	-0.179
	(0.001)	(0.001)	(0.004)	(0.004)	(0.036)	(0.161)
Rivalry	0.146***	0.177***		0.012	0.573*	8.021***
	(0.015)	(0.020)		(0.056)	(0.317)	(1.654)
Rivalry*Democracy					0.115***	0.297*
					(0.038)	(0.173)
Urbanization		-0.001	-0.006*	-0.006	0.014	-0.129*
		(0.001)	(0.003)	(0.004)	(0.019)	(0.076)
Population growth		-0.001**			0.053***	0.011
		(0.001)			(0.019)	(0.043)
Military expenditure p.c.		-0.053**	-0.492***	-0.502***		
before 1914		(0.026)	(0.090)	(0.091)		
Military expenditure p.c.		0.000	-0.001***	-0.001**		
after 1914		(0.000)	(0.000)	(0.000)		
Military size / Population				-3.702		
				(3.005)		
At war					1.470**	6.885
					(0.577)	(4.260)
Observations	4489	3140	817	715 *rests*	2028	2321
R-squared	0.353	0.391	0.813	0.804	0.599	0.452

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. In columns (1) and (2), the dependent variable is the probability of observing a war involving the country in the next 10 years. In columns (3) and (4), the sample includes only countries which experience a war outbreak in the next 10 years, and the dependent variable is the probability of winning this future war. Primary enrollment is defined per 100 inhabitants (instead of per 10,000 inhabitants) for this table only. In columns (5) and (6), the dependent variable is military expenditure respectively as a share of GDP and as a share of total government expenditure..

Table 4: Components of Democracy (updated)

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

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

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

	Primary enrollment rate	
	(1)	(2)
Neighboring rivalry	283.702***	251.776***
	(17.688)	(19.419)
Democracy	-7.560***	-17.659***
	(1.226)	(2.088)
Neighboring rivalry*Democracy		14.239***
		(2.210)
Urbanization	15.857***	15.250***
	(1.101)	(1.091)
Population growth	6.230***	6.115***
	(0.793)	(0.758)
Military expenditure p.c.	210.618***	211.708***
before 1914	(61.586)	(61.698)
Military expenditure p.c.	-0.837***	-0.807***
before 1914	(0.133)	(0.130)
Observations	4237	4237
R-squared	0.749	0.753

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

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

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

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

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

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

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

Table 6: Clustering with/without controls

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

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

Table 7: Road Investments, Rivalry and Democracy (updated)

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

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

C Web Appendix: Education and Military Rivalry

Table W1: IV Regressions
Panel A: First Stage Regressions (updated)

	(1)	(2)	(3)
1st Stage	Rivalry	Rivalry	Rivalry*Democracy
Neighboring rivalry	0.107***	0.113**	-1.130***
	(0.035)	(0.036)	(0.226)
Neighboring rivalry*Democracy		-0.005	0.364***
		(0.004)	(0.029)
Democracy	-0.007***	-0.003	0.389***
	(0.002)	(0.004)	(0.028)
Urbanization	-0.001	-0.001	0.036***
	(0.001)	(0.001)	(0.011)
Population growth	0.003***	0.003***	-0.002
	(0.001)	(0.001)	(0.004)
Military expenditure (p.c)	0.015	0.016	0.676***
before 1914	(0.0186)	(0.019)	(0.198)
Military expenditure (p.c)	-0.000**	-0.000**	-0.001
after 1914	(0.000)	(0.000)	(0.000)
Excluded Instruments	Neighboring rivalry	Neighboring rivalry	Neighboring rivalry
		Neigh. rivalry*Democracy	Neigh. rivalry*Democracy
F-statistic of Excluded Instruments	9.46	5.06	85.93
Observations	3013	3013	3013
R-squared	0.903	0.903	0.869

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. For country i, *Neighboring rivalry*$_{i,t}$ is equal to 1 if in year t one of its bordering countries j is engaged in a rivalry with at least one other country k which is not contiguous to i. The sample includes all countries during the entire time period (including the Cold War, which was excluded in Table 5). The F-statistic in Panel A and the Cragg-Donald Wald F statistic and Kleibergen-Paap Wald r F statistic in Panel B show that the instruments are weak.

Table W1: IV Regressions
Panel B: Second Stage Regressions (updated)

2nd Stage	Primary enrollment rate	
Rivalry	2824.270***	3395.818***
	(908.131)	(1184.921)
Rivalry*Democracy		90.751**
		(40.491)
Democracy	16.745**	-39.941
	(8.459)	(26.451)
Urbanization	13.738**	10.971**
	(3.197)	(4.303)
Population growth	-1.374	-2.902
	(3.413)	(4.244)
Military expenditure (p.c.)	143.562***	72.154
before 1914	(54.077)	(67.992)
Military expenditure (p.c.)	-0.364*	-0.200
after 1914	(0.204)	(0.262)
Endogenous Regressors	Rivalry	Rivalry
		Rivalry*Democracy
Instruments	Neighboring rivalry	Neighboring rivalry
		Neighboring rivalry*Democracy
Anderson-Rubin Wald test	148.71	92.38
Cragg-Donald Wald F statistic	21.26	8.63
Kleibergen-Paap Wald rk F statistic	9.46	3.97
Observations	3013	3013
R-squared	0.607	0.460

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

Table W2: Future Neighboring Rivalries and Education

	Future Neigborwar
	(1)
Primary enrollment rate	0.000104***
	(0.0000182)
Neighboring rivalry	0.603***
	(0.0298)
Democracy	-0.00161
	(0.00111)
Government expenditure	1.14e-09**
	(4.46e-10)
Population growth	0.000627
	(0.000466)
Military expenditure (p.c.)before 1913	0.0212*
	(0.0128)
Military expenditure (p.c.) after 1914	-3.16e-06
	(0.0000531
Urbanization	-0.0002758
	(0.000996)
Observations	2578
R-squared	0.835

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

Table W3: Robustness: Education Reforms and Military Rivalry

Panel A: Imputed reforms

| | Logit for "imputed reforms" | | | |
	(1)	(2)	(3)	(4)
Rivalry	0.271**	0.177	0.190*	0.379***
	[0.119]	[0.113]	[0.113]	[0.145]
Democracy		-0.055***	-0.059***	-0.061***
		[0.007]	[0.010]	[0.010]
Rivalry*Democracy			0.009	0.013
			[0.014]	[0.017]
Relative arrmy of rivals				-0.005
				[0.019]
Population growth.	0.009***	0.004	0.004	0.003
	[0.003]	[0.003]	[0.003]	[0.003]
Military expenditure p.c.	-0.001**	-0.001**	-0.001**	-0.001
	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1390	1299	1299	1163

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

Table W3: Robustness: Education Reforms and Military Rivalry
Panel B: Known reforms

| | Logit for "known reforms" | | | |
	(1)	(2)	(3)	(4)
Rivalry	0.522***	0.531**	-0.157	0.148
	[0.085]	[0.052]	[0.237]	[0.522]
Democracy		0.005	0.004	0.005
		[0.013]	[0.052]	[0.054]
Rivalry*Democracy			0.075	0.049
			[0.074]	[0.058]
Relative army of rivals			0.145***	0.166***
			[0.034]	[0.034]
Government expenditure p.c.				0.000
				[0.001]
Population growth	-0.001	-0.000	0.009	0.009
	[0.009]	[0.009]	[0.008]	[0.013]
Military expenditure p.c.	0.000	0.000	0.001	0.001
Observations	741	741	720	666

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

Table W4: Robustness: Industrialization and Urbanization (updated)

	Primary enrollment rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	116.463***	-33.225	196.974***	-66.067	169.932***	-155.684***
	(23.966)	(39.836)	(24.386)	(41.922)	(25.963)	(46.247)
Democracy	-6.494**	-6.456**	-13.200***	-4.672*	-16.135***	-8.880***
	(2.618)	(2.635)	(2.476)	(2.715)	(2.502)	(2.613)
Rivalry*Democracy	3.774	3.257	17.066***	7.426**	20.281***	11.642***
	(2.508)	(2.579)	(2.703)	(3.009)	(2.701)	(2.913)
Industry/GDP	6.206***	2.130				
	(1.398)	(1.778)				
Rivalry*industry/GDP		5.014***				
		(1.274)				
% Urban (50,000)			3.321**	-4.996***		
			(1.292)	(1.656)		
Rivalry*% urban (50,000)				10.939***		
				(1.425)		
% Urban (20,000)					3.575***	-2.716**
					(1.087)	(1.305)
Rivalry*% urban (20,000)						9.389***
						(1.198)
Population growth	5.412***	5.581***	8.253***	8.331***	7.904***	7.923***
	(0.980)	(0.981)	(1.191)	(1.198)	(1.199)	(1.188)
Military expenditure p.c. before 1914			184.885***	195.107***	156.536***	162.221***
			(67.169)	(68.512)	(60.658)	(60.313)
Military expenditure p.c. after 1914	-0.251***	-0.251***	-0.741***	-0.773***	-1.069***	-1.090***
	(0.083)	(0.082)	(0.169)	(0.168)	(0.182)	(0.176)
Observations	1740	1740	2921	2921	2793	2793
R-squared	0.853	0.855	0.766	0.773	0.773	0.781

Notes: All specifications include country and time fixed effects. Robust standard errors in brackets. *** $p <0.01$, ** $p <0.05$, * $p <0.1$. "% Urban (50,000)" is the share of the population living in cities of 50,000 or more inhabitants (in %) and "% Urban (20,000)" is the share of the population living in cities of 20,000 or more inhabitants (in %). "Industry/GDP" is the share of industrial output in GDP (in %).

Table W5: Robustness: Specification and Sample Selection (updated)

	Primary enrollment rate				
	(1)	(2)	(3)	(4)	(5)
Rivalry	254.349***	-197.831***	88.757***	317.320***	88.537***
	(64.904)	(41.520)	(18.492)	(30.246)	(24.288)
Democracy	-4.986*	-6.731**	1.869	-9.787***	-0.172
	(2.556)	(2.709)	(2.263)	(3.207)	(2.908)
Rivalry*Democracy	1.426	8.301***	-1.966	15.445***	1.534
	(2.911)	(2.942)	(2.290)	(3.609)	(2.660)
Ethnic fractionalization	-15.382***				
	(2.636)				
Ethnic fractionalization*Rivalry	-32.388**				
	(1.151)				
Relative army of rivals		3.984**	1.219	1.291	1.701*
		(1.627)	(0.835)	(1.238)	(0.983)
Primary enrollment of rivals		0.259***			
		(0.023)			
Lagged Primary enrollment			0.722***		
			(0.032)		
Urbanization	10.235***	9.819***	4.112***	9.434***	7.410***
	(1.413)	(1.665)	(1.125)	(1.433)	(1.556)
Population growth	6.045***	7.064***	4.421***	5.227***	2.400***
	(1.050)	(1.171)	(1.014)	(0.937)	(0.733)
Military expenditure p.c.		91.768*	55.848*	14.746	28.583
before 1914		(48.128)	(29.348)	(19.840)	(24.903)
Military expenditure p.c.	-0.310***	-0.469***	-0.254***	-0.309***	-0.253***
after 1914	(0.080)	(0.111)	(0.073)	(0.092)	(0.094)
Observations	1717	2617	2604	2272	2617
R-squared	0.854	0.800	0.864	0.864	0.889

Notes: All specifications include country and time fixed effects. Standard errors in brackets. ***$p<0.01$, **$p<0.05$, *$p<0.1$. Column (1) includes the index of ethnic fractionalization from Alesina et al. (2003) and its interaction with rivalry; it covers only the post-1945 period. Column (2) includes the primary enrollment rate of the largest rival if any. In column (3) "Lagged. Primary enrollment" is the 10-year lagged primary enrollment rate per 10,000 inhabitants. Column (4) excludes Western Europe. In column (5) country fixed effects are interacted with before/after 1950 dummies.

Table W6: Barro-Lee Education Attainment Data

Percentage of primary schooling attained 5 years later by adults 15-19 years old				
	(1)	(2)	(3)	(4)
Rivalry	3.049*	3.243		
	[1.844]	[2.571]		
Democracy	-0.365**	-0.346**	-0.196	-0.198
	[0.146]	[0.153]	[0.123]	[0.122]
Rivalry*Democracy	0.452**	0.893***		
	[0.206]	[0.257]		
Relative army of rivals		-0.095		
		[0.558]		
War in previous 10 years			7.032***	
			[2.090]	
War in 10 years*Democracy			-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*Democracy				0.241
				[0.349]
Lost war in 10 years*Democracy				-0.338
				[0.315]
Military expenditure p.c.	0.006	-0.001	0.005	0.005
	[0.004]	[0.005]	[0.004]	[0.004]
Government expenditure p.c.	-0.002**	-0.001*	-0.001**	-0.001**
	[0.001]	[0.001]	[0.001]	[0.001]
Observations	1114	952	1114	1114
R-squared	0.112	0.098	0.116	0.122

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