Education and Military Rivalry

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Broad research question

What forces drive the expansion of primary education?

- common view: education the flipside of democratic reforms

The example of France

- a series of school reforms expanding enrollments in the 1880s, following democratic transition – from 2nd Empire to 3rd Republic – in years from 1870
- but another dramatic event in 1870: military defeat to Prussia in Battle of Sedan

Does military threats drive education reforms?

We use historical panel data for 19th century Europe plus more recent much broader panel to establish three empirical results on military rivalry, democracy and education

- primary education enrollments positively associated with military rivalry (or external war in past ten years)
- effect of democratization is negative, once we control for military rivalry
- interaction between military rivalry and democracy is positive

Related research

Education and democracy

- Bourguignon and Verdier (2000), Mulligan et al (2004), Glaeser et al (2007)

Economic and political impact of war

- Glick and Taylor (2005), Martin et al (2008), Acemoglu and Yared (2009), Ticchi and Vindigni (2009)

Military threats and state (fiscal) capacity

- Hintze (1906), Tilly (1975), Besley and Persson (2011), Scheve and Stasavage (2011)

Roadmap

1. Case Studies
2. Panel Data
3. Econometric Results
4. Some Theory
5. Final Remarks

Case Studies: France (1)

- September 2, 1870: Napoleon III made prisoner at Sedan; and on February 26, 1871, Germany takes over control of Alsace and Lorraine
- In 1870, French education lagged that in European countries
  $\longrightarrow$ mostly private, run around churches, communication largely in local dialects
  $\longrightarrow$ debate: some saw defeat at Sedan as resulting from superior Prussian school system

Case Studies: France (2)

- Jules Ferry's education reforms
  $\longrightarrow$ no tuition fees (1881), compulsory enrollment 6-13 (1882), 20 school-age children villages must host public elementary school (1883), Freycinet plan to facilitate school access, curriculum transformed: geography, history, dictation emphasized, religion eliminated
- Outcomes from around 1870 to 1910
  $\longrightarrow$ enrollment from 1,176 to 1,430 (per 10,000), literacy rate from 80% to 96%

Case Studies: Japan (1)

- From 17th century, Japan was ruled by military lords (shoguns) of the Tokugawa dynasty
- Under Tokugawa dynasty, study of Confucian classics a privilege of the Samurai
- New threats by Western powers
  $\longrightarrow$ In 1853, Commodore Matthew Perry arrived in Japan with ultimatum: agree to trade or suffer the consequences of war
  $\longrightarrow$ In 1854, American warships were sent to Japan by West
  $\longrightarrow$ Kanagawa Treaty signed in 1854 under war threat

Case Studies: Japan (2)

- Debate between those who wanted to preserve focus on Confucian classics;and those who wanted to introduce secular Western science and to stress mathematics and rationalistic thought
- Internal political crisis and Meiji Restoration in 1868 with commitment to modernization, state building and education reforms
- Meiji education reforms
  $\longrightarrow$ four-year compulsory school (1872), complemented with national teacher education
- Outcomes from around 1870 to 1910
  $\longrightarrow$ primary enrollment from 65 to 1,122 (per 10,000), literacy rate from 35% (8%) to 75% (68%) for men (women)

Why would education help meet military threat?

- Case studies suggest several possible channels
  $\longrightarrow$ cognitive skills: teach things like arithmetic and reading
  $\longrightarrow$ non-cognitive skills: instill some group discipline
  $\longrightarrow$ indoctrination: strengthen national identity and patriotic values
- Our empirical work will not distinguish between these

Panel data: Education

- Use an unbalanced panel of 137 countries
  $\longrightarrow$ Western Europe: 1830-2000, Others: 1960-2000
  $\longrightarrow$ main constraint is availability of school enrollment data
- Primary enrollment (Banks, 2011 data set)
  $\longrightarrow$ expressed per 10,000 inhabitants – sample average is 1,050 (std. 850)
  $\longrightarrow$ control for population growth
  $\longrightarrow$ also consider "imputed" or "known" education reforms

Panel data: Military threats

- Military Rivalry (Thompson, 2001)
  $\longrightarrow$ does a country have a *strategic rival* in year t ?
  $\longrightarrow$ from historical sources, leaders' perceptions of other countries in speeches, newspapers, etc.
  $\longrightarrow$ three main criteria: (i) a competitor, (ii) a source of threats, (iii) a hostile country
  $\longrightarrow$ 174 rivalries in original data set, e.g., Angola-South Africa 1977-1985, Britain-Japan 1932-1945, Israel-Jordan 1948-1994
- Past wars (Correlates of War data set)
  $\longrightarrow$ was a country in (interstate) war in years $t-10$ to $t-1$?
  $\longrightarrow$ recent war makes military concerns more salient
  $\longrightarrow$ drawback: backward rather than forward looking

Panel data: Democracy

- Polity2 score (Polity IV data set)
  $\longrightarrow$ composite index from -10 to $+10$, components include strength of executive constraints, and openness and competitiveness of executive recruitment
  $\longrightarrow$ sample average 0.37 (std. 7.12)
- Other controls:
  $\longrightarrow$ GDP per capita and total government expenditure (WDI and Banks)
  $\longrightarrow$ relative army size of strategic rivals (Thompson and Banks)
  $\longrightarrow$ initial primary enrollment

Econometric results

Baseline specification

$$\begin{aligned} enrollment_{i,t} &= \alpha_0 + \alpha_1 threat_{i,t} + \alpha_2 democracy_{i,t} + \\ &\quad \alpha_3 threat_{i,t} \cdot democracy_{i,t} + \alpha_4 X_{i,t} + \nu_i + \delta_t + u_{i,t} \end{aligned}$$

- threat measured by military rivalry or war in last 10 years
- include country and year fixed effects, as well as controls (military and government expenditures per capita, population growth, military size of country and rival)
- effect identified from within-country variation relative to world-wide average
- expect α_1 positive, but agnostic about signs of α_2 and α_3
- robust standard errors (results sensitive to clustering)

Primary enrollment and war threat – Table 2

	Primary enrollment			
	Threat=Strategic rivalry		Threat=War in last 10 years	
	(1)	(2)	(4)	(5)
Threat	54.878***	94.127***	101.970***	106.019***
	[20.388]	[21.376]	[16.581]	[17.222]
Democracy	-6.871***	-17.632***	-7.276***	-6.929***
	[1.277]	[1.603]	[1.266]	[1.328]
Threat*Democracy		22.276***		-2.736
		[2.199]		[2.158]
Observations	4,626	4,626	4,626	4,626
R-squared	0.669	0.679	0.671	0.672

Some sanity checks

- Does military rivalry really measure a threat?
  $\longrightarrow$ check if rivalry raises military spending – alternative dependent variable in same specification as the one above
- Does higher education help to meet military threat?
  $\longrightarrow$ check if it raises probability to win war in next 10 years

Sanity checks – Table 3

	Military expenditure per capita		Probability of winning war in next 10 years	
	(5)	(6)	(3)	(4)
Primary enrollment			0.002***	0.002***
			[0.000]	[0.000]
Rivalry	19.881***	19.651***		4.548***
	[6.581]	[6.577]		[1.270]
Democracy	-3.174***	-3.111***	0.028	0.003
	[0.317]	[0.564]	[0.032]	[0.037]
Rivalry*Democracy		-0.147		
		[0.984]		
Observations	7,517	7,517	544	455
R-squared	0.395	0.395		

The results on democracy

- Negative direct effect?
  $\longrightarrow$ a priori effect could have any sign: more pro-poor redistribution vs. shorter time horizons (because of more rapid turnover)
- Positive interaction with rivalry?
  $\longrightarrow$ harder to understand – attempt in model (see below)
- Perhaps democracy measure too wide?
  $\longrightarrow$ disaggregate into open elections and executive constraints
  $\longrightarrow$ results for each score similar to earlier, but results a bit stronger for executive constraints

Components of democracy: Primary enrollment

	Rate of primary enrollment per 10,000 people			
	(1)	(2)	(3)	(4)
Rivalry	12.620	48.516*	66.900***	87.435***
	[15.713]	[25.806]	[14.264]	[25.852]
Exec. constraints	-130.661***		12.939	-114.990***
	[17.174]		[13.057]	[17.567]
Exec. const.*Rivalry	256.399***			237.423***
	[21.635]			[22.010]
Exec. openness		-128.412***	-58.558***	-89.983***
		[19.943]	[14.928]	[20.276]
Exec. open.*Rivalry		142.901***		98.509***
		[26.657]		[26.764]
Observations	7492	7492	7492	7492
R-squared	0.692	0.688	0.687	0.693

All specifications include year and country FE. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Problems with endogeneity?

- OLS estimates biased by omitted variables or reverse causation
  $\longrightarrow$ nationalist regime may boost schooling (for indoctrination), and also create rivalries with other countries
  $\longrightarrow$ a country investing in education may feel strong and impose threats on its neighbors – or a weak country, not investing in education, may receive outside threats
  $\longrightarrow$ bias may go in either direction
- Try to solve by IV-strategy
  $\longrightarrow$ instrument by (binary) *Neighboring rivalry*
  $\longrightarrow$ equal to 1, for country i and year t, if one of its bordering countries j has a rivalry with another country k (which is non-contiguous to i), and neither j nor k has a rivalry with i
  $\longrightarrow$ use full sample except Western Europe and Eastern Bloc during cold war

IV first stage – Table 5A

	(1)	(2)	(3)
1st Stage	Rivalry	Rivalry	Rivalry*Democracy
Neig rivalry	0.131***	0.129***	-0.461*
	[0.024]	[0.024]	[0.249]
Neig rivalry*Democracy		0.0028	0.305***
		[0.002]	[0.025]
Democracy	-0.002*	-0.003*	0.276***
	[0.001]	[0.002]	[0.024]
Excluded Instruments	Neig.rivalry	Neig rivalry	Neig rivalry
		Neig rivalry*Democracy	Neig rivalry*Democracy
F Excl Instruments	31.10	17.04	76.26
Observations	3,760	3,760	3,760
R-square	0.838	0.838	0.839

IV second stage – Table 5B

	Primary enrollment rate	
2nd Stage	(1)	(2)
Rivalry	837.144***	860.127***
	[221.008]	[220.624]
Rivalry*Democracy		22.871***
		[8.376]
Democracy	-0.353	-12.020***
	[1.512]	[4.525]
Endogenous Regressors	Rivalry	Rivalry
		Rivalry*Democracy
Instruments	Neig rivalry	Neig rivalry
		Neig rivalry*Democracy
Anderson-Rubin Wald test	23.86	37.60
Kleibergen-Paap Wald rk F	31.100	14.652
Observations	3,760	3,760

Further robustness checks

Estimation results in Web Appendix

- what if the dependent variable is imputed or known education reforms? – results similar for rivalry, weaker for democracy (known reforms: Europe 1830-)
- are results robust to controlling for degree of industrialization or urbanization and do they hold equally at all levels of industrialization/urbanization?
- are results robust to adding additional controls (ethnic fragmentation, rival-country enrollment, lagged enrollments)? – yes
- ... to measuring education by 15-19 year old with primary education (at $t + 5$) in Barro-Lee data set? – yes

Industrialization

	Rate of primary enrollment per 10,000 people	
Rivalry	58.823***	-121.053***
	[17.376]	[30.671]
Democracy score	-7.499***	-7.736***
	[1.444]	[1.434]
Rivalry*Democracy	5.103***	4.987***
	[1.761]	[1.749]
Industry	8.803***	5.151***
	[0.720]	[0.881]
Rivalry*Industry		6.351***
		[0.895]
Observations	3693	3693
R-squared	0.788	0.791

All specifications include year and country FE. Standard errors in brackets.***p<0.01, ** p<0.05, * p<0.1

Urbanization

	Rate of primary enrollment per 10,000 people			
	% in cities > 50,000		% in cities > 20,000	
Rivalry	145.139***	-107.406***	114.623***	-189.859***
	[14.437]	[20.383]	[14.687]	[21.518]
Democracy score	-23.147***	-15.994***	-24.957***	-17.381***
	[1.227]	[1.268]	[1.242]	[1.269]
Rivalry*Democracy	25.821***	17.683***	28.036***	19.613***
	[1.566]	[1.600]	[1.576]	[1.591]
Urbanization	8.416***	-0.392	5.967***	-0.787
	[0.792]	[0.928]	[0.669]	[0.741]
Rivalry*Urbanization		13.862***		11.990***
		[0.809]		[0.635]
Observations	6039	6039	5815	5815
R-squared	0.731	0.744	0.735	0.751

All specifications include year and country FE. Standard errors in brackets.***p<0.01, ** p<0.05, *p<0.1

Some theory (1)

- Two groups: incumbent group and opposition group
- Probability of winning a war depends upon fighting efforts by members of both groups, and education investment (decided ex ante by incumbent group) reduces fighting effort cost
  $\longrightarrow$ incumbent has stronger incentives to invest in education if war becomes more likely
- But absent democracy, opposition-group members do not benefit much from winning the war
  $\longrightarrow$ if efforts by incumbent and opponent groups are sufficiently complementary, higher war threat increases incumbent group's incentives to invest in education all the more if more democracy (starting from zero initial democracy)

Some theory (2)

- Thus positive interaction of threats and democracy driven by unverifiable and complementary fighting efforts by incumbent and opposition groups – should not be present for regular investments in infrastructure
  $\longrightarrow$ looking at evidence on road investments, we find no interaction

Road infrastructure

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

Final remarks

We have uncovered a previously unknown driver of education, namely military threats

- democratic transitions do not seem to generate higher enrollments, other than indirectly together with military rivalries

Many possible extensions

- military rivalries might shape other investments, e.g., in state capacity – see Tilly (1975) and Besley and Persson (2011)
- other types of rivalries, e.g., competition in economic domain
- consider differences between lost wars and won wars
- look at not only size of education reforms, but also at their contents – e.g., horizontal vs. vertical pedagogy – see Algan, Cahuc and Shleifer (2011)

Appendix: Robustness checks: Barro-Lee data

Percentage of primary schooling attained 5 years later by adults 15-19 years old				
	(1)	(2)	(3)	(4)
Rivalry	2.920*	3.422*	5.804**	4.018**
	[1.719]	[1.745]	[2.929]	[1.794]
Democracy score	-0.211*	-0.340**	-0.778***	-0.430***
	[0.116]	[0.140]	[0.192]	[0.144]
Rivalry*Democracy score		0.314	0.450*	0.508**
		[0.191]	[0.271]	[0.198]
Fixed effects	yes	yes	yes	yes
Controls			GDP p.c. Income tax	Government expenditure
Observations	1278	1278	673	1207
R-squared	0.097	0.099	0.230	0.123

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

Appendix: Robustness checks: Country x period FE

	Primary enrollment rate			
	(1)	(2)	(3)	(4)
Rivalry	66.585***	112.019***	62.859***	81.010***
	[14.530]	[14.567]	[13.666]	[13.982]
Democracy score	-9.397***	-20.844***	-8.330***	-12.025***
	[0.993]	[1.226]	[0.811]	[1.028]
Rivalry*Democracy		24.569***		7.568***
		[1.594]		[1.301]
Year FE	Yes	Yes	Yes	Yes
Country FE	Time invariant	Time invariant	Before/after 1950	Before/after 1950
Observations	6675	6675	6675	6675
R-squared	0.666	0.678	0.832	0.833

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

Appendix: Robustness checks: Region-specific time trends

	Primary enrollment rate			
	(1)	(2)	(3)	(4)
Rivalry	118.583***	129.449***	101.777***	138.309***
	[12.376]	[12.066]	[12.198]	[13.163]
Democracy score		-4.099***	-4.628***	-3.785***
		[1.035]	[1.043]	[1.107]
Rivalry*Democracy		7.640***	8.692***	7.418***
		[1.323]	[1.335]	[1.422]
Controls			Gov't exp.	Military exp.
Year fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Time trends	Regional	Regional	Regional	Regional
Observations	6910	6476	6035	5764
R-squared	0.804	0.803	0.815	0.791

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

Appendix: Robustness checks: Reform thresholds

	5% threshold		15% threshold	
	(1)	(2)	(3)	(4)
Rivalry	0.199**	0.321***	0.320***	0.457***
	[0.096]	[0.120]	[0.104]	[0.122]
Polity2	-0.045***	-0.048***	-0.063***	-0.065***
	[0.008]	[0.008]	[0.011]	[0.011]
Rivalry*polity2	0.008	0.008	0.012	0.017
	[0.013]	[0.016]	[0.015]	[0.016]
Rel. army of rivals		-0.002		0.002
		[0.014]		[0.016]
Country FE	yes	yes	yes	yes
Time FE	yes	yes	yes	yes
Observations	1517	1364	1514	1361

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Appendix: Robustness checks: Military spending

	Primary enrollment rate			Probability of "imputed reforms"		
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	110.857***	76.848***	85.535***	0.439***	0.347***	0.511***
	[15.417]	[18.641]	[19.440]	[0.121]	[0.109]	[0.132]
Democracy score	-21.688***	-23.667***	-25.280***	-0.062***	-0.060***	-0.062***
	[1.328]	[1.501]	[1.565]	[0.011]	[0.009]	[0.011]
Rivalry*Democracy	26.429***	30.823***	31.572***	0.010	0.010	0.011
	[1.667]	[1.892]	[1.951]	[0.016]	[0.013]	[0.016]
Size of military/Pop.	0.812***		0.619***	-0.004***		-0.004***
	[0.085]		[0.095]	[0.001]		[0.001]
Defense/Govt exp.		-0.229***	-0.365***		0.000	0.000
		[0.062]	[0.063]		[0.001]	[0.001]
Country FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes
Observations	5604	4772	4290	1073	1220	892

Appendix: Robustness checks: Future wars

	Primary enrollment rate			
	(1)	(2)	(3)	(4)
Future wars	128.207***	134.543***	134.218***	131.792***
	[13.619]	[13.744]	[13.737]	[13.268]
Democracy score		-9.319***	-9.967***	-7.416***
		[0.988]	[1.015]	[0.969]
Future wars*Democracy			4.741***	0.033
			[1.740]	[1.694]
Fixed effects	yes	yes	yes	yes
Control for total govt exp.	no	no	no	yes
Observations	7199	6675	6675	6130
R-squared	0.692	0.670	0.670	0.727

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

Appendix: Robustness checks: Education and victories

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

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

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