

## **State Capacity and Military Conflict**

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**This version: October 2013  
(November 2011)**

*Barcelona GSE Working Paper Series*

*Working Paper n° 593*

# STATE CAPACITY AND MILITARY CONFLICT

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ABSTRACT. In 1500, Europe was composed of hundreds of statelets and principalities, with weak central authority, no monopoly over the legitimate use of violence, and overlapping jurisdictions. By 1800, only a handful of powerful, centralized nation states remained. We build a model that explains both the emergence of capable states and growing divergence between European powers. We argue that the impact of war was crucial for state building, and depended on: i) the importance of financial resources for military success, and ii) a country's initial level of domestic political fragmentation. We emphasize the role of the "Military Revolution", which raised the cost of war. Initially, this caused more cohesive states to invest in state capacity, while more divided states rationally dropped out of the competition, causing divergence between European states. As the cost of war escalates further, all remaining states engaged in a race to the top, resulting in greater state building.

## 1. INTRODUCTION

Capable states cannot be taken for granted. States as we know them today only begin to appear after 1500 in Europe. Then, the continent was divided into more than 500 "states, would-be states, statelets, and state-like organizations" (Tilly 1990); rulers possessed limited tax powers; there was no professional bureaucracy; armies were largely composed of mercenaries; and powerful elites were often above the law. Within three short centuries, however, European powers led the rest of the world in terms of state capacity.

The leading explanation for this rapid transition emphasizes the role of warfare. Tilly (1990) famously argued that "states made war, and war made states". Armed conflict gave monarchs the incentive to create an effective fiscal infrastructure: the ability to finance war was key for survival. Empirically, Besley and Persson (2009) show that fiscal capacity today is typically greater in countries that fought more wars in the past. Economists have also proposed formal models to study the incentives to create a capable state, arguing that war is a common-interest public good that allows for accelerated investments in state building (Besley and Persson 2011). This perspective helps to explain the coexistence of frequent warfare and growing state capacity.

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*Date:* 8-10-2013.

Gennaioli: Bocconi University and IGIER; Voth: UPF and CREI. We have received helpful comments from Philippe Aghion, Roland Benabou, Tim Besley, Francesco Caselli, Mark Dincecco, Regina Grafe, Avner Greif, Phil Hoffman, Peter Koudjis, Gerard Padro-i-Miquel, Roger Myerson, Nancy Qian, Torsten Persson, Jim Robinson, Enrico Spolaore, Jean Tirole, Mathias Thoenig, Nico Voigtländer, Pierre Yared, Fabrizio Zilibotti and from seminar participants at FU Amsterdam, IMT Lucca, CREI, U Penn, the NBER Summer Institute, the 2011 MOVE conference at UAB, and the 2012 NBER Political Economy spring meeting. We thank the European Research Council for support through StG (#241114) and AdG (#230515).

At the same time, four important issues remain. First, warfare is not unique to either Europe or the early modern period. States mostly failed to develop much before 1600 despite frequent warfare, contradicting the view that war will necessarily translate into state building. For example, hunter-gatherer communities registered high rates of violent death (Clark 2007), but did not engage in state building on any significant scale. Why do modern states only emerge in a small corner of the Eurasian landmass after 1500? Second, the growth in state capacity was highly uneven, with some powers such as Britain or France building stronger and bigger states, others such as Spain or Austria falling behind, and some, like Poland, disappearing altogether. If war boosted state building in some countries, it must have had a smaller (or even the opposite effect) in others. Currently, the literature on state capacity is silent on divergence in the cross-section. Third, warfare during the period of initial state building (1600-1800) was rarely a common-interest public good. Instead, the “sport of kings” was often a private good for princes in pursuit of glory and personal power. Demands for greater financial resources were typically opposed by domestic taxpayers. Fourth, wars are not exogenous events. Instead, rulers deliberately decide to go to war. They do so partly as a result of a country’s existing ability to wage it. Thus, having a strong state may be a cause (instead of a consequence) of war.

This paper addresses these issues by presenting a model in which two contending rulers invest in state building, taking the risk of military conflict into account. State building consists of centralizing the tax system, which increases the extent to which the ruler (and not local power holders) controls revenue collection. Rulers trade off greater future fiscal revenue created by centralization with the current cost of sidelining domestic power holders. State building therefore entails a domestic political cost (similar to Besley and Persson 2009).

Military conflict is financed with taxes and redistributes fiscal revenues from the losing ruler to the winning one. In this setup, sections 3 and 4 show that war’s impact on state building depends on two aspects – the cost of war and initial political fragmentation. When military success crucially depends on the ability to spend, raising fiscal revenues becomes imperative for a ruler’s control of territory. Political fragmentation of existing states in turn influences the cost of state-building. *Ceteris paribus*, centralization will be more costly for the rulers of ethnically heterogeneous and previously politically fragmented states.

When the cost of war is low, our model implies that - contrary to Tilly’s hypothesis - military conflict dampens state building compared to a peaceful world. The reason is that, in this case, both contenders are similarly likely to win the war regardless of their fiscal revenues. As a result, war is akin to a tax on the ruler – it creates the risk of a ruler losing his additional fiscal revenues, which reduces his gains from centralization and higher fiscal revenues. Furthermore, given that the odds of victory are even, weak rulers have a large incentive to go to war against strong ones in a bid to grab their rival’s fiscal revenues. Due to both effects, when war is cheap, frequent warfare and the presence of weak states endogenously reinforce each other.

In contrast, when the cost of war is high, the possibility of armed conflict causes strong divergence in state building. Now, the odds of winning a war are stacked in favour of the stronger state. As a result, divided states that find it costly to centralize rationally drop out of the competition; their chances of success are too

low. By contrast, cohesive states do not only engage in state building but will also aggressively attack divided ones. Warfare is still frequent, but now it coexists with the consolidation of strong, cohesive states; weak, divided ones gradually lose out. Eventually, a “race to the top” emerges, with all powers building state capacity as they compete more and more in fiscal and military terms.

Historically, the growth of state capacity was often associated with the emergence of institutions limiting the prerogatives of central rulers, particularly with respect to taxation (Dincecco 2009). Section 5 shows that in our model, good institutions can reduce domestic opposition to centralization. Therefore, these institutions emerge if a ruler engages in state building but not otherwise (Acemoglu 2005). Our results highlight the conditions under which a war threat induces an upgrading of state capacity (Besley and Persson 2009), and when it does not.

In Section 6 we confront the predictions of our model with data on state-building in Europe after 1500. The “military revolution” – a set of interrelated technological and organizational changes between the 16th and 17th century – made wars more costly and protracted (e.g., Downing 1992, Roberts 1956). Using a dataset of 374 battles, we measure the extent to which fiscal resources translated into battlefield success. Over time, the odds of the fiscally stronger power winning increased dramatically. Therefore, the military revolution created strong incentives to invest in state building. Data on the number of predecessor states, linguistic heterogeneity, and geography allows us to test for interaction effects between fragmentation and the importance of money for military success. As the importance of fiscal revenue for winning at arms grew, more homogenous states disproportionately increased their revenue collection ability.

FIGURE 1. Revenue-Raising and the Odds of Success for Richer Powers

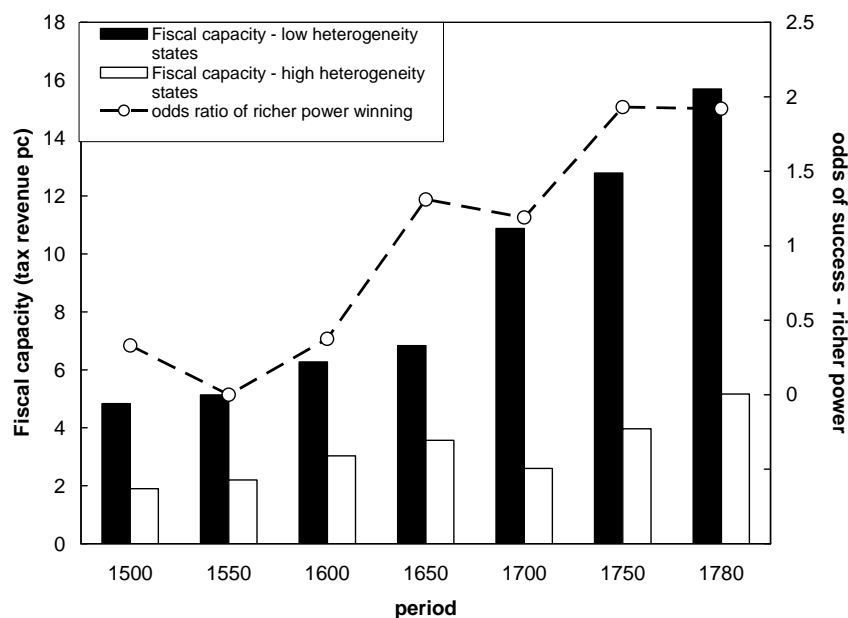


Figure 1 tells our story in a single chart. The line shows the chance of success of the richer power in the 374 battles we analyze. As the military revolution unfolds, the odds ratio rises, from less than unity in the 16th century to almost 2 by the late 18th century – indicating a huge increase in the importance of fiscal resources for military success. The bars show the success of two groups of powers in raising revenue; they indicate fiscal capacity (tax revenue normalized by average wages). The white bars show tax revenues for the less homogenous powers; the black ones for the more homogeneous ones.<sup>1</sup> While both groups show increases overall, the less homogenous group lags far behind the more homogenous ones – and they also show periods of absolute decline. Our model suggests the following interpretation: As the military revolution unfolded, and fiscal resources increasingly determined battlefield outcomes, the less fragmented states could respond more easily to the need to raise revenues; their more fragmented competitors fell behind. States such as Britain or France succeeded in this highly competitive environment, and came to exert centralized control over their territories on an impressive scale. Divided and weak states such as Poland failed to do so, and disappeared from the map. We discuss the advantages and disadvantages of our interpretation relative to alternative hypotheses in Section 6, after presenting our regression results.

In addition to recent work on state capacity (Besley and Persson, 2009, 2011), we also contribute to the empirical literature on taxation and the growth of European states after 1500 (Tilly 1990, Brewer 1990, Bonney 1999, Oestreich 1969). Countries with parliamentary representation typically had higher tax rates than those governed by princes (Hoffman and Norberg 1994, Mathias and O’Brien 1976, Hoffman and Rosenthal 1997). The statistical evidence is analyzed *inter alia* by Dincecco (2009). The paper that is closest in spirit to ours is Karman and Pamuk (2013), who find evidence that urbanized countries in early modern Europe saw greater increases in tax revenue, and that the pressure of war on average drove up tax collection. The arrangements that allowed representative assemblies and the ruler to strike a bargain in general is explored in Hoffman and Rosenthal (1997). Stasavage (2003) examines coalition formation within countries that favors the development of public credit. These studies generally show that representative assemblies were effective at taxing themselves, as reflected in lower interest rates. Dincecco (2009) also finds that a combination of centralization and representation led to the highest rates of taxation. Karman and Pamuk (2013) find that representative assemblies succeeded more in urbanized economies in raising revenue, while authoritarian regimes performed better in rural societies.

Our work also relates to recent research on economic incentives, political interests, and interstate conflict. Martin, Mayer and Thoenig (2008), and Rohner, Thoenig and Zilibotti (2013) study the link between war and trade. Jackson and Morelli (2007) survey the political factors leading to military conflict. Alesina and Spolaore (2005) analyze how the risk of war affects the optimal size of countries. Spolaore and Wacziarg (2010) examine the link between war and genetic distance.

Our contribution also touches on the vast literature studying the economic consequences of institutions (e.g. Acemoglu 2005, Acemoglu, Johnson and Robinson 2001, 2005, North 1989, Greif 1993, Delong and Shleifer 1993). This literature does not explicitly consider the role of external conflict, but it sometimes argues

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<sup>1</sup>We discuss how initial homogeneity is defined in section 6.

TABLE 1. War Frequency in Europe

Century	Number of wars	Average duration (years)	Percentage years under warfare (%)
16 <sup>th</sup>	34	1.6	95
17 <sup>th</sup>	29	1.7	94
18 <sup>th</sup>	17	1	78
19 <sup>th</sup>	20	0.4	40
20 <sup>th</sup>	15	0.4	53

Source: Tilly 1990

that war can overcome domestic agency problems that stand in the way of better institutions (e.g. Acemoglu and Robinson 2006).

Relative to the existing literature, we make the following contributions: First, we build a simple model that investigates the effects of war on state capacity building in a two-player setup. This allows us to clarify the conditions under which we should expect greater war threats to aid state building. One key result is that the link need not be positive – a belligerent environment can lead to lower state building. Second, our paper systematically investigates why there is a synergy between state building and better institutions, and the extent to which external war threats create it. Third, we present a micro-founded model in which the economic efficiency gains of centralization emerge naturally. Fourth, we compile quantitative measures of the rising importance of fiscal revenues for military success, and demonstrate how they interacted with fiscal centralization. These results demonstrate the importance of the Military Revolution in driving state building. Fifth, we present quantitative evidence for important interaction effects between underlying heterogeneity in a country and the rise of “money-intensive” war.

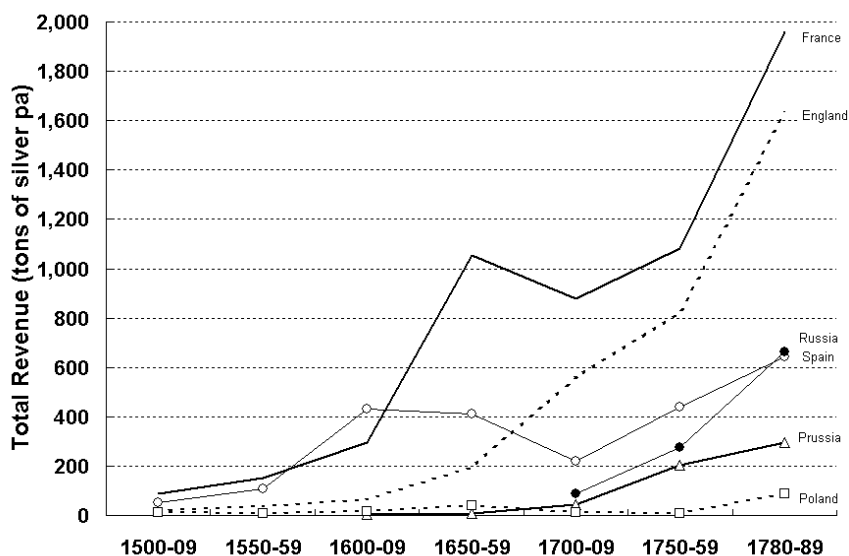
## 2. HISTORICAL BACKGROUND AND CONTEXT

How did Europe after 1500 create the predecessors of modern-day states? The leading explanation emphasizes the role of war (Tilly 1990). Wars were indeed frequent in early modern Europe. The data collected by Levy (1983) show that in Europe between 1500 to 1700, a Great Power war was underway in 95% of all years (Table 1).

We argue that this is more of a starting point than an answer. Numerous, extended wars were also fought during the medieval period, from the *Reconquista* in Spain to the Hundred Years War between England and France and to innumerable wars between Italian city states. War is also not unique to Europe. China, for example, experienced prolonged conflict during the “warring states period”, between 475BC and 221BC (Hui 2005). In neither medieval Europe nor early China did frequent warfare coincide with the creation of highly capable and centralized states.

Our answer to the puzzle is that aggressive state building was shaped by a unique synergy between military conflict and changes in military technology, the so-called “military revolution”. Before spelling out the mechanism, this section briefly describes our explanandum – the rise in state capacity in early modern Europe – and our explanatory factor, the military revolution.

FIGURE 2. Fiscal Capacity in Europe, 1500-1789



2.1. **The building of state capacity in Europe after 1500.** Two facts are striking about the rise of state capacity in Europe after 1500. One is the sheer magnitude of the increase in state centralization, tax capacity, and military ability over time. The second is growing divergence between European states.

Fiscal revenue is one important indicator of fiscal capacity. Figure 2 shows the tax revenue of major European powers, in tons of silver per year. We plot levels over time, to capture the speed of the increase. In 1500, the combined revenue for all major European powers was 214 tons p.a. Some 280 years later, this had increased by a factor of twenty, to 4,400 tons p.a. Part of the total increase reflected growing population numbers, but an important part was driven by higher tax pressure. Measured in grams of silver per head and year, average fiscal revenue increased eight-fold between 1500 and 1780.<sup>2</sup> Differences in the cross-section of European powers also grew considerably. In 1500, Poland's total revenue was half of England's. In 1780, it was equivalent to only 5%. Some powers increased their tax revenue by a small margin, others by a lot: Venetian tax receipts doubled during the course of the early modern period, while those of England surged by a factor of 78.

The vast increase in revenue was facilitated by a new administrative structure. Medieval rulers had largely been expected to 'live on their own', i.e. to finance themselves from their domain income (Landers 2003). After 1500, this became increasingly impossible. To raise large amounts of tax, states needed to centralize and bureaucratize their administration. Overall, states by the late 18th century had succeeded in this task. By 1780, Britain had centralized collection of excise

<sup>2</sup>The value of silver declined, but only gradually. The real increase was still by a factor of more than 13.

TABLE 2. Army size in Early Modern Europe (in 1,000s)

	1550			1700			1780		
	army	navy	total	army	navy	total	army	navy	total
England	41	25	66	76	115	191	79	109	188
France	43	14	57	224	118	34	183	85	268
Dutch Republic				90	86	176	27	22	49
Spain	145	18	163	37	26	63	64	62	126
Austria	9	0	9	62	0	62	253	0	253
Prussia				37	0	37	181	0	181
Russia				52	0	52	408	19	427
Ottoman Empire	90	50	140	130	30	160	120	30	150

*Source:* Karman and Pamuk 2010

and customs taxes, and was about to introduce the first successful income tax in history. France, on the other hand, continued to use tax farming for both direct and indirect taxes all the way up to the French Revolution (Bonney 1981). There, tax exemptions for the nobility and the clergy repeatedly hamstrung the monarchy's attempts to raise revenue.

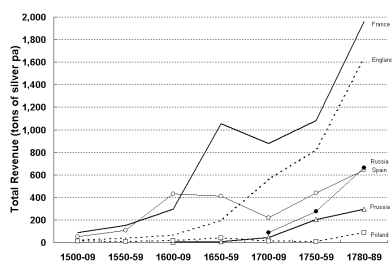
Changes in tax collection were part of a broader pattern of administrative reforms. Ancient legal privileges in many composite states were being reduced. At the same time, the pace at which states succeeded in pushing through administrative and political reforms varied greatly. Spain, for example, had scant success in reducing the fragmentation of its internal market, or in extending taxation beyond the Castilian heartland (Elliott 1963). Reforms in Poland foundered on the unanimity principle in the *sejm*, the assembly of nobles.

**2.2. The “military revolution”.** During the early modern period, armies grew in size, and war became much more costly. Military capacity also grew over time, but diverged sharply between different powers. By 1780, European armies (excluding Russia and the Ottoman Empire) had more than a million men under arms. The equivalent figure for 1550 was a mere 300,000. Figure 3 puts these changes in long-term perspective. Compared to the armies of Rome and Byzantium, early modern armies were large (measured as percentage of the population under arms). Indeed, Sweden in 1700 already reached levels of mobilization similar to those in Europe during World War I and II. Some powers succeeded in mobilizing many more resources than others (see also Table 2). At one end of the spectrum, England after 1700 quickly conquered vast parts of the globe. Its armed forces tripled in size between 1550 and 1780. France's army increased by a factor of five, and Austria's, by a factor of 28. In contrast, Poland was partitioned out of existence as a result of military impotence caused by internal strife and fiscal weakness.

Rising costs were driven by three factors - larger army size, increasing use of standing armies, and technological change. After 1650 armies were increasingly equipped from state arsenals, and composed of professional soldiers receiving a regular salary; mercenaries played a diminishing role. Changes in military technology and tactics - referred to by historians as the “Military Revolution” (Roberts 1956, Parker 1996) - resulted in a rise in the financial cost of war. As a result of these



FIGURE 3. Military Manpower Mobilization over Time



changes, fiscal strength became the main determinant of success in war. As a Spanish 16th century military commander put it, “victory will go to whoever possesses the last *escudo*” (Parker 1996). We do not take a position on the origins of the military revolution, but simply stress that by increasing the importance of money for conducting war, it had an important impact on state building.

The use of gunpowder was a turning point for military technology. The spread of (mobile) cannon after 1400 meant that medieval walls could be destroyed quickly. Fortresses that had withstood year-long sieges in the Middle Ages could fall within hours.<sup>3</sup> In response, Italian military engineers devised a new type of fortification --

<sup>3</sup>The Neapolitan fortress of Monte San Giovanni had withstood medieval sieges for up to seven years; Charles VIII’s artillery breached its walls in a matter of hours (Duffy 1996).

the *trace italienne*. It consisted of large earthen bulwarks, clad with brick, which could withstand cannon fire. These new fortifications were immensely costly to build.<sup>4</sup> The existence of numerous strongpoints meant that wars often dragged on even longer – winning a battle was no longer enough to control a territory. Roger Boyle, the British soldier and statesman observed in the 1670s (Parker 1996):

Battells do not now decide national quarrels, and expose countries to the pillage of conquerors, as formerly. For we make war more like foxes, more than Lyons; and you will have 20 sieges for one battell.

The introduction of standing armies is the third main element of the “military revolution” (Roberts 1956, Parker 1996). Due to the need for firearms training, states began to organize, equip, and drill soldiers, effectively investing in their human capital. Starting with William of Nassau’s reforms during the Dutch rebellion, soldiers were garrisoned and trained continuously.

At the same time, states began to organize permanent navies. While the English had beaten the Spanish Armada in 1588 with an assortment of refitted merchant vessels, navies after 1650 became highly professionalized, with large numbers of warships kept in readiness for the next conflict. Investments in naval dockyards, victualling yards, and ships were costly. Even smaller ships in the English navy of the 18th century cost more than the largest industrial companies had in capital (Brewer 1990).

Fortifications, artillery, and ever-larger, better-equipped, and professional standing armies and navies made war an increasingly costly pursuit. The expenses of medieval campaigns had often been met by requisitioning and through the feudal service obligations of medieval knights. After 1500, the business of war was increasingly transacted in cash and credit, and not in feudal dues.<sup>5</sup> The late Middle Ages and the early modern period also saw the increasing use of debt financing.<sup>6</sup> During wartime, 80% and more of government expenditure would regularly be devoted to military costs. Military spending could exceed the sum of all tax revenues in a single year. For example, military spending exceeded revenue by 50% in Habsburg Spain during the 1570s (Bean 1973).

### 3. THE BASIC MODEL

We now present a model shedding light on the link between state building and the military revolution. Sections 3.1 and 3.2 illustrate the role of centralization. Section 3.3 describes a ruler’s decision to centralize or not when there is no external war threat. External war is introduced in Section 4.

**3.1. Production.** There are three dates  $t = 0, 1, 2$ . A country consists of a measure 1 of identical districts, each of which is inhabited by a density 1 of agents who are risk neutral and do not discount the future. They obtain utility by consuming the only perishable good produced in the economy. At  $t = 1, 2$ , an agent can undertake either local ( $l$ ) or market ( $m$ ) production. Local production yields output  $A_l$  and

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<sup>4</sup>The fortress of Besancon was so expensive that when informed of the total cost, Louis XIV allegedly asked if the walls had been made of gold (Parker 1996).

<sup>5</sup>Landers (2003). Some have argued that the true increase in the cost of war after 1500 was correspondingly less (Thompson 1995). This is unlikely – indirect social costs probably grew in line with war frequency and army size.

<sup>6</sup>We discuss this point in more detail below.

occurs in an agent's own district. Market production is more profitable, it yields  $A_m > A_l$ , but requires the agent to carry out some steps of the production process (e.g. input purchases) in a neighboring district.<sup>7</sup> Agents may also engage in home production ( $h$ ), the least profitable activity ( $A_h < A_l$ ). If a share  $n_x$  of agents undertakes activity  $x = l, m, h$ , where  $n_m + n_l + n_h = 1$ , the country's total output is equal to:

$$(1) \quad Y = n_m A_m + n_l A_l + n_h A_h.$$

Output is maximized when all agents engage in market production (i.e.  $n_m = 1$ ).

**3.2. State Building, Taxation and Output.** A self-interested ruler finances his expenditures using his domain income  $D > 0$  and taxes. There are no financial markets.<sup>8</sup> The ruler can tax local and market production. Home production cannot be taxed. The equilibrium pattern of taxation depends on the degree of centralization.

Consider first a fully *centralized* country. The ruler sets uniform taxes  $(\tau_l, \tau_m)$  in all districts, where  $\tau_x$  is the tax on activity  $x = l, m$ . Since market production yields greater surplus than local production, the optimal taxes  $(\tau_l^*, \tau_m^*)$  seek to: i) discourage local and home production, and ii) extract productive surplus. This is attained by setting:

$$(2) \quad \tau_l^* \geq \frac{A_l - A_h}{A_l}, \quad \tau_m^* = \frac{A_m - A_h}{A_m}.$$

At these tax rates, everybody produces for the market (i.e.,  $n_m = 1$ ), the ruler extracts the full surplus  $(A_m - A_h)$ .

Consider the opposite benchmark of a fully *decentralized* country. The administration of each district  $i$  is delegated to a local power holder (e.g., a nobleman) who sets taxes  $(\tau_{l,i}, \tau_{m,i})$  on local and market production. There are two key differences with respect to centralization. First, market production initiated in district  $i$  is now taxed also in the other district  $i'$  where it occurs (see footnote 7). Thus, a producer operating in districts  $i$  and  $i'$  pays a total tax rate of  $(\tau_{m,i} + \tau_{m,i'})$ , and his net income is  $(1 - \tau_{m,i} - \tau_{m,i'})A_m$ . Second, control over taxation allows each power holder to grab a share of tax revenues for himself. For simplicity, we assume that under decentralization power holders keep all local tax revenues for themselves. Our results extend to milder assumptions on tax appropriation.

Appendix 2 then proves that in a symmetric equilibrium where each power holder  $i$  non-cooperatively sets optimal taxes  $(\tau_{l,i}, \tau_{m,i})$ , we have:

**Lemma 1.** *There always exist symmetric equilibria in which all districts set taxes  $\tau_{l,d} = (A_l - A_h)/A_l$  and  $\tau_{m,d} > 1 - (A_l + A_h)/2A_m$ . In these equilibria, everybody engages in local production.*

<sup>7</sup>Formally, we view districts  $i \in [0, 1]$  as being located around a circle and market production as spatially ordered: each agent undertaking market production in district  $i$  must carry out one step of production in either of the immediately adjacent districts. This structure simplifies the analysis the efficiency gains created by centralization but is not crucial for our results.

<sup>8</sup>Our results go through if the ruler has some ability to borrow/lend in financial markets. In fact, a ruler's ability to borrow today increases in the volume of fiscal revenue it can generate in the future. As a result, adding borrowing to our model would not change the analysis fundamentally (other than allowing rulers to borrow short-term, before repaying).

This is a standard inefficiency from un-coordinated taxation. Each local power holder tries to steal revenue from the others. As a result, taxes on market production are too high and market activity is too low. Tax revenues are also below the first best.<sup>9</sup>

We take the equilibria described in Lemma 1 as our decentralization benchmark: production in each district is  $A_l$ , each power holder obtains  $A_l - A_h$ , and the central ruler's revenues are 0. This latter feature is key: power holders prefer decentralization precisely because the latter arrangement allows them to keep tax revenues for themselves.

Consider now the intermediate case of a country where only a measure  $\kappa \in (0, 1]$  of districts are centralized. As the ruler internalizes social surplus across centralized districts, he sets taxes  $(\tau_l^*, \tau_m^*)$  in all of them. The centralized region is equivalent to a fully centralized country consisting of  $\kappa < 1$  districts.<sup>10</sup> In each centralized district, output is  $A_m$  and the central ruler's tax revenue is  $(A_m - A_h)$ . By contrast, in the  $(1 - \kappa)$  decentralized districts each local power holders overtaxes market production, sets the taxes  $(\tau_{l,d}, \tau_{m,d})$  of Lemma 1, and grabs tax revenues.

This implies that when only  $\kappa$  districts are centralized, total output and the central ruler's total tax revenue are respectively equal to:

$$(3) \quad Y(\kappa) = A_l \cdot (1 - \kappa) + A_m \cdot \kappa,$$

$$(4) \quad R(\kappa) = (A_m - A_h) \cdot \kappa,$$

and both increase in centralization  $\kappa$ . The ruler's revenue in Equation (4) is equal to the surplus generated by market production times the measure of districts that are centralized.

This setup captures the reality of early modern Europe where, before the formation of strong nation states, tax collection often relied on local representative bodies or noblemen. These operated through a system of fixed-sum payments, regional monopolies and overlapping tax schemes which stifled factor mobility and innovation. In this context, centralizing and streamlining tax collection allowed for

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<sup>9</sup>The logic of the result works as follows. For given taxes charged in adjacent districts, the power holder of district  $i$  faces a dilemma. He can either: i) encourage market production by setting a sufficiently low tax on it, or ii) discourage market production by taxing it heavily and extract all surplus from local production. Clearly, when adjacent power holders heavily tax market production, the power holder of district  $i$  has the incentive to do so as well.

This game also admits an efficient equilibrium where all power holders perfectly coordinate to set  $\tau_{m,d} = (A_m - A_h)/2A_h$ . In this case, market production occurs in all districts, and the tax revenues of local power holders are at the first best. It is still the case, though, that the central ruler's tax revenues are zero, because local power holders continue to control tax collection.

In the remainder, we focus on the inefficient taxation equilibrium of decentralization. We do so for two reasons. First, because it neatly capture the efficiency losses created by decentralized tax collection, which would still be present in sunspot equilibria where high taxes on market production are played with positive probability. Second, the efficient equilibrium could be ruled out (at the cost of more complex algebra) by allowing the return to market production to vary across agents, which also underscored the fragility of the full efficiency equilibrium.

<sup>10</sup>Formally, this requires the additional assumption that the  $\kappa$  centralized districts form a neighborhood around the ruler's own original district  $i = 1/2$ . Given the spatial pattern of market production described in previous footnotes, all market production occurs within centralized districts and only a zero-measure of centralized districts border with decentralized ones. Since the ruler obtains no revenue from decentralized districts, we assume that economic activity between centralized and decentralized districts is banned. As a result, a partially centralized country can be split into a fully centralized and a fully decentralized region.

less distortionary taxation, which generated additional revenues for the monarch while facilitating the growth of commerce. Of course, we do not imply that political centralization might not have led to an undesirable concentration of power in early modern Europe. In fact, as we show in Section 4, in our model centralization of tax collection is most effective when it occurs in tandem with the creation of checks and balances limiting central power.<sup>11</sup>

**3.3. State Building and Domestic Conflict.** At  $t = 0$  the ruler chooses what measure  $\kappa$  of districts to centralize (initially, centralization is zero). To do so, he must overcome opposition by local power holders. These agents lose the tax rent  $(A_l - A_h)$  under centralization, amounting to a loss of  $2(A_l - A_h)$  over periods  $t = 1, 2$ . Centralization increases total tax revenues, but at  $t = 0$  the ruler cannot commit to compensate power holders for losing tax control. This creates opposition to centralization. In Section 5 we show how institutions alleviate this commitment problem.

Overcoming domestic opposition is costly. In particular, we assume that crushing (or buying off) the power holder of district  $i$  costs  $\beta_i \cdot 2 \cdot (A_l - A_h)$  to the ruler. Here  $\beta_i \geq 0$  proxies for the ability and willingness of power holder  $i$  to oppose the ruler, and is distributed across districts according to c.d.f  $H(\beta)$ , which captures the intensity of domestic conflicts.<sup>12</sup> In countries with greater ethnic or religious divisions, or stronger regional power structures,  $H(\beta)$  is lower. This admittedly reduced-form formalization allows us to keep the analysis of external wars tractable. The regional interpretation of power holders is perhaps most intuitive, but we think of them as a metaphor for all powerful domestic players capable of hindering the implementation of an administrative centralization program.<sup>13</sup>

The ruler begins to centralize districts with low conflict  $\beta$  and then moves to more hostile districts. As a result, the cost of centralizing a measure  $\kappa$  of districts is equal to:

$$(5) \quad C(\kappa) = 2 \cdot (A_l - A_h) \cdot \int_0^{\beta(\kappa)} \beta \, dH(\beta),$$

<sup>11</sup>Focusing on political (not administrative) settings, Acemoglu, Johnson and Robinson (2005) show that “absolutist” states not placing constraints on their elites grew less in early modern Europe. Dincecco (2009) finds similar negative effects.

<sup>12</sup>Cost  $2\beta_i \cdot (A_l - A_h)$  can include both pecuniary and non-pecuniary components of a ruler’s centralization effort (e.g., both the material resources as well as the organizational and emotional effort spent in conflict). This cost can be microfounded by assuming that power holder  $i$ : a) can commit to spend in a revolt against the central ruler up to share  $z_i$  of the control rent  $2 \cdot (A_l - A_h)$  and that b) this translates into “defensive power”  $2d_i \cdot z_i (A_l - A_h)$ , where  $d_i$  is the productivity of the power holder’s defense. To defeat the power holder, the central ruler’s effort must be commensurate to the power holder’s tax rent  $(A_l - A_h)$  and to his fighting ability  $d_i \cdot z_i$ . In particular, if the ruler exerts effort  $I_i$ , he generates “offensive power”  $r_i I_i$ , where  $r_i$  is the effectiveness of the ruler’s repression in district  $i$ . Here  $d_i/r_i$  proxies for the relative strength of the central ruler. If the party with greater (offensive or defensive) power wins, the central ruler must spend  $I_i^* = z_i \cdot (d_i/r_i) \cdot 2 \cdot (A_l - A_h)$  to centralize (either by going to conflict or by bribing the local power holder, who is assumed to have all the bargaining power). By denoting  $\beta_i = z_i \cdot (d_i/r_i)$ , this microfoundation maps exactly into our model.

<sup>13</sup>In the context of the previously discussed circular location of districts, one should think of parameter  $\beta$  as increasing with the distance from the central ruler’s district  $i = 1/2$ . In light of this interpretation, the distribution  $H(\beta)$  adds heterogeneity on both the right and left semicircles.

where threshold  $\beta(\kappa)$  defines the resistance faced by the ruler in the marginal district, which fulfills  $H[\beta(\kappa)] = \kappa$ . In the remainder we assume:

**A.1:**  $\beta$  is uniformly distributed in  $[0, B]$ .

This implies that Equation (5) takes the convenient form:

$$(6) \quad C(\kappa) = \kappa^2 B \cdot (A_l - A_h).$$

The cost of reform is convex because marginal districts are increasingly opposed to reform. The cost of reform grows with parameter  $B$ , which captures the strength of domestic conflict.<sup>14</sup>

Consider the extent of centralization undertaken at  $t = 0$  in “autarky”, namely absent any external threat. The ruler sets  $\kappa$  to maximize his utility over  $t = 0, 1, 2$ . At  $t = 0$ , the ruler’s consumption utility is equal to domain income minus reform cost  $D - C(\kappa)$ , while at  $t = 1$  and  $t = 2$  it is equal to the fiscal revenues generated in these periods.

To ease notation, it is useful to view the ruler as choosing his desired fiscal revenue  $R$  at  $t = 1, 2$  and thus the centralization level  $\kappa(R) = R / (A_m - A_h)$ , that uniquely implements it. By plugging  $\kappa(R)$  into (6), we can see that the ruler solves:

$$(7) \quad \arg \max_R 2R - \frac{B(A_l - A_h)}{(A_m - A_h)^2} \cdot R^2.$$

The ruler chooses  $R$  by trading off the benefit of obtaining more fiscal revenues over  $t = 1, 2$  with the cost of curtailing opposition at  $t = 0$ . In autarky, the optimal tax revenue is then equal to:

$$(8) \quad R_{aut} = (A_m - A_h) \cdot \min \left[ \frac{1}{B} \frac{(A_m - A_h)}{(A_l - A_h)}, 1 \right],$$

which is the product between the surplus created by market production and the optimal degree of centralization.

The model predicts that the optimal degree of centralization  $\kappa^* = \min \left[ \frac{1}{B} \frac{(A_m - A_h)}{(A_l - A_h)}, 1 \right]$  falls in the strength of domestic opposition  $B$ , which increases the cost of state building, and increases in the relative productivity  $A_m/A_l$  of market production, which increases the benefit of state building. Thus, the model captures the idea that state formation is shaped by the tension between the advantages of a national market and the opposition against central rulers by a myriad of local princes, cities, principalities, and estates. This tradeoff rationalizes a popular notion among historians, namely that marketization and the “commercial revolution” contributed importantly to the rise of capable states in early modern Europe (Tilly 1990, Karman and Pamuk 2010).<sup>15</sup>

We throughout assume that  $B > (A_m - A_h) / (A_l - A_h)$ , which implies that optimal centralization is interior  $\kappa^* < 1$ . In this case, Equation (8) allows us to

<sup>14</sup>Higher  $B$  increases both the mean and the dispersion of domestic opposition. For the purpose of our analysis, the increase in the mean is the key dimension. Dispersion in domestic opposition is a convenient modelling device avoiding bang-bang solutions of the ruler’s centralization decision.

<sup>15</sup>An alternative approach would be to keep  $B$  constant across countries, but let the benefits of market integration fall with the degree of heterogeneity of conditions in a country. This would lead to isomorphic predictions of the model, but with a different rationale.

rewrite - with slight abuse of notation - the cost of centralization as:

$$(9) \quad C(R) = c \cdot R^2 \quad \text{where} \quad c \equiv \frac{1}{R_{aut}},$$

with  $R_{aut}$  being identified by (8). A higher marginal cost  $c$  proxies for stronger domestic divisions  $B$  or a lower benefit of centralization  $(A_m - A_h) / (A_l - A_h)$ . Depending on analytical convenience, we will use  $c$  or the (inverse of the) autarky reform  $R_{aut}$  to proxy for the cost of centralization.

#### 4. WAR AND STATE BUILDING

There are two-countries, “home”  $H$  and “foreign”  $F$ . At  $t = 1$  they exogenously enter armed conflict with probability  $\theta$ , where  $\theta$  reflects the belligerence of the environment. If  $\theta = 0$ , we are in autarky; if  $\theta = 1$ , war occurs with certainty. Parameter  $\theta$  captures factors leading to war that are unrelated to rulers’ economic payoffs, such as empire-building motives, religious conflict, dynastic struggles, and inter-ruler rivalry. Here we assume that these exogenous events always trigger war. In Section 5 we allow rulers to endogenously choose whether or not to go to war conditional on the realization of a trigger.

War is costly. It absorbs the fiscal revenues of both rulers while it is fought, and redistributes fiscal revenues from the losing to the winning ruler thereafter. Denote by  $R_J$  the fiscal revenues available at  $t = 1, 2$  to the ruler of country  $J = H, F$ . If at  $t = 1$  there is a war, each ruler spends  $R_J$  to wage it.<sup>16</sup> At  $t = 2$ , the winner is awarded the fiscal revenues of the two countries  $R_H + R_F$ . The loser obtains nothing. As a result, at  $t = 0$  the consumption utility of ruler  $J$  is equal to  $D - C_J(R_J)$ , where  $C_J(R_J)$  is the cost of his reform. If war does not break out, the ruler consumes  $2R_J$  over  $t = 1, 2$ . If instead war erupts, the ruler spends his  $t = 1$  revenues to wage the war, so that his consumption utility is zero in this period. At  $t = 2$ , the war outcome is determined and the ruler consumes nothing if he loses while he consumes  $R_H + R_F$  if he wins.

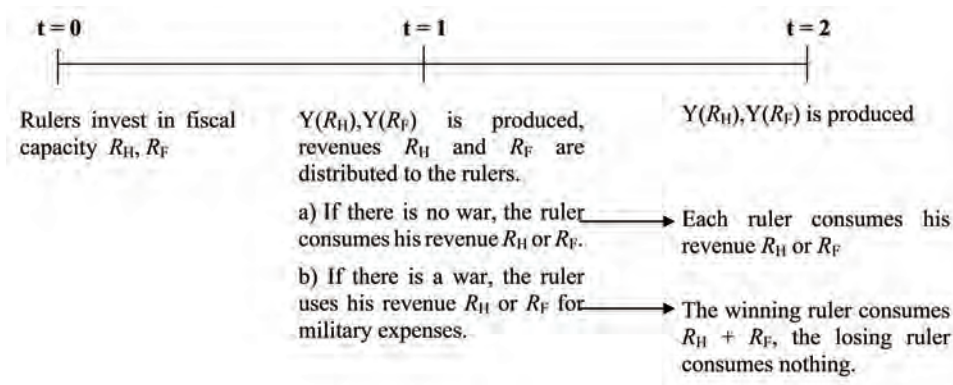
The war outcome is stochastic and depends on the military strength of the two contestants. The military strength of country  $J$  takes the Cobb-Douglas form  $L_J^\alpha R_J^\lambda$ , where  $L_J$  is the population of the country. Parameters  $\alpha, \lambda \geq 0$  respectively measure the extent to which military might is driven by manpower and fiscal revenues. When  $\lambda > 0$ , higher fiscal revenues render the army’s “workforce” more productive by allowing a ruler to purchase better equipment, build more effective fortifications, and to better train his soldiers. Holding  $\alpha$  constant, a higher  $\lambda$  captures both a greater intensity of war in financial capital, as well as greater returns to scale in the military technology. We call parameter  $\lambda$  the “money sensitivity of military strength”, and view the military revolution as an increase in  $\lambda$ .

In line with much of the literature on conflict (see Dixit 1987, and Skaperdas 1992 for a review), we assume that ruler  $H$  wins with probability:

$$(10) \quad p(R_H, R_F) = \frac{L_H^\alpha R_H^\lambda}{L_H^\alpha R_H^\lambda + L_F^\alpha R_F^\lambda},$$

<sup>16</sup>The assumption that at  $t = 1$  the ruler spends all fiscal revenues in the war is realistic. During the war there are few opportunities for the king to spend resources on personal consumption. We have studied the case in which at  $t = 1$  rulers optimally choose how much to spend in the war and our main results continue to hold, particularly with the linear contest success function we will use in Section 4.2. The results are available upon request.

FIGURE 4. Timing



while ruler  $F$  wins with probability  $1 - p(R_H, R_F)$ . Intuitively, the probability with which ruler  $H$  wins the war increases in his relative military strength with respect to ruler  $F$ . Accordingly, a ruler is more likely to win if his tax revenues are higher, because in this case he can finance a stronger army.<sup>17</sup>

For simplicity, we take labor inputs as fixed and set  $L_H = L_F$  consistent with the assumption that the two countries have the same population. Appendix 2 studies the effects arising when  $L_H \neq L_F$ . We leave to future work the analysis of the endogenous determination of  $(L_H, L_F)$ : given labor-money complementarity in producing military strength, the model may generate a joint occurrence of state building and the rise of mass armies.

A key role in this setup is played by the absolute value of the derivative of the probability for  $H$  to win with respect to the revenue of ruler  $J = H, F$ , formally  $|p_J| = |\partial p(R_H, R_F) / \partial R_J|$ . When  $|p_J|$  is high, fiscal revenues are crucial to win the war. Equation (10) implies that:

$$(11) \quad |p_J| = \lambda \cdot \frac{p(1-p)}{R_J},$$

which increases, for given  $(p, R_J)$ , in the money sensitivity  $\lambda$ . In the theory of conflict,  $\lambda$  is called “decisiveness parameter” and Hirshleifer (1995) associates its increase with a breakdown of anarchy.

<sup>17</sup>Equation (10) can be microfounded by assuming that, for given population and revenues, there is a random shock  $\epsilon$  to the relative strength of country  $F$ , so that country  $H$  wins if:

$$L_H^\alpha R_H^\lambda \geq \epsilon L_F^\alpha R_F^\lambda,$$

where the natural logarithm of  $\epsilon$  follows a logistic distribution with mean 0 and location 1. The typical contest success function used in the literature on conflict takes the more general form:

$$p(R_H, R_F) = \frac{f_H(R_H)}{f_H(R_H) + f_F(R_F)},$$

where function  $f_J(R_J)$  are assumed to feature  $f_J(0) = 0$ ,  $f_J'(\cdot) > 0$  and  $f_J''(\cdot) < 0$ . These conditions ensure existence and uniqueness of equilibrium (see Hirai 2012).

Here we use the specific functional form in (10) for two reasons. First, parameter  $\lambda$  neatly captures the importance of money for military strength. Second, some central results in our paper require us to depart from the assumption of concavity, which in the specific case of our function means relaxing the condition  $\lambda \leq 1$ .



Figure 4 summarizes the timing of the model. Given these preliminaries, ruler  $H$  chooses revenue  $R_H$  so as to solve:

$$(12) \quad \max_{R_H} \theta \cdot \{p(R_H, R_F)(R_H + R_F) - 2R_H\} + 2R_H - c_H \cdot R_H^2,$$

while ruler  $F$  chooses revenue  $R_F$  so as to solve:

$$(13) \quad \max_{R_F} \theta \cdot \{[1 - p(R_H, R_F)](R_H + R_F) - 2R_F\} + 2R_F - c_F \cdot R_F^2.$$

Under risk neutrality, parameter  $\theta$  can also be interpreted as the share of revenues (or land) a ruler can lose in the war. For simplicity, we stick to interpreting  $\theta$  as the ex-ante probability of war. The marginal cost  $c_J$  of centralization does not change with respect to autarky,<sup>18</sup> and it can differ across countries, owing to differences in domestic conflict  $B_J$  among contestants. We abstract from country differences in productive efficiencies, which are assumed to be  $A_m, A_l$  in all countries.

Equilibrium centralization levels constitute a Nash equilibrium of the game where rulers choose  $R_H$  and  $R_F$  according to (12) and (13). When the rulers' objective functions are concave (in the remainder we focus on parameter ranges where this is the case), a Nash equilibrium is identified by the first order conditions:

$$(14) \quad c_H \cdot R_H = 1 + (\theta/2) [p_H(R_H + R_F) - (1 - p) - 1],$$

for country  $H$ , and:

$$(15) \quad c_F \cdot R_F = 1 + (\theta/2) [-p_F(R_H + R_F) - p - 1],$$

for country  $F$ .

The presence of a war threat ( $\theta > 0$ ) exerts three *direct* effects, which are included in square brackets above. First, war boosts the incentive to centralize: higher fiscal revenues enhance the probability of winning the war, allowing the ruler to predate on his competitor. This is the first term in square brackets (captured by  $p_H > 0$  and  $p_F < 0$ ). On the other hand, war lowers the benefit of centralization by creating the risk that fiscal revenues are lost in the war. By increasing its fiscal revenue, a ruler simply becomes a more attractive prey, which stunts the incentive to centralize. This is the second (negative) term in square brackets. Third, and finally, the resource cost of war, which absorbs fiscal revenues at  $t = 1$ , also reduces the benefit of centralization. This is the third (negative) term in square brackets.

Overall, war boosts a ruler's incentive to centralize when the sum of the terms in square brackets is positive while dampens it otherwise.

**4.1. Determinants of Equilibrium State Building.** We now study which factors shape state building in our model. Under the contest success function (10) the first order conditions (14) and (15) are necessary and sufficient for an optimum provided the effect of fiscal resources on military strength  $\lambda$  is sufficiently low so that the rulers' program is concave. In particular, Appendix 1 proves:

<sup>18</sup>This is because in our model external threats do not affect the severity of domestic divisions. There are two reasons for this. First, power holders are atomistic. Hence, their opposition to centralization does not affect the outcome of war. Second, power holders are equally "exploited" by the two rulers (as war just reallocates fiscal revenues across the latter), so they see no systematic reason for standing in support or against the incumbent. Of course, in reality conflict may influence the extent of domestic opposition (Magalhães and Giovannoni 2012), but the systematic analysis of this possibility is beyond the scope of the current paper.

**Proposition 1.** *Suppose that  $\lambda \leq 1$ . Then, if a Nash equilibrium  $(R_H^*, R_F^*)$  exists, it is also unique. In particular, the following properties hold:*

a) *If countries are symmetric (i.e.  $c_H = c_F$ ), the equilibrium exists and features*

$$(16) \quad R_H^* = R_F^* \equiv \left(\frac{1}{c}\right) \cdot \left[1 + \frac{\theta}{4}(\lambda - 3)\right].$$

*Given that  $\lambda \leq 1$ , the presence of a war threat stifles centralization in both countries, namely  $R_J^* < R_{J,aut}$  for  $J = H, F$ .*

b) *If countries are asymmetric, and an equilibrium exists, the less divided country is the most aggressive centralizer, formally  $R_H^* > R_F^*$  if and only if  $c_H < c_F$ . This equilibrium features the following comparative statics properties:*

b.1) *A marginal drop of domestic divisions in country  $J = H, F$  (i.e., a lower cost  $c_J$ ) boosts centralization in the same country.*

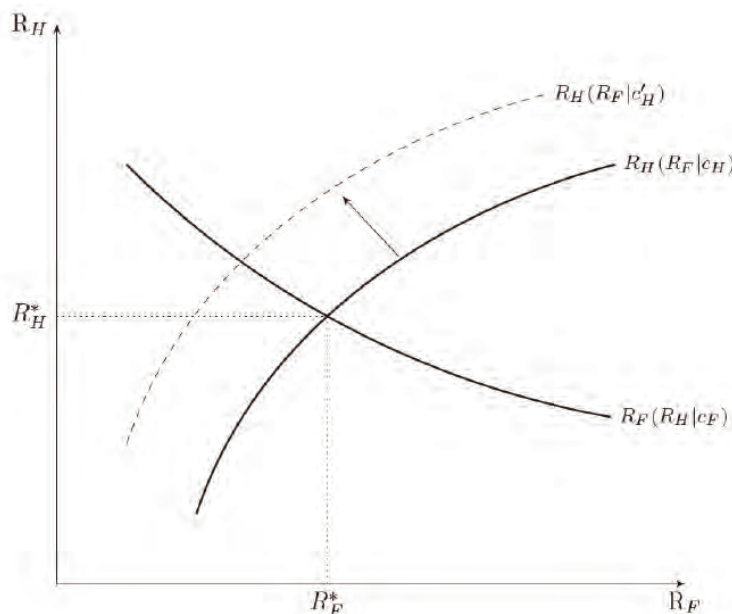
b.2) *A marginal drop of domestic divisions in country  $J$  (i.e. a lower  $c_J$ ) dampens centralization in the opponent country  $-J$  if and only if the latter country is less divided to begin with (i.e.  $c_{-J} < c_J$ ).*

The appendix identifies the conditions for equilibrium existence. According to point a), the military technology plays a key role. When the level of the money sensitivity  $\lambda$  is low, the presence of a war threat reduces centralization relative to a peaceful world. Formally, in Equation (16) the extent of centralization falls with the probability of war  $\theta$ . Intuitively, when  $\lambda$  is low even the richest ruler becomes a prey with high probability, which reduces his incentive to centralize. This is the exact opposite of the conventional wisdom, according to which war necessarily fosters state building (or leaves it unaffected).

On the other hand, conditional on the war threat  $\theta$ , centralization increases in the money sensitivity  $\lambda$ . When warfare becomes more reliant on making large technological and organizational investments, rulers have a greater incentive to centralize to boost their revenues and predate on their competitor. For large values of  $\lambda$  this effect may lead to greater centralization than in autarky, but not in the case considered above where  $\lambda \leq 1$ .

Point b) stresses that domestic divisions are also important. If an equilibrium exists, the ruler facing less domestic conflict is the more aggressive state builder and the more likely winner of war. This effect arises also in autarky, but here it crucially implies that external war does not automatically transform state building into a common interest public good. Because power holders are atomistic, they oppose centralization even if external conflict is possible. But then, the ruler of a divided country may be unable to respond to external war as much as a cohesive opponent, reducing the former's incentive to centralize. An interesting finding of Proposition 1 is that, when  $\lambda \leq 1$ , there is a limit in the divergence of state building that may occur across countries. In fact, point b.2) shows that the ruler of the divided country increases state building when the cohesiveness of his opponent increases. This effect is due to a strategic interaction between reforms. As the cohesive ruler centralizes more, the divided ruler sees his opponent as a better prey, which boosts his incentive to centralize. This effect critically relies on having a low money sensitivity: the prospect of defeating the richer opponent is sufficiently likely only when  $\lambda$  is low. Accordingly, this implies that stronger state building in the divided country will dampen state building in the cohesive country. Formally, when  $\lambda \leq 1$  the reaction function of the cohesive country is negatively sloped, while

FIGURE 5. Revenue-Raising and Military Success



that of the divided country is positively sloped. Figure 4.1 illustrates this effect when the cohesive ruler is the foreign one (i.e., when  $c_F < c_H$ ). As a result, if the reaction function of the divided country H shifts up, state building in the cohesive country drops.

In sum, the military technology is crucial in determining whether external wars will boost or dampen the overall level of state building and its inequality across countries. In particular, Proposition 1 shows that when the money sensitivity of war is low (i.e.,  $\lambda \leq 1$ ), military conflict causes a race to the bottom reducing the overall level of state building, and strategic interactions among reforms that dampen inequality in state building across countries.

The role of military conflict drastically changes when the military sensitivity of war is high. In particular, consider the following observation (which is proven in the Appendix).

**Remark.** If  $\lambda > 1$ , an equilibrium may neither exist nor be unique. However:

- a) When the countries are identical (i.e.,  $c_H = c_L$ ), a symmetric equilibrium exists in which a higher probability of war  $\theta$  increases state building for  $\lambda > 3$ .
- b) Suppose  $c_H \neq c_L$  and an equilibrium exists. Then, around such an equilibrium the reaction function of the more centralized country is positively sloped, and that of the less centralized country is negatively sloped.

Some key properties of Proposition 1 are twisted when the money sensitivity of war is high. When  $\lambda > 1$ , external war threats can boost the overall level of state building efforts, as in point a), and at the same time magnify inequality in state building across countries, as in point b). When  $\lambda > 1$ , greater centralization by the

cohesive country strongly increases the probability for the divided country to lose the war, which stunts its incentive to centralize.

Unfortunately, the case where  $\lambda > 1$  is highly intractable because the rulers' maximization problem is no longer concave. This is why the literature on conflict has focused on  $\lambda \leq 1$  (e.g. see Hirshleifer 1995). In order to study the role of the military technology and its interaction with domestic divisions, in the remainder we consider a linearized version of Equation (10). This allows us to maintain concavity and to characterize equilibria for a large range of values of  $\lambda$ .

**4.2. Linearized Contest Success Function.** By linearizing (10) around the point where both countries win with probability 1/2, we obtain:<sup>19</sup>

$$(17) \quad p(R_H, R_F) = \frac{1}{2} + \lambda \cdot (R_H - \gamma \cdot R_F).$$

The money sensitivity of military strength  $\lambda$  pins down the slope of the win probability with respect to fiscal revenues. Parameter  $\gamma$  here is equal to  $(L_F/L_H)^{\alpha/\lambda}$ , and captures the fact that the fiscal revenues of country  $F$  are relatively more effective when the army size in  $F$  is relatively higher, owing to the money-labor complementarity in Equation (10).

Our main analysis abstracts from this feature because it considers the case in which the countries have the same size, so that  $L_F = L_H$  and thus  $\gamma = 1$ . One shortcoming of this assumption is that when  $\gamma = 1$  the contest success function in (17) does not allow for the kind of strategic interactions discussed in point b.2) of Proposition 1. We revisit those interactions in Appendix 2, when we study the case where  $\gamma \neq 1$ .

In Appendix 1 we then prove the following result.

**Proposition 2.** *There are two positive thresholds  $\Psi$  and  $\bar{\lambda}$  such that, for  $(\max_J R_{J,aut} - \min_J R_{J,aut}) < \Psi$  and  $\lambda < \bar{\lambda}$  the unique equilibrium for  $\gamma = 1$  features interior win probabilities and interior centralization  $\kappa_J^* < 1$  for  $J = H, F$ . In this equilibrium, we have that:*

$$(18) \quad R_J^* = \min \left[ \left( \frac{1 - 3\theta/4}{1 - \lambda\theta/c_J} \right) \cdot R_{J,aut}, A_m - A_h \right] \quad \text{for } J = H, F,$$

and the following properties hold:

*i) Centralization  $\kappa_J^* = R_J^*/(A_m - A_h)$  increases in the money sensitivity of military strength  $\lambda$  for all  $J = H, F$ . In country  $J$ , centralization increases with the frequency of external conflict  $\theta$  if and only if money sensitivity  $\lambda$  is large relative to the marginal cost of reform, namely*

$$\lambda > 3 \cdot c_J/4.$$

*ii) The presence of a war threat (i.e.,  $\theta > 0$ ) increases the relative revenue of the country having the lower marginal cost of reform, formally  $R_H^*/R_F^* > R_{H,aut}/R_{F,aut}$  if and only if  $c_H < c_F$ .*

<sup>19</sup>We focus on cases in which the military strength of contestants is evenly matched because, by doing so, we can study the divergence created by the threat of war. Formally, Equation (10) is linearized around the symmetric revenues  $(R_{H,0}, R_{F,0})$  such that  $L_H^\alpha R_{H,0}^\lambda = L_F^\alpha R_{F,0}^\lambda$ . We normalize  $R_{H,0}$  to 1, which allows us to get rid of a multiplicative constant in our expressions, without affecting our main results.

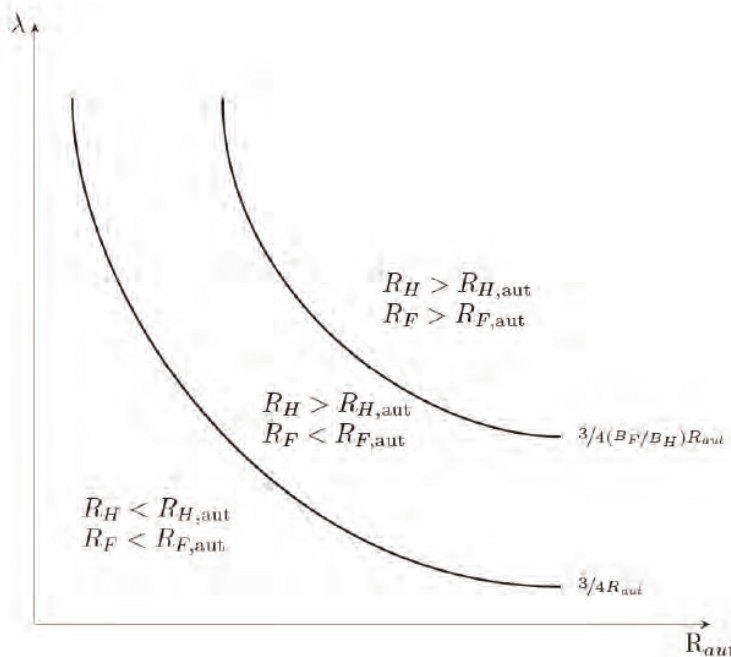
The upper bound  $\Psi$  on the heterogeneity across countries guarantees that win probabilities are interior, the upper bound  $\bar{\lambda}$  on money sensitivity guarantees concavity and that centralization is interior.

As in Proposition 1, centralization  $\kappa_J^*$  increases with the importance of money for military success  $\lambda$ . Critically, however, the presence of a war threat can now boost state building, in line with conventional wisdom. The ruler centralizes more than in autarky if and only if the money sensitivity of war is sufficiently large with respect to domestic divisions, namely  $\lambda > 3 \cdot c_J/4$ . When war-making requires large financial investments, centralization does not only increase a ruler's revenues for consumption, it also boosts his chances to prey upon his opponent. This effect boosts centralization relative to autarky.

Additionally, point ii) shows that the presence of a war threat amplifies inequality in state building relative to autarky. This result is due to effect b.1) described in Proposition 1 for the nonlinear contest success function: the ruler of the internally divided country finds it hard to build a strong army. As a result, he perceives a strong risk of becoming a prey, which stunts his incentive to centralize.

To visualize the predictions of Proposition 1, suppose that country  $H$  is less divided than country  $F$ , formally  $B_H < B_F$ . Denote by  $R_{aut}$  the autarky revenue in  $H$ , so that autarky revenue in  $F$  is  $R_{F,aut} = (B_H/B_F)R_{aut}$ . Figure 6 then plots the pattern of equilibrium state building in the two countries.

FIGURE 6. The Cost of War, Heterogeneity, and State-Building



Along the horizontal axis, a higher  $R_{aut}$  reflects a global boost in the efficiency of market production, due to increasing commercialization, which reduces the marginal cost of centralization  $c_J = 1/R_{J,aut}$  in all countries. The vertical axis reports

$\lambda$ . In the southwest region, the gains from increasing fiscal revenues are so low relative to the political cost of centralization that a race to the bottom prevails: state building declines in all countries. As  $\lambda$  increases above  $3/4R_{aut}$ , the ruler of the cohesive country  $H$  can tilt the war outcome in his favour by centralizing. At the same time, the ruler of  $F$  cannot do so because of domestic divisions. Here external war creates strong inequality in state building across countries. As the sensitivity of war to fiscal revenues becomes large, we move to the northeast region in which the war threat boosts centralization even in country  $F$ . Eventually, for very large  $\lambda$ , both countries centralize fully, i.e.  $\kappa_H^* = \kappa_F^* = 1$ .

In sum, our model shows that three patterns of state consolidation should occur as the money sensitivity of military strength  $\lambda$  increases. To visualize them, interpret Figure 6 as describing changes occurring to the equilibrium of the model at increasing values of  $\lambda$ .

In the first phase, the sensitivity of war to fiscal revenues is low relative to the cost of centralization ( $\lambda \leq 3 \cdot c_H/4$ ), and the risk of entering a war discourages state building in all countries. In this range, the state system is highly fragmented, the balance of power within political entities is unstable, and it does not lead to the emergence of a strong centralized power. Marginal increases in the importance of money for military success make rulers more hungry for fiscal revenues. They thus increasingly centralize their power and streamline tax administration. Taxes become less distortionary, which spurs commerce and growth. As the tax base expands, so do the stakes involved in warfare, further boosting state building. Thus, increases in  $\lambda$  create a positive feedback between improvements in tax collection and economic growth, begetting further state building.

As the influence of money on military outcomes becomes intermediate ( $3 \cdot c_H/4 < \lambda < 3 \cdot c_F/4$ ), the monarchs of less divided countries disproportionately centralize while the rulers of less powerful countries drop out of the competition and restrain their state building efforts. Now the international system consists of politically strong and economically developed centralized countries and weaker, poorer, less centralized countries. These laggard countries are unlikely to survive as they increasingly fall prey to the strong ones.

Finally, as  $\lambda$  becomes very high ( $\lambda \geq 3 \cdot c_F/4$ ), we enter a third phase where all rulers maximally boost their state building efforts and countries converge to the full centralization benchmark where tax distortions are lowest and production is highest.

## 5. INSTITUTIONS, STATE BUILDING AND THE DECISION TO GO TO WAR

We now show that the link between state building and the military technology becomes stronger once one accounts for the possibility for rulers to create institutional constraints limiting their own prerogatives, as well as for their endogenous choice of whether or not to go to war.

**5.1. Institutions and State Building.** We view institutions as constraints on the ruler (Acemoglu, Johnson and Robinson 2001), limiting his ability to extract resources from power holders under centralization. Specifically, institutions set the share  $(1 - \pi_J) \in [0, 1]$  of tax revenues that the ruler can extract from a *centralized* district in country  $J = H, F$ . The remaining share  $\pi_J$  of taxes goes to the power holder. As before, power holders fully retain fiscal revenues in decentralized districts. When  $\pi_J = 0$ , the central ruler is unconstrained and our previous analysis

applies. Higher  $\pi_J$  captures greater power of legislative assemblies, constitutional review, and so forth.<sup>20</sup>

Consider the payoff implications of introducing institutions. First, given a total amount of fiscal revenues  $R_J = \kappa_J \cdot (A_m - A_h)$  collected in centralized districts, the total revenue accruing to the central ruler is now equal to  $\tilde{R}_J = (1 - \pi_J) \cdot R_J$ . Second, the power holder of a centralized district now obtains  $2\pi_J \cdot (A_m - A_h)$  over two periods, in contrast to getting zero in the absence of institutions. As a consequence, the loss experienced by a power holder when his district is centralized is now equal to  $2[(A_l - A_h) - \pi_J \cdot (A_m - A_h)]$ .

This last consideration implies that the extent of feasible centralization depends on the strength of institutions. In particular, institutions now allow power holders to internalize some of the efficiency gains. Indeed, if the institutional commitment to share efficiency gains is sufficiently strong, namely

$$(19) \quad \pi_J \geq \hat{\pi}_J \equiv \frac{(A_l - A_h)}{(A_m - A_h)},$$

then even local power holders gain from centralization. In this extreme case, institutions enable a mutually advantageous revenue-sharing arrangement, and there is no local opposition to state building.

In reality, of course, it may be too costly or simply infeasible for the central ruler to setup institutions that are as strong as threshold  $\hat{\pi}_J$ . We model this notion by assuming that to create institutions  $\pi_J > 0$  a ruler must spend  $K(\pi_J)$ , where  $K(\cdot)$  is an increasing and convex function (implicitly, there are no institutional safeguards at the outset, namely  $\pi_{0,J} = 0$ ). As a result, provided the cost of building institutions is sufficiently large - which we assume throughout - the ruler will set  $\pi_J < \hat{\pi}_J$ .

Let us study the optimal institutional and centralization reforms in this constrained world. We assume that at the outset each ruler first chooses institutions  $\pi_J$ , next he chooses centralization  $\kappa_J$ , and then military and market interactions occur. To solve the model backwards, we must consider how institutions affect the ruler's decision to centralize. Provided  $\pi_J < \hat{\pi}_J$ , there rule will face some opposition to centralization. However, the severity of such opposition depends on the strength of institutions  $\pi_J$ . To see this, replace  $R_J$  with the ruler's effective tax revenue  $\tilde{R}_J = (1 - \pi_J) \cdot R_J$  in the maximization problems (12) and (13). It is then easy to find that the cost for the ruler of raising  $\tilde{R}_J$  is equal to:

$$(20) \quad C_J(\tilde{R}_J) = \tilde{c}_J \cdot \tilde{R}_J^2, \quad \text{where } \tilde{c}_J \equiv \frac{1}{\tilde{R}_{J,aut}},$$

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<sup>20</sup>One could view this arrangement as giving to a representative assembly some control over both spending. In this interpretation,  $\pi_J$  is the share of spending benefitting local elites.

We have solved the model under the alternative assumption that the establishment of institutions consists of the creation of a representative assembly of power holders from centralized districts. Such assembly has the right to vote on whether to give fiscal revenues to the central ruler or not. In carrying out this analysis, we have assumed that each local power holder loses the fixed amount  $L > 0$  when their country is defeated. As a result, power holders have an incentive to let the central ruler grab fiscal revenue if a war threat is present (but not otherwise). In this case, under a linear contest success function, in the presence of a war threat the assembly votes to hand over all fiscal revenues to the ruler provided  $\lambda L > 1$ . This formalization allows: i) the financing of war to become a common interest public good, and thus ii) the cost of centralization to depend on the severity of the war threat. This more nuanced portrayal of institutions renders the analysis more complicated but does not change our main results.

where, in the spirit of Equation (8), we have:

$$(21) \quad \tilde{R}_{J,aut} = (1 - \pi_{J,aut}) \cdot R_c \cdot \min \left[ \frac{(1 - \pi_{J,aut})}{(A_l - A_h) - \pi_{J,aut} \cdot (A_m - A_h)} \cdot \frac{(A_m - A_h)}{B_J}, 1 \right],$$

where  $\pi_{J,aut}$  is the strength of institutions chosen by the ruler in autarky.

Equation (21) shows that stronger institutions exert two conflicting effects on  $\tilde{R}_{J,aut}$  (which is the inverse of the cost of centralization). On the one hand, higher  $\pi_{J,aut}$  reduces power holders' loss and thus their opposition to centralization, increasing the extent of centralization and thus fiscal revenues. On the other hand, higher  $\pi_{J,aut}$  reduces the share of fiscal revenues appropriated by the ruler, which reduces the ruler's ability to collect revenues. Here we assume that the former, positive, influence of institutions on the ruler's revenues always dominates. This occurs when the efficiency gains of centralization are large (i.e.,  $(A_m - A_h) > 2(A_l - A_h)$ ).

In this setting, then, stronger institutions can be conceptualized as a reduction in the marginal cost  $\tilde{c}_J$  of state building. We assume, without loss of generality, that country  $H$  is the low cost country, namely  $\tilde{c}_H \leq \tilde{c}_F$ . Critically, this is the case when  $H$  is sufficiently more cohesive than  $F$  (i.e.,  $B_H < B_F$ ).

The mapping between the strength of institutions and the cost of centralization suggest an important preliminary observation: the country having relatively better institutions centralizes relatively more than its opponent and thus enjoys greater fiscal revenues. Fully in line with this prediction, Dincecco (2009) documents that constrained governments in Europe taxed more than fragmented or "absolutist" entities between 1650 and 1913.

Consider now the initial stage of institutions-setting. Appendix 1 then proves that under the conditions of Proposition 2 the following result holds.

**Corollary 1.** *Denote by  $\pi_{J,aut}$  the endogenously chosen degree of institutional upgrading by ruler  $J = H, F$  in autarky and by  $\tilde{R}_{J,aut}$  and  $\tilde{c}_J$  the associated autarky revenues and marginal cost, respectively. Denote by  $\kappa_J^*$  and  $\pi_J^*$  the equilibrium centralization and institutions prevailing in country  $J$  when an external threat is present (i.e., when  $\theta > 0$ ). In equilibrium, we then have that:*

- 1) *Institutions and centralization in country  $J$  are stronger than in autarky if and only if  $\lambda > 3 \cdot \tilde{c}_J/4$*
- 2) *If centralization and institutions are partial, namely  $\kappa_J^* < 1$  and  $\pi_J^* < \hat{\pi}_J$  for  $J = H, F$ , the less divided country has higher  $\kappa_J^*$  and  $\pi_J^*$  than its opponent.*

As in Besley and Persson (2009), different dimensions of state development - centralization and institutional quality - cluster together. In a cohesive country, the ruler invests in institutional upgrading, particularly when he must centralize to meet an external war threat. In a highly divided country, only major institutional improvements can reduce opposition to centralization. This discourages the ruler from undertaking both institutional upgrading and state building, stifling all reforms.<sup>21</sup>

<sup>21</sup>The intuition for why divided countries have a lower incentive to upgrade their institutions is that in these countries a marginal improvement in institutions appeases fewer opponents than in cohesive countries. This result is due to the uniform distribution of "political distance"  $\beta$ , recalling of course that we realistically assume that in all countries conflict is sufficiently strong that autarky centralization is partial (i.e.  $B_J > (A_m - A_h) / (A_l - A_h)$ ) and that institutions are sufficiently weak that some conflict is present (i.e.  $\pi_J < \hat{\pi}_J$ ).



Critically, the strength of these effects is shaped by the military technology. When  $\lambda$  is low, the external war threat dampens investments in institutions and centralization in all countries. As  $\lambda$  becomes intermediate, only the ruler of the less divided country boosts centralization and institutional quality, generating strong divergence. A very large  $\lambda$  leads to the emergence of strong and accountable states everywhere.

**5.2. The Decision to Go to War.** So far the outbreak of war was exogenous. We now endogenize the decision to go to war as follows. Suppose that a war trigger arises (with probability  $\theta$ ). Both rulers have financed their armies, they are ready to go to war, but can choose whether to do so or not. If war is averted, each ruler enjoys his future revenues with probability one. If war occurs, the usual war lottery is played. Critically, we assume that war destroys a share  $(1 - \sigma) > 0$  of revenues at  $t = 2$  in all countries. Given this deadweight loss, it would be welfare improving to negotiate the war away, but we realistically assume that such negotiations do not occur because rulers cannot commit to make the necessary transfers. This assumption implies that war does not occur if both rulers lose from war, but it occurs when either ruler expects to benefit from it (given  $\sigma < 1$ , it is impossible for both rulers to benefit from war).

We now solve the model under these assumptions. This amounts to characterizing the rulers' decision of whether or not to go to war for given equilibrium revenues  $(R_H^*, R_F^*)$ , and then to endogenously solve for these revenues at the ex-ante stage, when the probability  $\theta$  of the war trigger and the choice to go to war are all taken into account.

To solve the model backwards, consider the last stage. Given equilibrium revenues  $(R_H^*, R_F^*)$ , and conditional on the realization of a war event, conflict occurs either when  $H$  benefits from triggering a war, formally when:

$$(22) \quad p(R_H^*, R_F^*) \cdot \sigma \cdot (R_H^* + R_F^*) \geq R_H^*,$$

or when  $F$  benefits from triggering a war, namely when:

$$(23) \quad [1 - p(R_H^*, R_F^*)] \cdot \sigma \cdot (R_H^* + R_F^*) \geq R_F^*.$$

War is averted if and only if none of the above conditions holds. Intuitively, (22) and (23) ensure that a ruler's expected revenue from going to war - the left hand side in the above expressions - is higher than what he can obtain by taxing only his own economy - the right hand side above.

Under the assumed symmetric contest success function [i.e., given that  $p(R, R) = 1/2$ ], it is easy to show that war cannot occur in a symmetric equilibrium where countries raise the same revenue ( $R_H = R_F$ ); in this case, going to war is like burning some fiscal revenues to toss a coin. Given risk neutrality, no ruler is willing to do it. Hence, when  $R_H = R_F$  both rulers prefer peace.

The incentive to go to war arises instead if countries are unequal, namely  $R_H \neq R_F$ . In this case, the war favors one contestant, who may be eager to initiate conflict. In solving for a full equilibrium, Appendix 1 shows that under the assumptions of Proposition 2 the following result obtains.

**Proposition 3.** *Denote by  $\lambda^*$  the sensitivity of war outcomes to financial resources at which  $\max(R_H^*, R_F^*) = (A_m - A_h)$ , so that for  $\lambda \leq \lambda^*$  centralization in the two countries is partial. Then, there exist two thresholds  $\lambda_0, \lambda_1$  where  $0 \leq \lambda_0 < \lambda_1 \leq \lambda^*$  such that, conditional on the realization of a war event:*

- 1) If  $\lambda \leq \lambda_0$ , war occurs with probability one and the more divided (poorer) ruler expects to benefit from it
- 2) If  $\lambda \in (\lambda_0, \lambda_1)$ , the equilibrium is in mixed strategies and war occurs with an equilibrium probability  $\omega \in [0, 1)$ .
- 3) If  $\lambda \geq \lambda_1$ , war occurs with probability one and the more cohesive (richer) ruler stands to benefit from it.

War is most likely to arise if financial resources influence military success either to a great extent, or hardly at all. Crucially, the identity of the party initiating conflict is different in these two cases. When the influence of financial resources on military success is high, the wealthier country is the one initiating conflict. Because this country is disproportionately more likely to win the war, it is eager to attack. When instead the influence of financial resources on military success is low, the less wealthy country is the one initiating conflict. This country wins the war with less than 50% probability. However, because of the low  $\lambda$ , the odds for such country to win are non-negligible, and the payoff of conquering a wealthy opponent acts as an inducement to conflict.<sup>22</sup>

There are two important implications. First, the link between the war technology and the frequency of military conflict is non-linear. As a result, it is difficult to draw univocal predictions linking the frequency of conflict, the war technology and state building. Second, and more interestingly, endogenous wars create an additional force towards convergence or divergence. When  $\lambda$  is low, state consolidation is weak not only because each ruler has little incentive to centralize, but also because war redistributes revenues from larger to smaller countries, fostering fragmentation. In contrast, when  $\lambda$  is high, state consolidation is extensive not only because each ruler has strong incentives to centralize, but also because war tends to redistribute fiscal revenues and territories from smaller countries to larger ones, increasing concentration.

## 6. EMPIRICAL RESULTS

We now confront the main predictions of our model with data from early modern Europe. To do so, we first empirically examine how much money mattered for victory on the battlefield. Next, we take the estimated money sensitivity of war and study its interaction with domestic heterogeneity in determining state building. Finally, we consider interactions between fiscal capacity, war frequency, and economic efficiency. The goal of this analysis is not to identify the causal impact of changing war technology and domestic divisions on state building, but rather to assess whether the basic correlations in the data are consistent with our theory.

**6.1. Financial Resources and Military Success.** We first provide evidence of the growing importance of financial resources for military might. We do so by analyzing data on the outcomes of 374 major battles in Europe between 1500 and 1800. We focus on this period since it encompasses the military revolution and the centuries during which state consolidation in Europe accelerated, reaching a high level by the end of the period. The principal sources for our data are Jaques (2007), whose “Dictionary of Battles and Sieges” covers over 8,500 military

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<sup>22</sup>Matters are more complicated when  $\lambda$  is intermediate, as now the probability of war  $\omega \in (0, 1)$  is determined so that - at the optimal investments in state building - the more belligerent ruler just indifferent between initiating the war or not. See Appendix 1 for details.

TABLE 3. War and Fiscal Resources  
(land battles only)

	richer wins?		odds of success (richer power)
	Yes	No	
1500-1800	148	115	1.29
1500-1550	4	12	0.33
1550-1600	0	4	0
1600-1650	6	16	0.375
1650-1700	21	16	1.31
1700-1750	19	16	1.19
1750-1775	27	14	1.93
1775-1800	71	37	1.92

*Notes:* Based on Jaques 2007 and Landers 2003; cf. Appendix 4.

engagements from antiquity to the 21st, combined with information in Landers (2003) on the outcomes of conflicts. We also use fiscal data from the European State Finance Database (ESFD; Bonney 1989), as compiled, augmented and summarized by Karman and Pamuk (2010).<sup>23</sup> For each battle, we code the outcome as either success or defeat. For each combatant state, we collect data on total tax revenue at the nearest point in time, as well as on population size (from McEvedy and Jones 1978). The sources are described in Appendix 4.

Table 3 presents a simple way of looking at the extent to which money spelled military might after 1500. We show the number of battles won by the fiscally stronger power (measured in terms of total revenue), as well as the odds ratio, for the early modern period, including subperiods. In the centuries after 1500, powers with greater financial resources actually won wars with greater frequency - and did so to an increasing extent. As table 3 shows, the odds of success were on average some 29 percent greater for the richer power. There was also substantial change in the centuries after 1500. For the period 1500-1650, richer powers on average seem to have had no discernable advantage. Thereafter, they consistently won with greater frequency than their poorer opponents. By the end of the sample period, the odds of success on the battlefield for the richer power were twice as high as those of poorer belligerents.

Table 3 examines the odds of the richer contestant winning without using information on the revenue gap between contestants. The probability of success will be influenced not only by which power is fiscally stronger, but by the size of the difference. We therefore estimate the likelihood of success for the richer power as a function of the fiscal revenues of both sides:

<sup>23</sup>We go beyond the Karaman and Pamuk dataset by including observations from the ESFD on smaller countries. The revenue documented by Karman and Pamuk (2010) and in the ESFD almost always refer to centralized tax revenues, i.e. part of the rise in overall income documented here simply reflects of the tax recipient from local magnates to central rulers.

TABLE 4. Battlefield Success and Fiscal Revenues

	(1) All	(2) All	(3) All	(4) Pre-1650	(5) Post-1650	(6) Interaction
$TR^H$	0.288*** (0.0686)	0.479*** (0.0792)				
$TR^F$	-0.356** (0.116)	-0.422** (0.141)				
$P^H$		-0.0139** (0.00451)	-0.0121** (0.00388)	-0.0294 (0.0205)	-0.0141*** (0.00343)	-0.0148*** (0.00331)
$P^F$		-0.0112 (0.00622)	-0.0101 (0.00593)	-0.00758 (0.00832)	-0.00943 (0.00653)	-0.00790 (0.00526)
$[TR^H - TR^F]$			0.477*** (0.0794)	0.130 (0.673)	0.380*** (0.0811)	0.458 (0.394)
$post1650$						0.298*** (0.0749)
$[TR^H - TR^F] * post1650$						-0.0686 (0.414)
Constant	0.419*** (0.0656)	0.575*** (0.0898)	0.565*** (0.0922)	0.604 (0.387)	0.708*** (0.0716)	0.407*** (0.0971)
$N$	374	257	257	42	215	257
$R^2$	0.0597	0.135	0.134	0.0631	0.0981	0.166

Notes: \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ ; Standard errors clustered at the opponent-pair-period level, in parentheses;  $TR^H$  is the total fiscal revenue of the richer power;  $TR^F$  is total fiscal revenue of the poorer power;  $P^H$  is the population of the richer power;  $P^F$  is the population of the poorer power;  $post1650$  is a dummy taking the value of unity in years after 1650, and zero otherwise. See Appendix 4 for sources.

$$(24) \quad S_{H,t} = C + \lambda_1 T_{H,t} + \lambda_2 T_{L,t} + \alpha_{\epsilon_{H,t}}$$

where  $S_{H,t}$  is a dummy variable equal to unity if the stronger power wins, and zero otherwise,  $C$  is a constant, and  $T_{H,t}$  is the tax revenue of the fiscally stronger power,  $T_{L,t}$  is the revenue of the fiscally weaker power. The coefficients  $\widehat{\lambda}_1$  and  $\widehat{\lambda}_2$  capture the importance of money for winning a war, providing a proxy for the sensitivity of war outcomes to fiscal revenues  $\lambda$  in our model.

We estimate linear probability models under OLS.<sup>24</sup> Standard errors are clustered at the opponent-pair-period level, so that two battles, say between the same adversaries in the same 50-year period (with identical values for revenue) receive less weight than two battles between different powers in different periods. The dependent variable takes the value of unity if the richer power wins, and zero otherwise.

Table 4 presents the results. The intercept in column (1) is 0.42, relatively close to 0.5, indicating that without taking fiscal variables into account, the likely outcome of a battle is roughly even. When we consider differences in population size (column 2), the intercept becomes 0.575, again close to an even chance of success. Columns 1 and 2 show that the higher the revenues of the richer power, the greater the likelihood of success. Conversely, the greater the fiscal revenue of the weaker power, the lower the likelihood of the richer power winning. The coefficients are of meaningful size - a one standard deviation increase in the revenues of the richer power is associated with an increase in the success ratio of 0.21. Similarly, the odds of the fiscally weaker state prevailing rise by 0.16 with a one standard deviation increase in its fiscal resources. As is to be expected, the difference in revenues between both powers is a strong predictor of the chances of success (column 3).

<sup>24</sup>We present (largely unchanged) results using probit in Appendix 3.

Population size has no clear effect on the odds of success. There is a small negative effect for both the fiscally stronger and poorer power according to our estimation; this largely reflects the inclusion of the Ottoman Empire in our sample.

The estimated coefficient  $\lambda$  – our measure of the extent to which money matters for military might – is not stable over time. Instead, it increases substantially during our sample period. Before 1650, the link between battlefield success and fiscal resources is positive, but weak and imprecisely estimated (column 4). After 1650, the effect becomes almost three times larger, and it is highly significant (column 5). In column 6, we add a post-1650 dummy, pool all observations and interact the post-1650 dummy with the revenue difference. The post-1650 dummy itself is highly significant, indicating that the chances of success for the fiscally stronger power were markedly higher after that point in time. Before 1650, the fiscally stronger power won 40% of the time; thereafter, the probability was over 70%. In addition, we find that the size of the revenue gap is positively associated with the probability of success, but the effect is not tightly estimated; there is also no indication of a positive interaction effect. We conclude that the odds were increasingly stacked in favor of the fiscally stronger powers after 1650, but that there is no significant evidence to suggest that the the of the revenue gap in addition was closely related with the chances of success.

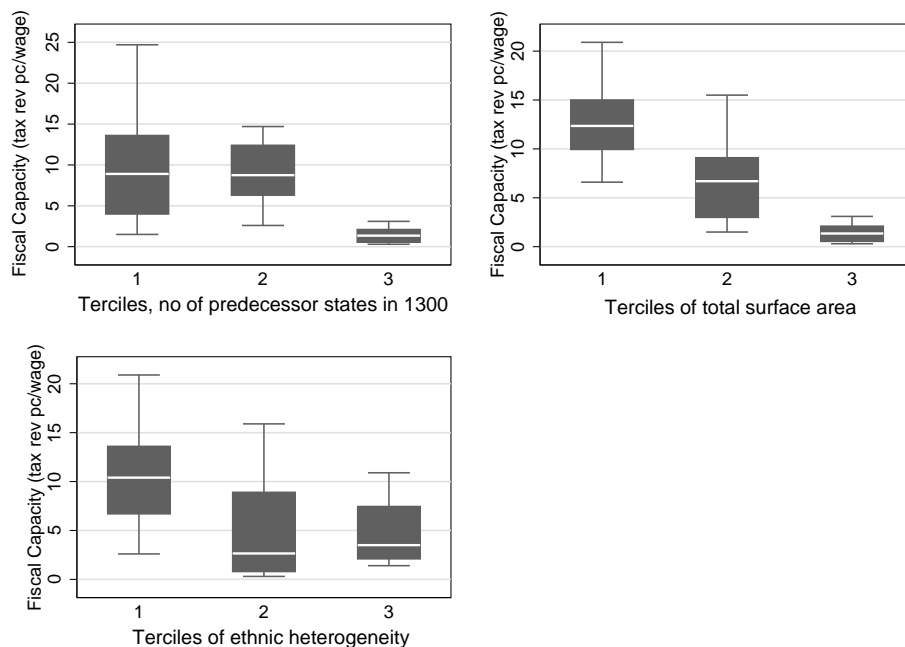
In Appendix 3, Table A3.1, we show that our basic result holds if we drop battles where allies were involved, and if we use probit estimation. We therefore conclude that after 1650, fiscal revenue became a much better predictor of battlefield success. This is consistent with the main driving force behind state building in the theoretical part: an increase in the sensitivity of the war outcomes to fiscal revenues.

**6.2. Determinants of Fiscal Capacity.** Our model predicts that a state’s ability to raise taxes is limited by pre-existing domestic conflicts and divisions, and that the more money matters for military success, the greater state building will be.

*6.2.1. The effect of heterogeneity.* We use data on fiscal revenues per capita over the period 1500-1800, scaled by the average country-specific urban wage, to measure fiscal capacity. To capture deeper, structural constraints that undermined a prince’s ability to pursue a state-building agenda, we use three indicators. First, we count the number of states existing in 1300 within the territory of each country in our sample (using 1500 borders) – a full two centuries before the start of our sample period. In feudal societies, territorial expansion went hand-in-hand with a new set of local magnates becoming vassals of the king or prince. Therefore, the number of predecessor states can proxy for the potential strength of domestic opposition – the extent to which local power-holders can resist centripetal forces. For example, much of the difficulty encountered by the Spanish monarchy in raising revenue was a result of territorial expansion: Castile paid high taxes, but extending the tax net to Aragon and Catalonia, to Navarra and Portugal produced only conflict and attempted secession - but little by the way of revenue (Elliott 1963).

Second, we use total surface area of each territory as an indicator of  $B$ , the extent to which there is domestic opposition to a centralizing agenda. Before efficient means of transport, physical distance put severe constraints on a ruler’s ability to project power to the furthest corners of his territory. In addition, everything else being equal, a larger state is more likely to contain more diverse groups in both cultural and linguistic terms. Third, we employ ethnic heterogeneity as a proxy

FIGURE 7. Heterogeneity and Fiscal Capacity



*Notes:* The y-axis measures average per capita fiscal revenue as a multiple of the urban wage. The x-axis shows the terciles of the indicator of heterogeneity, ordered from 1 (lowest) to 3 (highest) – the number of predecessor states in the first quadrant, total surface area in the second, and ethnic heterogeneity in the third.

for internal fragmentation that might hinder state building. Ethnic divisions are well-known to be correlated with a host of negative outcomes, including lower state capacity (Alesina and La Ferrara 2000; Herbst 2002).

One challenge is that domestic heterogeneity can be viewed, at least in part, as the outcome and not the cause of state building – central rulers often tried to homogenize the population, by engaging in cultural assimilation, mass conversions or ethnic cleansing. In the light of this concern, the number of predecessor states in 1300 is arguably the most useful indicator of pre-existing cleavages. The measure predates our period of interest by at least 200 years, providing a more exogenous measure of the domestic divisions faced by rulers in 1500 and later

Our preferred indicator of fiscal strength is revenue per capita expressed as a multiple of the daily wage. This indicator corrects for the fact that tax revenue will typically be higher in countries with higher output per capita. We pool the data for 17 European states over the period 1500 to 1780, giving a (theoretical) maximum number of 119 observations. In actual fact, missing data results in a markedly lower number of observations. As a first step, in Figure 7, we examine how tax-raising interacted with the three indicators of potential opposition to centralization - prior territorial divisions in Europe after 1500, surface area, and ethnic heterogeneity. We divide the data into terciles for each of these variables. The size of each box

indicates the 25th and 75th percentiles, while the median is highlighted as the light line inside the box. The "whiskers" show the rest of the distributional range. There is a clear inverse pattern between the number of predecessor states on a country's territory and the average tax take in grams of silver per capita. The terciles are ordered from 1st (lowest number of prior states) to 3rd (highest quintile). There is substantial heterogeneity, especially at lower levels, as indicated by the wide range of the box and whiskers plot. At the same time, the only states with substantial income are the ones in the lowest quintile of the number of predecessor states. At the opposite end of the spectrum, amongst those states with a high number of predecessors, the average tax take is very low, and there is little variation overall. This suggests that ruling a territory with few predecessor states was a necessary, but not a sufficient condition for raising high levels of revenue.

Similar patterns emerge for the other two measures of fragmentation - territorial size and ethnic heterogeneity. The former shows a strong inverse relationship between average tax pressure and total area controlled by the ruler; the variance in the highest tercile of surface area is remarkably small. This shows that no large states succeeded in raising high levels of per capita revenue. Ethnic fractionalization also shows an inverse relationship with tax revenue. The average falls sharply from the first to the second tercile; it stays roughly constant in the third tercile, but the variance declines, suggesting that the most successful states in the highest tercile of heterogeneity were much less capable of raising revenue than the best ones in the second tercile. In table A3.3 in the appendix, we show the strength of this pattern of association in statistical terms.

6.2.2. *The effects of  $\lambda$  and  $B$ .* Our theory predicts that as rulers expect battlefield success to depend more and more on fiscal strength, they will have a greater incentive to invest in state building. For each period, we construct a measure of money intensity of military conflict and use it as our explanatory variable for fiscal capacity. If the data support our theory, we should find that higher money sensitivity is systematically associated with higher fiscal capacity.

Table 5 gives an overview of the results. In Panel A, we use the odds ratios as presented in Table 2 as an explanatory variable; in Panel B, we use the slope parameter  $\lambda$ , estimated over each fifty-year period separately, as a measure of the extent to which military might depended on fiscal revenues.<sup>25</sup> In col 1, we use simple OLS, and find a large and significant effect of the money sensitivity of military success on fiscal capacity, independent of whether we use the odds ratios or  $\lambda$ . Col 2 shows that the effect is almost equally strong if we use fixed effects, to account of country-specific differences in revenue-raising ability. The result implies that a one standard deviation increase in the importance of money for victory translates into 0.44 standard deviations higher tax revenues on average - equivalent to a rise by 2.44 daily wages compared to an average of 7.36. In col 3, we use fixed effects and control for constraints on the executive, along the lines of Acemoglu, Johnson and Robinson (2005). In our model, institutions endogenously depend on money sensitivity. As a result, by controlling for money sensitivity in col 3, we estimate the independent effect of institutions on revenue raising. Again, we obtain a large and significant coefficient on *Odds* and  $\lambda$ , the importance of fiscal resources for

<sup>25</sup>We regress, period by period, a dummy for military success (1=stronger power wins) on the ratio of fiscal revenues of the combatants - as in Table 3. We estimate without additional controls and without a constant.

military success. The coefficient on institutions is also positive, but smaller and less significant.<sup>26</sup> Finally, in col 4 of Table 5 we show that adding country-level controls does not weaken our results – the coefficient for both measures of money sensitivity remains highly significant.

The second key prediction of our model concerns interactions with the effects of pre-existing heterogeneity. In states where it was higher, state-building should be markedly harder, leading to lower revenue on average. All powers in Europe were confronted to raise fiscal capacity in the face of frequent warfare – the ones that succeeded exhibit a higher degree of initial homogeneity. To test this hypothesis, we split our sample into high- and low-fragmentation states, and then examine if the effect of money-sensitivity is systematically lower where initial heterogeneity made state-building more difficult.

We estimate

$$R_{i,t} = C + \beta \cdot B_{i,t} + \delta MoneySen + \rho B_{i,t} * MoneySen + \epsilon_{i,t}$$

where  $R_{i,t}$  is tax revenue (relative to average wages in a country  $i$  at time  $t$ ), which serves as our measure of fiscal capacity,  $B_{i,t}$  is our measure of underlying fragmentation,  $MoneySen$  is our measure of the importance of money for military success (either the odds ratio for the stronger power, or the estimate of  $\lambda$ ), and  $B_{i,t} * MoneySen$  captures interaction effects. We use clustered standard errors (at the level of period  $t$ ) to deal with the fact that the odds ratios are calculated by period.

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<sup>26</sup>Figure 10 in Appendix 4 compares the effect of both variables side-by-side (using the odds ratio as the measure of money sensitivity of war outcomes). While neither explanatory variable captures all of the existing variation, the fit is somewhat tighter in the case of the odds ratio.



TABLE 5. Revenue Raising and the Military Value of Money (dependent variable: revenue per capita)

	(1)	(2)	(3)	(4)
	OLS	FE	FE+institutions	Controls
<b>Panel A</b>				
<i>Odds</i>	3.845*** (5.99)	3.617*** (4.96)	3.513*** (5.09)	3.124*** (4.67)
<i>ConsExec</i>			1.082** (3.28)	
<i>Area</i>				-1.24e-12 (-1.41)
<i>Slope</i>				-0.163 (-0.64)
<i>Pop<sub>200</sub></i>				19.71*** (4.44)
<i>Constant</i>	3.006*** (4.87)	2.133 (1.26)	1.216 (0.68)	0.562 (0.28)
<i>N</i>	53	53	53	53
<i>R<sup>2</sup></i>	0.196	0.805	0.820	0.670
<b>Panel B</b>				
$\lambda$	66.45** (2.85)	59.66** (2.5)	57.42** (2.5)	55.47** (2.75)
<i>ConsExec</i>			1.18** (2.89)	
<i>Area</i>				-1.21e-12 (-1.35)
<i>Slope</i>				-0.137 (-0.54)
<i>Pop<sub>200</sub></i>				20.64*** (4.22)
<i>Constant</i>	-2.9 (0.81)	-2.1 (0.59)	-2.9 (0.8)	-4.8 (1.5)
<i>N</i>	53	53	53	53
<i>R<sup>2</sup></i>	0.11	0.74	0.76	0.62

Notes: \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ ; t-statistics in parentheses; *Odds* is the period-specific odds ratio of success for the richer power,  $\lambda$  is the estimated slope parameter from a regression of military outcomes on relative fiscal strength, *ConsExec* is constraints on the executive, *Area* is the total surface area of a state, *Slope* is the average slope of terrain - a measure of ruggedness -, and *Pop<sub>200</sub>* is the share of the population residing within 200 km of the capital.

TABLE 6. State Building, Fragmentation, and the Military Value of Money (dependent variable: revenue per capita)

	(1)	(2)	(3)	(4)
	low-fraction $Sum^H=0$	high-fraction $Sum^H=1$	inter	inter+FE
<b>Panel A</b>				
<i>Odds</i>	5.001*** (4.78)	1.524** (3.07)	4.970*** (5.85)	5.001*** (4.75)
<i>Sum<sup>H</sup></i>			-1.839* (-2.33)	
<i>Odds*Sum<sup>H</sup></i>			-3.761*** (-6.48)	-3.476** (-3.59)
<i>Constant</i>	-0.067 (-0.04)	5.1*** (5.29)	3.84*** (4.24)	-0.067 (-0.04)

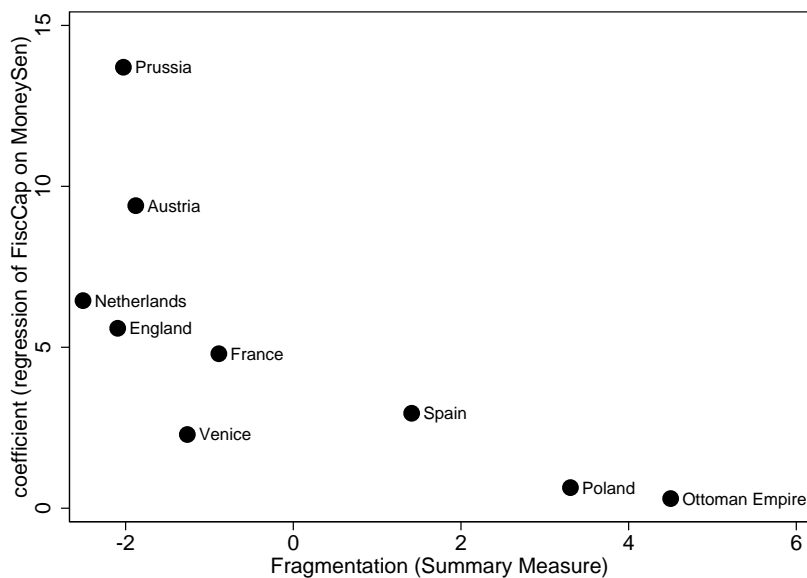
To capture underlying heterogeneity comprehensively, we construct a composite measure of fragmentation, based on the three indicators discussed above – total surface area, linguistic fragmentation, and the number of predecessor states. We standardize all variables to have zero mean and a standard deviation of unity, and sum the values for each observation ( $Sum$ ). Values below the mean then receive a value of zero in our composite measure; those above the mean, a one.

In Table 6, we regress our preferred measure of state building – revenue relative to wages – on the importance-of-money-in-war indicator. In col 1, we do so for country-period observations when pre-existing heterogeneity is low ( $Sum^H=0$ ); in col 2, for those where it is high ( $Sum^H=1$ ). In both groups, we find that revenue generation was systematically higher in periods when money mattered more for winning on the battlefield. However, the effect is more than three times bigger for the low-heterogeneity part of the sample, where the response of revenue to the growing importance of money in warfare is particularly elastic. In columns 3 and 4, we investigate if this difference in slopes is statistically significant. If we estimate without fixed effects (col 3), we find a large and significant coefficient for the interaction term, as well as a negative coefficient on high fragmentation itself. This is true in both specifications, using either the odds ratio or  $\lambda$  as a measure of the money sensitivity of military success. In col 4, the high fragmentation dummy drops out because we are estimating with fixed effects; the coefficient of the interaction term is marginally smaller and of somewhat lower statistical significance, but still well above the threshold for 5% significance in Panel A; in Panel B, it drops marginally below the cut-off.

The interaction results in col 3 and 4 bear out one of the key predictions of our model – that, at sufficiently high levels of fragmentation, increases in the usefulness of money for fighting war, as captured by either the odds ratio or by the estimated  $\lambda$ , leads to *lower* fiscal effort. In other words, as the military revolution unfolded, states with a higher  $B$  – underlying heterogeneity – rationally dropped out of the race to raise tax revenues. Figure 11 (based on the specification in col 3, Table 6, Panel A) in the Appendix shows graphically the range of values over which the net effect of higher war intensity becomes negative in expectation.

A simple way to summarize the patterns in the data is to look at the extent to which the military importance of money predicts state-building, state-by-state. To this end, we regress fiscal capacity on  $MoneySen$ , the odds ratio of success for the fiscally stronger power, country-by-country. Figure 8 plots the coefficients against the composite measure of fragmentation. We find that the correlation between (time-series) variation in  $MoneySen$  and fiscal capacity varies strongly in the cross-section, as the interaction effects in Table 6 suggest. Overall, there is a strong inverse pattern: The only states with a high responsiveness to growing odds ratios in favor of richer powers all have relatively low levels of fragmentation – the Netherlands, England, Austria, and Prussia. Countries with intermediate levels of fragmentation – like France, and Spain – showed positive responses, but smaller ones than the highly homogenous powers. Finally, weak and highly fragmented states like Poland and the Ottoman Empire show barely any association between revenue raising and the military value of money on average.

FIGURE 8. Revenue Raising and the Military Value of Fiscal Revenue



*Notes:* The y-axis shows the country-specific sensitivity of revenue-raising to *Odds*, the value of money in winning wars. The corresponding regressions are run separately for each country, with our time-varying measure of the odds ratio. The x-axis plots the aggregate measure of fragmentation.

Next, we examine which of our measures of heterogeneity is driving our result – and if there are indicators of uniformity for which there a synergy between money-sensitivity and low heterogeneity in revenue raising did not exist. Table 3.4 in the Appendix uses each measure of fragmentation separately as explanatory variables.

In Panel A, Table A3.4 in the Appendix, we use the number of predecessor states as a measure of pre-existing fragmentation. Again, the effect of money-intensity is lower for observations with high heterogeneity, by about half. The difference emerges as significant in both col 3 and col 4, where we use fixed effects. Next, in Panel B, we examine the effects of total surface area. The effect of money-intensity is twice as large for the low heterogeneity sample as for the high-heterogeneity one. When we estimate with fixed effects, the negative and significant interaction effect also shows that the difference in slope cannot reflect chance or sampling error. Finally, in Panel C, we use the Alesina measure of ethnic heterogeneity (*Ethnic*, where *Ethnic<sup>H</sup>* denotes countries with above-average values) as a measure of pre-existing fragmentation. We find results that are identical with those for the overall summary measure – the classification of high- and low-fragmentation observations coincides exactly for both measures. As before, we find significant attenuation of the revenue-boosting effect of money sensitivity in the high-heterogeneity part of the sample.

### 6.2.3. Instrumental variable results.

Our model predicts that a more belligerent environment may be associated with greater state-building, especially as the value of money for battlefield success rises. Taking this prediction to the data is complicated by the fact that war is endogenous; it is a choice variable, which depends on fiscal revenue because fiscal strength is a predictor of military success. As the model shows, in times when wars are typically won by richer powers, these have an incentive to initiate hostilities; the reverse holds when war outcomes are not determined by relative riches.

TABLE 7. War and Revenue Raising (OLS and IV-results)

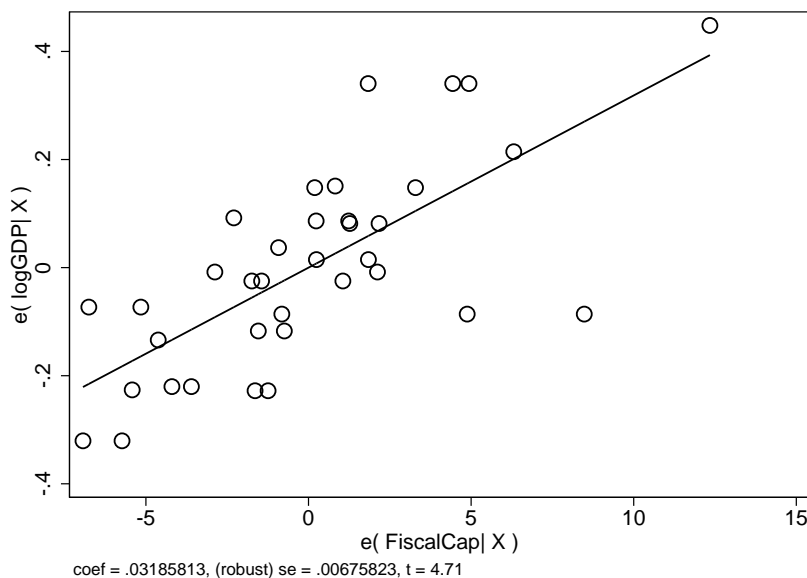
	(1)	(2)	(3)	(4)
dependent variable	FiscalCap	FiscalCap	Revenue pc	Revenue pc
estimator	OLS	IV	OLS	IV
<u>Second Stage/OLS</u>				
<i>WarFreq</i>	5.54** (2.25)	17.2** (0.03)	57.1*** (3.31)	137.26*** (0.0066)
<u>First Stage</u>				
<i>WarNeighbor</i>		0.32 (1.53)		0.414** (2.11)
<i>N</i>		45		54
<i>R</i> <sup>2</sup>	0.095		0.13	

*Notes:* \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ ; t-statistics in parentheses for OLS and the first stage; for the second stage under IV, we report Anderson-Rubin p-values; *WarFreq* is the frequency of warfare in each fifty-year period in each country, *WarNeighbor* is the frequency of war amongst immediately adjacent states in the same period.

To sidestep the issue of reverse causation we focus on an alternative measure of belligerence – the frequency of war in neighboring states. War in Europe came in waves; for example, the maelstrom of the Thirty Years War eventually drew in powers that had initially avoided participating. More frequent war in neighboring states during the same period should have heightened the expectation of rulers that they, too, might be affected by war.

In table 7, we use war frequency in neighboring states during the same period as a predictor of fiscal revenue (col 1 and 3). We find a strong and significant effect in a simple OLS setup, for two dependent variables – fiscal capacity (FiscalCap), the ratio of per capita tax revenue and country-specific wages, and Revenue per capita, measured in grams of silver (Revenue pc). Next, we use war frequency in neighboring states as an instrument to predict war frequency in the country in question. The exclusion restriction is that there is no effect of war frequency in neighboring country  $j$  on fiscal capacity in country  $i$  that is not a result of the risk of war. As the Anderson-Rubin test statistics show, war in neighboring states is a strong predictor of war in each individual country. The size of the coefficient grows as we use IV, which suggests that the relevant part of the variation identified by our instrument – fiscal capacity increases driven by the threat of war as a result of other powers' belligerence – is more strongly associated with revenue-raising than simple war frequency in a country itself. Our findings strongly suggest that there is a link between increasing state capacity and the frequency of war in early modern

FIGURE 9. GDP and State Capacity in the Early Modern Period



*Notes:* The y-axis shows fiscal revenues per capita, relative to the country-specific wage rate. The x-axis the odds ratios of success for the richer power, controlling for other factors (based on table 8, col3).

Europe – and the IV results show that the part of the variation reflecting the risk of war is highly correlated with fiscal revenue increases.

**6.3. State Capacity and Economic Efficiency.** Next, we explore the correlates of per capita income in the early modern period. Our model has the following testable predictions: (i) Output should be higher where fiscal capacity is greater. (ii) the share of variation in fiscal capacity predicted by the incidence of war should be associated with higher GDP. Here, we show that these predictions are borne out by the data.

In Figure 9, we provide a scatterplot of logGDP and fiscal capacity.<sup>27</sup> The two are strongly positively correlated in our sample, with a steep slope and a high t-statistic (4.7). In table 8, we explore this relationship in more detail. In col 1, we show that fiscal capacity is a strong and highly significant predictor of GDP per capita in the early modern period. This result holds whether we use fixed effects (col 2) or controls such as constraints on the executive and the combined degree of fragmentation (col 3).

Is it the war-driven variation in state capacity that predicts higher incomes? If we simply used war frequency of each state as an explanatory variable (or as an instrument), there would be severe endogeneity concerns – the decision to go to war is highly likely to respond to fiscal resources. In col 4 of Table tab8, we instead instrument fiscal capacity with war frequency in neighboring states. The exclusion restriction is that war in adjacent countries only influences output through

<sup>27</sup>The scatter is based on the regression reported in col 3 of table 8.

TABLE 8. GDP Growth and the Effects of War, State Capacity, and Institutions (dependent variable: logGDP per capita)

	(1)	(2)	(3)	(4)
	OLS	FE	Controls	IV
<i>FiscalCap</i>	0.0304*** (0.00769)	0.0286*** (0.00646)	0.0319*** (0.00676)	0.0968** (0.0444)
<i>ExecCons</i>		0.0783** (0.0306)	0.0371* (0.0213)	-0.0197 (0.0456)
<i>Sum</i>			-0.0790*** (0.0125)	0.0140 (0.0641)
Constant	6.680*** (0.0417)	6.610*** (0.0474)	6.448*** (0.0394)	6.205*** (0.248)
<i>N</i>	36	36	36	33
<i>R</i> <sup>2</sup>	0.915	0.931	0.846	
Anderson-Rubin p-value				0.001

Standard errors in parentheses

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ 

its effects on state-building.<sup>28</sup> The IV strategy yields a markedly larger and highly significant coefficient in the second stage, showing that the part of fiscal capacity building explained by the threat of war (as a result of having more belligerent neighbors) strongly predicts growth. The Anderson-Rubin statistic also suggests that the instrument in the first stage is strong. Similar to the results of Besley and Persson (2009) for 20<sup>th</sup> century states, our findings strongly suggest that greater tax powers are closely associated with higher incomes, and that the link may well be causal. We also find evidence that war was important in driving the positive relationship between output and fiscal capacity.

**6.4. Summary.** The empirical section provides support for the following predictions of the model: First, the importance of fiscal revenue for military success grew rapidly after 1500 as the “Military Revolution” unfolded. In the beginning, the odds of a richer power winning against a poorer one were roughly even. By the end of the early modern period, richer belligerents won wars with a much higher probability. Second, the ability of governments to raise revenue depended crucially on pre-existing domestic divisions, such as the number of predecessor states on a territory, ethnic heterogeneity, and the total surface area. We also show that greater state capacity - as measured by higher tax pressure relative to income - went hand in hand with more warfare.

Crucially, we also find evidence in favor of interaction effects - where initial fragmentation was high, states could only respond to the rising importance of money

<sup>28</sup>While there may have been secondary effects - both positive and negative, as a result of trade diversion and disruption, say - the exclusion restriction is plausible because the literature largely accepts that the immediate economic impact of war was probably limited before 1800 - De Vries (1976) concluded that “it is hard to prove that military action checked the growth of the European economy’s aggregate output.”

to a limited extent. Most of the increase in state capacity occurred in states that had inherited a relatively compact territory with a homogenous population. Overall, we conclude that there is substantial empirical support for our model’s predictions. The two key variables in our model –  $\lambda$ , the importance of money for winning in war, and  $B$ , the extent of domestic opposition to centralization, allow us to understand why war became a driver for state building, and why this process succeeded more in some locations than in others.

Our model also predicts that state building should lead to higher output. As in the work by Besley and Persson (2009), we find that states with greater fiscal capacity grew more quickly between 1500 and 1780. There is some evidence that the positive correlation between state capacity and output reflects the need to fight wars – war frequency predicts fiscal capacity, and in an IV-setting, the component of fiscal capacity thus identified is highly significant in predicting per capita incomes.

**6.5. Discussion and Alternative Interpretations.** One alternative explanation of early modern warfare and state building emphasizes the importance of the Black Death. After 1349, per capita incomes surged, and rulers tax revenue increased. Since war was a “superior good”, greater incomes, larger tax revenues, and higher war frequency went hand-in-hand (Voigtländer and Voth 2013). We do not dispute the individual elements of this story, which likely contributed to the confluence of economic success and state-building in early modern Europe, nor the fact that greater riches could have translated into more frequent wars. However, as the data on tax pressure indicate, the growth of fiscal revenue was far greater than can be explained by higher per capita incomes. Also, there is an important divergence in the cross-section of countries. These two facts are easier to explain in our model.

One limitation of our work is that we use current boundaries in the empirical section. The disadvantage is that they are based on an ex post measure, reflecting the success of states after 1500. The advantage is that the expansion of successful states – and the resulting changes in ethnic composition, and surface – do not bias our results. In so far as successful states expanded more, and hence ended up with more heterogenous populations, this creates a downward bias for our estimates. Also, since we use per capita measures of tax yield, we abstract from gains in total revenue due to successful conquests of, for example, Northern Catalonia by France after the Peace of the Pyrenees.

Our paper complements recent work emphasizing mechanisms that we deliberately abstract from. First, we take military technology as exogenous. Hoffman (2011) argues that Europeans refined military technologies like gunpowder more than China (where it was invented) because more frequent warfare gave them stronger incentives to do so.<sup>29</sup> Our model can help to understand Europe’s technological lead. By reducing domestic opposition, state building by European states facilitated the mobilization of greater resources. It is natural to think that this should have influenced not just the speed of technological advances, but also their direction, with an emphasis on ‘resource-intensive’ and technologically sophisticated forms of warfare (such as naval warfare, fortifications, etc.)

Second, we take domestic political divisions to be exogenous. In actual fact, as the pressure to raise revenue grew, rulers increasingly tried to shape the religious, cultural and ethnic composition of their populations (Alesina and Reich 2013). In

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<sup>29</sup>See also Lagerlöf (2011).

several cases, domestic opponents did not rally behind the king, and instead invited a foreign ruler to take over (such as in the case of England in the 17th century). In response to these threats, religious and ethnic minorities were frequently expelled or suppressed. At the same time, the threat of war could lead to internal realignments, with as domestic opponents sometimes allied themselves with central rulers to meet foreign threats (see Magalhães and Giovannoni 2012). For simplicity we abstract from these forces. Our analysis still goes through as long as the risk of war does not reduce all domestic rivalries to zero.

Third, a body of work focuses on interactions between war and institutional change. Acemoglu *et al.* (2011) demonstrate that foreign conquest spread institutional reforms across 19<sup>th</sup> century Europe. In a similar vein, Ticchi and Vindigni (2008) stress the importance of the rise of mass armies for extensions of the franchise in 19<sup>th</sup> century Europe.<sup>30</sup> We abstract from these specific 19<sup>th</sup> century mechanisms since our focus is on state capacity, and not institutional improvements. More broadly, our model highlights why there are synergies between both – as military conflict becomes more common, countries have ever strong incentives to improve state capacity. When reaching the highest levels of mobilization is easier with “consensually strong” institutions, then military competition and the desire to build a stronger state will foster their emergence.

## 7. CONCLUSION

In the cross-section of countries today, there is a positive correlation between good institutions and state capacity. This is puzzling: More powerful states could plausibly be expected to have fewer constraints on the executive, and greater state capacity can undermine property rights. There are several historical examples of highly capable states with relatively poor institutional constraints, such as the Soviet Union under Stalin, South Korea under General Park, or Singapore under Lee Kuan Yew. And yet, over the long run, and in most countries, political centralization and the rise of a powerful state have tended to go hand-in-hand with better institutions (Acemoglu 2013).

In this paper, we argue that the emergence of a positive correlation between state capacity and institutional quality over the long run can be explained as a response to frequent, costly warfare. We present a simple, unified framework for exploring the co-evolution of state capacity, institutional quality, and warfare. It allows us to examine why rich, powerful states with “good” institutions mainly emerged in Europe during the period after 1500.

We build a simple model of state-building, and then examine the effects of war in a two-player setting. In each territory, the ruler can invest in state capacity – centralizing tax collection, wresting control over tariffs from local princes, etc. Territories differ in their pre-existing levels of fragmentation. This affects the cost of centralization – states with high levels of internal divisions typically greater opposition to centralization. Unifying a more homogenous territory will produce the same benefits, but it requires less investment to overcome the local opposition. Without the threat of war, princes simply trade off future revenue gains against the threat of rebellion (or the cost of subduing it).

The threat of war changes this calculus. On the one hand, monarchs now have to fear that they may be attacked, and territory (and tax revenue) taken from them

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<sup>30</sup>For defensive modernization in Germany after 1815, cf. Blanning (1989) and Wehler (1996).



- as it was in the case of Silesia, for example (wrested from Austria by Prussia in 1742). This reduces a ruler's incentive to invest in state capacity. At the same time, the need to finance war makes money more valuable, increasing the benefits of greater state capacity. The relative strength of these two effects depends on how costly wars are. Everything else equal, expensive wars make it more attractive to invest in the infrastructure necessary to collect higher taxes, centralizing tax collection, professionalizing the administration, etc. In our model, war can become so costly that at least the stronger, less fragmented power will invest in greater state capacity because of the threat of war. Weaker powers can rationally drop out of the competition. As the cost of war increases even further, the importance of money for survival eventually outweighs the dangers of domestic rebellion. Therefore, when wars are very costly, both the cohesive and the fragmented power invest in state capacity.

We show under what conditions the threat of war can transform the nature of social bargaining, increasing the incentive to simultaneously upgrade institutions and enhance state capacity. As the importance of money for military success increases, finding efficient ways to raise revenue become increasingly attractive to rulers. We conceptualize institutional improvements as the ability of the ruler to commit to future payments to power holders who lose out from centralization. Good institutions in our setup allow for greater centralization because they enable bargaining between ruler and domestic elites along the lines of Britain's Glorious Revolution. In a belligerent environment with sharp incentives to raise revenues, institutional improvements that allow such deals to be struck become increasingly attractive. Of course, some states succeeded by tearing up the ancient "liberties" of towns, clergy, and the nobility, ignoring laws based on custom, imposing new legal norms uniformly, and abolishing tax exemptions. Nonetheless, over the long run, both military success and economic growth favoured states that found ways to constrain the sovereign in exchange for greater taxation (Brewer 1990, North and Weingast 1989, Acemoglu and Robinson 2012).

In the empirical part of our paper, we examine the model's predictions using data from Europe after 1500. This is an ideal testing ground for our theory: Following the Reformation, war became almost universal as religious motives provided an additional cause for war. With the invention of gunpowder and associated changes in arms and tactics, the cost of conflict rose (the so-called "Military Revolution"). Equipping ever large armies was expensive, and wars lasted longer. Armed conflict was the single biggest expenditure of European powers, and was responsible for most defaults. As money became crucial for success on the battlefield, rulers taxed more. This helped defend their independence, and it aided the persecution of wars of aggression. By 1800, what had earlier been a patchwork of small and weak states had consolidated into a few, powerful entities that enjoyed a monopoly of violence internally, jurisdictional unity, and the power to tax on a vast scale.

We first demonstrate empirically how the importance of financial resources for military success changed. As the "Military Revolution" unfolded, richer powers became increasingly likely to prevail on the battlefield. Next, we show that raising taxes was more difficult in fragmented (and fractious) territories: Where states were composed of numerous predecessor states, rulers were less successful in increasing tax pressure. Similarly, where ethnic heterogeneity hindered centralizing efforts, the average tax take after 1500 grew markedly less. Importantly, we find heterogeneous

effects – stronger powers increasingly invested in their ability to collect taxes as the importance of public finances for prosecuting successful wars grew. At the same time, weaker, more fragmented players actually responded with *lower* investments in fiscal capacity – a rational reaction predicted by our model, driven by the low probability of success and the high cost of opposition. Finally, we examine the effects of state capacity and institutional quality on output. According to our estimates, states with higher tax pressure (relative to income) grew more in the early modern period, as predicted by our model. Finally, we also show that both institutional improvements and state capacity mattered for growth.

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## Appendix 1: Proofs

*Proof of Lemma 1.* We want to show that the symmetric equilibrium of Lemma 1 where market production does not occur and only home production occurs always exists. Suppose that we are in such an equilibrium  $(\tau_{l,d}, \tau_{m,d})$  and suppose that at the tax rate  $\tau_{m,d}$  market production is less profitable than home production, namely  $\max[0, (1 - 2\tau_{m,d})] A_m < A_h$ . The question is whether it is profitable for an individual power holder  $i$  to deviate to a tax  $\tau_{m,i}$  at which market production is profitable again. Remember that in the equilibrium of Lemma 1 each power holder obtains  $(A_l - A_h)$  by fully extracting the local production surplus.

If  $\tau_{m,d} \geq (A_m - A_h)/A_m$ , it is unprofitable for the local power holder  $i$  to deviate to a tax rate inducing market production, because such tax rate should be non-positive.

If  $\tau_{m,d} < (A_m - A_h)/A_m$ , the maximal tax rate that the power holder of district  $i$  could deviate to is equal to:

$$\tau_{m,i} = 1 - \tau_{m,d} - \frac{A_h}{A_m}.$$

At this tax rate, the local power holder induces all people in his district and in the right adjacent district to undertake market production. As a result, his tax revenue is equal to:

$$2A_m\tau_{m,i} = 2A_m(1 - \tau_{m,d}) - 2A_h.$$

This tax revenue available for power holder  $i$  is less than the rent  $(A_l - A_h)$  that the same power holder obtains in the equilibrium of Lemma 1 (so that the deviation is not profitable) provided:

$$\tau_{m,d} > 1 - \frac{A_l + A_h}{2A_m}.$$

Thus, the equilibrium of Lemma 1 indeed exists for all parameter values.  $\square$

*Proof of Proposition 1.* Denote by  $\Pi^j(R_j, R_i)$  the payoff of ruler  $j = H, F$  as a function of the given revenue  $R_i$  chosen by ruler  $i \neq j$ . Denote by  $p_i = L_i^\alpha R_i^\lambda / (L_i^\alpha R_i^\lambda + L_j^\alpha R_j^\lambda)$  the win probability of ruler  $i$ . The first order condition of ruler  $i$  is equal to  $\Pi_{R_i}^i(R_i, R_j) = 0$  for  $i = H, F$ . The second order condition is instead equal to  $\Pi_{R_i R_i}^i(R_i, R_j) < 0$ . By plugging Equation (10) into Equations (14) and (15), we find that for  $R_j > 0$  the first order condition of ruler  $i$  is equal to:

$$(25) \quad \theta \frac{\lambda}{R_i} p_{(i)} (1 - p_{(i)}) (R_i + R_j) + \theta p_{(i)} + 2(1 - \theta) - 2c_i R_i = 0.$$

Note that here  $p_{(i)}$  is the probability with which country  $i$  wins the war. This must be distinguished from  $p_J$  which represents, according to our previous notation, the marginal impact of  $J$ 's revenue on the win probability of country  $H$ .

The second order condition of the problem is then equal to:

$$(26) \quad -\theta \frac{\lambda}{R_i^2} p_{(i)} (1 - p_{(i)}) [1 + \lambda(2p_{(i)} - 1)] (R_i + R_j) + 2\theta \frac{\lambda}{R_i} p_{(i)} (1 - p_{(i)}) - 2c_i < 0.$$

By plugging the expression for  $(\lambda/R_i) p_{(i)} (1 - p_{(i)})$  obtained from (25) into (26) we can see that a sufficient condition for the latter to be globally satisfied is that  $\lambda \leq 1$ . This restriction ensures that the term  $[1 + \lambda(2p_{(i)} - 1)]$  is always nonnegative.

In fact, the term  $\theta(\lambda/R_i)p_{(i)}(1-p_{(i)}) - c_i$  can be shown to be always negative by exploiting the expression for  $2c_i(R_i - R_j)$  entailed by (25). Critically,  $\lambda \leq 1$  ensures that the relation between fiscal revenues and military strength is concave. This parallels findings from existing analyses of models of contests with endogenous prizes, in which the same type of concavity is shown to be sufficient for the existence and uniqueness of equilibrium (e.g., Hirai 2012).

To show that Equation (25) identifies a unique best response  $R_i(R_j)$  for player  $i$  for any  $R_j$ , we only need to show that  $R_i(0)$  is positive and finite. When  $R_j = 0$ , we have that  $p_i = 1$ . By plugging this condition into (25) we can see that  $R_i(0) = (1 - \theta/2)/c_i > 0$ . If the opponent has zero revenue, the revenue of ruler  $i$  is still lower than under autarky because part of his revenue is wasted in the war.

Consider now the slope of the reaction functions. To ease intuition and streamline notation, we go back to labelling the two countries as  $H$  and  $F$  and to expressing the win probability of country  $H$  (and its derivatives) using its implicit notation of  $p$  (where  $1 - p$  is the win probability of country  $F$ ). By applying the implicit function theorem to (14) and (15), we have that:

$$(27) \quad \frac{dR_H(R_F)}{dR_F} = -\frac{\Pi_{R_F R_H}^H}{\Pi_{R_H R_H}^H} = -\frac{(\theta/2)[p_{HF}(R_H + R_F) + p_H + p_F]}{(\theta/2)[p_{HH}(R_H + R_F) + 2p_H] - 1/R_{H,aut}},$$

$$(28) \quad \frac{dR_F(R_H)}{dR_H} = -\frac{\Pi_{R_F R_H}^F}{\Pi_{R_F R_F}^F} = \frac{(\theta/2)[p_{HF}(R_H + R_F) + p_H + p_F]}{(\theta/2)[-p_{FF}(R_H + R_F) - 2p_F] - 1/R_{F,aut}},$$

where the denominator of both expression is negative by concavity and where  $p_{J,J'}$  denotes the second derivative of the win probability of country  $H$ . Thus, reaction functions have opposite signs, formally  $\text{sign}\left(\frac{dR_H(R_F|\cdot)}{dR_F}\right) = -\text{sign}\left(\frac{dR_F(R_H|\cdot)}{dR_H}\right)$ .

Given that the reaction function  $R_i(R_j)$  is well defined, an interior equilibrium  $(R_H^*, R_F^*)$  is then identified by the equation:

$$(29) \quad \{1 + (\theta/2)[-p_F(R_H(R_F^*) + R_F^*) - p - 1]\} - \frac{R_F^*}{R_{F,aut}} = 0,$$

together with  $R_H^* = R_H(R_F^*)$ . Note that Equation (29) is simply the first order condition of ruler  $F$  rewritten using a general and thus simpler notation for the win probability. Given that the optimal policy of ruler  $H$  depends on that of ruler  $F$  through the best response  $R_H(R_F^*)$ , the above condition identifies an equation that can be solved  $R_F^*$ .

To see whether a solution to (29) exists and is unique, consider the slope of (29) with respect to  $R_F^*$ . To do so, rewrite (29) in the yet more general form  $\Pi_{R_F}^F(R_H(R_F^*), R_F^*) = 0$ . By exploiting (27) and (28), we can find that the derivative of  $\Pi_{R_F}^F(R_H(R_F^*), R_F^*)$  with respect to  $R_F^*$  is equal to:

$$\left| \Pi_{R_F^* R_F^*}^F \right| \frac{dR_F(R_H^*)}{dR_H^*} \cdot \frac{dR_H(R_F^*)}{dR_F^*} + \Pi_{R_F^* R_F^*}^F.$$

At an interior equilibrium  $(R_F^*, R_H^*)$ , the above equation is negative. This is because, as we have previously established, at a interior equilibrium the two reaction functions have opposite slopes, namely  $\frac{dR_F(R_H^*)}{dR_H^*} \cdot \frac{dR_H(R_F^*)}{dR_F^*} \leq 0$ , and because at the optimum the problem is concave, namely  $\Pi_{R_F^* R_F^*}^F < 0$ . To ensure existence, it must be the case that  $\Pi_{R_F}^F(R_H(0), 0) > 0$  (which can be easily verified to hold) and  $\Pi_{R_F}^F(R_H(A_m - A_h), A_m - A_h) \leq 0$ . Consider now the cases in which the

latter condition is fulfilled (and thus existence is guaranteed). If country F is more cohesive of country H (i.e.,  $c_F < c_H$ ), the reaction function of country F is negatively sloped (see below). As a result, existence is guaranteed provided  $\Pi_{R_F}^F(0, A_m - A_h) < 0$ , which always holds given our assumption that in autarky centralization is partial. If instead country F is less cohesive of country H (i.e.,  $c_F > c_H$ ), the reaction function of country F is positively sloped (see below). As a result, existence is guaranteed provided  $\Pi_{R_F}^F(A_m - A_h, A_m - A_h) < 0$ . This latter condition holds if and only if  $c_F(A_m - A_h) > 1 + \frac{\theta}{4}(\lambda - 3)$ . As a result, existence is guaranteed provided  $\lambda$  is not too far above 3, provided  $c_F$  is not too low, and provided  $\theta$  is low.

Consider now the case in which the countries are symmetric. In a symmetric equilibrium we have that the two countries face the same win probability  $p = 1 - p = 1/2$ . As a result, the ruler's first order condition readily yields:

$$R_H^* = R_F^* = R_{aut} \left[ 1 + \frac{\theta}{4}(\lambda - 3) \right].$$

We know that when  $\lambda \leq 1$  that this equilibrium is unique.

Let us turn to the case of asymmetric countries, in which  $c_H \neq c_F$ . In this case, we know from Equations (14) and (15) that in such equilibrium we have:

$$(30) \quad c_H = \frac{1 + \frac{\theta}{2} \left[ \frac{\lambda p(1-p)}{R_H} (R_H + R_F) - 2 + p \right]}{R_H},$$

$$(31) \quad c_F = \frac{1 + \frac{\theta}{2} \left[ \frac{\lambda p(1-p)}{R_F} (R_H + R_F) - 1 - p \right]}{R_F}.$$

When  $c_H < c_F$ , it must be that the right hand side of (30) is smaller than the right hand side of (31). After some algebra, one can show that this condition is equivalent to:

$$(R_H - R_F) \left[ (1 - \theta) + \frac{\theta}{2} \lambda p(1-p) \frac{(R_H + R_F)^2}{R_H R_F} \right] + \frac{\theta}{2} [R_H(1-p) - R_F p] > 0.$$

One can check that for  $\lambda \leq 1$  the above condition can only be met if  $R_H > R_F$ . Thus, when  $c_H < c_F$ , in an interior equilibrium it must be that  $R_H^* > R_F^*$ .

Finally, consider the comparative statics properties of the equilibrium. To prove these properties, we differentiate the rulers' first order conditions with respect to reform costs. We then obtain:

$$(32) \quad \Pi_{R_H R_H}^H dR_H + \Pi_{R_H R_F}^H dR_F = R_H dc_H,$$

$$(33) \quad \Pi_{R_F R_H}^F dR_H + \Pi_{R_F R_F}^F dR_F = R_F dc_F.$$

By solving the linear system it is easy to see that:

$$(34) \quad dR_H = -\varphi R_H dc_H - \varphi \frac{\Pi_{R_H R_F}^H}{|\Pi_{R_F R_F}^F|} R_F dc_F,$$

$$(35) \quad dR_F = -\varphi \frac{|\Pi_{R_H R_H}^H| |\Pi_{R_F R_F}^F|}{|\Pi_{R_F R_F}^F|^2} R_F dc_F - \varphi \frac{\Pi_{R_F R_H}^F}{|\Pi_{R_F R_F}^F|} R_H dc_H$$

where  $\varphi = \frac{|\Pi_{R_F R_F}^F|}{|\Pi_{R_H R_H}^H \Pi_{R_F R_F}^F| + |\Pi_{R_H R_F}^H \Pi_{R_F R_H}^F|} > 0$ .



It is obvious from the above expressions that centralization in  $J$  decreases with the cost of reform in the same country, namely  $\frac{dR_H}{dc_H} < 0$  and  $\frac{dR_F}{dc_F} < 0$ . Accordingly, a drop in reform costs in  $J$  increases centralization in the same country. On the other hand, the equations also show that an increase in the cost of reform in country  $J$  boosts reform in country  $-J$ , namely  $\frac{dR_{-J}}{dc_J} > 0$  if and only if the reaction function of country  $-J$  is negatively sloped, namely  $\frac{dR_{-J}(R_J)}{dR_J} < 0$ , which occurs when  $\Pi_{R_{-J}R_J}^{-J} < 0$ .

As we previously established, in our model the reaction functions of the two countries have (weakly) opposite slopes. As a result, only one country will feature  $\frac{dR_{-J}}{dc_J} > 0$  while the other country will feature  $\frac{dR_J}{dc_J} < 0$ . To see which country moderates its reform if reform abroad becomes cheaper (namely  $\frac{dR_{-J}}{dc_J} > 0$ ), consider the expression for the mixed derivative of country  $-J$ , where we have w.l.o.g. taken  $-J = H$ . After some algebra, one finds that:

$$\Pi_{R_H R_F}^H \propto -\lambda(1-2p) \frac{R_H + R_F}{R_H R_F} + \frac{1}{R_H} - \frac{1}{R_F}.$$

The above expression is negative (so that  $\frac{dR_H}{dc_F} > 0$ ) provided:

$$\lambda \frac{R_H^\lambda - R_F^\lambda}{R_H^\lambda + R_F^\lambda} \leq \frac{R_H - R_F}{R_H + R_F}.$$

The above condition holds with equality at  $\lambda = 1$ . On the other hand, it is easy to show that the left hand side of the inequality is an increasing function of  $\lambda$  provided  $R_H > R_F$ . As a result, when  $\lambda \leq 1$  the above condition holds if and only if  $R_H > R_F$  which, by the previous result amounts to  $c_H < c_F$ .  $\square$

*Proof of Proposition 2.* In this and the remaining proofs, we will always replace the marginal cost of reform  $c_J$  with its counterpart  $1/R_{J,aut}$ . When  $\gamma = 1$ , the reaction functions yield:

$$(36) \quad R_J^* = \left( \frac{1 - 3\theta/4}{1 - \theta\lambda R_{J,aut}} \right) \cdot R_{J,aut},$$

which identifies a maximum provided  $\theta \cdot \lambda \cdot \max_J R_{J,aut} < 1$ . This condition imposes an upper bound on the money sensitivity of the war outcome:

$$\lambda < \lambda_0 \equiv \frac{1}{\theta \cdot \max_J R_{J,aut}}.$$

Note that the condition is very weak. It is consistent with very high values of  $\lambda$ , and in particular with values of  $\lambda$  at which both countries centralize more than in autarky (namely such that  $\lambda \cdot R_{J,aut} > 3/4$ ).

To ease notation, we impose two additional restrictions on the analysis. First, we impose that in equilibrium neither country centralizes fully. Given that under full centralization the tax revenue is equal to  $(A_m - A_h)$ , this is indeed the case provided:

$$\lambda < \lambda_1 \equiv \frac{1}{\theta} \left[ \frac{1}{\min_J R_{J,aut}} - \left( \frac{1 - 3\theta/4}{A_m - A_h} \right) \right].$$

After some algebra, it is easy to find that this condition is consistent with the possibility of having both countries centralize more than under autarky provided

that  $(A_m - A_h) > R_{J,aut}$ . The condition, which says that under autarky neither country centralizes fully, is fulfilled by the assumption  $B_J > \left(\frac{A_m - A_h}{A_l - A_h}\right)$ .

To simplify notation, we also focus on the case where the probability of either ruler winning is interior, which is guaranteed by the condition  $\lambda(\max_J R_J^* - \min_J R_J^*) < 1/2$ . This is equivalent to imposing:

$$(37) \quad 2(1 - 3\theta/4) \left( \max_J R_{J,aut} - \min_J R_{J,aut} \right) \leq \left( \frac{1}{\lambda} - \theta R_{H,aut} \right) \left( \frac{1}{\lambda} - \theta R_{F,aut} \right).$$

The left hand side above is increasing in  $1/\lambda$ , which implies that this condition also identifies a threshold  $\lambda_2$  on the money sensitivity of the war outcome such that win probabilities are interior if and only if  $\lambda < \lambda_2$ . Once again, this threshold is consistent with both countries centralizing more than in autarky provided the following parametric condition holds:

$$\frac{8}{9} \min_J R_{J,aut} \left( \min_J R_{J,aut} - \frac{3\theta}{4} \max_J R_{J,aut} \right) \geq \left( \max_J R_{J,aut} - \min_J R_{J,aut} \right).$$

After some algebra, one finds that there exists positive threshold  $\Psi$  such that the above condition is satisfied provided  $(\max_J R_{J,aut} - \min_J R_{J,aut}) < \Psi$ . Provided the two countries are sufficiently similar, imposing interior win probabilities does not preclude that war may boost centralization relative to autarky. This is the first condition of the proposition. the second condition is  $\lambda < \bar{\lambda} \equiv \min(\lambda_0, \lambda_1, \lambda_2)$ . The remaining properties are then straightforward. Property i) follow by inspection of the first order condition, while property ii) follows by inspection of the equation:s partial in all countries, namely  $\kappa_J^* < 1$  for  $J = H, F$ , we have that:

$$(38) \quad \frac{R_H^*}{R_F^*} = \frac{R_{H,aut}}{R_{F,aut}} \cdot \frac{1 - \lambda\theta/c_F}{1 - \lambda\theta/c_H},$$

which holds at equilibrium.  $\square$

*Proof of Proposition 4.* Equations (12) and (13) imply that:

$$W_J(\pi_J, B_J) = \max_{\tilde{R}_J} \theta \cdot \left\{ p_J(\tilde{R}_J, \tilde{R}_{-J})(\tilde{R}_J + \tilde{R}_{-J}) - 2\tilde{R}_J \right\} + 2\tilde{R}_J - \frac{\tilde{R}_J^2}{\tilde{R}_{J,aut}},$$

where  $p_J(\tilde{R}_J, \tilde{R}_{-J})$  is the probability with which the ruler of country  $J$  wins the war. By the envelope theorem:

$$\frac{dW_J(\pi_J, B_J)}{d\pi_J} = \frac{\left(\tilde{R}_J^*\right)^2}{\tilde{R}_{J,aut}} \cdot \frac{2 - (1 - \pi_J) - 2P_d/R_c}{[P_d/R_c - \pi_J](1 - \pi_J)},$$

It is then easy to see that :

$$(39) \quad \left. \frac{\partial W_H}{\partial \pi_H} \right|_{\pi_H = \pi} > \left. \frac{\partial W_F}{\partial \pi_F} \right|_{\pi_F = \pi} \Leftrightarrow \left( \frac{\tilde{R}_H^*}{\tilde{R}_F^*} \right)^2 > \frac{\tilde{R}_{H,aut}}{\tilde{R}_{F,aut}}.$$

$\square$

*Proof of Corollary 2.* By inspection and using the notions developed in the Proof of Proposition 2.  $\square$

*Proof of Proposition 5.* Under the linear-symmetric contest success function, (22) can be rewritten as:

$$(40) \quad \left[ \frac{1}{2} + \lambda(R_H^* - R_F^*) \right] \cdot \sigma \cdot (R_H^* + R_F^*) \geq R_H^*,$$

$$(41) \quad \Leftrightarrow \quad \lambda \sigma \left[ (R_H^*)^2 - (R_F^*)^2 \right] - (1 - \sigma)R_H^* \geq \frac{\sigma(R_H^* - R_F^*)}{2}.$$

Given the symmetry of the contest success function, (41) can be used to study under what conditions does the stronger or weaker ruler wish to initiate a war.

Suppose in fact that  $H$  is the strong ruler, namely  $R_H^* > R_F^*$ . Then (41) becomes:

$$(42) \quad \lambda \sigma (R_H^* + R_F^*) - (1 - \sigma) \frac{R_H^*}{R_H^* - R_F^*} \geq \frac{\sigma}{2}.$$

Given the dependence of  $(R_H^*, R_F^*)$  on  $\lambda$  in Proposition 2, it is easy to see that the left hand side increases in  $\lambda$  over the range where  $R_H^*, R_F^* < R_c$ . Define  $\lambda^*$  as the sensitivity at which  $R_H^* = R_c$ . Then, if  $\lambda^* R_c > 1/2$  there exists a  $\hat{\sigma} < 1$  such that, for  $\sigma \geq \hat{\sigma}$ , there exists a  $\lambda_1 < \lambda^*$  such that for  $\lambda \geq \lambda_1$  condition (42) is met. If  $\lambda^* R_c < 1/2$  or  $\sigma < \hat{\sigma}$ , then set  $\lambda_1 = \lambda^*$ . Clearly, even though  $\lambda_1 < \lambda^*$ , for  $\lambda > \lambda^*$  the distance  $R_H^* - R_F^*$  becomes smaller and smaller, so that at some point, when  $\lambda$  becomes large, (42) is violated.

Suppose now that  $F$  is the weak ruler, namely  $R_H^* < R_F^*$ . Then (41) becomes:

$$(43) \quad \lambda \sigma (R_F^* + R_H^*) + (1 - \sigma) \frac{R_H^*}{R_F^* - R_H^*} \leq \frac{\sigma}{2}.$$

Given the dependence of  $(R_H^*, R_F^*)$  on  $\lambda$  in Proposition 2, it is easy to see that the left hand side decreases in  $\lambda$  over the range where  $R_H^*, R_F^* < R_c$ . When  $\lambda = 0$ , the value of the left hand side is finite. As a result, there exists a  $\hat{\hat{\sigma}} < 1$  such that, for  $\sigma \geq \hat{\hat{\sigma}}$ , there exists a  $\lambda_0$  such that for  $\lambda \leq \lambda_0$  condition (43) is met. For  $\sigma < \hat{\hat{\sigma}}$ , set  $\lambda_0 = 0$ .

We thus have seen that in  $\lambda \in [0, \lambda_0] \cup [\lambda_1, \lambda^*]$  war occurs for sure and the optimal fiscal investments of Propositions 2 indeed characterize the full equilibrium. Suppose now that we are in  $\lambda \in (\lambda_0, \lambda_1)$ . Here our goal is not to fully derive the mixed strategy equilibrium but describe how the equilibrium works. In this range, at the fiscal investments of Proposition 2, countries have no incentive to go to war. How is an equilibrium determined in this case? Suppose first that for  $\lambda \in (\lambda_0, \lambda_1)$  the equilibrium probability of war is  $\omega = 0$ . In this case, countries go back to the autarky investments  $(R_{F,aut}, R_{H,aut})$ . If at these investments no country has an incentive to go to war, then the equilibrium is one where for  $\lambda \in (\lambda_0, \lambda_1)$  war does not occur and countries behave as in autarky. It is easy to check that if this is the case, then  $\lambda_0 = 0$ . The logic is that, again by Proposition 2, state building (and asymmetry among countries) fall in  $\lambda$ . As a result, if no ruler has an incentive to fight in autarky, when  $\lambda = 3/4 R_{J,aut}$ , a fortiori no ruler has any incentive to fight for  $\lambda = 0$ , for in this latter case countries are even more equal. In sum, if  $\omega = 0$ , war only arises for  $\lambda \in [\lambda_1, \lambda^*]$ .

If instead at the autarky investments either ruler has an incentive to go to war, then in equilibrium the probability  $\omega$  of going to war must be positive. Crucially, since autarky revenues are too high (and unequal) to avert war, it must be that a positive probability of war ( $\omega > 0$ ) *reduces* state building in the two countries, much in the spirit of Proposition 2 for  $\lambda < 3/4 R_{J,aut}$ . From an ex-ante standpoint,

an overall probability of going to war of  $\theta\omega$  induces (according to Proposition 2) optimal investments  $[R_F^*(\lambda, \omega), R_H^*(\lambda, \omega)]$ . The equilibrium is then reached by setting  $\omega$  such that, at the equilibrium probability of  $H$  winning  $p(R_F^*(\lambda, \omega), R_H^*(\lambda, \omega))$ , the party who at autarky revenues is willing to attack is just indifferent between attacking or not (and thus willing to mix with probability  $\omega$ ).  $\square$

## Appendix 2: Equilibrium under the linearized contest success function when the two countries have different army sizes

Denote autarky revenues in the two countries by  $(R_{H,aut}, R_{F,aut})$ . We continue to assume heterogeneity and  $\lambda$  are sufficiently small that the problem is concave and interior. Then, an interior equilibrium occurs at the intersection of the reaction functions:

$$(44) \quad R_H(R_F | \theta, c_H) = \left( \frac{1 - 3\theta/4}{1 - \theta\lambda/c_H} \right) \cdot R_{H,aut} + \frac{\theta(1 - \gamma)\lambda/c_H}{1 - \theta\lambda/c_H} \cdot R_F,$$

$$(45) \quad R_F(R_H | \theta, c_F) = \left( \frac{1 - 3\theta/4}{1 - \theta\lambda\gamma/c_F} \right) \cdot R_{F,aut} - \frac{\theta(1 - \gamma)\lambda/c_F}{1 - \theta\lambda\gamma/c_F} \cdot R_H.$$

The intercept captures the reform chosen by a ruler when his opponent does not reform at all (i.e., when  $R_{-j} = 0$ ), the second term captures a ruler's reaction to state building abroad. Notice that here two reaction functions have opposite slopes, and the reaction function of the country with a larger army has a positive slope. Suppose without loss of generality that the army of country  $H$  is larger, namely  $\gamma < 1$ . We then find:

**Proposition 4.** *When  $\gamma \leq 1$  equilibrium reforms fulfill:*

$$(46) \quad \frac{R_H^*}{R_F^*} = \frac{R_{H,aut}}{R_{F,aut}} \cdot \frac{1 + \theta\lambda(1 - 2\gamma)/c_F}{1 - \theta\lambda(2 - \gamma)/c_H}.$$

$R_H/R_F$  increases as  $\gamma$  becomes smaller.  $R_H/R_F \geq R_{H,aut}/R_{F,aut}$  if and only if  $\gamma \leq (c_H + 2c_F)/(2c_H + c_F)$ . In this case,  $R_H/R_F$  increases in  $\lambda$ .

If country  $F$  is not only less cohesive, but also weaker in the battlefield than country  $H$  (i.e.,  $c_F > c_H$  and  $\gamma < 1$ ), divergence in state building is very strong. Now the greater reform stance in the cohesive and more populous country  $H$  directly dampens reform in  $F$  also via strategic effects.

*Proof.* By a suitable choice of nonnegative coefficients  $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$  we can write Equations (44) and (45) in matrix form as:

$$\begin{pmatrix} 1 & -\alpha_2 \\ \alpha_4 & 1 \end{pmatrix} \begin{pmatrix} R_H^* \\ R_F^* \end{pmatrix} = \begin{pmatrix} \alpha_1 \\ \alpha_3 \end{pmatrix}.$$

Using Cramer's rule, the solution to the system is:

$$R_H^* = \frac{\alpha_1 + \alpha_2\alpha_3}{1 + \alpha_2\alpha_4}, \quad R_F^* = \frac{\alpha_3 - \alpha_1\alpha_4}{1 + \alpha_2\alpha_4}.$$

This implies that:

$$\frac{R_H^*}{R_F^*} = \frac{\alpha_1 + \alpha_2\alpha_3}{\alpha_3 - \alpha_1\alpha_4}.$$

After some manipulation, the above equation can be written as:

$$(47) \quad \frac{R_H^*}{R_F^*} = \frac{R_{H,aut}}{R_{F,aut}} \cdot \frac{1 + \theta \lambda R_{F,aut}(1 - 2\gamma)}{1 - \theta \lambda R_{H,aut}(2 - \gamma)}.$$

The other properties immediately follow by inspection. □

## Appendix 3: Additional Regression Results

Table A3.1: Battlefield results, battles without allies only

	(1) All	(2) All	(3) All	(4) Pre-1650	(5) Post-1650	(6) Interaction
$T^H$	0.198* (0.0882)	0.491*** (0.0873)				
$T^F$	-0.286 (0.183)	-0.542** (0.182)				
$P^H$		-0.0147** (0.00498)	-0.0160*** (0.00432)	0.0176 (0.0155)	-0.0172*** (0.00429)	-0.0169*** (0.00427)
$P^F$		-0.0118 (0.00812)	-0.0127 (0.00718)	-0.00274 (0.00649)	-0.00958 (0.00815)	-0.0100 (0.00653)
$TR^H - TR^F$			0.489*** (0.0871)	1.926** (0.394)	0.395*** (0.101)	0.934 (0.473)
post1650						0.361** (0.104)
$[TR^H - TR^F] * post1650$						-0.544 (0.504)
Constant	0.482*** (0.0718)	0.607*** (0.0949)	0.611*** (0.0903)	-0.230 (0.254)	0.717*** (0.0816)	0.355* (0.132)
N	270	182	182	25	157	182
$R^2$	0.0275	0.123	0.123	0.160	0.0865	0.152

Standard errors clustered at the opponent-pair-period level, in parentheses.

\* p &lt; 0.10, \*\* p &lt; 0.05, \*\*\* p &lt; 0.01.

Table A3.2: Battlefield results, probit

	(1)	(2)	(3)	(4)	(5)	(6)
	All	All	All	Pre-1650	Post-1650	Interaction
$TR^H$	0.749*** (0.188)	1.309*** (0.246)				
$TR^F$	-0.932** (0.313)	-1.163** (0.401)				
$P^H$		-0.0390** (0.0129)	-0.0346** (0.0114)	-0.104 (0.0591)	-0.0396*** (0.0104)	-0.0421*** (0.0103)
$P^F$		-0.0312 (0.0183)	-0.0286 (0.0176)	-0.0222 (0.0232)	-0.0262 (0.0193)	-0.0213 (0.0158)
$TR^H - TR^F$			1.304*** (0.246)	0.427 (1.769)	1.032*** (0.242)	1.565 (1.230)
post1650						0.918*** (0.263)
$[TR^H - TR^F]*post1650$						-0.499 (1.280)
Constant	-0.190 (0.170)	0.246 (0.252)	0.226 (0.257)	0.497 (1.019)	0.607** (0.230)	-0.316 (0.330)
N	374	257	257	42	215	257

Standard errors clustered at the opponent-pair-period level, in parentheses.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Table A3.3: Heterogeneity and state building  
 (dependent variable: revenue per capita - relative to wages)

	(1)	(2)	(3)	(4)
<i>Sum</i>	-1.515*** (-3.38)			
<i>Pred</i> <sub>1300</sub>		-0.283** (-2.64)		
<i>Area</i>			-4.21e-12*** (-4.50)	
<i>Ethnic</i>				-19.24 (-1.49)
_cons	7.395*** (6.67)	10.48*** (4.86)	11.45*** (6.23)	11.11*** (3.69)
<i>N</i>	53	53	53	53
<i>R</i> <sup>2</sup>	0.363	0.249	0.402	0.125

Note: Cf. Section 6.2.2 and the Data Appendix for data construction;  
 t-statistics in parentheses\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$



Table A3.4: Interaction effects - by measure of heterogeneity

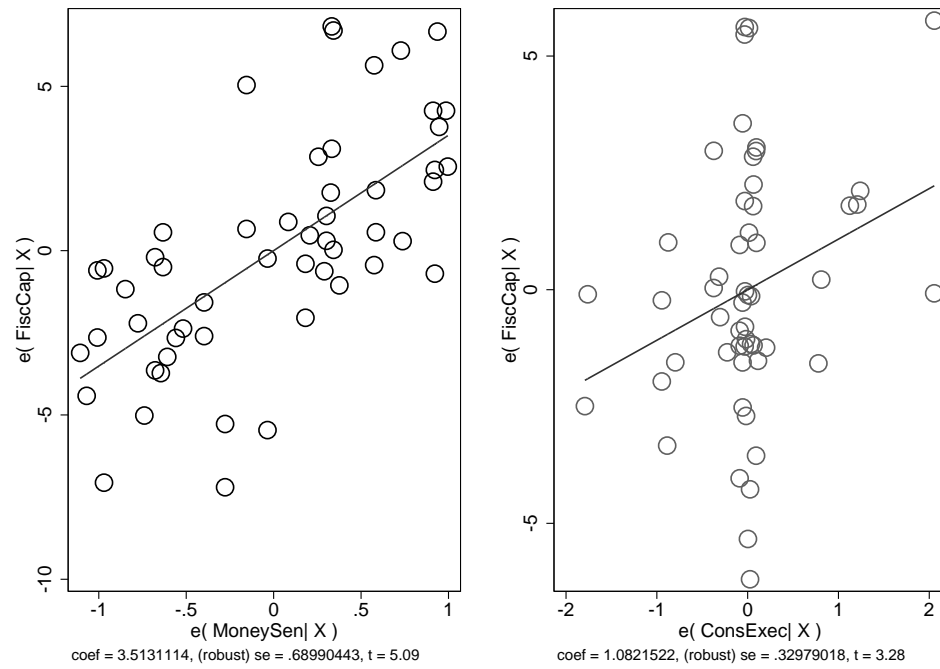
<b>Panel A</b>	(1)	(2)	(3)	(4)
	low-fraction $Pred^H=0$	high-fraction $Pred^H=1$	inter	inter+FE
<i>MoneySen</i>	5.113***	2.540***	5.890***	5.113***
	(5.43)	(4.27)	(6.26)	(5.39)
<i>Pred<sup>H</sup></i>			0.448	
			(0.25)	
<i>MoneySen*Pred<sup>H</sup></i>			-3.687**	-2.573***
			(-3.65)	(-5.69)
<i>Constant</i>	12.18***	3.843*	2.765	3.843*
	(5.41)	(2.04)	(1.94)	(2.02)
<i>N</i>	23	30	53	53
<i>R<sup>2</sup></i>	0.795	0.814	0.341	0.824
<b>Panel B</b>				
	<i>Area<sup>H</sup>=0</i>	<i>Area<sup>H</sup>=1</i>		
<i>MoneySen</i>	5.069***	2.480***	4.707***	5.069***
	(4.41)	(4.57)	(5.15)	(4.41)
<i>Area<sup>H</sup></i>			-2.782**	
			(-2.86)	
<i>MoneySen*Area<sup>H</sup></i>			-2.605***	-2.589**
			(-4.74)	(-2.73)
<i>Constant</i>	-0.172	-1.396	4.742***	-0.172
	(-0.09)	(-1.07)	(4.22)	(-0.09)
<i>N</i>	27	26	53	53
<i>R<sup>2</sup></i>	0.747	0.780	0.449	0.824
<b>Panel C</b>				
	<i>Ethnic<sup>H</sup>=0</i>	<i>Ethnic<sup>H</sup>=1</i>		
<i>MoneySen</i>	5.001***	1.524**	4.970***	5.001***
	(4.78)	(3.07)	(5.85)	(4.75)
<i>Ethnic<sup>H</sup></i>			-1.839*	
			(-2.33)	
<i>MoneySen*Ethnic<sup>H</sup></i>			-3.761***	-3.476**
			(-6.48)	(-3.59)
<i>Constant</i>	-0.0636	5.107***	3.840***	-0.0636
	(-0.04)	(5.29)	(4.24)	(-0.04)
<i>N</i>	34	19	53	53
<i>R<sup>2</sup></i>	0.778	0.801	0.477	0.839

*t* statistics in parentheses

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

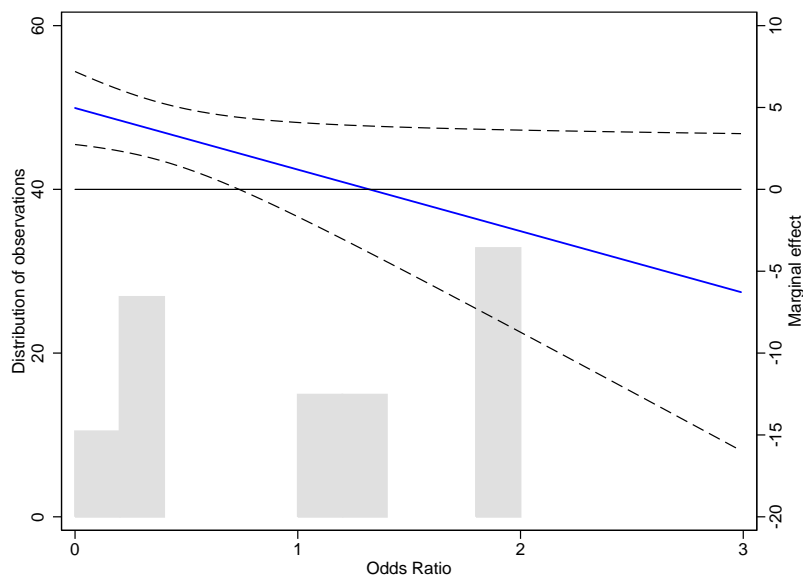
## Appendix 4: Supplementary Figures

FIGURE 10. Fiscal Capacity, Money Sensitivity, and Institutions



*Notes:* The y-axis shows fiscal revenues per capita, as a multiple of the the country-specific daily wage rate. The left x-axis gives the money-sensitivity of victory, controlling for other factors; the right one, constraints on the executive (based on Table 5, col 3).

FIGURE 11. Interaction Effects - Heterogeneity and Money Sensitivity



*Notes:* The y-axis on the right-hand side plots the overall marginal effect of increases in the odds ratio; the left y-axis gives the share of observations for different values of the odds ratio. The predicted line and confidence interval is based on Table 7, col 3, Panel A).

## Appendix 5: Data

Here, we detail the construction of the variables used in the empirical analysis in chapter 6.

Variable	Description and Source
<i>BattleOutcome</i>	Dummy variable that takes the value of 1 if the fiscally stronger power wins (Landers 2003), and 0 otherwise. The source for battle data is Jaques (2007), a dictionary of recorded battles and sieges from antiquity to today, containing information on the battle date, combatant sides and outcome. From this, we code the results of all battles fought on European soil from 1500 to 1800, involving England, Dutch Republic, France, Spain, Austria, Russia, Prussia, Poland-Lithuania and the Ottoman Empire. Excluding sieges, civil conflicts and peasant revolts, this leaves 374 battles. Of these, 80 were naval battles.
<i>TR<sup>H</sup></i>	Annual average of the richer power's total revenue, in tons of silver. Source: Karman and Pamuk (2010) and European State Finance Database (Bonney 1989).

Variable	Description and Source
$TR^F$	Annual average of the poorer power's total revenue, in tons of silver. Source: Karman and Pamuk (2010) and European State Finance Database (Bonney 1989).
$p^H$	Population of richer power, in millions, at the beginning of the period to which the fiscal data refers. Source: McEvedy and Jones (1978).
$p^F$	Population of poorer power, in millions, at the beginning of the period to which the fiscal data refers. Source: McEvedy and Jones (1978).
$Pred1300$	The number of independent predecessor states on the territory of countries existing in 1500 (using 1500 borders). All figures are based on historical maps available at <a href="http://www.euratlas.net">www.euratlas.net</a>
$Ethnic$	The ethnic fractionalization measure of Alesina <i>et al.</i> (2003).
$Area$	Total surface area as calculated in Q-GIS from the historical maps at <a href="http://www.euratlas.net">www.euratlas.net</a> .
$Sum$	Summary measure of heterogeneity, composed of the sum of standardized variables $Pred1300$ , $Ethnic$ , and $Area$ ; variables standardized so that mean=0 and st.dev.=1.
$Odds$	Odds ratio of success for the richer power, as calculated in Table 3.
$\lambda$	Estimated money sensitivity of war outcomes - based on a regression of battle outcome (richer power wins = 1, otherwise = 0) on the ratio of fiscal revenues.